Handheld Explosives Trace Detectors

Focus Group Report

September 2017

Homeland Security
Science and Technology

NUSTL
NATIONAL URBAN SECURITY TECHNOLOGY LABORATORY

SAVER-T-FGR-2

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FOREWORD

The U.S. Department of Homeland Security (DHS) established the System Assessment and Validation for Emergency Responders (SAVER) Program to assist emergency responders making procurement decisions. Located within the Science and Technology Directorate (S&T) of DHS, the SAVER Program conducts objective assessments and validations on commercially available equipment and systems and develops knowledge products that provide relevant equipment information to the emergency responder community. The SAVER Program mission includes:

- Conducting impartial, practitioner-relevant, operationally oriented assessments and validations of emergency response equipment
- Providing information, in the form of knowledge products, that enables decision-makers and responders to better select, procure, use and maintain emergency response equipment.

SAVER Program knowledge products provide information on equipment that falls under the categories listed in the DHS Authorized Equipment List (AEL), focusing primarily on two main questions for the responder community: "What equipment is available?" and "How does it perform?" These knowledge products are shared nationally with the responder community, providing a life-and cost-saving asset to DHS, as well as to Federal, state and local responders.

The SAVER Program is managed by the National Urban Security Technology Laboratory (NUSTL). NUSTL is responsible for all SAVER activities, including selecting and prioritizing program topics, developing SAVER knowledge products, coordinating with other organizations and ensuring flexibility and responsiveness to first responder requirements.

NUSTL provides expertise and analysis on a wide range of key subject areas, including chemical, biological, radiological, nuclear and explosive weapons detection; emergency response and recovery; and related equipment, instrumentation, and technologies. In support of this tasking, NUSTL will conduct a handheld explosive trace detectors comparative assessment to provide emergency responders with reference information on currently available technologies. Handheld explosive trace detectors fall under AEL reference number 07ED-01-IMOB titled Trace Detector, Explosive, Handheld. As part of this project, assessment recommendations were gathered from a focus group and are highlighted in this report.

For more information on NUSTL's SAVER Program or to view additional reports on handheld explosive trace detectors or other technologies, visit www.dhs.gov/science-and-technology/SAVER.

U.S. Department of Homeland Security

SAVER

System Assessment and Validation for Emergency Responders

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EXECUTIVE SUMMARY

Through its System Assessment and Validation for Emergency Responders (SAVER) Program, the National Urban Security Technology Laboratory (NUSTL) will conduct a comparative assessment of handheld explosive trace detectors to provide emergency responders with information that will assist with making operational and procurement decisions. Handheld explosive trace detectors are used by public safety organizations to screen public areas, packages, vehicles, luggage, clothing and other items for trace residues of explosives.

As a part of the assessment process, NUSTL convened a focus group in February 2017, with the primary objectives of recommending evaluation criteria, product selection criteria, products and possible scenarios for the assessment of handheld explosive trace detectors. Recommendations were provided by seven emergency responders from various jurisdictions during the focus group. The handheld explosive trace detector assessment will be conducted by emergency response professionals based on the recommendations presented in this report.

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1.0 INTRODUCTION

The System Assessment and Validation for Emergency Responders (SAVER) Program will conduct a comparative assessment of handheld explosive trace detectors to provide emergency responders with information that will assist with making operational and procurement decisions. As part of the assessment process, a focus group met in February 2017, with the primary objectives of recommending evaluation criteria, product selection criteria, products and possible scenarios for the assessment of handheld explosive trace detectors.

Handheld explosive trace detectors are used by public safety organizations to screen public areas, packages, vehicles, luggage, clothing and other items for trace residues of explosives. The handheld explosive trace detector assessment will be conducted by emergency response professionals based on the recommendations presented in this report.

Seven emergency responders from various jurisdictions participated in the focus group. The participants, whose demographics are shown in Table 1-1, all had experience using handheld explosive trace detectors, which facilitated meaningful and productive discussions. All of the participants acknowledged they did not have an employment or financial relationship that could create a potential conflict of interest with the work to be performed by the SAVER Program. Participants signed a nondisclosure agreement and a conflict of interest statement.

