EFFECTIVENESS MONITORING PLAN

HARTFORD HYDROCARBON PLUME SITE

HARTFORD, ILLINOIS

Prepared for

The Hartford Working Group
Hartford, Illinois

Revised September 2013

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REVISIONS

Date	Name/Company of Reviewer	Section	Revision

SECTIONONE Introduction

The Effectiveness Monitoring Plan (EMP) has been prepared by URS Corporation (URS), on behalf of the Hartford Working Group (HWG). The purpose of this plan is to provide a program to monitor the effectiveness of the Vapor Control System (VCS). Effectiveness will be demonstrated by collecting data from select monitoring points, as described in this EMP, documenting pneumatic control in the areas in which the monitoring points are located. The EMP describes the sampling program for collecting subsurface performance data associated with the SVE system

In addition, several other associated plans and protocols have been prepared in support of the operation and evaluation of environmental activities at Hartford Hydrocarbon Plume Site (Site). These include:

1) Modified SVE System Effectiveness Monitoring Program submitted to the United States Environmental Protection Agency (USEPA) on March 7, 2011 **(Appendix A)**;
2) Hartford Soil Vapor Extraction (HSVE) Monitoring and Maintenance and Manual (URS, 2013a);
3) VCS Operating and Maintenance Plan (URS, 2013b);
4) Quality Assurance Project Plan (URS, 2013c)

The Village of Hartford (Hartford) is located in the west central portion of Madison County, Illinois. The monitoring area is bound by Hawthorne Street to the South, Rand Avenue to the north, Old St. Louis Road to the west, and North Olive Street to the east. The general location of Hartford, as well as the United States Environmental Protection Agency (USEPA) defined site boundaries, is presented in **Figure 1**.

This monitored area is further subdivided into six zones. Vapor monitoring points screened in these six zones are shown in **Figure 2**.

- Zone 1
- Zone 2
- Zone 3
- Zone 4
- Zone 5
- Zone 6

The procedures presented in this document shall be reviewed and updated, as necessary, to address any changes field conditions.

The EMP has been established to monitor the effectiveness of the VCS and provide information for system adjustments.

2.1 OBJECTIVES

The objectives of the EMP are to:

- Compile data on vacuum influence and vapor concentration in the unsaturated soils in the monitored area;
- Demonstrate attainment of subsurface pneumatic control; and
- Demonstrate reduction in subsurface vapor concentrations over time.

2.2 SCOPE

The EMP provides data to evaluate changes in subsurface conditions at regular intervals across the monitored area. The EMP will coincide with the HSVE Maintenance and Monitoring Plan (URS, 2013a). The Proposed Modified SVE System Effectiveness Monitoring Program dated and submitted to the USEPA on March 7, 2011 **(Appendix A)** proposed monitoring of 154 vapor monitoring points. However, three (3) of the proposed vapor monitoring points (VMP-21S, VMP-44VS and VMP-44S) were damaged during excavation activities and two (2) of the proposed vapor monitoring points (VMP-37S and VMP-37M) were paved over during repaving of North Old St. Louis Road in 2011. A notification was submitted to the USEPA via email on October 5, 2011 informing them of the damaged vapor monitoring points and plans to abandon them. The email correspondence with the USEPA is provided in **Appendix B.** An assessment of vapor monitoring points that could be used as substitutes for the damaged or inaccessible locations was performed. It was determined that ports in the vicinity of those damaged or inaccessible are already included in the proposed EMP. With the removal of the aforementioned vapor monitoring ports, this EMP includes 149 locations as identified in **Tables 1** and **2** and on **Figure 2**.

The data collected during effectiveness monitoring provides a measure of the pneumatic response in the subsurface soil volume in the vicinity of the HSVE wells (radius of influence). Effectiveness monitoring data and data collected from the HSVE wells, as described in the HSVE Monitoring and Maintenance Manual (URS, 2013a), will be used collectively to assess performance of the SVE system. The data will be reviewed and used to determine if system

adjustments should be made and if maintenance activities should be performed. Site conditions such as groundwater elevations, rainfall, and geologic conditions could affect the effectiveness monitoring data and HSVE well data collected and will be considered when assessing if actions should be taken. SVE system adjustments or maintenance would include HSVE well valve settings, stinger position, removal of sediment, and line sweeping.

The EMP data includes:

- Physical data:
  - Stabilized Vacuum/Pressure (in. of H_20)
  - Liquid level gauging data (except VMP and VP designated locations; these locations are constructed with small diameter tubing and cannot be gauged).
- Screening data:
  - PID (ppmv)
  - FID (ppmv)
  - PHC (ppmv)
  - CH_4 (ppmv)
  - O_2 (%)
  - CO_2 (%)

The scope of the EMP is summarized below, including the applicable SOPs for each data collection task **(see Appendix C)**:

Type	Monitoring Point	QA/QC v Operation	Description	SOP
Physical	**HMW / MP / VP / VMP Wells**	Operation	Wellhead Vacuum	HWG SOP 02
		Operation	Well Gauging for Liquid Levels	HWG SOP 02
		Operation	Equipment Decontamination	HWG SOP 05
		QA/QC	Digital Manometer Calibration & Maintenance	HWG SOP 04
Screening	**HMW / MP / VP / VMP Wells**	Operation	Field Screening Sample Collection	HWG SOP 02
		Operation	Field Laboratory Instrument Calibration & Screening	HWG SOP 03
		QA/QC	Field Instrument Calibration and Maintenance	HWG SOP 06

2.3 MONITORING LOCATIONS

The EMP incorporates 149 individual monitoring points. Most of the 149 locations contain multiple monitoring points installed within a common "nested" well such that multiple vertical lithologic zones can be monitored.

A description of the four types of monitoring points is provided below.

Vapor Monitoring Points (VMPs)

The EMP includes 63 VMPs. VMPs consist of 0.5-inch outside diameter stainless steel screens connected to 0.125-inch inside diameter stainless steel riser tubing extended to ground surface. The stainless steel tubing is connected to a 4-way valve using silicone (or equivalent) tubing. Each VMP is labeled with a metal identification tag and is color coded to reflect its depth (white/clear - very shallow; yellow - shallow; red - medium; purple - deep).

Vapor Probes (VPs)

There is one VP monitoring location. The VPs consist of 0.5-inch outside diameter stainless steel screens connected to 0.125-inch inside diameter stainless steel riser tubing extended to ground surface. The tubing is connected to a 4-way valve using silicone (or equivalent) tubing. The nested VP is labeled and is color coded to reflect its depth (white/clear - very shallow; yellow - shallow; red - medium; purple -deep).

Monitoring Points (MPs)

The EMP includes 83 MPs. Wells designated MP are larger in diameter than the VMPs and VPs and are constructed one of two ways. Some MPs are constructed of 1 or 2-inch PVC screens and risers of varying lengths to ground surface, depending on the formation the point is screened across. Each MP is fitted with an expandable well cap and quick-connect fitting. The second type of MP is constructed of a 1-inch diameter stainless steel screen attached to 0.5-inch diameter nylon riser tubing to ground surface. Each of the flex tubing wells are labeled with the letters S/M/D (shallow/medium/deep) and color coded to reflect its depth (yellow - shallow; red - medium; purple - deep).

Hartford Monitoring Wells (HMWs)

The EMP includes two HMWs. All HMW points are 2-inch diameter PVC wells with two inch diameter slotted screens set in various formations. Each HMW is fitted with an expandable well cap and quick-connect fitting.

2.4 SCHEDULING

Effectiveness monitoring activities will take place on a monthly basis for five consecutive months and quarterly thereafter. Field measurements from subsurface monitoring points within the monitored area shall be completed over a two consecutive day period, pending delays due to weather, safety concerns or other unforeseen circumstances, and will coincide with the HSVE data collection. **Appendix D** contains manufacturers' equipment manuals for field equipment.

At the end of the fourth consecutive month of monitoring, the data will be evaluated to assess the level of pneumatic control in the subsurface. The evaluation period will span approximately one month and will be complete before the end of the fifth round of monthly monitoring activities. Data will be reviewed for demonstration of subsurface pneumatic control. The data to be evaluated will include:

- Stabilized Vacuum/Pressure (in. of H_2O)
- PID (ppmv)
- FID (ppmv)
- CH_4 (ppmv)
- PHC (ppmv)
- O_2 (%)
- CO_2 (%)

In addition to the data listed above, data collected from HSVE wells and In-Home Monitoring activities (conducted by Apex Oil Company, Inc. [Apex]) will also be evaluated.

2.5 QUALITY ASSURANCE / QUALITY CONTROL

The Quality Assurance/Quality Control (QA/QC) protocols for EMP activities rely on procedures outlined in this plan and the relevant SOPs located in **Appendix C**. The QA/QC is

designed to enhance data validity and reduce the potential for transcription errors by using electronic data entry methods (i.e. Panasonic Toughbook[1]) in the field that compares each data point to the most recent historical reading and the operating range of the instrument.

[1] Field forms will be used if electronic data entry cannot be performed.

SECTION THREE

Effectiveness Monitoring
Data Review and Reporting

Field data collected under the EMP shall be reviewed and reported to the HWG and Agencies according to the guidelines below.

3.1 DATA REVIEW

Data collected during effectiveness monitoring activities shall be reviewed to evaluate the pneumatic control and distribution of hydrocarbon vapors in the monitored area. This data review shall include the current data set and, where appropriate, data from previous effectiveness monitoring activities. The objective of the data review is to assess if subsuface conditions have changed requiring adjustment to operation of the SVE system as specified in the HSVE Monitoring and Maintenance Manual (URS, 2013a). The effectiveness monitoring data, data collected from the HSVE wells as described in the HSVE Monitoring and Maintenance Manual (URS, 2013a) and in-home monitoring data (collected by Apex) will be used collectively to assess performance of the SVE system as described below.

