



System Assessment and Validation for Emergency Responders (SAVER)

Handheld Multi-Gas Meters Market Survey Report

September 2016



**Homeland
Security**

Science and Technology

U.S. Department of Homeland Security



System Assessment and Validation for Emergency Responders

Prepared by Los Alamos National Laboratory

The *Handheld Multi-Gas Meters Market Survey Report* was funded under Interagency Agreement No. HSHQPM-14-X-00143 from the U.S. Department of Homeland Security, Science and Technology Directorate.

The views and opinions of authors expressed herein do not necessarily reflect those of the U.S. Government.

Reference herein to any specific commercial products, processes, or services by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the U.S. Government.

The information and statements contained herein shall not be used for the purposes of advertising, nor to imply the endorsement or recommendation of the U.S. Government.

With respect to documentation contained herein, neither the U.S. Government nor any of its employees make any warranty, express or implied, including but not limited to the warranties of merchantability and fitness for a particular purpose. Further, neither the U.S. Government nor any of its employees assume any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed; nor do they represent that its use would not infringe privately owned rights.

The cover photo and images included herein were provided by Los Alamos National Laboratory. Product images are courtesy of their respective vendor.

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.

As a SAVER Program Technical Agent, the Los Alamos National Laboratory (LANL) has been tasked to provide expertise and analysis on key subject areas, including chemical detection and radiation detection and monitoring, among others. In support of this tasking, LANL conducted a market survey of handheld multi-gas meters. Handheld multi-gas meters fall under AEL reference number 07CD-01-DPMG, titled Detector, Multi-Sensor Meter, Point, Chemical.

For more information on the SAVER Program or to view additional reports on handheld multi-gas meters or other technologies, visit www.dhs.gov/science-and-technology/SAVER.

POINT OF CONTACT

SAVER Program
National Urban Security Technology Laboratory
U.S. Department of Homeland Security
Science and Technology Directorate
201 Varick Street
New York, NY 10014

E-mail: NUSTL@hq.dhs.gov

Website: www.dhs.gov/science-and-technology/SAVER

Los Alamos National Laboratory
Nuclear Engineering and Nonproliferation Division
International Threat Reduction Group
Bikini Atoll Road, SM 30
Los Alamos, NM 87545
MS E541

E-mail: lanl-saver@lanl.gov

TABLE OF CONTENTS

Foreword.....	i
Point of Contact	ii
1. Introduction.....	1
2. Handheld Multi-Gas Meter Overview	1
2.1 Current Technologies	2
2.2 Applications	3
3. Product Information.....	4
3.1 BW Technologies by Honeywell	8
3.1.1 Gas Alert Max XT II.....	8
3.1.2 Gas Alert Microclip XL.....	8
3.1.3 Gas Alert Microclip XT.....	8
3.1.4 Gas Alert Microclip X3	9
3.1.5 Gas Alert Quattro.....	9
3.2 Crowcon	10
3.2.1 Gas Pro.....	10
3.2.2 Tetra 3	10
3.2.3 T4.....	10
3.3 Draeger.....	11
3.3.1 X-am 2500	11
3.3.2 X-am 5000	11
3.4 Honeywell	11
3.4.1 Impact	11
3.4.2 MicroMAX Pro.....	12
3.4.3 MultiPro Multi-Gas	12
3.4.4 PhD6™	12
3.5 Industrial Scientific	13
3.5.1 MX6 iBrid.....	13
3.5.2 Ventis MX4	13
3.6 MSA	13
3.6.1 ALTAIR® 4x.....	13
3.6.2 Solaris® MSHA.....	14

3.7 RAE.....	14
3.7.1 MultiRAE	14
3.7.2 MultiRAE Lite Pumped.....	14
3.7.3 QRAE II.....	15
3.7.4 QRAE 3	15
3.8 RKI Instruments	15
3.8.1 GX-2009	15
4. Vendor Contact Information.....	16
5. Summary.....	16

LIST OF TABLES

Table 3-1. Handheld Multi-Gas Meter Specifications	5
Table 4-1. Vendor Contact Information.....	16

1. INTRODUCTION

Handheld multi-gas meters (MGMs) are equipped with sensors to monitor oxygen (O₂) levels and additional sensors to detect the presence of combustible or toxic gases in the environment. This report is limited to operational response-type MGMs that include at least four different sensors. These sensors can vary by type and by the chemical monitored. In real time, the sensors report the concentration of monitored gases in the atmosphere near the MGM. To provide emergency responders with information on handheld multi-gas meters, the System Assessment and Validation for Emergency Responders (SAVER) Program conducted a market survey.