Table 1-1 Focus Group Participant Demographics

Practitioner	Years of Experience	State
Firefighter/HAZMAT	45-50	MD
Law Enforcement/HAZMAT/EOD Retired	15-20	NV
Firefighter/HAZMAT/WMD	15-20	TX
Law Enforcement/HAZMAT/WMD	15-20	VA
Law Enforcement/Counterterrorism	10-15	NY
Law Enforcement	10-15	NM
Law Enforcement/Counterterrorism	10-15	NY

2.0 FOCUS GROUP METHODOLOGY

The focus group opened with an overview of the SAVER Program, the handheld explosive trace detectors project, and the focus group goals and objectives. Once the background material was covered, a facilitator led focus group discussions on five sets of recommendations:

1) Evaluation criteria recommendations – General criteria that are important to consider when making acquisition or operational decisions
2) Assessment scenario recommendations – Operational scenarios in which the products should be assessed to evaluate their performance
3) Product selection criteria recommendations – Criteria that identify specifications, attributes or characteristics a product should possess to be considered for the assessment
4) Product recommendations – Products and vendors that are relevant to the emergency responder community and should be candidates for inclusion in the comparative assessment
5) Laboratory testing recommendations – Laboratory performance tests that should be performed by the Transportation Security Laboratory, incorporating challenges identified by the focus group.

Figure 2-1 highlights the process followed to gather these recommendations.

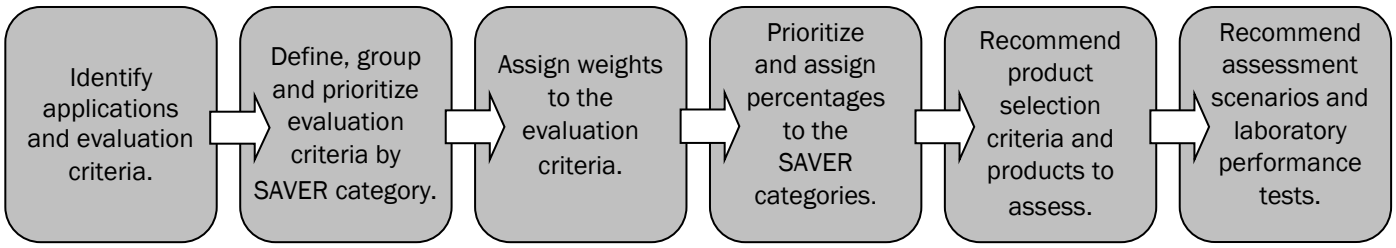

Figure 2-1 Focus Group Process

Focus group participants first identified applications in which handheld explosive trace detectors are commonly used. Next, the focus group participants identified and defined evaluation criteria, which were then grouped and prioritized in the SAVER categories: Affordability, Capability, Deployability, Maintainability and Usability. The SAVER categories are defined as:

- Affordability evaluation criteria related to the total cost of ownership over the life of the product. This includes purchase price, training costs, warranty costs, recurring costs and maintenance costs.
- Capability evaluation criteria related to product features or functions needed to perform one or more responder relevant tasks.
- Deployability evaluation criteria related to preparing to use the product, including transport, setup, training and operational/deployment restrictions.

- **Maintainability** evaluation criteria related to the routine maintenance and minor repairs performed by responders, as well as included warranty terms, duration and coverage.
- **Usability** evaluation criteria related to ergonomics and the relative ease of use when performing one or more responder relevant tasks.

Once the evaluation criteria were prioritized within the SAVER categories, focus group participants assigned a weight for each criterion's level of importance on a 1-5 scale, where 5 is of utmost importance and 1 is of minor importance. Table 2-1 highlights the evaluation criteria weighting scale.