3.1.1 DATA COORDINATION

Currently, there are three activities which will be included in monitoring and data coordination efforts:

1. Effectiveness Monitoring
2. In-home Monitoring
3. HSVE System Monitoring and Maintenance (M&M)

Effectiveness monitoring and HSVE M&M will be performed by URS for the HWG. In-home monitoring will be performed by TriHydro Corporation for Apex. Apex will be notified of the EMP schedule and therefore can coordinate in-home monitoring efforts, if possible. Data collected during effectiveness monitoring activities will be made available to Apex for their use. Similarly, data collected during in-home monitoring activities will be made available to the HWG. Data will be provided to the other party within a reasonable timeframe to be agreed upon by Apex and the HWG.

3.1.2 COMMUNICATION PROCEDURES

Streamlined communication procedures will promote faster response time for necessary SVE system adjustments. Communication between the HWG and Apex regarding onsite activities will be as follows:

In-home Monitoring

1. Apex field team will collect in-home monitoring data which will be managed in accordance with their established plans and procedures.
2. Data including in-home observations and screenings will be provided to the HWG.
3. Apex will notify the HWG/URS HSVE Maintenance & Monitoring team (HSVE team) immediately if an observation or data indicate a change in subsurface vapor concentration at a home of concern (change criteria to be determined by Apex and USEPA).
4. In-home monitoring data will be reviewed to determine nature of system adjustment.
5. HSVE team will respond with adjustments to the SVE system and will inform Apex of the change so in-home monitoring activities can continue.
6. Apex will report back to the HSVE team lead regarding the effectiveness of the system adjustment.

Effectiveness Monitoring

1. HSVE team will collect effectiveness monitoring data which will be managed in accordance to data review and reporting procedures established in the EMP.
2. Data including field observations and screening data will be provided to Apex.
3. Effectiveness monitoring data will be reviewed to determine if any system adjustments are necessary.
4. HSVE team will respond with necessary adjustments to the SVE system according to the HSVE Monitoring and Maintenance Manual (URS, 2013a).
5. Apex will be informed of system adjustments made.

3.2 DATA REPORTING

The data collected during EMP activities will be tabulated and uploaded to the USEPA portal. This table will contain cumulative data from each monitoring event and will include the following:

- Monitoring Point Location
  - Date
  - Time
  - Stabilized Vacuum/Pressure (in. of H_2O)
  - PID (ppmv)
  - FID (ppmv)
  - CH_4 (ppmv)
  - PHC (ppmv)
  - O_2 (%)
  - CO_2 (%)

SECTION FOUR References

Hartford Working Group (HWG), 2011, *Proposed Modified SVE System Effectiveness Monitoring Program: Hartford Area Hydrocarbon Plume Site Hartford, Illinois*; dated March 7, 2011

URS Corporation (URS), 2013 (URS, 2013a); *HSVE Monitoring and Maintenance Plan*; Prepared for the Hartford Working Group (HWG); dated July 2013

URS Corporation (URS), 2013 (URS, 2013b); *VCS Operation and Maintenance Plan*; Prepared for the Hartford Working Group (HWG); dated August 2013

URS Corporation (URS), 2013 (URS, 2013c); *Quality Assurance Project Plan (QAPP)*; Prepared for the Hartford Working Group (HWG); dated August 2013

Tables

TABLE 1
SHALLOW ZONE WELLS
(0-10 FT BGS)

MP-012S	MP-122S	VMP-062S
MP-016S	MP-123S	VMP-062VS
MP-022	MP-124S	VMP-064S
MP-031A	MP-125S	VMP-064VS
MP-033A	MP-126S	VMP-065VS
MP-035A	MP-127S	VMP-066VS
MP-043A	MP-128S	VMP-067VS
MP-044A	MP-130S	VMP-068VS
MP-059A	VMP-001S	VMP-069VS
MP-060A	VMP-015VS	VMP-070VS
MP-064A	VMP-021S[1]	VMP-071VS
MP-078A	VMP-023S	VMP-073S
MP-084A	VMP-026S	VMP-074VS
MP-086A	VMP-027S	VMP-075VS
MP-087A	VMP-036VS	VMP-076VS
MP-088A	VMP-037S[2]	VMP-080VS
MP-090A	VMP-044VS[1]	VMP-089VS
MP-112S	VMP-052VS	VMP-090VS
MP-113S	VMP-053VS	VMP-093S
MP-114S	VMP-057VS	VMP-094VS
MP-115S	VMP-058VS	

Note:

[1] - VMP-021S and VMP-044VS were damaged during excavation activities associated with the repaving of North Old St. Louis Road in 2011.

[2] - VMP-037S was paved over during repaving of North Old St. Louis Road in 2011.

TABLE 2
INTERMEDIATE ZONE WELLS
(10-20 FT BGS)

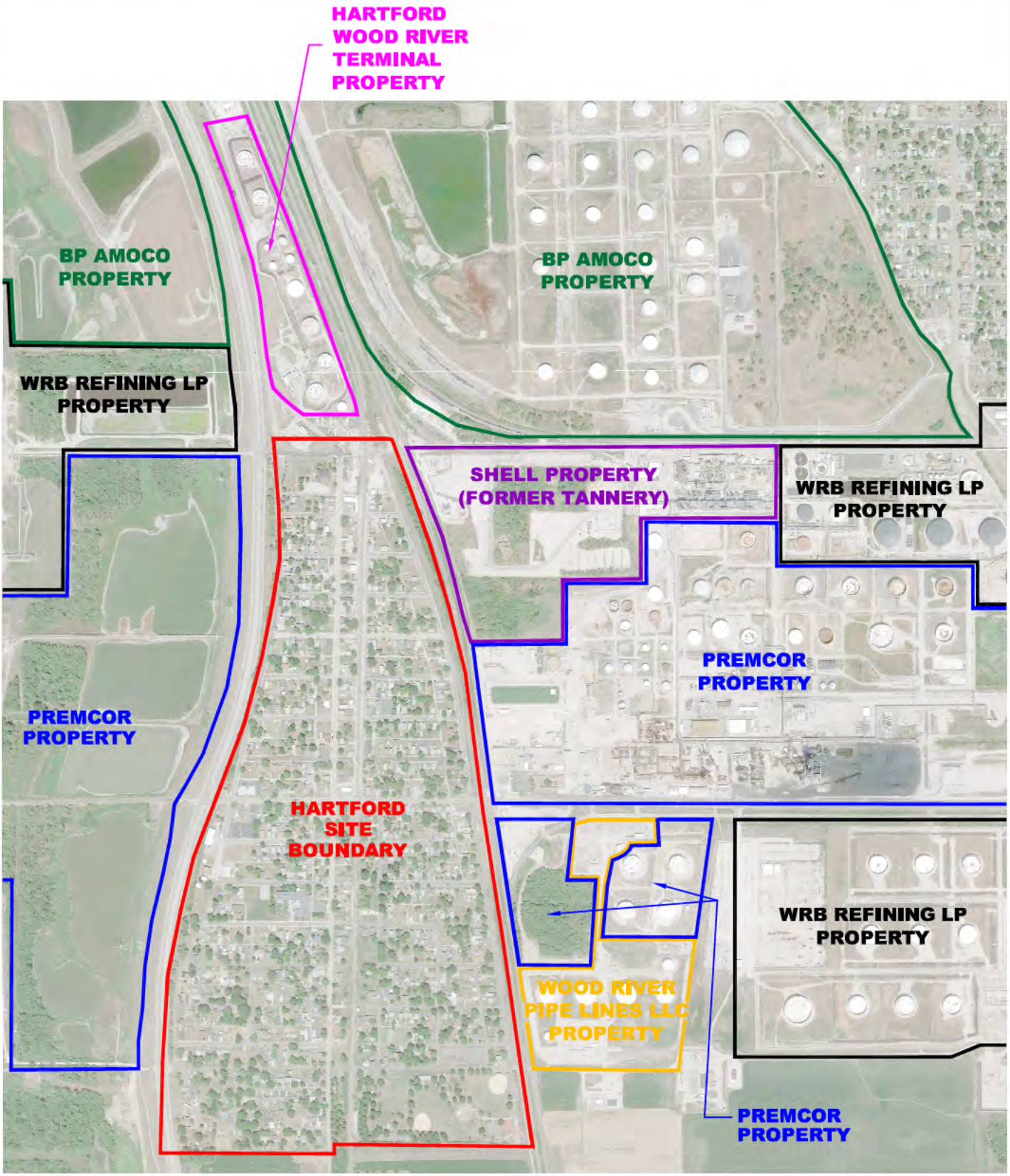
HMW-053A	MP-058A	VMP-015S
HMW-054A	MP-059B	VMP-023M
MP-029A	MP-068	VMP-026M
MP-030A	MP-078B	VMP-027M
MP-031B	MP-079A	VMP-036S
MP-032A	MP-080A	VMP-037M[2]
MP-033B	MP-083A	VMP-044S[1]
MP-034A	MP-085A	VMP-052S
MP-035B	MP-088B	VMP-053S
MP-036A	MP-090B	VMP-058S
MP-037A	MP-091B	VMP-064M
MP-038A	MP-112M	VMP-065S
MP-039A	MP-113M	VMP-066M
MP-040A	MP-114M	VMP-066S
MP-041A	MP-116S	VMP-067S
MP-042A	MP-117S	VMP-068S
MP-043B	MP-118S	VMP-069M
MP-044B	MP-120S	VMP-070M
MP-045A	MP-121S	VMP-071S
MP-046A	MP-124M	VMP-073M
MP-047A	MP-126M	VMP-074M
MP-048A	MP-127D	VMP-075S
MP-049A	MP-127M	VMP-076S
MP-050A	MP-129S	VMP-078M
MP-051B	MP-130M	VMP-080S
MP-052A	VMP-002D	VMP-081M
MP-053A	VMP-006S	VMP-081S
MP-054A	VMP-007	VMP-089S
MP-055A	VMP-012M	VMP-094S
MP-056A	VMP-012S	VP-004S
MP-057A	VMP-015M	

Note:

[1] - VMP-044S was damaged during excavation activities associated with the repaving of North Old St. Louis Road in 2011.

