



**Homeland  
Security**

Science and Technology

# Summary

**U.S. Department of Homeland Security**



**System Assessment and Validation for Emergency Responders**

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 commercial equipment and systems, and provides those results along with other relevant equipment information to the emergency responder community in an operationally useful form. SAVER provides information on equipment that falls within the categories listed in the DHS Authorized Equipment List (AEL).

The SAVER Program is supported by a network of technical agents who perform assessment and validation activities. Further, SAVER focuses primarily on two main questions for the emergency responder community: "What equipment is available?" and "How does it perform?"

For more information on this and other technologies, contact the SAVER Program Support Office.

RKB/SAVER Telephone: 877-336-2752

E-mail: [saver@dhs.gov](mailto:saver@dhs.gov)

Website: <https://www.rkb.us/saver>

Reference herein to any specific commercial products, processes, or services by trade name, trademark, manufacturer, or otherwise does not constitute or imply its endorsement, recommendation, or favoring by the U.S. Government. Neither the U.S. Government nor any of its employees make any warranty, expressed or implied, including but not limited to the warranties of merchantability and fitness for a particular purpose for any specific commercial product, process, or service referenced herein.

## Handheld Raman Spectrometers

(AEL reference number 07CD-01-DPRS)

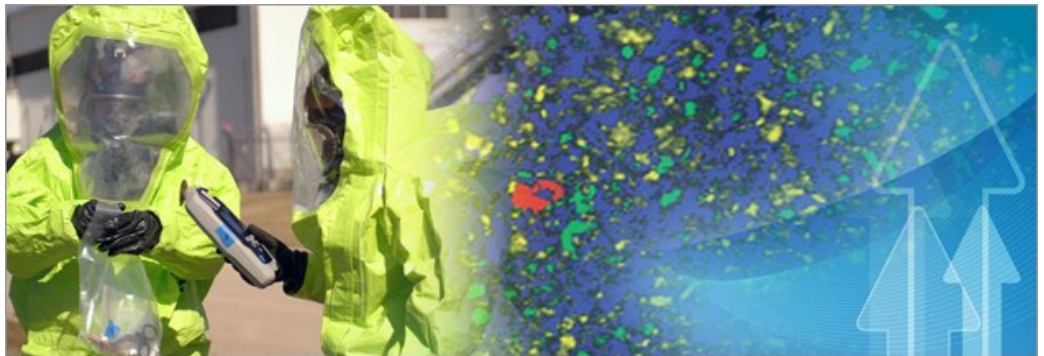
Handheld Raman spectrometers are rugged, field-portable instruments used to identify unknown solid and liquid materials encountered during hazardous materials (HAZMAT) operations. The equipment utilizes a laser to interrogate materials and provides responders with information regarding the chemical or compound analyzed without destroying the sample. Common applications include the identification of illicit drugs or drug production precursors, explosives or explosives production precursors, industrial chemicals, and common household materials.

In order to provide responders with information on currently available handheld Raman spectrometers, Science Applications International Corporation conducted a comparative assessment of these spectrometers for the System Assessment and Validation for Emergency Responders (SAVER) Program in March 2012. Detailed findings are provided in the *Handheld Raman Spectrometers Assessment Report*, which is available by request at <https://www.rkb.us/saver>.

### Assessment Methodology

Prior to the assessment, eight responders were chosen from various jurisdictions to participate in a focus group. Participants possessed strong backgrounds in HAZMAT response, explosive ordnance disposal (EOD) response, firefighting, and emergency medical services. The group identified evaluation criteria and recommended product selection criteria and possible scenarios for assessment.

After identifying evaluation criteria, the focus group assigned each criterion to one of five SAVER categories, and then assigned a weight for its level of importance. Once the criteria were weighted, the five SAVER categories were assigned a percentage value to represent the level of each category's importance relative to the other categories.



Based on focus group recommendations, market research, and system availability, the following handheld Raman spectrometers were selected for assessment:

- StreetLab<sup>®</sup> Mobile, Morpho Detection;
- FirstDefender RM, Thermo Scientific;
- ReporteR<sup>™</sup>, DeltaNu<sup>®</sup>;
- Responder RCI<sup>™</sup>, Smiths Detection;
- Fido<sup>®</sup> Verdict<sup>™</sup>, FLIR<sup>®</sup>; and
- FirstGuard<sup>™</sup>, Rigaku.

Nine certified HAZMAT technicians served as evaluators for this assessment. All evaluators had at least 8 years of experience using sampling and monitoring equipment.