This market survey report is based on information gathered between November 2015 and February 2016 from vendors, Internet research, industry publications, an emergency responder focus group, and a government issued Request for Information (RFI) that was posted on the Federal Business Opportunities website. For inclusion in this report, an MGM had to meet the following criteria:

- Be intrinsically safe
- Accept at least four gas sensors simultaneously, including O₂, lower explosive limit (LEL), and two other toxic gas sensors
- Have available sensors for O₂, LEL, hydrogen sulfide (H₂S), and carbon monoxide (CO) at a minimum
- Be configurable for hands-free, unattended operation
- Feature a pump either integrated or as an accessory.

Due diligence was performed to develop a report that is representative of products in the marketplace.

2. HANDHELD MULTI-GAS METER OVERVIEW

MGMs allow responders to detect multiple chemicals that could pose a hazard to emergency responders or others. MGMs are available in a range of configurations and capabilities ranging from simple single gas detectors such as CO or O₂ monitors to complex handheld instruments with multiple simultaneous gas sensors combined with other specialized sensors such as photoionization detectors (PIDs) or radiation detectors. Capabilities include identification of oxygen-deficient or oxygen-rich atmospheres, combustible gas levels (percentage of LEL), other organic vapors, and a wide selection of toxic gases. Some MGMs also offer PID capabilities, which can detect volatile organic compounds (VOC) at parts per billion (ppb) levels, and other detection technologies, such as infrared (IR) absorption, which can detect and identify gases at low concentrations or gases that are difficult to detect with other sensors (e.g., carbon dioxide [CO₂], combustible gases, and chlorofluorocarbons (CFC)), and gamma detectors to detect radioactive materials.

MGMs can be used in different ways depending on requirements. The more complex instruments, such as those that include PIDs, IR sensors, or radiation detectors, are generally used in a technical response. That is they are used by emergency responders trained and tasked

with characterizing chemical hazards at a scene. In a technical response, the first responder is typically either directly operating or paying close attention to the device.

MGMs can also be used for operational responses (i.e., when emergency responders carry MGMs during response to an incident/accident to quickly and easily identify and alert the user to hazardous atmospheric conditions). In these situations, the first responder only interacts or pays attention to the MGM if it alarms indicating a potentially hazardous condition. For operational response situations the MGM is configured for hands-free, unattended operation; generally attached to a first responder gear harness; and configured to alarm in the presence of hazardous conditions. Less complex meters are preferred for operational response as they are better suited for unattended operation and require less training and maintenance. Generally they are also less expensive, which allows as many responders as possible to be equipped with MGMs during a response.

This report is limited to MGMs best suited for operational response. Based on our selection criteria, we have limited this report to MGMs that simultaneously operate at least four sensors at a time and at least have the following specific sensors available: O₂, LEL, H₂S, and CO. The report does not include more complex MGMs such as those with PID, IR, or radiation detectors. In 2008 the SAVER Program produced market survey and assessment reports on multi-sensor meter (MSM) chemical detectors that addresses these more complex MGMs.

2.1 Current Technologies

MGM configurations include various sensor combinations, battery options, sampling methods (i.e., diffusion or pumped), confined space kit options, and other options. Various types of alarms are also available and can be set to trigger on short-term exposure limit (STEL), time weighted average (TWA) readings, or other pre-determined concentrations. There are also alarms for operating conditions such as low battery, blocked pump, etc. Alarms can include audio, visual, or vibrating alerts or various combinations of these options.

Accessories may include pumps (for those without integrated pumps), probe filters, probe attachments, rubber or leather instrument jackets or cases, harnesses for hands free operation, extension hoses, and calibration kits. MGM detectors are usually available for a base-price plus additional costs depending on the sensors included and other options.

MGMs can be configured with various different sensors. The most important sensors identified by the SAVER focus group were O₂ and LEL sensors.

O₂ sensors monitor the environment to identify deficiency or enrichment in O₂ levels. O₂ sensors typically display readings as a percent of O₂ by volume in the air. This information can indicate the presence of other gases as these gases may displace the available O₂. O₂ sensors are either lead wool or solid polymer electrolyte (SPE). Lead wool O₂ sensors have a lifespan of about 2 years while SPE O₂ sensors generally last 3 to 5 years. While SPE sensors may last longer than lead wool O₂ sensors, they have higher power requirements, shortening battery runtime.

LEL sensors, also referred to as combustible gas sensors, detect elevated levels of combustible gases. The results are generally presented in the percent of the LEL present (%LEL). The sensors indicate the %LEL of the gas for which they are calibrated such as methane (natural gas). If another combustible gas is present, the sensor will report a %LEL, but the value may be incorrect. Most LEL sensors are calibrated for methane but can be calibrated for other

combustible gases, such as pentane or propane. Different types of LEL sensors are available and include metal oxide semiconductor (MOS), catalytic bead, and IR detectors. MOS sensors are the most sensitive of LEL sensor types and therefore perhaps most useful in determining the source of small gas leaks.

