



**MDA Scientific Single Point Monitor
For Hydrogen Sulfide Monitoring
Near Solid Waste Facilities**

**Maine Department of Environmental Protection
Bureau of Remediation and Waste Management
Division of Technical Services**

Standard Operating Procedure: **TS LG02**

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1.0 APPLICABILITY:

This standard operating procedure (SOP) is designed to be a guideline for hydrogen sulfide gas monitoring using a MDA Scientific Single Point Monitor. The meter will be used to monitor hydrogen sulfide levels in ambient air adjacent to solid waste facilities. Calibration range is 5 to 90 parts per billion with an accuracy of $\pm 25\%$ true value. Concentrations as low as 1 part per billion may be detected with the H₂S Chemcassette® and 2 parts per billion may be detected with the Hydrides Chemcassette®, however; accuracy has not been verified below 4 parts per billion.

2.0 PURPOSE:

The purpose of this document is to describe the Maine Department of Environmental Protection, Bureau of Remediation and Waste Management [MEDEP/BRWM], Division of Technical Services procedure for monitoring low level hydrogen sulfide concentrations in ambient air near solid waste facilities.

3.0 RESPONSIBILITIES:

All Division Staff must follow this procedure when using the MDA Scientific Single Point Monitor to monitor hydrogen sulfide levels in ambient air near solid waste facilities. Staff must read this procedure and relevant sections of the instrument operating manual prior to using the instrument in the field. All managers and supervisors within MEDEP/BRWM/Technical Services are responsible for ensuring that their staff is familiar with, and adhere to, this procedure. The solid waste engineering unit will be responsible for maintaining the instrument.

4.0 DEFINITIONS:

- 4.1 SPM: single point monitor
- 4.2 ppm: parts per million
- 4.3 ppb: parts per billion
- 4.4 H₂S: hydrogen sulfide
- 4.5 operating manual: MDA Scientific Single Point Monitor Operating Instructions, Rev 5.3, September, 2003
- 4.6 reference guide: ACR System Inc. Reference Guide Revised December 2000

5.0 PROCEDURES:

5.1 Operation:

- Monitor location and set-up: Monitors are located by site specific plan, and set up according to the operating manual in temperature controlled enclosures.
- Every 30 days [or less] MEDEP technical staff download data, change cartridges and verify both flow rate and system response of the monitor.
 - Note SPM alarm conditions, if any. Reset alarms once verified and the condition remediated.
 - Replace Chemcassette® cartridges according to section 1.5 of the operating manual. The Chemcassette® cartridge part number (P/N) for H₂S is 700304 (EP). For Hydrides, the Chemcassette® cartridge P/N is 700300 (EP).

Prior to installation, note the expiration date of the replacement cartridge. Chemcassette® cartridges should not be used if they exceed their expiration date either at the time of installation or over the expected operating period of the cartridge.

- The H₂S Chemcassette® is formulated for sensitivity and specificity to H₂S. The H₂S Chemcassette® will respond to: Hydrogen Selenide (H₂Se) and H₂S. Substances that have a negative affect on the H₂S Chemcassette when combined with equal concentrations of H₂S include strong oxidizers such as chlorine (Cl₂), nitrogen dioxide (NO₂) and sulfur dioxide (SO₂). The H₂S Chemcassette® is designed for use within a controlled environment with a relative humidity between 35-80%.
- The Hydrides Chemcassette® is formulated for sensitivity and specificity to hydride gas and is the MEDEP/BRWM/Technical Services preferred method for low level hydrogen sulfide monitoring in the ambient air adjacent to solid waste facilities. The Hydrides Chemcassette® will respond to: Arsine (AsH₃), Beryllium Hydride, Cadmium Hydride, Diborane (B₂H₆), Dichlorosilane (SiH₂Cl₂), Disilane (Si₂H₆), Gallium Hydride, Germane (GeH₄), Hydrogen Selenide (H₂Se), Hydrogen Sulfide (H₂S), Phosphine (PH₃), Silane (SiH₄), Stibine (SbH₃), Tellurium Hydride, Trichlorosilane (SiHCl₃), Zinc Hydride, Biphosphyl Ethane, Monoethyl Arsine, Monoethyl Phosphine, Tert-butylarsine (TBA), Tert-butylphosphine (TBP), Tert-butylthiol, Diethyl arsine, Diethyl Phosphine, Diethyl Silane, Di-tert-butylsilane, ACT 935 Photresist Stripper, EKC265™ Photresist Stripper, TOMCATS® tetramethylcyclotetrasiloxane, Cupra Select®, and Hydroxylamine. The Hydrides Chemcassette® may be desensitized by high Hydrogen Chloride (HCL) concentrations.
- Verify system response according to section 1.8 [Verifying System Response] of the operation manual. Note the date and time of the System Response Check.
- Clean optics area monthly with compressed air.
- Check flow through the monitor by attaching the inlet tubing to the outlet end of the flow meter. Note the date of flow check. The flow rate should be 810 ± 5% ml/min with the H₂S Chemcassette® and 350 ± 5% ml/min with the Hydrides Chemcassette®. A properly calibrated flow meter is used to measure flow rate. A McMillan S-110-6 Flo-Meter is used and maintained according to the Operating Manual by the solid waste engineering unit. The Flo-Meter should be calibrated on a yearly basis. If the flow rate is not within the required range visually inspect the filters. If compromised, the filters should be removed and replaced according to the following:
 - Acid scrubber filter P/N 710235
 - Particulate filter P/N 780248