During the assessment, evaluators rated the spectrometers based on evaluation criteria established by the focus group. The assessment was separated into two phases: the specification assessment and the operational assessment. Evaluators assessed the systems based on vendor-provided information during the specification assessment. Hands-on experience using the spectrometers served as the basis for the operational assessment.

## Assessment Results

Table 1 displays the composite assessment scores as well as the category scores for each spectrometer. Higher scores indicate a higher rating by evaluators. For specifications, see table 2. The advantages and disadvantages of each spectrometer, as identified by evaluators, are listed in table 3. To view how each spectrometer scored against the evaluation criteria assigned to the SAVER categories, see table 4.

An analysis of evaluator comments and scores revealed the following common observations concerning the assessed handheld Raman spectrometers:

- Evaluators placed a high value on spectrometers that are durable and can be easily decontaminated.
- Evaluators distinguished between spectrometers intended for use by standard first response personnel and by specially trained technician-level personnel.
- Evaluators expressed a strong preference for spectrometers that have integrated vial compartments as well as vial compartments with ambient light shields.
- Evaluators expressed a strong preference for spectrometers that offer remote operability for personal computer (PC) operation outside of a hot zone.
- Evaluators favored spectrometers that are ergonomic, portable, and easy to use in gloved hands and personal protective equipment (PPE).
- Evaluators placed a high value on spectrometers that are intuitive and easy to use.
- Evaluators favored spectrometers that have internal menu options to create a user-developed library.
- Evaluators placed a high value on spectrometers that offer reasonably priced extended maintenance and warranty plans as well as 24/7 technical reach back support.
- Evaluators expressed a strong preference for spectrometers that include adequate and reasonable training with the purchase price.

Responder agencies that may be considering the purchase of a handheld Raman spectrometer should review the detailed findings in the *Handheld Raman Spectrometers Assessment Report* and carefully consider each spectrometer's overall capabilities and limitations in relation to their jurisdiction's operational needs. All reports in this series, as well as reports on other technologies, are available in the SAVER section of the Responder Knowledge Base (RKB) website, <https://www.rkb.us/saver>.

SAVER Category Definitions
<b>Affordability</b> groups criteria related to life-cycle costs of a piece of equipment or system.
<b>Capability</b> groups criteria related to the power, capacity, or features available for a piece of equipment or system to perform or assist the responder in performing one or more relevant tasks.
<b>Deployability</b> groups criteria related to the movement, installation, or implementation of a piece of equipment or system by responders at the site of its intended use.
<b>Maintainability</b> groups criteria related to the maintenance and restoration of a piece of equipment or system to operational condition by responders.
<b>Usability</b> groups criteria related to the quality of the responders' experience with the operational employment of a piece of equipment or system. This includes the relative ease of use, efficiency, and overall satisfaction of the responders with the equipment or system.