Detectors with MOS LEL sensors will shut off when the LEL of a monitored gas is exceeded to protect the sensor, since the longer the sensor is exposed to gas above the LEL, the faster it will deteriorate and require replacement. Catalytic bead LEL sensors also shut off the detector when the LEL is exceeded; however, these sensors are a little more durable since they feature a dual-sensor construction that compensates for ambient temperature, humidity, and atmospheric pressure, all of which can shorten sensor life. Both MOS and catalytic bead LEL sensors require sufficient O₂ levels in the environment to monitor combustible gases, whereas IR LEL sensors can monitor combustible gases in O₂ deficient atmospheres. In addition, IR sensors can withstand relatively longer exposure to gases than MOS or catalytic bead sensors and are therefore capable of reporting the percent by volume of a monitored gas even after levels exceed the LEL.

Common MGM toxic gas sensors include CO and H₂S, and vendors may have sensors for other toxic gases such as ammonia, chlorine, formaldehyde, carbon dioxide, nitrogen oxides, sulfur dioxide, ozone, and others. MGM toxic gas sensors are small, generally easily interchangeable, consume very little battery power, and are generally specific to the target gas being monitored, though some may alarm on various other gases, i.e., gases with similar properties to a monitored gas may cause false positives. For example, when monitoring for chlorine, the sensor may detect other chemicals within the halogen group that have similar properties (e.g., bromine) and provide a positive reading for chlorine. MOS toxic gas sensors are also available; these are not chemical specific but are designed to identify a wide-range of chemicals. This low level of specificity could be an advantage in situations where unknown toxic gases may be present. The chief limitations of MOS-based sensors are high battery consumption, the potential for false positives (i.e., mistaking background gases for toxic gases), and the effects of humidity on the sensor output (i.e., as humidity increases, sensor output increases as well; as humidity drops to low levels, sensor output may fall to zero, even in the presence of toxic gas).

Important chemical considerations related to MGMs include: sensitivity, the lowest gas concentrations that are detectable; specificity, the ability to distinguish among different chemicals; and operating range, the measurable ranges of concentrations that can be reported. For some sensors types, once the operating range has been exceeded a clear-out period is required before the sensor is operational again. The sensitivity, specificity, and operating ranges will vary by sensor and thus by the type of hazard being monitored.

2.2 Applications

MGMs are important tools for emergency responders when responding to calls involving confined space entry, home CO alarms, natural gas leaks, unknown odor reports, fuel spills, firefighting operations, clandestine laboratories, and arson investigations. They are also used in response to any emergency situation to help identify unexpected hazardous conditions. MGMs can also be used to monitor an area to determine if the air is acceptable for normal, unprotected breathing or if the area is clear of potential contaminants. MGMS are usually the first line of

screening for environmental hazards such as the enrichment or deficiency of O₂, or elevated levels of combustible or toxic gases.

A critical function of MGMs is the ability to alarm or warn the user when dangerous conditions are present. Alarms can be audible, visible, or vibratory. Alarms are either latching or non-latching. A latching alarm locks on if an alarm condition is reached and the user must manually turn off the alarm. A non-latching alarm sounds while the sensor readings are in alarm conditions, but turns off automatically when readings return to normal. Alarm levels and other options are configurable on most MGMs.

3. PRODUCT INFORMATION

This section provides information on 23 MGMs that range in price from \$500 to over \$3,000 depending on how they are configured. Table 3-1 provides general product specifications and the following sections provide product specific information. Product information presented in this section was obtained directly from vendors, their websites, and written materials (e.g., brochures, manuals, etc.). The information has not been independently verified by the SAVER Program.

In addition to the products listed in this report, some of the manufactures produce other MSMs that were not included because those products did not meet or exceeded the product selection criteria.