Each monitor should be equipped with an internal and end-of-line particulate filter. Adjust the flow valve if filter replacement is not needed. Note the date of flow adjustment. If the flow rate can not be adjusted properly the flow valve may need to be replaced or the monitor may need to be sent back to the factory for additional maintenance.

- Separately, block the inlet and outlet tubing and verify that the SPM reports a Fault 17 alarm. Reset the alarm in order to resume operations. Perform this check monthly.

- Disconnect and replace the OWL Data Logger according to the ACR Systems Inc. Reference Guide. Note the date and time data loggers are installed and removed. Data loggers continue to record values even when not connected to the monitor, so it is important to keep track of in-service dates. Data loggers are transported back to the office to download data on TrendReader™ for Windows software, version 1.31c, according to instructions in the reference guide. SPM response sampling time is typically 15 minutes. The OWL data loggers are programmed to take a reading every 5 minutes. Data loggers can store up to 32,767 readings. Typically, data is downloaded on a monthly basis or more frequently as needed. Conversion formulas for TrendReader™ for Windows were developed for our SPM. The unprocessed data that is recorded by the datalogger is converted to a gas reading in ppb as follows:

$$\text{ANSWER } \emptyset = (\text{SOURCE } \emptyset / 248) * 24 * 5.625 - 22.5$$

$$\text{IF ANSWER } \emptyset < \emptyset \text{ THEN ANSWER } \emptyset = \emptyset$$

Please note that spaces have been added to the above equations for readability. ANSWER \emptyset is the gas reading in ppb and SOURCE \emptyset is the unprocessed data obtained from the datalogger. The SOURCE \emptyset values can be viewed by applying Equation 38 to the datalogger file.

$$\begin{array}{ll} \text{SOURCE } \emptyset_{\text{min}} = 0 & \text{SOURCE } \emptyset_{\text{max}} = 206.7 \\ \text{ANSWER } \emptyset_{\text{min}} = 0 & \text{ANSWER } \emptyset_{\text{max}} = 90 \end{array}$$

For more information, see section 6 or the TrendReader™ for Windows reference guide.

- Monitors equipped with the ChemKey™ Gas Selection System can be calibrated for different gases, detection ranges, and specialized alarm ranges. See the attached Appendix A for specific information regarding the Low Level Hydrogen Sulfide ChemKey™ System. Contact the SPM manufacturer if needing additional ChemKey™ System information.
- Maintenance is performed on the monitor according to section 3 of the operating manual. Units are sent back to the factory at least annually for maintenance and calibration verification. Alternately, field calibration can be performed with a target gas. Note date of maintenance.
 - For factory maintenance: Call 1-800-321-6320 extension 8230, provide monitor serial number, and request a Service Event Number. Send the monitor and an attached cover letter with problem statement to the following address. Put the Service Event Number on the outside of the box.
 - Honeywell Analytics, Inc.
405 Barclay Boulevard
Lincolnshire, IL 60069

5.2 Quality Control:

- SPM flow rate is the most important field measurement affecting accuracy of the system. Flow rate is checked monthly. If the flow rate is not within the correct range the source of the problem must be corrected and the affected data flagged.

- SPM sensitivity check is performed monthly according to section 1.8 [Verifying System Response] of the operation manual. Positioning and cleanliness of the optics affect system sensitivity. If the system fails this check the source of the problem must be corrected before placing the system back in service.
- The manufacturer performs annual factory maintenance and calibration check of the SPM. Alternately, field calibration can be performed with a target gas. If the calibration check fails, factory maintenance is needed.
- The factory performs quality control testing on the H₂S and Hydrides Chemcassette® cartridges such that a properly functioning SPM will achieve an accuracy of ± 25% true value for H₂S between 4 and 100 ppb with cartridges used prior to their expiration date. H₂S and Hydrides cartridges are refrigerated prior to use, and are used before the expiration date of the cartridge.
- Sample field and maintenance logs are attached.