[2] - VMP-037M was paved over during repaving of North Old St. Louis Road in 2011.

Figures



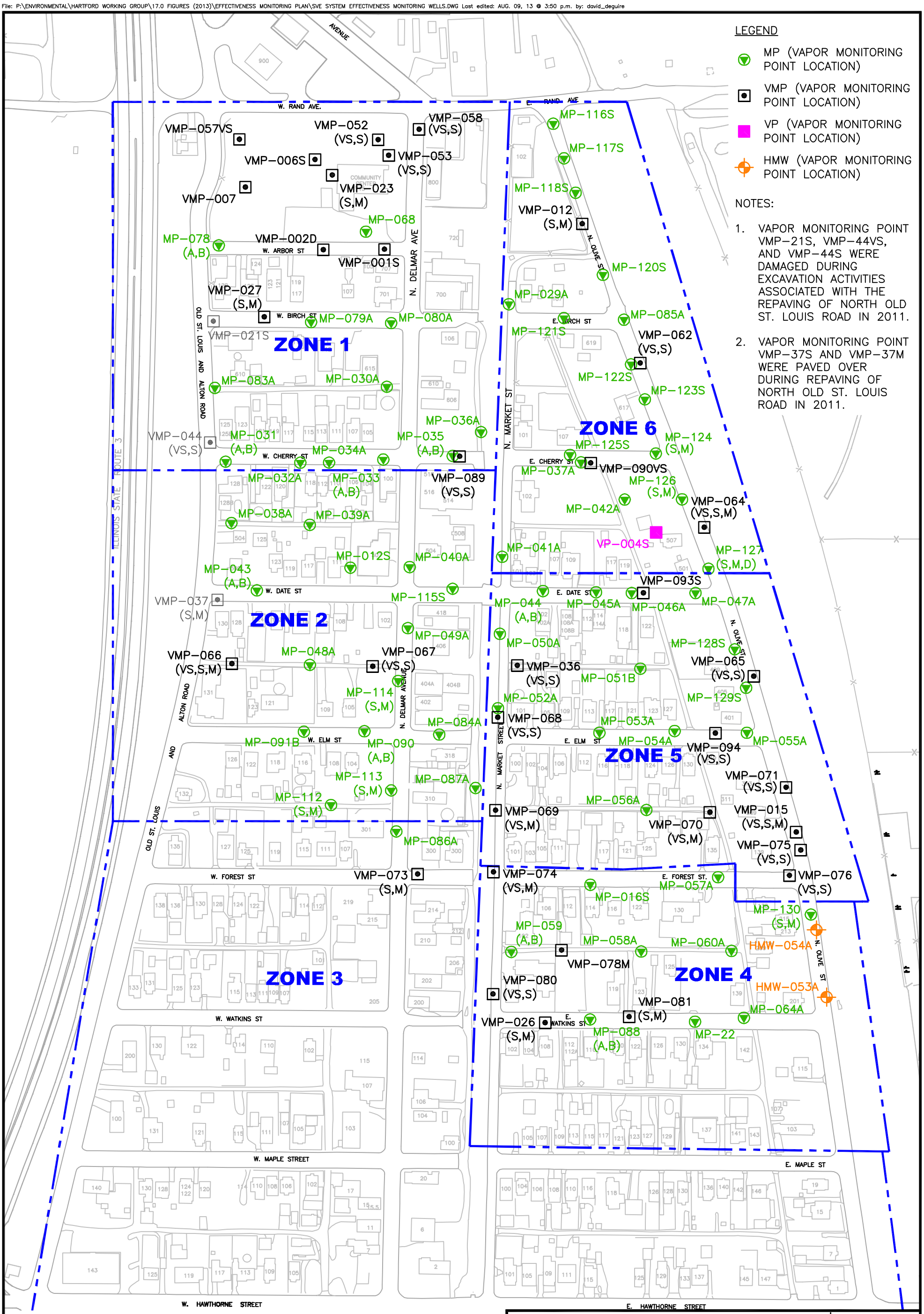
NOTE:
MAP CREATED FROM BASEMAP
PROVIDED BY BVNA.

NOT TO SCALE

HARTFORD WORKING GROUP (HWG) HARTFORD, ILLINOIS		PROJECT NO. 21562860
URS		
DRN. BY:djd July 2013 DSGN. BY:kh CHKD. BY:	Site Location Map	FIG. NO. 1

File: P:\ENVIRONMENTAL\HARTFORD WORKING GROUP\17.0 FIGURES (2013)\HSVE PLAN\FIGURE 1-SITE LOCATION MAP.DWG Last edited: JUL 25, 13 @ 4:28 p.m. by: david_deguire

File: P:\ENVIRONMENTAL\HARTFORD WORKING GROUP\17.0 FIGURES (2013)\EFFECTIVENESS MONITORING PLAN\SVE SYSTEM EFFECTIVENESS MONITORING WELLS.DWG Last edited: AUG. 09, 13 @ 3:50 p.m. by: david_deguire



HARTFORD WORKING GROUP HARTFORD, IL	PROJECT NO. 21562860
URS	
DRN. BY:cs August 2013 DSGN. BY:kh CHKD. BY:	Vapor Monitoring Point Locations
	FIG. NO. 2

APPENDIX A

Modified SVE System Effectiveness Monitoring Program Dated March 7, 2011

PROPOSAL

MODIFIED SVE SYSTEM EFFECTIVENESS MONITORING PROGRAM
HARTFORD AREA HYDROCARBON PLUME SITE
HARTFORD, ILLINOIS
March 7, 2011

The purpose of this proposal is to request that the United States Environmental Protection Agency (USEPA) give serious consideration to several modifications to the SVE System Effectiveness Monitoring (SVE EM) program. The Hartford Working Group (HWG) has assessed its SVE EM data collection efforts throughout the Village of Hartford (Hartford) which have been ongoing since 2005. For the purposes of this proposal, the focus was on data collected between October 2008 and November 2009. This time frame was selected because it provided more than one year of data for review and included data collected during or near the time frame of a rise in the Mississippi River stage which triggered an event. During the aforementioned 14 month time frame, a total of seven events occurred. Based on this assessment the HWG has determined that data from a number of the wells currently monitored did not significantly change. Therefore, future monitoring events will focus data collection efforts on those monitoring wells that will achieve the following objectives:

1. Collect data which can be used to evaluate the effectiveness of the SVE system as it relates to the residences and other properties in Hartford; and
2. Collect data to establish values to which threshold criteria are compared for the shallow and intermediate zones, as described in Section 6.1 of the *Draft Event-Based Monitoring Plan* (Draft EBMP) dated March 26, 2009.

The current SVE EM program consists of collecting soil vapor data and/or pressure measurements from 382 monitoring wells on a monthly basis. Of these wells, 330 are designated for collection of soil vapor samples and pressure measurements; the remaining 52 wells are designated for pressure measurements only. An additional 65 wells are designated for collection of soil vapor samples and pressure measurements on a quarterly basis. Table 1 lists the monitoring wells currently in the SVE EM program and designated for the collection of soil vapor data.

SVE EM data collected during the aforementioned 14 month period were reviewed and the following general observations made:

- Soil vapor data was not collected from 33 of the 395 wells (approximately 8%) because they were occluded or water was encountered during sampling activities;
- Flame Ionization Detector (FID) readings of 100,000 parts per million volume (ppmv) and higher were typically observed in wells screened in the deep zone (depths greater than 20 feet below ground surface (ft bgs));
- FID readings of 100 ppmv or less were observed at 186 of the 395 wells (approximately 47%). Of these, 140 wells were screened in the shallow and intermediate zones (20 ft bgs or less); and
- FID readings of 10 ppmv or less are frequently observed in wells located in the southern and western portions of the project area, including the Buffer Zone.

Following the data review, wells were assessed for their inclusion in the modified SVE EM program based on objectives 1 and 2 stated above. Wells where data historically has not been collected due to field conditions (i.e. occluded screens, water encountered during sampling, etc.) have been removed from the

list of SVE EM wells. Table 2 lists the wells from which data was not collected during the reviewed period.

The next step in assessing if a well should be included in the modified SVE EM program was to consider well depth/screen interval. As described above, an objective of the modified SVE EM program is to collect data from wells screened at depths consistent with the sampling approach presented in the Draft EBMP. Three depth intervals (0-10, 10-20, and 20-30 ft bgs) were proposed for monitoring in the Draft EBMP. These intervals were discussed with the USEPA during development of the Draft EBMP and were agreed to, in concept. The 0-10 foot interval is considered the shallow zone and was selected during development of the Draft EBMP to capture the zone most likely to include the basements of properties located in Hartford. The 10-20 foot interval is an intermediate zone for monitoring vapor concentration change that could impact the shallow zone. Of the 395 wells currently designated for soil vapor sampling, 90 wells are screened from 0-10 ft bgs and 136 wells are screened from 10-20 ft bgs. Wells screened in the shallow and intermediate zones were considered for inclusion in the modified SVE EM program.

The third depth interval described in the Draft EBMP (20-30 ft bgs) is considered the deep zone. There are wells currently in the SVE EM program that are screened deeper than 30 ft bgs. Therefore, for purposes of assessing wells for inclusion in the modified SVE EM program, all wells screened greater than 20 ft bgs were considered deep wells. As described above, FID readings of 100,000 ppmv and higher are typically observed in the deep wells. Additionally, petroleum hydrocarbons, if detected, is typically observed in the deep wells. Since elevated FID readings and the presence of petroleum hydrocarbons have been consistently observed in the deep wells within the ROST response area, monthly monitoring of these wells to confirm this observation is no longer required. Therefore, wells screened to depths greater than 20 ft bgs have been removed from the list of SVE EM wells. Table 3 lists the wells screened greater than 20 ft bgs.

