



Preparedness Directorate
Office of Grants and Training

Summary



The U.S. Department of Homeland Security, Preparedness Directorate, Office of Grants and Training (G&T) established the System Assessment and Validation for Emergency Responders (SAVER) Program to assist emergency responders in performing their duties. The mission of the SAVER Program is to

- Provide impartial, practitioner relevant, and operationally oriented assessments and validations of emergency responder equipment.
- Provide information that enables decision-makers and responders to better select, procure, use, and maintain emergency responder equipment.
- Assess and validate the performance of products within a system, as well as systems within systems.
- Provide information and feedback to the user community through a well-maintained, Web-based database.

The SAVER Program established and is supported by a network of technical agents who perform the actual 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?”

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Multi-Sensor Meter Chemical Detectors Assessment Report

Responders use chemical detection equipment to confirm the presence, concentration, and type of contamination. This confirmation is crucial in determining the necessary level of protection, first aid, and decontamination measures. Multi-sensor meters (MSM), commonly known as multi-gas monitors, allow for the simultaneous detection of more than one gas. The capability to recognize oxygen-deficient or oxygen-rich atmospheres, combustible gas levels, certain combustible vapors, and a wide selection of toxic gases detected by specialized sensors make MSM an essential piece of emergency responder equipment. Additionally, some MSM also incorporate photo-ionization detection (PID) technology which allows the same instrument to detect volatile organic compounds (VOC).

In order to provide emergency responders with information on currently available MSM technologies, capabilities, and limitations, G&T's Center for Domestic Preparedness (CDP) conducted a comparative assessment of MSM in July 2006. Although many MSM models are commercially available, the CDP assessed the following six MSM models:



RAE Systems MultiRAE Plus MSM Screen

- RAE Systems MultiRAE Plus
- BW Technologies GasAlertMicro 5 PID
- Industrial Scientific Corporation iTX Multi-Gas Monitor
- AIM Commander
- Biosystems PhD⁵ Multi-Gas Detector
- ION SCIENCE Limited FirstCheck 4000

The assessment was conducted using a scenario selected from the Homeland Security National Planning Scenarios and activities recommended by the MSM focus group held in June 2006. Seven emergency response subject matter experts (SME) were selected to serve as evaluators. Each MSM was evaluated in the same manner, and operational conditions were controlled to make the evaluation of each system as similar as possible. Simulants were used during the assessment and responders were outfitted in PPE.

MSM Assessment Results

Evaluators scored the MSM based on the evaluation criteria established by the MSM focus group and prioritized within the five SAVER categories (capability, usability, affordability, deployability, and maintainability). The scoring system was based on a 100 point scale and utilized the evaluation criteria weighting factors established by the focus group. Higher scores indicate better MSM performance. As shown

in table 1, the composite scores of five of the six MSM were between 74.2 and 76.2 out of a possible 100. The FirstCheck 4000 scored lower for reasons explained in the MSM Assessment Report. Figure 1, the SAVER QuickLook chart, provides a graphical representation of the results. The QuickLook chart is available on the SAVER Web site.

The following section provides a brief summary of the evaluator comments and feedback on each MSM during the assessment. The MSM are listed by evaluator scoring (highest to lowest). The full report includes a breakdown of evaluator comments by individual criteria.

RAE Systems MultiRAE Plus

The MultiRAE Plus received the highest overall evaluator score, and scored highest in the capability and affordability categories. The compact design made the MultiRAE easy to handle, but the evaluators noted that the detector was not very ergonomic. Readings from all of the installed sensors appeared on the display screen at the same time. The display was easy to see in all of the assessment conditions. The screen was easy to read in bright sunlight and the bright backlight worked well in dark rooms. However, the small size of the display screen and its location on the detector made viewing readings difficult. Evaluators found the buttons were difficult to use while wearing Class 1

VID/Category	Overall	Affordability	Capability	Deployability	Maintainability	Usability
MultiRAE Plus	76.2	15.6	24.8	7.7	10.7	17.4
GasAlertMicro 5 PID	76.1	15.0	23.9	7.9	10.8	18.5
iTX	75.8	14.3	24.7	7.4	10.7	18.7
Commander	75.1	15.1	23.6	7.5	11.0	17.9
PhD ⁵	74.2	14.6	23.0	7.7	11.0	17.9
FirstCheck 4000	61.9	12.5	16.6	6.9	10.0	15.9

Table 1: MSM Assessment Results.