Table 2-1 Evaluation Criteria Weighting Scale

Weight	Definition
5	The evaluation criterion is *of utmost importance*. ***"I would never consider purchasing a product that does not meet my expectations of this criterion or does not have this feature."***
4	The evaluation criterion is ***very important***. *"I would be* ***hesitant*** *to purchase a product that does not meet my expectations of this criterion or does not have this feature."*
3	The evaluation criterion is ***important***. ***"Meeting my expectations of this criterion or having this feature would strongly influence my decision to purchase this product."***
2	The evaluation criterion is ***somewhat important***. *"Meeting my expectations of this criterion or having this feature would* ***slightly*** *influence my decision to purchase this product."*
1	The evaluation criterion is *of minor importance*. ***"Other things being equal, meeting my expectations of this criterion or having this feature may influence my decision to purchase this product."***

After the evaluation criteria were assigned a weight, the focus group participants recommended whether the criteria should be assessed operationally or according to vendor-provided specifications. Next, considering the evaluation criteria in each category, the focus group participants ranked the SAVER categories in order of importance. Based on the ranking, a percentage was assigned to each category to represent its level of importance.

After rating the SAVER categories, focus group participants identified product selection criteria. The focus group also identified products that should be considered for the assessment. The focus group then indicated which laboratory performance tests would be of most value to them. Lastly, the focus group participants reviewed the applications identified at the beginning of the focus group session and recommended operational scenarios for the assessment.

3.0 EVALUATION CRITERIA RECOMMENDATIONS

The focus group identified 25 evaluation criteria and concluded that capability was the most important SAVER category, followed by usability, deployability and maintainability categories, respectively. The focus group discussed the affordability category but did not identify any criteria for the category. Table 3-1 presents the percentages assigned to the SAVER categories, the evaluation criteria and the evaluation criteria weights.

Table 3-1 Evaluation Criteria

Capability	Usability	Deployability	Maintainability
Overall Weight 35%	Overall Weight 30%	Overall Weight 20%	Overall Weight 15%
Explosives Library Weight: 5	**User Interface** Weight: 5	**Verification** Weight: 5	**Durability** Weight 5:
Alarm Threshold Adjustability Weight: 5	**Startup Time** Weight:5	**Included Accessories** Weight: 4	**Consumables** Weight: 4
Power Options Weight: 4	**Ergonomics** Weight: 5	**Ease of Battery Replacement** Weight: 4	**Decontaminability** Weight: 4
Alarm Configurability Weight: 4	**Data Transfer** Weight: 5	**Storage Case Quality** Weight: 3	**Level-1 Maintenance** Weight: 4
Reachback Weight: 2	**Battery Life/ Indicator** Weight: 4	**Optional Accessories** Weight: 2	**Training** Weight: 3
Data-Logging Capability Weight: 2	**Ease of Use** Weight: 4	**Covertness** Weight: 1	**Warranty** Weight: 2
	Ability to Modify Library Weight: 2		

3.1 CAPABILITY

Six Capability criteria were identified and defined by the focus group.

Explosives Library refers to the spectra that are included in the product's software to which the unknown explosive spectra will be compared. Participants indicated that the trustworthiness of the source of the data in the library, all the "red flag indicators" (-ates, -ides, etc.,) being present and the extensiveness or specificity of the library were all important.

Alarm Threshold Adjustability refers to the ability of the user to change the sensitivity of the alarm in response to specific conditions. The local environment, humidity and the level of interferences play a role in explosive trace detection. If there is a very high level of contamination (i.e., near an

industrial area) the ability to raise an alarm threshold can greatly reduce the number of false positives recorded.

Power Options refers to the types of batteries that can be used (e.g., standard alkaline, rechargeable, etc.), how many batteries are needed and if the unit can be operated with alternating current (AC) from the wall or from a car battery, thus allowing warmup of the detector on way to the scene.

Alarm Configurability refers to the types of alarms available (e.g., visual, audible, haptic (vibrational), etc.) and the ability to turn them on or off and adjust their intensity.

Reachback refers to the ability to send spectra and other sample information to a vendor or third party for technical or scientific support.

Data Logging Capability refers to the ability to store relevant spectra on the device and the ability to quickly and easily offload data to an external device. The amount of data that can be stored and what happens when this limit is reached are important. Participants preferred that data not be overwritten.

3.2 USABILITY

Seven Usability criteria were identified and defined by the focus group.

User Interface refers to the type and layout of buttons used to control the detector. Participants noted that buttons had to be usable with gloves, respirators and other personal protective equipment (PPE); they mentioned that a stylus would be very useful.

Startup Time refers to the time needed after powering on or exiting from sleep mode to be able to run an analysis.

Ergonomics refers to the way the detector feels when it is carried, its ability to be carried and operated with one hand and screen clarity when viewed while wearing PPE.