Following selection of the shallow and intermediate zones as the depth intervals to be monitored as part of the modified SVE EM program, geographic well distribution was reviewed based on the following criteria:

- Areas where elevated FID readings have been historically observed in the shallow or intermediate zones;
- Areas where historical data indicates changes in FID values during a rise in the Mississippi River stage; and
- Even distribution of monitoring locations within the ROST response area.

FID data collected from wells screened in the shallow (0-10 ft bgs) and intermediate (10-20 ft bgs) zones during the 14 month period were reviewed. Additionally, FID concentration maps developed from the SVE EM data, previously provided to the USEPA, were reviewed to assess areas where continued monitoring should be conducted. Based on this review, the wells selected for monitoring consist of 62 wells in the shallow zone (Table 4) and 92 wells in the intermediate zone (Table 5). These wells encompass properties where elevated or changes in FID values have been observed in the past, including the Hartford Community Center, 101 E. Birch, 119 W. Cherry, 119 W. Date, 504 N. Delmar, 516 N Delmar, and 610 N. Old St. Louis. These wells are depicted on Figures 1 (shallow zone) and 2 (intermediate zone).

Monitoring activities for the modified SVE EM program will be conducted on a semi-annual basis. The first 2011 monitoring event was completed in February 2011; the second event is anticipated to occur in August 2011. Procedures for data collection will remain unchanged, with the exception of wells which contain measurable free product. If a well is gauged and determined to contain measurable free product, the information will be noted in the field documentation, however a soil vapor sample will not be screened. Monitoring of additional wells on a quarterly basis will not be conducted. Data management, including

posting of data to the USEPA's portal, will continue. Additionally, FID concentration maps for the shallow and intermediate zones will be prepared and posted to the portal.

TABLE 1
CURRENT SVE SYSTEM EFFECTIVENESS MONITORING WELLS

HMW-013	MP-040C	MP-065A	MP-110S	VMP-019D	VMP-066S
HMW-014	MP-041A	MP-065B	MP-111D	VMP-019M	VMP-066VS
HMW-039A	MP-041B	MP-067A	MP-111M	VMP-019S	VMP-067D
HMW-040A	MP-041C	MP-067B	MP-111S	VMP-020D	VMP-067M
HMW-040B	MP-042A	MP-067C	MP-112D	VMP-020M	VMP-067S
HMW-041A	MP-042B	MP-068	MP-112M	VMP-020S	VMP-067VS
HMW-042A	MP-042C	MP-069	MP-112S	VMP-021D	VMP-068S
HMW-043A	MP-043A	MP-070	MP-113D	VMP-021M	VMP-068VS
HMW-043B	MP-043B	MP-071	MP-113M	VMP-021S	VMP-069D
HMW-045A	MP-043C	MP-072	MP-113S	VMP-022D	VMP-069M
HMW-045B	MP-044A	MP-073	MP-114D	VMP-022M	VMP-069VS
HMW-045C	MP-044B	MP-074	MP-114M	VMP-022S	VMP-070M
HMW-046A	MP-044C	MP-077A	MP-114S	VMP-023M	VMP-070S
HMW-046C	MP-044D	MP-077B	MP-115M	VMP-023S	VMP-070VS
HMW-047A	MP-045A	MP-077C	MP-115S	VMP-026D	VMP-071M
HMW-047B	MP-045B	MP-078A	MP-116M	VMP-026M	VMP-071S
HMW-047C	MP-045C	MP-078B	MP-116S	VMP-026S	VMP-071VS
HMW-048A	MP-046A	MP-078C	MP-117M	VMP-027D	VMP-072D
HMW-048B	MP-046B	MP-078D	MP-117S	VMP-027M	VMP-072M
HMW-052A	MP-046C	MP-079A	MP-118M	VMP-027S	VMP-072S
HMW-052B	MP-047A	MP-079B	MP-118S	VMP-030D	VMP-073D
HMW-052C	MP-047B	MP-079C	MP-119M	VMP-030M	VMP-073M
HMW-053A	MP-047C	MP-079D	MP-119S	VMP-030S	VMP-073S
HMW-054A	MP-048A	MP-080A	MP-120M	VMP-030VS	VMP-074D
HMW-054B	MP-048B	MP-080B	MP-120S	VMP-031D	VMP-074M
MP-005D	MP-048C	MP-080C	MP-121M	VMP-031M	VMP-074VS
MP-005S	MP-049A	MP-081A	MP-121S	VMP-031S	VMP-075M
MP-009D	MP-049B	MP-081B	MP-122M	VMP-032D	VMP-075S
MP-009S	MP-049C	MP-081C	MP-122S	VMP-032M	VMP-075VS
MP-010D	MP-050A	MP-082A	MP-123D	VMP-033D	VMP-076D
MP-010S	MP-050B	MP-082B	MP-123M	VMP-033S	VMP-076M
MP-012D	MP-050C	MP-082C	MP-123S	VMP-033VS	VMP-076S
MP-012S	MP-051A	MP-083A	MP-124D	VMP-035D	VMP-076VS
MP-016D	MP-051B	MP-083B	MP-124M	VMP-035M	VMP-077D
MP-016S	MP-051C	MP-083C	MP-124S	VMP-035S	VMP-077M
MP-022	MP-051D	MP-084A	MP-125D	VMP-036M	VMP-077VS
MP-029A	MP-052A	MP-084B	MP-125M	VMP-036S	VMP-078D
MP-029B	MP-052B	MP-084C	MP-125S	VMP-036VS	VMP-078M
MP-029C	MP-052C	MP-085A	MP-126D	VMP-037D	VMP-078S
MP-029D	MP-053A	MP-085B	MP-126M	VMP-037M	VMP-079D
MP-030A	MP-053B	MP-085C	MP-126S	VMP-037S	VMP-079M
MP-030B	MP-053C	MP-085D	MP-127D	VMP-037VS	VMP-079VS
MP-030C	MP-054A	MP-086A	MP-127M	VMP-039D	VMP-080D
MP-031A	MP-054B	MP-086B	MP-127S	VMP-039M	VMP-080M
MP-031B	MP-054C	MP-086C	MP-128M	VMP-039S	VMP-080S
MP-031C	MP-055A	MP-087A	MP-128S	VMP-039VS	VMP-080VS
MP-032A	MP-055B	MP-087B	MP-129M	VMP-042D	VMP-081D
MP-032B	MP-055C	MP-087C	MP-129S	VMP-042M	VMP-081M
MP-032C	MP-056A	MP-088A	MP-130D	VMP-042S	VMP-081S
MP-033A	MP-056B	MP-088B	MP-130M	VMP-043D	VMP-083D
MP-033B	MP-056C	MP-088C	MP-130S	VMP-043M	VMP-083S
MP-033C	MP-057A	MP-089A	MP-131M	VMP-043S	VMP-083VS
MP-033D	MP-057B	MP-089B	MP-131S	VMP-044M	VMP-084D
MP-034A	MP-057C	MP-089C	MP-132M	VMP-044S	VMP-084M
MP-034B	MP-058A	MP-090A	MP-132S	VMP-044VS	VMP-084S
MP-034C	MP-058B	MP-090B	VMP-001S	VMP-047S	VMP-084VS
MP-035A	MP-058C	MP-090C	VMP-002D	VMP-047VS	VMP-088S
MP-035B	MP-059A	MP-091A	VMP-002S	VMP-052S	VMP-088VS
MP-035C	MP-059B	MP-091B	VMP-006D	VMP-052VS	VMP-089S
MP-035D	MP-059C	MP-091C	VMP--006S	VMP-053S	VMP-089VS
MP-036A	MP-060A	MP-092A	VMP-007	VMP-053VS	VMP-090S
MP-036B	MP-060B	MP-092B	VMP-012M	VMP-057S	VMP-090VS
MP-036C	MP-060C	MP-092C	VMP-012S	VMP-057VS	VMP-091S
MP-037A	MP-061A	MP-092D	VMP-012VS	VMP-058S	VMP-092S
MP-037B	MP-061B	MP-102A	VMP-015D	VMP-058VS	VMP-092VS
MP-037C	MP-061C	MP-102B	VMP-015M	VMP-062S	VMP-093S
MP-037D	MP-062A	MP-102C	VMP-015S	VMP-062VS	VMP-093VS
MP-038A	MP-062B	MP-103A	VMP-015VS	VMP-064S	VMP-094S
MP-038B	MP-062C	MP-103B	VMP-017D	VMP-064VS	VMP-094VS
MP-038C	MP-063A	MP-103C	VMP-017M	VMP-065D	VP-004D
MP-039A	MP-063B	MP-104A	VMP-017S	VMP-065M	VP-004M
MP-039B	MP-063C	MP-104B	VMP-017VS	VMP-065S	VP-004S
MP-039C	MP-064A	MP-104C	VMP-018D	VMP-065VS	
MP-040A	MP-064B	MP-110D	VMP-018M	VMP-066D	
MP-040B	MP-064C	MP-110M	VMP-018S	VMP-066M	

TABLE 2
WELLS WITH NO DATA[1]

MP-029D	MP-085D	MP-126D
MP-030C	MP-091A	VMP-012VS
MP-036C	MP-116M	VMP-017D
MP-039B	MP-117M	VMP-017S
MP-040C	MP-119M	VMP-021M
MP-041C	MP-119S	VMP-036M
MP-049B	MP-120M	VMP-057S
MP-056C	MP-122M	VMP-070S
MP-079C	MP-123D	VMP-072D
MP-080C	MP-123M	VMP-092VS
MP-085B	MP-124D	VMP-093VS

1 - No data collected due to occluded screens or water encountered during sampling.