**Table 3. Handheld Raman Spectrometer Advantages and Disadvantages**











Product	Advantages	Disadvantages
 <p><b>StreetLab® Mobile</b> Composite Score: 4.3</p>	<ul style="list-style-type: none"> <li>• Kit is all-inclusive and no accessories are required; well-organized case</li> <li>• Well balanced and ergonomic</li> <li>• Scan delay and remote operable</li> <li>• Intuitive menu and controls</li> <li>• Easy to manipulate joystick control and trigger; one-hand operation</li> <li>• Comprehensive library</li> <li>• Easy to decontaminate</li> <li>• Waterproof, sealed system, drop tested, rugged</li> <li>• Simple operation and startup</li> </ul>	<ul style="list-style-type: none"> <li>• Extended warranty options are prohibitively expensive</li> <li>• Large, cumbersome case without wheels</li> <li>• Unit is large and would be cumbersome to carry with other monitors</li> <li>• Vial compartment does not secure the vial</li> <li>• Collar on sampling head can be difficult to adjust; would be improved with position markings for sample type</li> </ul>
 <p><b>FirstDefender RM</b> Composite Score: 4.2</p>	<ul style="list-style-type: none"> <li>• Portable case with cut foam inserts; well organized and small profile</li> <li>• Ergonomic, self-contained unit that is easy to hold in one hand</li> <li>• Large, raised, backlit control buttons</li> <li>• Integrated vial compartment; accepts multiple vial sizes</li> <li>• Onboard NIOSH and CAMEO reference documents</li> <li>• Visual fluorescence diagnostic and color-coded analysis results based on match confidence</li> <li>• Scan delay of up to 120 seconds</li> </ul>	<ul style="list-style-type: none"> <li>• Unit price is expensive</li> <li>• Extended warranties are expensive</li> <li>• Unit does not feature wireless capability</li> </ul>
 <p><b>Reporter™</b> Composite Score: 3.8</p>	<ul style="list-style-type: none"> <li>• Simple to use and inexpensive in comparison; better suited for non-technician users</li> <li>• Compact and portable</li> <li>• Adjustable vial holder</li> <li>• Backlit controls</li> <li>• Easily decontaminated</li> <li>• Well-organized case with foam inserts</li> <li>• Variety of battery charging options and adapters provided</li> </ul>	<ul style="list-style-type: none"> <li>• Small control buttons difficult to use in PPE</li> <li>• Straight sample head requires constant pressure to prevent reset</li> <li>• No light shield for vial compartment</li> <li>• Display screen is difficult to see in sunlight</li> <li>• Sample heads have to be changed based on application</li> </ul>
 <p><b>Responder RCI™</b> Composite Score: 3.2</p>	<ul style="list-style-type: none"> <li>• Case-within-a-case design; storage case well-organized</li> <li>• Easy to access the vial compartment and communications port</li> <li>• Onboard storage for vials and pipettes</li> <li>• Forced calibration at startup</li> <li>• Menu is easy to navigate and offers file naming and organizing by incident</li> <li>• Software is all internal; no PC application needed</li> <li>• Onboard NIOSH information and ability to create certificates of analysis</li> </ul>	<ul style="list-style-type: none"> <li>• Excessive startup time</li> <li>• Not practical for off-tabletop-and-shoot analysis due to weight and ergonomics</li> <li>• Small keyboard buttons; stylus is difficult to retrieve from case while in PPE</li> <li>• No auto-detect feature for vial versus point-and-shoot sampling; user must set in the menu</li> <li>• Many areas for contaminants to settle</li> </ul>
 <p><b>Fido® Verdict™</b> Composite Score: 3.0</p>	<ul style="list-style-type: none"> <li>• Display screen provides CAS and NFPA 704 information</li> <li>• Display offers confidence bars for sample match quality</li> <li>• Unit is small and compact</li> <li>• Inexpensive in comparison, making it better suited for non-technician users</li> <li>• Tether/wrist strap included; polystyrene standard is attached to tether</li> </ul>	<ul style="list-style-type: none"> <li>• Storage case lacked good organization</li> <li>• Screen was not easily visible in sunlight conditions</li> <li>• Sample heads have to be changed based on application</li> </ul>
 <p><b>FirstGuard™</b> Composite Score: 2.9</p>	<ul style="list-style-type: none"> <li>• Hot-swappable battery</li> <li>• User permission settings by log on</li> <li>• Integrated calibration standard</li> <li>• Secure vial compartment and automatic laser path redirection</li> <li>• Detailed analysis information and presentation on display screen</li> </ul>	<ul style="list-style-type: none"> <li>• Poor carrying and storage case design; foam components not durable</li> <li>• Plastic housing with vent/fan openings decrease durability and ability to be decontaminated</li> <li>• Small buttons and menu selections</li> <li>• Option-intensive menus and too many settings can result in inaccurate results</li> </ul>

Table 4. Handheld Raman Spectrometer Criteria Ratings<sup>1</sup>

KEY	     										
	Least Favorable	→		Most Favorable		StreetLab® Mobile	FirstDefender RM	Reporter™	Responder RCI™	Fido® Verdict™	FirstGuard™
<b>Affordability</b>											
Initial cost											
Cost of software/library updates											
Maintenance/warranty costs											
Technical analysis support											
Accessory costs											
<b>Capability</b>											
Notifications and alerts											
Vial compartment											
Controls											
Self-check diagnostics											
Multiple power options											
Expandable/customizable libraries											
Operating conditions											
Scan delay											
Evidence protection features <sup>2</sup>	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed	Not assessed
Onboard support and reference docs.											
Data transfer											
<b>Deployability</b>											
Efficient startup procedures											
Portability											
<b>Maintainability</b>											
Software and library updates											
Ease of decontamination											
Technical support											
Calibration											
Battery life											
<b>Usability</b>											
User-friendly											
Display functions											
Use while wearing PPE											
Size and stability											
Quick reference guide											

Note:

- <sup>1</sup> Averaged criteria ratings for each assessed product are graphically represented by colored and shaded circles. Highest ratings are represented by full green circles.
- <sup>2</sup> Criterion did not apply to any of the assessed spectrometers.