Table 3-1. Handheld Multi-Gas Meter Specifications

Vendor	Product	MSRP	Number of Sim. Sensors	Weight (oz)	O ₂ Sensor	%LEL Sensor	H ₂ S Sensor	CO Sensor	Other
BW Technologies by Honeywell	Gas Alert Max XT II	\$880	4	11.1	✓	✓	✓	✓	None
BW Technologies by Honeywell	Gas Alert Microclip XL	\$615	4	6.7	✓	✓	✓	✓	None
BW Technologies by Honeywell	Gas Alert Microclip XT	\$600	4	6	✓	✓	✓	✓	None
BW Technologies by Honeywell	Gas Alert Microclip X3	\$675	4	6.7	✓	✓	✓	✓	None
BW Technologies by Honeywell	Gas Alert Quattro	\$700	4	11 to 12	✓	✓	✓	✓	None
Crowcon	Gas Pro	\$850	5	11.9 to 12.7	✓	✓	✓	✓	Dual toxic (CO+H ₂ S), H-filtered CO, Cl ₂ , Ozone (O ₃), SO ₂ , ClO ₂ , NH ₃ , NO, NO ₂
Crowcon	Tetra 3	\$1,100	4	10.4	✓	✓	✓	✓	Hydrogen-filtered CO, O ₃ , SO ₂ , NH ₃ , CO ₂
Crowcon	T4	\$550	4	9.9	✓	✓	✓	✓	None
Draeger	X-am 2500	\$750	4	7 to 8	✓	✓	✓	✓	NO ₂ , SO ₂
Draeger	X-am 5000	\$1,500 to \$2,000	5	8 to 9	✓	✓	✓	✓	NH ₃ , NO, NO ₂ , SO ₂ , PH ₃ , HCN, CO ₂ , Cl ₂ , H ₂ , Organic vapors, COCl ₂ , O ₃
Honeywell	Impact	\$1,000	4	18	✓	✓	✓	✓	NH ₃ , SO ₂ , CL ₂ , NO ₂ , CO ₂

Handheld Multi-Gas Meters Market Survey Report

Vendor	Product	MSRP	Number of Sim. Sensors	Weight (oz)	O ₂ Sensor	%LEL Sensor	H ₂ S Sensor	CO Sensor	Other
Honeywell	MicroMAX Pro	\$700	5	17.6	✓	✓	✓	✓	NH ₃ , Cl ₂ , ClO ₂ , SO ₂ , PH ₃ , NO ₂ , HCN
Honeywell	MultiPro Multi-Gas	\$700 to \$800	4	11	✓	✓	✓	✓	Dual-toxic CO/H ₂ S
Honeywell	PhD6™	\$1,100	6	20	✓	✓	✓	✓	PH ₃ , NO ₂ , HCN, ComboTox (CO and H ₂ S), CH ₄ , PID, IR-CH ₄ , IR-CO ₂ , NO, NO ₂ , Cl ₂ , SO ₂
Industrial Scientific	MX6 iBrid	\$2,000 to \$3,000	6	18	✓	✓	✓	✓	NO ₂ , Combined CO/H ₂ S, NH ₃ , Cl ₂ , ClO ₂ , PH ₃ , CO High, SO ₂ , HCl, HCN, H ₂ , PH ₃ High, NO
Industrial Scientific	Ventis MX4	\$700 to \$1,000	4	13.4	✓	✓	✓	✓	SO ₂ , NO ₂ , Combined CO/H ₂
MSA	ALTAIR® 4x	\$1,000	4	7.9	✓	✓	✓	✓	NO ₂
MSA	Solaris® MSHA	\$1,300	4	8	✓	✓	✓	✓	None
RAE	MultiRAE	\$1,000 to \$2,500	6	31	✓	✓	✓	✓	NH ₃ , VOC, CO ₂ , Multiple ranges of CO, Cl ₂ , ClO ₂ , EtO-A and B, HCHO, HCN, CH ₃ SH, NO, NO ₂ , PH ₃ , SO ₂
RAE	MultiRAE Lite Pumped	\$950	6	31	✓	✓	✓	✓	NH ₃ , VOC, CO ₂ , Multiple ranges of CO, Cl ₂ , ClO ₂ , HCHO HCN, CH ₃ SH, NO, NO ₂ , PH ₃ , SO ₂
RAE	QRAE II	\$500	4	12	✓	✓	✓	✓	None

Handheld Multi-Gas Meters Market Survey Report

Vendor	Product	MSRP	Number of Sim. Sensors	Weight (oz)	O ₂ Sensor	%LEL Sensor	H ₂ S Sensor	CO Sensor	Other
RAE	QRAE 3	\$1,000	4	14.5	✓	✓	✓	✓	NH ₃ , SO ₂ , HCN, PH ₃ , Cl ₂ , NO ₂
RKI Instruments	GX-2009	\$700	4	4.6	✓	✓	✓	✓	None
Notes: ✓—system is equipped with corresponding feature Cl ₂ —Chlorine ClO ₂ —Chlorine dioxide COCl ₂ —Phosgene CO—Carbon monoxide CO ₂ —Carbon dioxide CH ₄ —Methane CH ₃ SH—Methyl mercaptan EtO-A and B—Different sensors for O ₂ H ₂ —Hydrogen HCHO—Formaldehyde HCN—Hydrogen cyanide					H ₂ S—Hydrogen sulfide IR-CH ₄ —Infrared methane detector IR-CO ₂ —Infrared carbon dioxide detector LEL—Lower explosive limit NH ₃ —Ammonia NO—Nitrogen oxide NO ₂ —Nitrogen dioxide O ₂ —Oxygen O ₃ —Ozone PID—Photoionization detector PH ₃ —Phosphine SO ₂ —Sulfur dioxide VOC—Volatile organic carbon				

Information in the table is based on data gathered from vendors and their websites from November 2015 through February 2016.