TABLE 3
DEEP ZONE WELLS
(GREATER THAN 20 FT BGS[1])

HMW-039A	MP-048B	MP-083C	VMP-027D
HMW-042A	MP-049B	MP-084B	VMP-030D
HMW-043B	MP-049C	MP-084C	VMP-030M
HMW-045B	MP-050B	MP-085B	VMP-031D
HMW-045C	MP-050C	MP-085C	VMP-032D
HMW-052A	MP-051C	MP-085D	VMP-033D
HMW-052B	MP-051D	MP-086B	VMP-035D
HMW-052C	MP-052B	MP-086C	VMP-036M
MP-009D	MP-052C	MP-087B	VMP-037D
MP-012D	MP-053B	MP-087C	VMP-039D
MP-016D	MP-053C	MP-088C	VMP-042D
MP-029B	MP-054B	MP-089C	VMP-042M
MP-029C	MP-054C	MP-090C	VMP-043D
MP-029D	MP-055B	MP-091C	VMP-043M
MP-030B	MP-055C	MP-092C	VMP-044M
MP-030C	MP-056B	MP-092D	VMP-065D
MP-031C	MP-056C	MP-110D	VMP-065M
MP-032B	MP-057B	MP-111D	VMP-066D
MP-033C	MP-057C	MP-112D	VMP-067D
MP-034B	MP-058B	MP-113D	VMP-067M
MP-034C	MP-058C	MP-114D	VMP-069D
MP-035C	MP-059C	MP-115M	VMP-071M
MP-036B	MP-060B	MP-117M	VMP-072D
MP-036C	MP-060C	MP-118M	VMP-073D
MP-037B	MP-061B	MP-119M	VMP-074D
MP-037D	MP-061C	MP-121M	VMP-075M
MP-038B	MP-062C	MP-123D	VMP-076D
MP-038C	MP-063B	MP-124D	VMP-076M
MP-039B	MP-063C	MP-125D	VMP-077D
MP-039C	MP-064B	MP-126D	VMP-077M
MP-040B	MP-064C	MP-128M	VMP-078D
MP-040C	MP-065B	MP-129M	VMP-079D
MP-041B	MP-067B	MP-130D	VMP-080D
MP-041C	MP-067C	MP-132M	VMP-080M
MP-042B	MP-078C	VMP-006D	VMP-081D
MP-042C	MP-078D	VMP-015D	VMP-083D
MP-044C	MP-079B	VMP-017D	VMP-084D
MP-045B	MP-079C	VMP-017M	VMP-084M
MP-045C	MP-080B	VMP-018D	VP-004D
MP-046B	MP-080C	VMP-019D	VP-004M
MP-046C	MP-081C	VMP-020D	
MP-047B	MP-082C	VMP-021D	
MP-047C	MP-083B	VMP-026D	

1 - Feet Below Ground Surface

TABLE 4
MODIFIED SVE SYSTEM EFFECTIVENESS MONITORING
SHALLOW ZONE WELLS
(0-10 FT BGS[1])

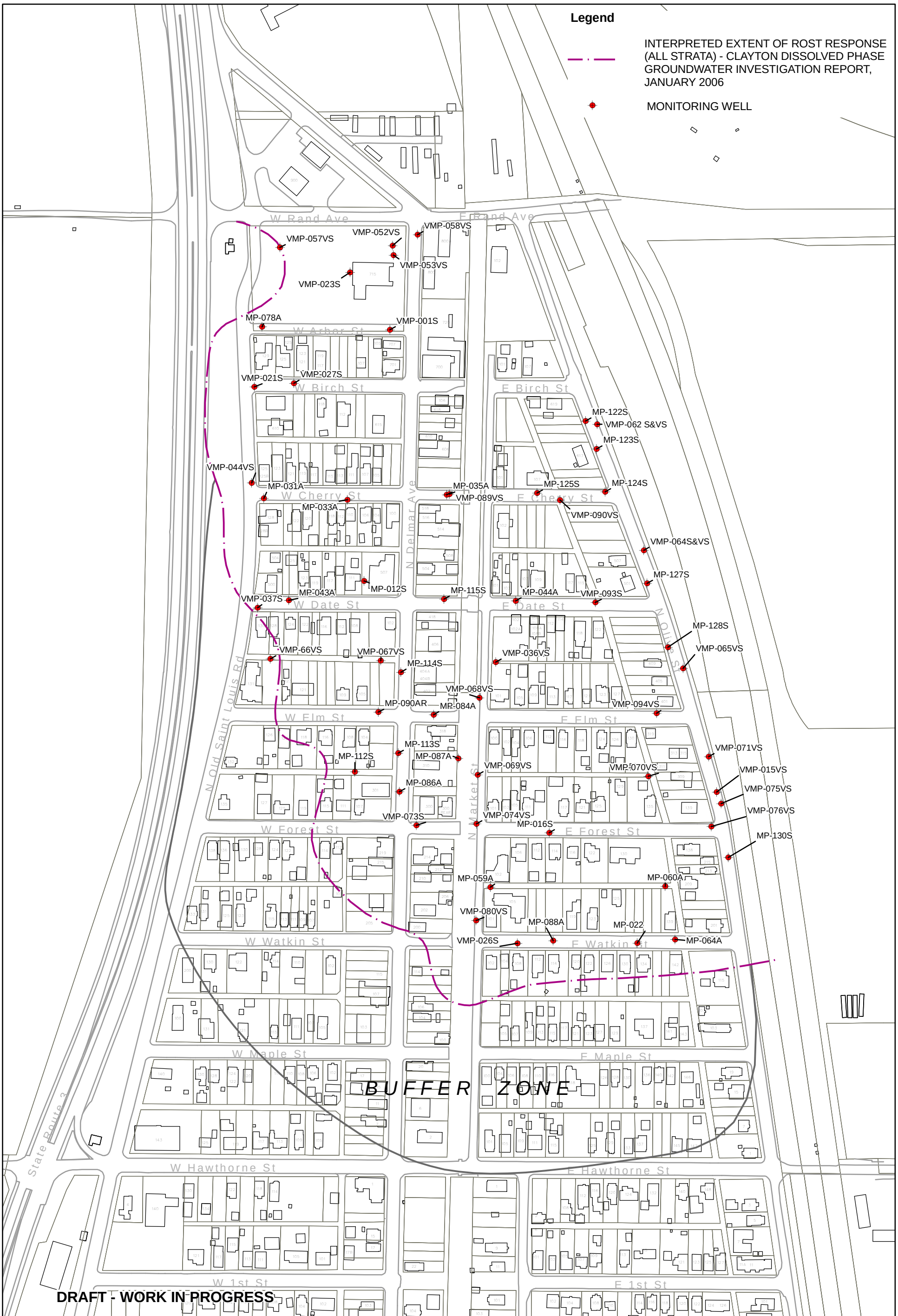
MP-012S	MP-122S	VMP-062S
MP-016S	MP-123S	VMP-062VS
MP-022	MP-124S	VMP-064S
MP-031A	MP-125S	VMP-064VS
MP-033A	MP-126S	VMP-065VS
MP-035A	MP-127S	VMP-066VS
MP-043A	MP-128S	VMP-067VS
MP-044A	MP-130S	VMP-068VS
MP-059A	VMP-001S	VMP-069VS
MP-060A	VMP-015VS	VMP-070VS
MP-064A	VMP-021S	VMP-071VS
MP-078A	VMP-023S	VMP-073S
MP-084A	VMP-026S	VMP-074VS
MP-086A	VMP-027S	VMP-075VS
MP-087A	VMP-036VS	VMP-076VS
MP-088A	VMP-037S	VMP-080VS
MP-090A	VMP-044VS	VMP-089VS
MP-112S	VMP-052VS	VMP-090VS
MP-113S	VMP-053VS	VMP-093S
MP-114S	VMP-057VS	VMP-094VS
MP-115S	VMP-058VS	

1 - Feet Below Ground Surface

TABLE 5
MODIFIED SVE SYSTEM EFFECTIVENESS MONITORING
INTERMEDIATE ZONE WELLS
(10-20 FT BGS[1])

HMW-053A	MP-058A	VMP-015S
HMW-054A	MP-059B	VMP-023M
MP-029A	MP-068	VMP-026M
MP-030A	MP-078B	VMP-027M
MP-031B	MP-079A	VMP-036S
MP-032A	MP-080A	VMP-037M
MP-033B	MP-083A	VMP-044S
MP-034A	MP-085A	VMP-052S
MP-035B	MP-088B	VMP-053S
MP-036A	MP-090B	VMP-058S
MP-037A	MP-091B	VMP-064M
MP-038A	MP-112M	VMP-065S
MP-039A	MP-113M	VMP-066M
MP-040A	MP-114M	VMP-066S
MP-041A	MP-116S	VMP-067S
MP-042A	MP-117S	VMP-068S
MP-043B	MP-118S	VMP-069M
MP-044B	MP-120S	VMP-070M
MP-045A	MP-121S	VMP-071S
MP-046A	MP-124M	VMP-073M
MP-047A	MP-126M	VMP-074M
MP-048A	MP-127D	VMP-075S
MP-049A	MP-127M	VMP-076S
MP-050A	MP-129S	VMP-078M
MP-051B	MP-130M	VMP-080S
MP-052A	VMP-002D	VMP-081M
MP-053A	VMP-006S	VMP-081S
MP-054A	VMP-007	VMP-089S
MP-055A	VMP-012M	VMP-094S
MP-056A	VMP-012S	VP-004S
MP-057A	VMP-015M	