Data Transfer refers to the ability to retrieve data from the detector and send it to a command center through Wi-Fi or Bluetooth. The ability to send data as a word document or pdf was considered useful by responders. A docking station that could download and store data remotely and reset device memory was considered an attractive option.

Battery Life/Indicator refers to the length of time the detector operates without the batteries needing to be replaced or recharged. Participants wanted to know times for both actively running analyses and being in standby mode. Having an easy-to-read indication of remaining battery life was judged to be a useful feature.

Ease of Use refers to the level of difficulty involved in navigating through various menus, interpreting results, calibrating the detector, operating controls with gloves and other PPE and screen readability in bright sunlight.

Ability to Modify Library refers to being able to add or remove explosives spectra from the threat library to meet specific needs. Administrator and user levels of control for modifications were considered a useful feature.

3.3 DEPLOYABILITY

Six Deployability criteria were identified and defined by the focus group.

Verification refers to the process by which the detector indicates it is working properly and ready to do analyses. This can be done through verification samples, self-calibration and health checks. Results should be easily read by the user.

Included Accessories refers to the completeness of the product when the base model is purchased. Participants would prefer all required accessories to be included and functional.

Ease of Battery Replacement refers to the level of difficulty of changing batteries in the field, and whether it is possible when wearing gloves or other PPE.

Storage Case Quality refers to the sturdiness of the carrying case for the detector. Rubber corner guards were considered a useful feature.

Optional Accessories refers to components that are not included with the base model such as swabs, wands, vapor barrier cards, traps, verification samples, computer interface, vapor concentration kits, etc.

Covertness refers to the ability to silence or lower audible alarms, dim visual alarms, or switch to vibrational alarms so as not to distress the public and/or to allow for covert operations.

3.4 MAINTAINABILITY

Six Maintainability criteria were identified and defined by the focus group.

Durability refers to the ability to remain in good condition over a long period of time and to withstand drops and daily wear and tear. Rubberized corners on the detector and as few external components as possible were noted as desirable features.

Consumables refers to items needed for everyday use including desiccants, dopants, verification samples and sieve packs. The costs associated with these items were considered important.

Decontaminability refers to how difficult the detector is to clean, particularly after analyzing a very dirty sample. Participants noted that some detectors took up to 30 minutes to decontaminate, greatly reducing analysis throughput.

Level-1 Maintenance refers to the decontamination the user can perform without having to send the detector back to the vendor. Participants want to be able to communicate with the vendor and get instructions on decontamination procedures.

Training refers to the length of required training, whether the training is on-site, online or through a DVD and if a manual is included.

Warranty refers to the amount of time in which the vendor promises to repair or replace equipment that is not functioning properly, and the terms of such agreement.

4.0 EVALUATION CRITERIA ASSESSMENT RECOMMENDATIONS

The focus group provided recommendations on whether the evaluation criteria should be assessed operationally, or according to vendor-provided specifications. In an operational assessment, evaluators assess criteria based on their hands-on experience using the product. In a specification assessment, evaluators assess criteria based on product information provided by the vendor. In some cases, criteria may be assessed both operationally and according to vendor-provided specifications.

Table 4-1 presents the focus group's assessment recommendations for the evaluation criteria.

Table 4-1 Evaluation Criteria Assessment Recommendations

Category	Criteria	Operational	Specification
Capability	Explosives Library		✓
	Alarm Threshold Adjustability	✓	✓
	Power Options	✓	✓
	Alarm Configurability	✓	
	Reachback		✓
	Data Logging Capability	✓	✓
Usability	User Interface	✓	
	Startup Time	✓	✓
	Ergonomics	✓	
	Data Transfer		✓
	Battery Life/Indicator	✓	✓
	Ease of Use	✓	
	Ability to Modify Library	✓	✓
Deployability	Verification	✓	
	Included Accessories		✓
	Ease of Battery Replacement	✓	
	Storage Case Quality	✓	
	Optional Accessories		✓
	Covertness	✓	
Maintainability	Durability	✓	✓
	Consumables	✓	
	Decontaminability	✓	
	Level-1 Maintenance		✓
	Training		✓
	Warranty		✓

5.0 ASSESSMENT SCENARIO RECOMMENDATIONS

The focus group identified vehicle, facility, person and object screening as the applications in which they use handheld explosive trace detectors. Based on these applications, the focus group recommended five scenarios in which products could be assessed using the evaluation criteria recommended for an operational assessment (Table 4-1).