3.1 BW Technologies by Honeywell

3.1.1 Gas Alert Max XT II

The Gas Alert Max XT II costs about \$880 depending on configuration. It measures 5.1 x 2.8 x 2.0 inches and weighs 11.1 ounces. It can be configured to include up to four simultaneous sensors and has single button operation. Sensor options include O₂, %LEL, H₂S, and CO. It has a rechargeable battery with a manufacturers estimated run time of 10 hours or an alkaline battery pack. The Gas Alert Max XT II includes the SmartSample pump that combined with sampling tubes, supports remote sampling for confined space entry.



Gas Alert Max XT II

Alarms include visual, vibrating, and audible. The alarms can be set for various concentration levels and are latching alarms. User options include safe display mode, stealth mode, calibration lock, auto zero on startup, O₂ calibration on startup, and an option to force a bump test when the test is overdue. It includes a 2-year warranty on all sensors.

3.1.2 Gas Alert Microclip XL

The Gas Alert Microclip XL costs about \$615 depending on configuration. It differs from the Gas Alert Microclip XT in extended battery run time. It is slightly heavier and thicker. It measures 4.4 x 2.4 x 1.2 inches and weighs 6.7 ounces. It can be configured to include up to four simultaneous sensors and has single button operation. Sensor options include O₂, %LEL, H₂S, and CO. It has a rechargeable battery with a manufacturers estimated run time of 18 hours or an alkaline battery pack.



Gas Alert Microclip XL

Alarms include visual, vibrating, and audible. The alarms can be set for various concentration levels and are latching alarms. User options include safe display mode, stealth mode, calibration lock, auto zero on startup, O₂ calibration on startup, and an option to force a bump test when the test is overdue. It includes a 2-year warranty on all sensors.

3.1.3 Gas Alert Microclip XT

The Gas Alert Microclip XT costs about \$600 depending on configuration. It measures 4.4 x 2.4 x 1.1 inches and weighs 6 ounces. It can be configured to include up to four simultaneous sensors and has single button operation. Sensor options include O₂, %LEL, H₂S, and CO. It has a rechargeable battery with a manufacturers estimated run time of 10 hours or an alkaline battery pack.



Gas Alert Microclip XT

Alarms include visual, vibrating, and audible. The alarms can be set for various concentration levels and are latching alarms. User options include safe display mode, stealth mode, calibration lock, auto zero on startup, O₂ calibration on startup, and an option to force a bump test when the test is overdue. It includes a 2-year warranty on all sensors.

3.1.4 Gas Alert Microclip X3

The Gas Alert Microclip X3 costs about \$675 depending on configuration. It differs from the Gas Alert Microclip XL in that it has an extended 3 year warranty. It measures 4.4 x 2.4 x 1.2 inches and weighs 6.7 ounces. It can be configured to include up to four simultaneous sensors and has single button operation. Sensor options include O₂, %LEL, H₂S, and CO. It has a rechargeable battery with a manufacturers estimated run time of 18 hours or an alkaline battery pack.



Gas Alert Microclip X3

Alarms include visual, vibrating, and audible. The alarms can be set for various concentration levels and are latching alarms. User options include safe display mode, stealth mode, calibration lock, auto zero on startup, O₂ calibration on startup, and an option to force a bump test when the test is overdue. It includes a 3-year warranty on all sensors.

3.1.5 Gas Alert Quattro

The Gas Alert Quattro costs about \$700 depending on configuration. It measures 5.1 x 3.2 x 1.9 inches and weighs 11 to 12 ounces. It can include up to four simultaneous sensors and has single button operation. Sensor options include O₂, %LEL, H₂S, and CO. In addition to alarms, the display shows continuous sensor readings and calibration status. Power options include either an interchangeable battery pack that is rechargeable or an alkaline battery pack. Manufacturers estimated run time is 21 hours for the rechargeable battery.



Gas Alert Quattro

Alarms include visual, vibrating, and audible. The alarms can be set for various concentration levels and are latching alarms. The Gas Alert Quattro includes data logging and event logging capabilities. The Gas Alert Quattro does not include a pump but is compatible with an available accessory motorized pump. It includes a 2-year warranty on all sensors.

3.2 Crowcon

3.2.1 Gas Pro

The Gas Pro costs about \$850 depending on the configuration. It measures 1.7 x 5.1 x 3.3 inches and weighs 11.9 to 12.7 ounces depending on the number of sensors included. It can be configured to include up to five simultaneous sensors and has single button operation. Sensor options include O₂, %LEL, H₂S, CO, dual toxic (CO+H₂S), Hydrogen- filtered CO, chlorine (Cl₂), Ozone (O₃), sulfur dioxide (SO₂), phosgene (ClO₂), ammonia (NH₃) nitrogen oxide (NO), and nitrogen dioxide (NO₂). It has a rechargeable battery with an



Gas Pro

estimated run time of 13 hours and a recharge time of 7.5 hours or an alkaline battery pack.

