Handheld Raman Spectrometers
Assessment QuickLook

Science and Technology

NUSTL NATIONAL URBAN SECURITY TECHNOLOGY LABORATORY

HANDHELD RAMAN SPECTROMETERS

Handheld Raman spectrometers are used by first responders during field operations to identify solids and liquids that are suspected to contain toxic industrial chemicals, explosives, illicit drugs, or other hazardous substances. This equipment falls under Authorized Equipment List (AEL) reference numbers 07CD-01-DPRS titled "Detector, Raman Spectroscopy, Point," 07ED-01-LASR titled "Detector, Explosive, Laser-Based" and 07ED-04-LASR titled "Detector, Explosive, Laser-Based, Standoff."

Assessment Overview

From April 25–29, 2022, the National Urban Security Technology Laboratory's (NUSTL) System Assessment and Validation for Emergency Responders (SAVER) program, with the support of the Pacific Northwest National Laboratory (PNNL), conducted an assessment of handheld Raman spectrometers. The assessment was held at NUSTL in New York City, where emergency responders performed hands-on activities with ten handheld Raman spectrometers and provided feedback to help response agencies make operational and procurement decisions. Assessment activities and evaluation criteria were based on recommendations gathered from a focus group of subject matter expert (SME) responders with experience using Raman and other chemical detection technologies. A report on that focus group, as well as a market survey report with detailed product specifications can be found in the SAVER Documents Library at www.dhs.gov/publication/handheld-raman-spectrometers.

Figure 1. First responders kick off a SAVER assessment of handheld Raman spectrometers.

Six responders from Florida, Maryland, New Jersey, Washington and Washington DC assessed ten Raman spectrometers (identified below) by using them in simulated operational scenarios, including measuring samples through varied containers such as zip-top plastic bags, amber jars and semi-opaque plastic bottles. Throughout these scenarios, the SMEs assessed each device against 20 evaluation criteria in four SAVER Categories: Capability, Usability, Deployability and Maintainability. Eight criteria were assessed operationally; seven other criteria, by reviewing manufacturer provided specification; and five, operationally and by specification. Assessment method for each criterion is identified in Table 2 below.

Figure 2. An evaluator uses an Agilent Resolve to measure a sample inside of a plastic zip-top bag.

Laboratory testing of a number of samples and containers was performed prior to the assessment. A limited distribution report can be made available to federal, state, local, tribal and territorial responders only, upon request by emailing NUSTL@hq.dhs.gov.

Products Assessed

Agilent Resolve
Wavelength: 830 nm

B&W Tek TacticID-1064
Wavelength: 1064 nm

Chemring PGR-1064
Wavelength: 1064 nm

Metrohm Mira DS
Wavelength: 785 nm

Pendar X10
Wavelength: 830 nm

Rigaku ResQ CQL
Wavelength: 1064 nm

Serstech Arx
Wavelength: 785 nm

Smiths Detection Ace-ID
Wavelength: 785 nm

Thermo Scientific
First Defender RMX
Wavelength: 785 nm

Thermo Scientific
Gemini
Wavelength: 785 nm

Image credit for each device photo is due to its respective manufacturer

Overall Results

Overall assessment scores for the Raman spectrometers ranged from 2.8 to 4.3, with the Agilent Resolve scoring the highest overall. Table 1 presents the overall and category scores for each product. Products are listed from highest to lowest overall score. Each criterion was scored on a scale from 1 to 5. The category scores are determined by calculating a weighted average of the evaluation criteria scores. The overall score is a weighted average of the four category scores. An average rating for each criterion is calculated by summing the evaluators' scores and dividing the sum by the number of responses. The most significant differences between product ratings appeared in the Capability and Usability categories, which included 14 of the 20 evaluation criteria.

Table 1 Overall and Category Scores by Product

Maker	Model	Overall Score	Capability	Usability	Deployability	Maintainability
Agilent	Resolve	4.3	4.5	4.4	4.2	3.7
Thermo Scientific	Gemini	4.2	4.3	4.4	3.9	3.7
Thermo Scientific	First Defender RMX	4.0	4.0	4.2	4.1	3.8
Rigaku	ResQ CQL	3.9	4.1	4.1	3.6	3.7
B&W	Tactic ID 1064 ST	3.8	3.8	4.2	3.8	3.4
Metrohm	Mira DS	3.5	3.5	3.7	3.5	3.3
Smiths Detection	ACE-ID	3.0	2.6	3.3	3.2	3.6
Serstech	Arx	3.0	2.5	3.1	3.2	3.9
Pendar	X10	2.9	3.1	2.9	2.4	3.1
Chemring	PGR-1064	2.8	2.4	2.7	3.3	3.5