5.1 STARTUP/INITIALIZATION

A startup/initialization scenario will be performed to assess many of the routinely used operational criteria including power options, startup time, alarm configurability, verification, user interface, accessories, consumables needed, and alarm threshold adjustability.

5.2 VEHICLE INSPECTION

Handheld explosive trace detectors will be used to inspect a vehicle during a traffic stop or when entering a public event. The steering wheel, door handle and trunk will be checked for explosives. This will provide an indication of how well the instrument works on different surfaces—metal, leather, vinyl, etc.—which can affect detection.

5.3 FACILITY INSPECTION

Handheld explosive trace detectors will be used to screen VIP rooms, for pre-event screening and to inspect clandestine labs. This will include both indoor and outdoor screening to see how the detector responds in different environments.

5.4 PERSON INSPECTION

Handheld explosive trace detectors will be used to screen individuals suspected of handling bomb making materials. Hands, umbrella handles and briefcase handles may be screened.

5.5 OBJECT SCREENING

Handheld explosive trace detectors will be used to screen packages, carrying cases, backpacks and unattended items.

6.0 PRODUCT SELECTION RECOMMENDATIONS

The focus group identified six product selection criteria that may be used to select products for the handheld explosive trace detector assessment. Table 6-1 presents the product selection criteria in priority order.

Table 6-1 Product Selection Criteria

Product Selection Criteria	Description
Handheld	Detector must be lightweight and able to be easily carried by one person, preferably with one hand.
Threat Library	Library must contain the minimum number of explosive spectra required by the user.
Indoor/Outdoor Use	Detector must perform well and be easily operated both in temperature-controlled environments and outdoors in bright sunshine and extreme temperatures.
Battery Operated	Detector must be capable of being operated on internal battery power. It can also run on, and be charged by, other power sources.
Mass Screenings	Detector must be able to perform mass screenings.
Vapor/Swipe	Detector should be capable of analyzing both vapor and swipe samples.

The focus group participants suggested products from the following vendors be considered for the assessment:

- Bruker
- FLIR
- Morpho Detection Inc.
- Smiths Detection Inc.
- Rapiscan Systems.

Vendors responding to a Request for Information posted in March 2017 will also be considered for the assessment.

7.0 LABORATORY TESTING RECOMMENDATIONS

Laboratory testing will verify the accuracy of the detectors and their spectral libraries when trace explosives are analyzed. The focus group members were most interested in having the detectors analyze explosives they had recently encountered, including triacetone triperoxide (TATP), hexamethylene triperoxide diamine (HMTD), ammonium nitrate-fuel oil (AMFO), Tannerite, black powder, perchlorates and trinitrophenol (TNP). They also stated that the type of surface the explosive trace was attached to greatly affected detection likelihood. Surfaces that can make detection difficult include metals (door knobs), steering wheels, plastic and cloth luggage handles, laminated driver's licenses, leather, vinyl and surfaces treated with Armor All®. Performance should also be tested in the presence of interferences such as kerosene, urban dust, grease, organic solvents, adhesives, petroleum and other fuels. Participants also wanted information on clear-down times when the detector was heavily contaminated. Clear-down time is the time needed for a detector to recover from an alarm through a repeated sequence of automated cleansing to clear out the residual sample from the instrument until the signal is reduced below a set threshold.

8.0 FUTURE ACTIONS

The focus group recommendations will be used to guide the development of a handheld explosive trace detector assessment plan as well as the selection of products to evaluate in the assessment. Once the assessment is complete, the results will be available on www.dhs.gov/science-and-technology/SAVER.

9.0 ACKNOWLEDGMENTS

The National Urban Security Technology Laboratory thanks the focus group participants for their valuable time and expertise. Their insights and recommendations will guide the planning and execution of this assessment as well as future SAVER projects. Appreciation is also extended to the home jurisdictions of the participants for allowing them to participate in the focus group.