Alarms include visual, vibrating, and audible. The alarms can be set for various concentration levels and are latching alarms.

3.2.2 Tetra 3

The Tetra 3 costs about \$1,100 depending on the configuration. It measures 4.5 x 2.8 x 1.9 inches and weighs 10.4 ounces. It can be configured to include up to four simultaneous sensors and has single button operation. Sensor options include O₂, %LEL, H₂S, CO, H-filtered CO, Ozone (O₃), SO₂, NH₃, and IR-based CO₂. It has a rechargeable Li-ion battery with an estimated run time of 12 hours and a 5 hour recharge time or an alkaline battery pack.



Tetra 3

Alarms include visual, vibrating, and audible. The alarms can be set for various concentration levels and are latching alarms. Each sensor channel can have two instantaneous alarms.

3.2.3 T4

The Crowcon T4 costs about \$550 depending on the configuration. It measures 5.3 x 3.1 x 1.4 inches and weighs 9.9 ounces. It can be configured to include up to four simultaneous sensors and has a single button operation. Sensor options include O₂, %LEL, H₂S, and CO. It has a rechargeable battery with a manufacturers estimated run time of 24 hours and a recharge time of about 5.5 hours or an alkaline battery pack.



T4

Alarms include visual, vibrating, and audible. The alarms can be set for various concentration levels and are latching alarms. The T4 has data logging for up to 130 hours of data or 3,500 events.

3.3 Draeger

3.3.1 X-am 2500

The Draeger X-am 2500 cost about \$750 depending on the configuration. It measures 1.9 x 5.1 x 1.7 inches and weighs 7 – 8 ounces. It can be configured for up to four simultaneous sensors. Sensors options include O₂, %LEL, H₂S, CO, NO₂, and SO₂. It has an option for a rechargeable NiCad battery or replaceable alkaline cells with an estimated run time of 12 hours for the rechargeable battery. A pump is available as an accessory.



X-am 2500

Alarms include visual, vibrating, and audible. The alarms can be set for various concentration levels and are latching alarms.

3.3.2 X-am 5000

The Draeger X-am 5000 cost about \$1,500 to \$2,000 depending on the configuration. It measures 1.9 x 5.1 x 1.7 inches and weighs 8 – 9 ounces. It can be configured for up to five simultaneous sensors. Sensors options include O₂, %LEL, H₂S, CO, NH₃, NO, NO₂, SO₂, PH₃, HCN, CO₂, Cl₂, H₂, organic vapors, COCl₂, and O₃. It has an option for a rechargeable Ni-MH battery or replaceable alkaline cells with an estimated run time of 12 hours for the rechargeable battery. A pump is an available accessory.



X-am 5000

Alarms include visual, vibrating, and audible. The alarms can be set for various concentration levels and are latching alarms.

3.4 Honeywell

3.4.1 Impact

The Impact costs about \$1,000 depending on the configuration. It measures 1.9 x 3.3 x 5.4 inches and weighs 18 ounces. It can be configured for up to four simultaneous sensors and single button operation. Sensor options include O₂, %LEL, H₂S, CO, NH₃, NO₂, SO₂, CO₂, and Cl₂. It has a rechargeable Ni-MH battery with a manufacturers estimated run time of 10 hours or an alkaline battery pack. It has a built in pump.



Impact

Alarms include visual, vibrating, and audible. The alarms can be set for various concentration levels and are latching alarms.

3.4.2 MicroMAX Pro

The MicroMAX Pro cost about \$700 depending on the configuration. It measures 4.75 x 3 x 1.8 inches and weighs about 17.6 ounces with a pump. It can be configured for up to five simultaneous sensors and has single button operation. Sensor options include O₂, %LEL, H₂S, CO, NH₃, Cl₂, ClO₂, SO₂, PH₃, NO₂, and HCN. It has a data recorder capable of 2,400 data points which is 40 to 200 hours depending on recording frequency. It has either a rechargeable Ni-MH battery or replaceable alkaline cells with a manufacturers estimated



MicroMAX Pro

run time of 13 hours and a 5 hour recharge time for the rechargeable battery.

Alarms include visual, vibrating, audible, and a voice alarm (speaking alarm). The alarms can be set for various concentration levels and are latching alarms.