1 - Feet Below Ground Surface



1

Figure

N

0 150 300 600 Feet

SVE SYSTEM EFFECTIVENESS MONITORING WELL LOCATIONS SHALLOW ZONE (0-10 FT BGS) HARTFORD, ILLINOIS

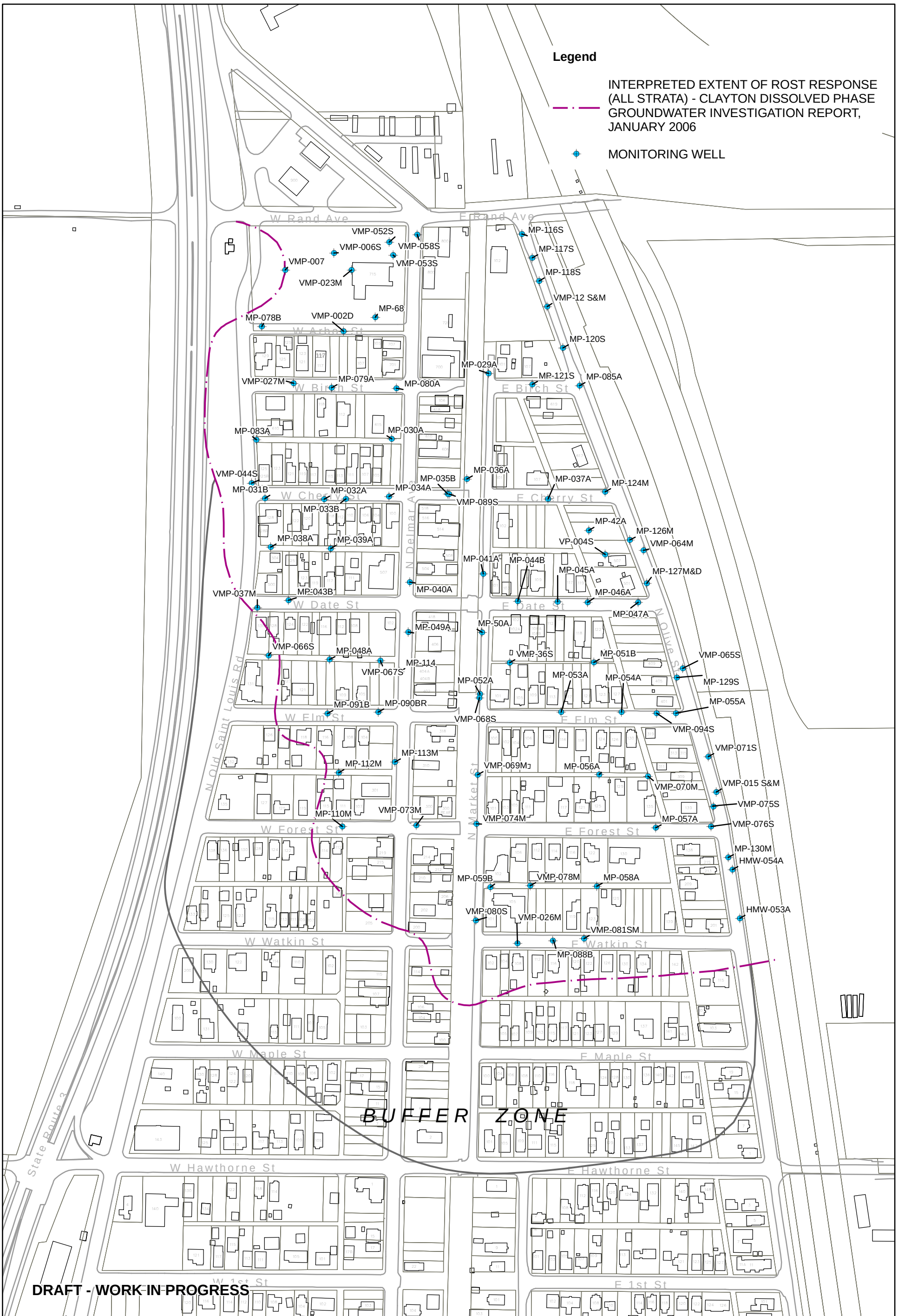
AECOM

Prepared for:
Hartford Working Group
Hartford, Illinois

Date: December 22, 2009

Project Number: 60141205

File: U:\GIS\010\01005 - BP\01005-093 - Hartford\2009\Event_Based_Monitoring\MXD\SVE_System_Effectiveness_Monitoring_Zone_A_120409.mxd



2

Figure

N

0 130 260 520 Feet

SVE SYSTEM EFFECTIVENESS MONITORING WELL LOCATIONS INTERMEDIATE ZONE (10-20 FT BGS) HARTFORD, ILLINOIS

AECOM

Prepared for:
Hartford Working Group
Hartford, Illinois

Date: December 22, 2009

Project Number: 60141205

File: U:\GIS\010\01005 - BP\01005-093 - Hartford\2009\Event_Based_Monitoring\MXD\SVE_System_Effectiveness_Monitoring_Zone_B_120409.mxd

APPENDIX B

Abandonment of VMP-21 and VMP-44
Notification to the USEPA (October 5, 2011)

From: Mooshegian, Robert
Sent: Wednesday, October 05, 2011 3:02 PM
To: 'Turner.Kevin@epamail.epa.gov'
Cc: 'asalhotra@ramgp.com'; 'Chris.Cahnovsky@Illinois.gov'; 'john.frankenthal@bp.com'; 'kevin.dyer@shell.com'; 'Kaysen.Michelle@epamail.epa.gov'; 'steve.mulkey@valero.com'; 'tbinz@pe-engrs.com'; 'thomas.mroz@valero.com'; 'Tom.Miller@Illinois.gov'
Subject: RE: Abandonment of VMP-21 and 44
Attachments: MP-31 Super Tuesday Data.pdf; VMP-44 Super Tuesday Data.pdf; VMP-21 Super Tuesday Data.pdf; VMP-27 Super Tuesday Data.pdf

Kevin,

Attached is the Super Tuesday data collected by the HWG from monitoring points VMP-21 and 44. The last Super Tuesday event conducted by the HWG was in February 2011 (USEPA suspended Super Tuesday activities on March 7, 2011). Therefore, data collected from VMP-21 or 44 after February 2011, if any, would have been collected by others and the HWG is not in possession of that data. Please note that no data was collected from VMP-44 since July 2010. This monitoring point was paved over, presumably by the Village of Hartford, after the July 2010 sampling event.

Regarding repair of VMP-21 and 44, the HWG considered having the monitoring points repaired, however we are concerned about their integrity. For example, during excavation the well protector for VMP-44 was hooked with the bucket of the excavator and ripped off the monitoring point. The VMPs are constructed of a six-inch stainless screen and one-eighth inch diameter stainless steel tubing from the screen to near ground surface; multiple screens are nested in the same borehole. When the excavator ripped off the well protector, the tubing could potentially have been pulled out of the screens. For this reason, we believe abandoning the wells is the most appropriate action.

The current schedule for reconstructing North Old St. Louis, according the Village's engineer, is to have all existing pavement and subgrade removed and the aggregate base course installed by October 7, 2011. Installation of the binder and asphalt will commence the week of October 10th.

Although VMP-21 and 44 will be abandoned, there are other monitoring points in close proximity that will be available for sampling if needed. VMP-27 is located on West Birch, east of VMP-21 and MP-31 is located on West Cherry, southeast of VMP-44. Both VMP-27 and MP-31 are Super Tuesday monitoring points and were regularly monitored. Data for these monitoring points is also attached.

Considering the questionable integrity of VMP-21 and 44, and the Village's construction schedule, the HWG would like to proceed with abandoning the aforementioned monitoring points by October 7th.

Thank you.

Robert E. Mooshegian, CHMM
Senior Project Manager
URS Corporation
1001 Highlands Plaza Drive West, Suite 300 St. Louis, MO 63110

314-743-4106 Direct
314-791-2469 Cell
314-429-0462 Fax
robert.mooshegian@urs.com

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-----Original Message-----
From: Turner.Kevin@epamail.epa.gov [mailto:Turner.Kevin@epamail.epa.gov]
Sent: Wednesday, October 05, 2011 10:32 AM
To: Mooshegian, Robert
Cc: asalhotra@ramgp.com; Chris.Cahnovsky@Illinois.gov; john.frankenthal@bp.com; Turner.Kevin@epamail.epa.gov; kevin.dyer@shell.com; Kaysen.Michelle@epamail.epa.gov; steve.mulkey@valero.com; tbinz@pe-engrs.com; thomas.mroz@valero.com; Tom.Miller@Illinois.gov
Subject: Re: Abandonment of VMP-21 and 44

Two days to respond is not good

From the map it appears that VMP-44 is actually in Old St. Louis Rd. and that VMP-21 may be more on Birch.

Though, Apex might not be using these monitoring points, I would like to see historical data for both wells. Just because Apex is not using them does not make them expendable.

Have you asked and/or told Christ Brothers to repair them??????

Kevin Turner
U.S. EPA
(618) 525-3665 (cell)

From: "Mooshegian, Robert" <robert.mooshegian@urs.com>
To: Kevin Turner/R5/USEPA/US@EPA, Michelle Kaysen/R5/USEPA/US@EPA, "Chris.Cahnovsky@Illinois.gov" <Chris.Cahnovsky@Illinois.gov>, "Tom.Miller@Illinois.gov" <Tom.Miller@Illinois.gov>, "asalhotra@ramgp.com" <asalhotra@ramgp.com>, "tbinz@pe-engrs.com" <tbinz@pe-engrs.com>
Cc: "thomas.mroz@valero.com" <thomas.mroz@valero.com>, "steve.mulkey@valero.com" <steve.mulkey@valero.com>, "john.frankenthal@bp.com" <john.frankenthal@bp.com>, "kevin.dyer@shell.com" <kevin.dyer@shell.com>
Date: 10/05/2011 09:24 AM
Subject:Abandonment of VMP-21 and 44

To The Agencies Representatives,

The Village of Hartford is reconstructing North Old St. Louis Avenue from Rand Avenue to Hawthorne Street. The work is being done for the Village by Christ Brothers Asphalt of Lebanon, Illinois. Prior to the start of work URS reviewed the project with Christ Brothers, including their plans to protect the monitoring points along North Old St. Louis.

In preparation for the work, URS walked the locations with a Christ Brothers representative; the location of the monitoring points were marked. As part of the reconstruction, Christ Brothers is excavating materials beneath the existing road surface to construct a new road base. During the excavation activities, monitoring points VMP-21 and VMP-44 were damaged. VMP-21 is located at the intersection of West Birch and North Old St. Louis; VMP-44 is located on North Old St. Louis near West Cherry.