5.3 Data Assessment:

- Download raw data from the data loggers.
- Select appropriate equation and units from TrendReader™ for Windows software.
- Round raw data to the nearest tenth.
- Present data in a spreadsheet and graph format.
- For the H₂S Chemcassette®, data between the quantitation limit of 4 ppb and the detection limit of 1 ppb should be qualified with a "J". Numerical data below the detection limit of 1 ppb should not be reported. This data should be noted as "U" for undetected.
- For the Hydrides Chemcassette®, data between the quantitation limit of 4 ppb and the detection limit of 2 ppb should be qualified with a "J". Numerical data below the detection limit of 2 ppb should not be reported. This data should be noted as "U" for undetected.
- Where available, correlate on-site meteorological data from landfill with meteorological data from the closest permanent weather station as reported by the Department's Bureau of Air Quality Online Data Service or a comparable service.
 - If data does not correlate reasonably well try to determine reason.
- Correlate meteorological data with gas data to determine the likelihood that the data registered by the monitor is generated by the landfill.
 - Eliminate chances of false positives by evaluating potential off-site influences. H₂S might come from natural sources including the anaerobic decomposition of plant and animal material or from anthropogenic sources such as diesel fuel emissions, wastewater treatment plants, manure handling operations, and solid waste landfills.
 - Provide a side by side comparison of gas and meteorological data. At a minimum, meteorological data should consist of temperature, wind speed, and wind direction. Present data in a spreadsheet.
 - Note likelihood that the gas data registered during any given time is likely to be generated by the landfill. This can be accomplished in the data summary.
 - If data is suspect note reason.
- Provide peer review of data.
 - Peer review should be completed prior to data dissemination to the public.

- At a minimum, data should be verified by data downloader and a secondary reviewer. The secondary reviewer should perform a spot check of the data. If any inconsistencies are noted then a more detailed review should be performed.

6.0 REFERENCES:

- 6.1 MDA Scientific Single Point Monitor Operating Instructions, Rev 5.3, September, 2003.
- 6.2 BRWM Site Monitoring SOP, February 27, 2001.
- 6.3 SOP OC-PE-0001, Standard Operating Procedure Development, Format, Approval and Distribution, June 15, 2001.
- 6.4 McMillan Company Operating Manual, MCM-S-110 Rev. A, July 1998.
- 6.5 ACR System Inc. Reference Guide Revised December 2000.

Appendix A

Specifications for Low Level Hydrogen Sulfide ChemKey™ System

1.0 APPLICABILITY:

This appendix is designed to be a guideline for hydrogen sulfide gas monitoring using the SPM ChemKey™ System and is intended to supplement the above SOP. Specific procedures outlined within the above SOP including operation, quality control, and data assessment still need to be followed except as described below. Calibration range is 0 to 1400 ppb with an accuracy of $\pm 20\%$ true value although accuracy has not been verified below 100 parts per billion.

2.0 PROCEDURES:

2.1 Operation:

- The SPM Low Level Hydrogen Sulfide ChemKey™ System Calibration P/N is MVIP1464-2C. This ChemKey™ System uses a Hydrides Chemcassette®.
 - Response sampling time for this ChemKey™ System is typically 120 seconds. The OWL data loggers are programmed to take a reading every 40 seconds. Data logger storage capacity is 32,767 readings. At a minimum, data must be downloaded every 15 days. Unprocessed data that is recorded by the data logger is converted to a gas reading in ppb using the following conversion formula in TrendReader™ for Windows:

$$\text{ANSWER } \emptyset = (\text{SOURCE } \emptyset / 248) * 24 * 93.75 - 375$$

$$\text{IF ANSWER } \emptyset < \emptyset \text{ THEN ANSWER } \emptyset = \emptyset$$

Please note that spaces have been added to the above equations for readability. ANSWER \emptyset is the gas reading in ppb and SOURCE \emptyset is the unprocessed data obtained from the datalogger. The SOURCE \emptyset values can be viewed by applying Equation 38 to the datalogger file.

$$\begin{array}{ll} \text{SOURCE } \emptyset_{\text{min}} = 0 & \text{SOURCE } \emptyset_{\text{max}} = 206.7 \\ \text{ANSWER } \emptyset_{\text{min}} = 0 & \text{ANSWER } \emptyset_{\text{max}} = 1500 \end{array}$$

For more information, see section 6 or the TrendReader™ for Windows reference guide.

2.2 Data Assessment:

- For the ChemKey™ System using the Hydrides Chemcassette®, data between the quantitation limit of 100 ppb and the detection limit of 53 ppb should be qualified with a "J". Numerical data below the detection limit of 53 ppb should not be reported. This data should be noted as "U" for undetected.

3.0 REFERENCES:

- 3.1 MDA Scientific Single Point Monitor Technical Note Special Calibration Information
T/N MVIP1464-2C Rev 1 5/01.