3.4.3 MultiPro Multi-Gas

The MultiPro Multi-Gas costs about \$700 to \$800 depending on the configuration. It measures 6.75 x 2.7 x 1.7 inches and weighs about 11 ounces with a pump. It can be configured for up to four simultaneous sensors and has single button operation. Sensor options include O₂, %LEL, H₂S, CO, and a dual-toxic sensor for CO/H₂S. It has a data recorder capable of 40 hours of storage and up to 20 events. It has either a rechargeable Li-Ion battery or replaceable alkaline cells with a manufacturers estimated run time of 22 hours and a 5 hour recharge time for the rechargeable battery.



MultiPro Multi-Gas

Alarms include visual, vibrating, and audible. The alarms can be set for various concentration levels and are latching alarms.

3.4.4 Phd6™

The Phd6™ cost about \$1,100 depending on the configuration. It measures 6.6 x 3.1 x 2 inches and weighs about 20 ounces with a rechargeable battery and pump. The pump is optional. It can be configured for up to six simultaneous sensors. Sensor options include O₂, %LEL, H₂S, CO, PH₃, NO₂, HCN, ComboTox (CO & H₂S), CH₄, PID, IR-CH₄, IR-CO₂, NO, NO₂ Cl₂, and SO₂. It has a data recorder capable of recording 3,800 data points and 20 events and an optional full data



Phd6™

recorder. It has either a rechargeable Li-ion battery or replaceable alkaline cells with a manufacturers estimated runtime of 16 hours.

Alarms include visual, vibrating, audible, and a voice alarm (speaking alarm). The alarms can be set for various concentration levels and are latching alarms.

3.5 Industrial Scientific

3.5.1 MX6 iBrid

The MX6 iBrid costs about \$2,000 to \$3,000 depending on the configuration. It measures 6.6 x 3.1 x 2.2 inches and weighs about 18 ounces with a pump. It can be configured for up to six simultaneous sensors. Sensor options include O₂, %LEL, H₂S, CO, NO₂, combined CO/H₂S, NH₃, Cl₂, ClO₂, PH₃, CO High, SO₂, HCl, HCN, H₂, PH₃ High, and NO. It has either a rechargeable Li-ion battery or replaceable alkaline cells with a manufacturers estimated run time of 20 hours with pump.



MX6 iBrid

Alarms include visual, vibrating, audible, and a voice alarm (speaking alarm). The alarms can be set for various concentration levels and are latching alarms.

3.5.2 Ventis MX4

The Ventis MX4 costs about \$700 to \$1,000 depending on the configuration. It measures 6.8 x 2.6 x 2.6 inches and weighs about 13.4 ounces with a pump. It can be configured for up to four simultaneous sensors. Sensor options include O₂, %LEL, H₂S, CO, NO₂, combined CO/H₂, and SO₂. It has either a rechargeable Li-ion battery or replaceable alkaline cells with a manufacturers estimated run time of 12 hours with pump.



MX4

Alarms include visual, vibrating, audible, and a voice

alarm (speaking alarm). The alarms can be set for various concentration levels and are latching alarms.

3.6 MSA

3.6.1 ALTAIR® 4x

The ALTAIR® 4x costs about \$1,000 depending on the configuration. It measures 4.4 x 3.0 x 1.3 inches and weighs about 7.9 ounces. It can be configured for up to four simultaneous sensors. Sensor options include O₂, %LEL, H₂S, CO, NO₂. It has either a rechargeable Li-ion battery or replaceable alkaline cells with a manufacturers estimated run time of 24 hours and a charging time of 4 hours. It has a data logger capable of recording for 50 hours and 500 standard events.



ALTAIR® 4x

Alarms include visual, vibrating, and audible. The alarms can be set for various concentration levels and are latching alarms. It includes a 3-year warranty.

3.6.2 Solaris® MSHA

The Solaris® MSHA costs about \$1,300 depending on the configuration. It measures 4.5 x 2.5 x 1.3 inches and weighs about 8 ounces with an optional pump. It can be configured for up to four simultaneous sensors. Sensor options include O₂, %LEL, H₂S, and CO. It has either a rechargeable Li- ion battery or replaceable alkaline cells with a manufacturers estimated run time of 14 hours with pump.



Solaris® MSHA

Alarms include visual, vibrating, audible, and a voice

alarm (speaking alarm). The alarms can be set for various concentration levels and are latching alarms.

3.7 RAE

3.7.1 MultiRAE

The MultiRAE costs about \$1,000 to \$2,500 depending on the configuration. It measures 7.8 x 3.8 x 2.6 inches and weighs about 31 ounces. It can be configured for up to six simultaneous sensors. Sensor options include O₂, %LEL, H₂S, CO, NH₃, VOC, CO₂, multiple range of CO, Cl₂, ClO₂, HCHO, HCN, CH₃SH, NO, NO₂, PH₃, and SO₂. There are also PID, IR, and other exotic sensors available. The unit has wireless connectivity for remote observation. It has a data logger capable of logging 5 sensors for 6 months at a 1-minute interval. It has



MultiRAE

either a rechargeable Li-ion battery or replaceable alkaline cells with a manufacturers estimated run time of 14 hours with pump.