The HWG has spoken with an Apex representative (Cliff Wright) to determine if monitoring points VMP-21 and VMP-44 are used by Apex. Per Mr. Wright's response, it appears that Apex does not use them. Since Apex does not use VMP-21 and VMP-44 and because of the damage, the HWG has initiated plans to abandon both monitoring points. Due to the road construction schedule, we anticipate the abandonment will be completed on or before October 7, 2011.

URS has met again with Christ Brothers regarding their plans for protecting the remaining monitoring points along North Old St. Louis.

Thank you.
Robert E. Mooshegian, CHMM
Senior Project Manager
URS Corporation
1001 Highlands Plaza Drive West, Suite 300 St. Louis, MO 63110

314-743-4106 Direct
314-791-2469 Cell
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robert.mooshegian@urs.com

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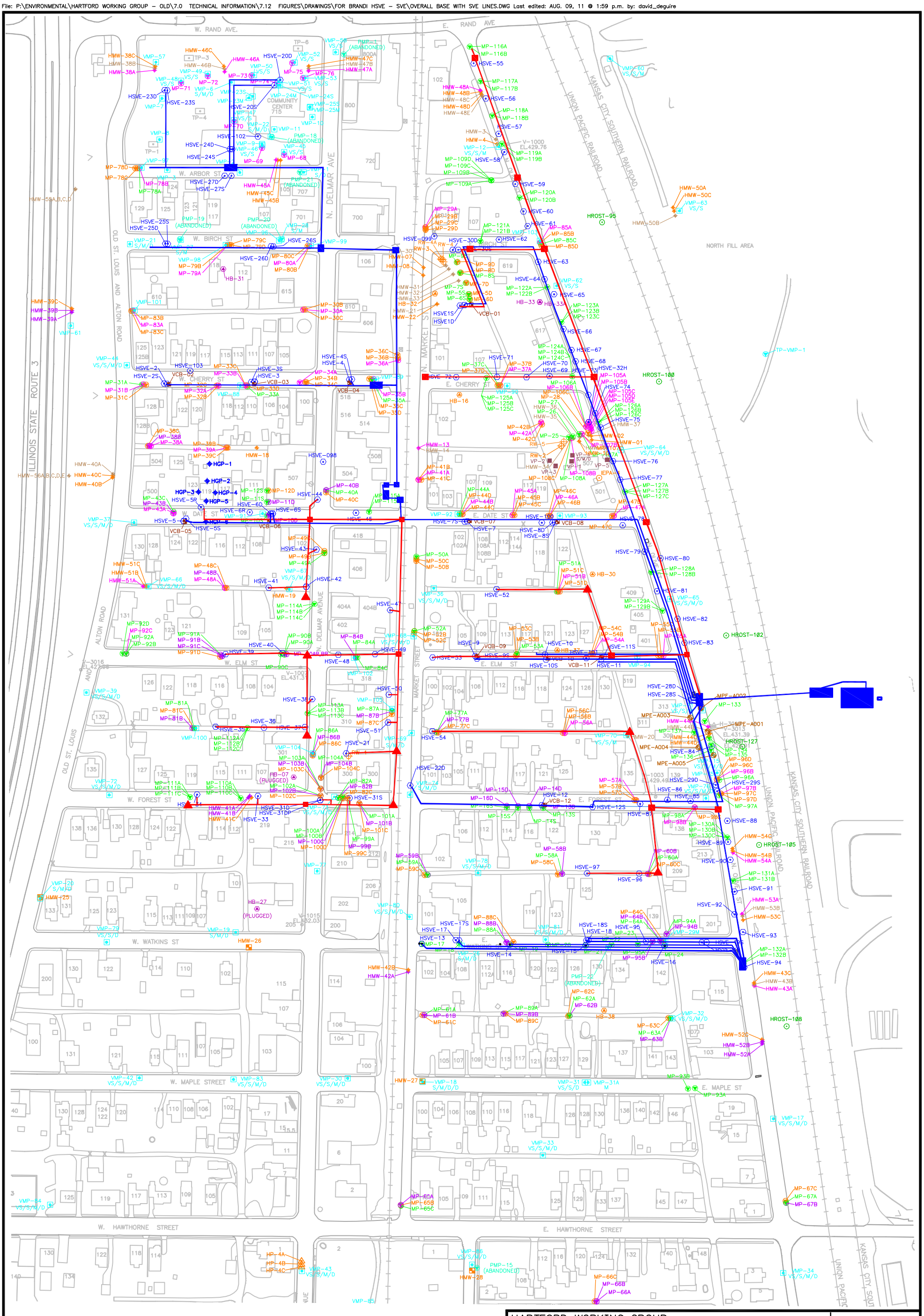
[attachment "Overall Base with SVE Wells and Lines.pdf" deleted by Kevin Turner/R5/USEPA/US]

File: P:\ENVIRONMENTAL\HARTFORD WORKING GROUP - OLD\7.0 TECHNICAL INFORMATION\7.12 FIGURES\DRAWINGS\FOR BRANDI HSVE - SVE\OVERALL BASE WITH SVE LINES.DWG Last edited: AUG. 09, 11 @ 1:59 p.m. by: david_deguire



HARTFORD WORKING GROUP HARTFORD, IL		PROJECT NO. 21561955
URS		
DRN. BY:lrm 5/6/08 DSGN. BY:bh CHKD. BY:	Overall Basemap with SVE Lines	FIG. NO. 2

Location	Stratum ID	Date	Time	Stabilized Vacuum / Pressure (in. of H2O)	PID (ppmv)	FID (ppmv)	CH4 (ppmv)	PHC (ppmv)	O2 (%)	CO2 (%)
VMP-020M	Main Silt (Rand Horizon)	1/17/2008	9:02	0.01						
VMP-020M	Main Silt (Rand Horizon)	4/15/2008	13:08	0.31	0.15	1.7	0.00	1.7	12.2	9.6
VMP-020M	Main Silt (Rand Horizon)	4/16/2008	11:25	0.03						
VMP-020M	Main Silt (Rand Horizon)	7/15/2008	10:15	0.24	1.6	2.4	0.00	2.4	10.2	8.7
VMP-020M	Main Silt (Rand Horizon)	7/16/2008	10:48	-0.22						
VMP-020M	Main Silt (Rand Horizon)	10/21/2008	8:13	0.00	1.4	0.50	0.00	0.50	13.3	8.9
VMP-020M	Main Silt (Rand Horizon)	1/20/2009	15:41	-0.05	0.27	0.34	0.00	0.34	16.6	6.6
VMP-020M	Main Silt	5/19/2009	12:50	0.24	0.53	1.3	0.00	1.3	13.3	7.3
VMP-020M	Main Silt	7/21/2009	12:52	-0.05	0.92	2.4	0.00	2.4	12.6	7.9
VMP-020M	Main Silt	10/21/2009	15:40	0.16	0.47	1.2	0.00	1.2	12.4	8.8
VMP-020M	Main Silt	1/20/2010	16:13	-0.09	0.33	3.5	0.00	3.5	13.4	7.7
VMP-020M	Main Silt	4/20/2010	12:50	0.00	0.34	3.8	0.00	3.8	12.1	7.9
VMP-020M	Main Silt	10/18/2010	9:54	0.00	0.26	3.6	0.00	3.6	11.7	11.0
VMP-020M	Main Silt	1/18/2011	10:32	-0.07	0.41	2.9	0.00	2.9	13.5	8.3
VMP-020S	A Clay	5/18/2005	10:11	0.05						
VMP-020S	A Clay	5/24/2005	14:31	0.01						
VMP-020S	A Clay	6/1/2005	8:26	-0.01						
VMP-020S	A Clay	6/7/2005	11:23	-0.03						
VMP-020S	A Clay	6/21/2005	8:31	-0.02						
VMP-020S	A Clay	7/19/2005	7:50	0.18				0.00		
VMP-020S	A Clay	8/2/2005	8:10	0.08				0.00		
VMP-020S	A Clay	8/16/2005	9:57	0.11						
VMP-020S	A Clay	8/30/2005	11:14	0.00						
VMP-020S	A Clay	9/13/2005	14:55	0.42						
VMP-020S	A Clay	9/27/2005	8:40	0.06						
VMP-020S	A Clay	10/11/2005	8:41	-0.01						
VMP-020S	A Clay	10/25/2005	14:58	-0.01						
VMP-020S	A Clay	11/8/2005	15:11	0.05						
VMP-020S	A Clay	11/21/2005	10:51	0.01						
VMP-020S	A Clay	12/8/2005	9:14	0.03						
VMP-020S	A Clay	12/20/2005	16:19	0.01						
VMP-020S	A Clay	1/4/2006	15:10	-0.10						
VMP-020S	A Clay	1/17/2006	10:57	-0.06	0.50	0.90	0.00	0.90	12.2	8.0
VMP-020S	A Clay	1/31/2006	8:18	-0.03	0.00	0.70	0.00	0.70	13.2	8.2
VMP-020S	A Clay	2/14/2006	10:42	0.02	0.00	0.80	0.00		12.5	8.0
VMP-020S	A Clay	2/28/2006	10:26	0.08	0.00	1.0	0.00	1.0	13.3	7.7
VMP-020S	A Clay	3/14/2006	11:06	-0.28	0.00	1.6	0.00	1.6	13.4	7.7
VMP-020S	A Clay	3/28/2006	10:21	-0.17	1.0	3.2	0.00	3.2	12.7	8.0
VMP-020S	A Clay	4/11/2006	7:27	-1.10	0.84	1.5	0.00	1.5	13.5	7.0
VMP-020S	A Clay	5/16/2006	11:23		0.80	2.9	0.00	2.9	11.7	9.1
VMP-020S	A Clay	7/18/2006	15:27	0.00	1.4	3.2	0.00	3.2	11.8	10.5
VMP-020S	A Clay	8/15/2006	13:48	-0.02	1.5	2.6	0.00	2.6	11.9	11.3
VMP-020S	A Clay	9/19/2006	9:38	0.00	0.70	1.7	0.00	1.7	12.6	10.0
VMP-020S	A Clay	10/17/2006	13:06		0.37	2.7	0.00	2.7	11.9	10.1
VMP-020S	A Clay	10/18/2006	10:00	-0.02						
VMP-020S	A Clay	11/20/2006	12:57	-0.22	0.10	1.6	0.00	1.6	12.4	9.1
VMP-020S	A Clay	12/19/2006	10:00	0.00	0.35	3.7	0.00	3.7	14.1	6.3
VMP-020S	A Clay	1/16/2007	16:07	0.00	0.10	1.1	0.00	1.1	14.0	6.1
VMP-020S	A Clay	2/21/2007	10:10	0.14	0.20	1.0	0.00	1.0	12.8	8.0
VMP-020S	A Clay	3/20/2007	13:20	0.00	0.55	1.3	0.00	1.3	12.6	7.0
VMP-020S	A Clay	4/17/2007	11:14	-0.39	0.76	2.7	0.00	2.7	11.0	8.4
VMP-020S	A Clay	5/16/2007	8:41	-0.05	0.41	0.72	0.00	0.72	9.6	9.9
VMP-020S	A Clay	6/19/2007	14:58	0.01	0.70	1.0	0.00	1.0	10.8	10.3
VMP-020S	A Clay	9/18/2007	15:25	-0.02	0.74	1.7	0.00	1.7	10.2	11.6
VMP-020S	A Clay	4/15/2008	13:08	0.35	0.17	1.7	0.00	1.7	12.6	8.6
VMP-020S	A Clay	4/16/2008	11:40	0.24						
VMP-020S	A Clay	7/15/2008	10:15	-0.05	0.93	2.6	0.00	2.6	14.0	9.8
VMP-020S	A Clay	10/21/2008	8:12	0.00	0.53	2.8	0.00	2.8	13.7	10.1
VMP-020S	A Clay	5/19/2009	12:50	0.20	0.58	0.90	0.00	0.90	12.3	7.4
VMP-020S	A Clay	7/21/2009	12:51	-0.02	0.72	1.9	0.00	1.9	16.0	5.3
VMP-020S	A Clay	10/21/2009	15:40	0.00	0.28	1.0	0.00	1.0	13.6	7.8
VMP-020S	A Clay	1/20/2010	16:13	-0.04	0.28	3.3	0.00	3.3	15.7	5.5
VMP-020S	A Clay	4/20/2010	12:50	0.00	0.36	2.7	0.00	2.7	12.3	2.9
VMP-020S	A Clay	7/20/2010	11:24	-0.02	0.31	1.7	0.00	1.7	11.2	9.4
VMP-020S	A Clay	10/18/2010	9:54	0.00	0.32	3.1	0.00	3.1	11.6	11.2
VMP-020S	A Clay	1/18/2011	10:32	-0.06	0.62	3.2	0.00	3.2	15.0	6.7
VMP-021D	C Clay	5/18/2005	10:56	0.00	13000	2000000			3.8	4.1
VMP-021D	C Clay	5/24/2005	12:05	0.00	3170	2400000			2.3	9.0
VMP-021D	C Clay	6/1/2005	9:30	0.02	900	400000			1.6	9.1
VMP-021D	C Clay	6/7/2005	13:55	-0.02	390	1000000			2.6	8.8
VMP-021D	C Clay	6/21/2005	8:05	0.00	0.00					
VMP-021D	C Clay	7/15/2005	9:27	-0.21	220	2850000			3.2	9.1
VMP-021D	C Clay	7/19/2005	13:13	-0.03	91.6	1000000	1000000	0.00	1.1	9.9