PPE. The MultiRAE had a good audible alarm but the visual indicator was poorly located and was not easily seen unless the operator was looking at the screen. The MultiRAE was easy for the user to calibrate as well as change sensors or batteries. Evaluators liked the detector's easy "bump" or functional test and the rugged design of the detector.

BW Technologies GasAlertMicro 5 PID

The GasAlertMicro 5 PID was rated only slightly lower overall than the MultiRAE Plus and scored highest in the deployability category. The GasAlertMicro 5 PID was the easiest to calibrate PID model included in the assessment. The detector's small and lightweight ergonomic design made it easy to carry and to operate with one hand. The display screen and text were large and easy to read. All sensor readings appeared on a single screen; however, the sensor text labels were too small for easy viewing. The buttons were small but easy to manipulate. The visual, audible, and vibrating alarms were easily recognized by the evaluators while wearing Class 1 PPE. The GasAlertMicro 5 PID was the only assessed detector that has a vibrating alarm as a standard feature. The batteries and sensors were easily changed by the evaluators. Evaluators liked the detector's overall easy use, optional integrated pump design, and quick-connect hoses.

Industrial Scientific Corporation iTX Multi-Gas Monitor

The iTX was rated highest in the usability category. The detector was small, lightweight, and easy to operate. The iTX display screen displayed readings from all of the installed sensors on a single screen. Evaluators found the screen easy to read and, once enabled, the menus were easy to navigate. The audible and visual alarms were easily recognized while wearing Class 1 PPE. The battery packs were easily changed but sensors were more difficult to change than in other models. Evaluators were frustrated that they could only enable menus during startup and they had difficulty securely attaching the external pump.

Evaluators commented favorably on the iTX's durable housing and automatic backlight.

AIM Commander

The Commander and the PhD⁵ tied for the highest maintainability category score. The Commander had the largest display text of all the assessed models and displayed all of the sensor readings simultaneously on a single, easy-to-read display screen. Right-handed evaluators praised the ergonomic design of the detector, but a left-handed evaluator had difficulty operating the Commander with one hand. The buttons were larger than most but were difficult to press while wearing multiple layers of gloves. The Commander was easy to calibrate, with evaluators experiencing only slight problems with the tubing connections. The audible alarm was loud and easily recognized while wearing Class 1 PPE, but the visual alarm was repeatedly obscured by the evaluators' large gloves. Battery packs and sensors were easily changed by the evaluators. According to the evaluators, the biggest drawback to the Commander was that the detector required an infrared-capable computer for setup. They commented that they would prefer that setup be done without the need for the computer or additional software. Evaluators also liked the Commander's rugged construction and calibration schedule.

Biosystems PhD⁵ Multi-Gas Detector

The PhD⁵ LCD screen displayed readings for all four installed sensors on the primary screen but the LCD text was smaller than the iTX and the Commander. Evaluators stated that the screen was too small for easy use and the screen location made it difficult to view the small text when wearing Class 1 PPE. Shadows from the screen location and leather case as well as glare from sunlight and fluorescent lighting also created problems for the evaluators. Because of the location of the sensors, evaluators had difficulty viewing the screen without blocking the sensors when using the detector without the

external pump. The leather carrying case and strap helped the evaluators avoid blocking the sensors but the case obscured their view of the screen. The leather case and carry strap could not be used with the external pump and the pump's locking mechanism was easily dislodged during use.

Evaluators were impressed with the “text only,” “basic,” “basic peak,” and “technician” display modes, but the display mode setup was somewhat time-consuming because of the menu navigation. Once the modes were set up, it allowed the evaluators to toggle through the menu display using one large button. Problems with the battery pack connections on one of the assessed detectors caused the menu settings to be lost during one of the rotations, and the evaluators discovered that it was impossible for them to move the belt clip to reveal the keypad buttons while wearing gloves. The battery pack and sensors were easy to change, and the detector was easy to calibrate, but calibration took slightly longer than the other models. Evaluators liked the rugged metal housing and the size of the mode button.