Alarms include visual, vibrating, audible, and a voice alarm (speaking alarm). The alarms can be set for various concentration levels and are latching alarms.

3.7.2 MultiRAE Lite Pumped

The MultiRAE Lite Pumped costs about \$950 depending on the configuration. It measures 7.8 x 3.8 x 2.6 inches and weighs about 31 ounces. It can be configured for up to six simultaneous sensors. Sensor options include O₂, %LEL, H₂S, CO, NH₃, VOC, CO₂, multiple range CO, Cl₂, ClO₂, HCHO, HCN, CH₃SH, NO, NO₂, PH₃, and SO₂. It has a data logger capable of logging 5 sensors for 6 months at a 1-minute interval. It has either a rechargeable Li- ion battery or replaceable alkaline cells with a manufacturers estimated run time of 14 hours with pump.



MultiRAE Lite Pumped

Alarms include visual, vibrating, audible, and a voice alarm (speaking alarm). The alarms can be set for various concentration levels and are latching alarms.

3.7.3 QRAE II

The QRAE II costs about \$500 depending on the configuration. It measures 5 x 2.8 x 2 inches and weighs about 12 ounces with the optional pump. It can be configured for up to four simultaneous sensors. Sensor options include O₂, %LEL, H₂S, and CO. It has a data logger capable of recording 12 days at 1-minute intervals. It has either a rechargeable Li-ion battery or replaceable alkaline cells with a manufacturers estimated run time of 14 hours with pump.



QRAE II

Alarms include visual, vibrating, audible, and a voice alarm (speaking alarm). The alarms can be set for various concentration levels and are latching alarms.

3.7.4 QRAE 3

The QRAE 3 costs about \$1,000 depending on the configuration. It measures 5.5 x 3.2 x 1.7 inches and weighs about 14.5 ounces with the optional pump. It can be configured for up to four simultaneous sensors. Sensor options include O₂, %LEL, H₂S, CO, NH₃, SO₂, HCN, PH₃, CL₂ and NO₂. It has a data logger capable of recording 4 sensors for 3 months at 1-minute intervals. It has either a rechargeable Li-ion battery or replaceable alkaline cells with a manufacturers estimated run time of 8 hours with pump.



QRAE 3

Alarms include visual, vibrating, audible, and a voice alarm (speaking alarm). The alarms can be set for various concentration levels and are latching alarms.

3.8 RKI Instruments

3.8.1 GX-2009

The GX-2009 costs about \$700 depending on the configuration. It measures 2.7 x 3 x 1 inches and weighs about 4.6 ounces. It is configured for four simultaneous sensors and has single button operation. It includes a data logger with log times from 10 to 300 hours. Sensor options include O₂, %LEL, H₂S, and CO. It has a rechargeable Ni-MH battery with a manufacturers estimated run time of 20 hours.



GX-2009

Alarms include visual, vibrating, and audible. The alarms can be set for various concentration levels and are latching alarms.

4. VENDOR CONTACT INFORMATION

Additional information on the MGMs included in this market survey report can be obtained from the vendors listed in Table 4-1 below.

Table 4-1. Vendor Contact Information

Vendor	Website/E-Mail
BW Technologies by Honeywell	www.bw-gasmonitors.com
Crowcon	www.crowcon.com/us/products/portables.html
Draeger	www.draeger.com/Sites/enus_us/Pages/Fire-Services/ProductSelector.aspx?navID=2281
Honeywell	www.honeywellanalytics.com/en/product/portable-gas-detection
Industrial Scientific	www.indsci.com/products/multi-gas-detectors/
MSA	us.msasafety.com/Portable-Gas-Detection/c/114?isLanding=true
RAE	www.raesystems.com/products/portable-gas-detector/portable-single-gas-or-multi-gas-monitors
RKI Instruments	www.rkiinstruments.com/pages/gx2009.htm

5. SUMMARY

This market survey report provides information on 23 MGMs. The products differ in cost, number and types of available sensors, data logging capabilities, size and weight, and complexity of operation. All the MGMs were capable of having four simultaneous sensors and came with either a standard pump or had a pump available as an option or accessory. All the MGMs had visible, audible, and vibrating alarms. The way the alarms could be set and the number of alarms differed. One manufacturer offered a unit with a talking alarm option. All of the MGMs had both a rechargeable and a replaceable (alkaline) battery option available. Battery runtimes differed. Some units had data logging capabilities with differing capacities. One unit had wireless capability to relay information to a remote command post.

Emergency responder agencies that consider purchasing MGMs should carefully research each product's overall capabilities and limitations in relation to their agency's operational need.