ION SCIENCE Limited FirstCheck 4000

The FirstCheck 4000 received the lowest evaluator scores in all five SAVER categories. Evaluators commented favorably on the ergonomic design and one-hand operation of the detector. The large numeric display mode was large and easy to read, but only displayed the readings from one sensor at a time. An analysis of the evaluator scoring and comments indicates the following key factors contributed to the evaluator scoring in each category:

- The user cannot change the sensors or interchange alkaline and rechargeable battery packs—resulting in a lower capability score.
- The usability score can be attributed to the difficult-to-recognize audible and visual alarms, the difficult-to-read multiple numeric display mode, and the need for a computer to enable or select all of the detector's features.
- The affordability score can be attributed to the fact that the sensors must be replaced by the

manufacturer and the questionable durability of the housing.

- The lack of a “ready” indicator confirming warm-up and confusing calibration and bump test recommendations contributed to a lower deployability score.
- The maintainability score can be attributed to the detector's annual factory calibration requirement and manufacturer-replaced sensors.

MSM Assessment Summary

Only slight differences were noted in the five highest rated MSM. However, evaluators expressed a preference for the MSM which included PID technology. Because of the lack of dexterity and diminished vision created by Class 1 PPE, evaluators stressed the need for more emergency responder input into MSM design. Evaluators desired larger display screens, larger text, and larger buttons on all of the assessed MSM – even those models which they ranked higher by comparison. Further detail on the MSM assessment procedures and performance can be found in the full assessment report.

For Further Information

For complete MSM chemical detectors assessment recommendations, visit the SAVER Web site. All of the CDP's reports pertaining to the MSM chemical detectors assessment can be found on the Web site, along with reports on other technology assessed as part of the SAVER Program.

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For more information on the MSM chemical detectors project please see the SAVER Web site or contact the SAVER Program Support Office.

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Product		COMPOSITE AFFORDABILITY CAPABILITY DEPLOYABILITY MAINTAINABILITY USABILITY					Features	
	Specs  RAE Systems MultiRAE Plus	★	★	★	★	★	★	<ul style="list-style-type: none"> Sensors installed: O2, LEL, CO, H2S, PID Batteries: Alkaline, Lithium-ion battery Alarm(s): audible, visual Other: AreaRAE wireless networked system, optional computer interface and software, optional calibration kit
	Specs  BW Technologies GasAlertMicro 5 PID	★	★	★	★	★	★	<ul style="list-style-type: none"> Sensors installed: O2, LEL, CO, H2S, PID Batteries: Alkaline, Rechargeable NiCad Alarm(s): audible, visual Other: optional slip-on pump
	Specs  Industrial Scientific Corporation ITX Multi-Gas Monitor	★	★	★	★	★	★	<ul style="list-style-type: none"> Sensors installed: O2, LEL, CO, H2S Batteries: Alkaline, Lithium-ion Alarm(s): audible, visual, vibrating Other: optional external parasitic sampling pump
	Specs  AIM Commander	★	★	★	★	★	★	<ul style="list-style-type: none"> Sensors installed: O2, LEL, CO, H2S Batteries: Alkaline, Rechargeable NiMH Alarm(s): audible, visual, vibrating Other: pre-calibrated smart sensors, optional pump, Know Your Air PC software
	Specs  Biosystems PhD ⁵ Multi-Gas Detector	★	★	★	★	★	★	<ul style="list-style-type: none"> Sensors installed: O2, LEL, CO, H2S Batteries: Alkaline, Rechargeable NiCad Alarm(s): audible, visual Other: optional slip-on pump
	Specs  ION SNIENCE FirstCheck 4000	★	★	★	★	★	★	<ul style="list-style-type: none"> Sensors installed: O2, LEL, CO, H2S, PID Batteries: Alkaline, Rechargeable NiMH Alarm(s): audible, visual Other: standard powered pump

Figure 1: SAVER QuickLook chart.