SVE Data Thru Week Ending February 18, 2011
Hartford, Illinois

Location	Stratum ID	Date	Time	Stabilized Vacuum / Pressure (in. of H2O)	PID (ppmv)	FID (ppmv)	CH4 (ppmv)	PHC (ppmv)	O2 (%)	CO2 (%)
VMP-021D	C Clay	8/2/2005	15:25	-0.01	131	1000000	1000000	0.00	3.2	9.2
VMP-021D	C Clay	8/16/2005	11:25	0.00	83.7	1000000	1000000	0.00	1.1	10.2
VMP-021D	C Clay	8/31/2005	13:27	0.42	147	1000000	788000	212000	0.9	10.7
VMP-021D	C Clay	9/15/2005	12:20	-0.51	96.0	1000000	920000	80000	0.5	10.8
VMP-021D	C Clay	9/27/2005	13:07	0.04	130	1000000	860000	140000	0.5	11.1
VMP-021D	C Clay	10/11/2005	11:51	0.00	127	1000000	860000	140000	1.6	11.3
VMP-021D	C Clay	10/26/2005	13:26	0.51	77.7	1000000	1000000	0.00	0.9	11.5
VMP-021D	C Clay	11/8/2005	13:37	0.14	163	1000000	1000000	0.00	0.3	11.2
VMP-021D	C Clay	11/21/2005	13:06	0.01	93.8	1000000	1000000	0.00	1.6	11.6
VMP-021D	C Clay	12/6/2005	14:45	-0.39	377	1000000	1000000	0.00	0.9	11.9
VMP-021D	C Clay	12/20/2005	13:54	-0.01	92.0	1000000	819000	181000	0.9	11.7
VMP-021D	C Clay	1/4/2006	13:12	-0.09	152	1000000	1000000	0.00	1.5	12.1
VMP-021D	C Clay	2/28/2006	14:50	0.00	208	1000000	272000	728000	1.1	12.0
VMP-021D	C Clay	3/14/2006	9:23	-0.35	138	1000000	133000	867000	0.7	12.4
VMP-021D	C Clay	3/28/2006	13:22	-0.21	246	1000000	378000	622000	0.7	12.7
VMP-021D	C Clay	4/11/2006	9:58	0.00	179	1000000	210000	790000	0.5	12.0
VMP-021D	C Clay	5/16/2006	8:06	-0.27	145	1000000	189000	811000	0.9	10.5
VMP-021D	C Clay	6/20/2006	12:09	-0.12	214	1000000	125000	875000	0.6	10.1
VMP-021D	C Clay	7/18/2006	13:02	-0.03	290	1000000	73500	926500	0.9	10.1
VMP-021D	C Clay	8/15/2006	11:21		289	1000000	118000	882000	1.1	10.6
VMP-021D	C Clay	9/19/2006	8:42	-0.32	211	1000000	218000	782000	1.0	11.2
VMP-021D	C Clay	10/17/2006	12:25	-0.34	207	1000000	209000	791000	0.5	11.3
VMP-021D	C Clay	11/20/2006	11:11	-0.02	189	579000	222000	357000	0.4	11.5
VMP-021D	C Clay	12/19/2006	11:18		145	1000000	463000	537000	0.6	11.0
VMP-021D	C Clay	12/20/2006	11:53	-0.25						
VMP-021D	C Clay	1/16/2007	14:34	-0.19	144	1000000	333000	667000	0.6	11.2
VMP-021D	C Clay	3/20/2007	13:25	-0.04	245	1000000	223000	777000	1.6	10.0
VMP-021D	C Clay	4/17/2007	11:40	-0.08	181	1000000	404000	596000	0.7	9.7
VMP-021D	C Clay	7/17/2007	16:25	-0.06	242	1000000	1000000	0.00	1.2	9.9
VMP-021D	C Clay	8/21/2007	12:45		278	1000000	1000000	0.00	0.0	10.6
VMP-021D	C Clay	9/18/2007	16:22	-0.52	129	1000000	461000	539000	1.6	11.6
VMP-021D	C Clay	10/16/2007	10:44	-0.51	216	1000000	500000	500000	3.3	10.8
VMP-021D	C Clay	11/13/2007	16:45	0.02	143	1000000	586000	414000	0.2	11.7
VMP-021D	C Clay	1/15/2008	10:46	-0.33	124	1000000	792000	208000	4.2	11.5
VMP-021D	C Clay	2/19/2008	10:57	0.14	83.0	1000000	1000000	0.00	3.5	11.3
VMP-021D	C Clay	2/20/2008	15:08	0.00						
VMP-021D	C Clay	3/18/2008	10:03	-0.32	116	1000000	790000	210000	1.4	11.4
VMP-021D	C Clay	8/18/2008	8:48	0.00						
VMP-021D	C Clay	11/18/2008	9:45	-0.78	77.3	1000000	1000000	0.00	1.8	7.7
VMP-021D	C Clay	1/20/2009	9:38	-0.12	120	1000000	1000000	0.00	1.2	10.7
VMP-021D	C Clay	2/17/2009	9:58	0.05	100.0	1000000	1000000	0.00	2.0	9.4
VMP-021D	C Clay	7/21/2009	7:18	0.01	1.4	1000000	1000000	0.00	0.9	7.2
VMP-021D	C Clay	8/18/2009	7:42	0.00	54.6	1000000	1066	998934	2.1	7.3
VMP-021D	C Clay	9/15/2009	7:38	0.74	7.5	1000000	1000000	0.00	0.8	7.9
VMP-021D	C Clay	12/15/2009	7:04	0.07	4.7	24.8	2.0	22.8	20.9	0.0
VMP-021D	C Clay	1/20/2010	7:35	-0.01	57.2	1000000	1000000	0.00	1.9	8.9
VMP-021D	C Clay	2/16/2011	7:58	0.00	77.4	1000000	1000000	0.00	2.4	9.7
VMP-021M	Rand	5/18/2005	10:47	0.00	8700	670000			3.4	6.7
VMP-021M	Rand	5/24/2005	12:00	-0.03	1860	900000			2.0	11.4
VMP-021M	Rand	6/1/2005	9:30	1.15	108	500000			3.7	11.2
VMP-021M	Rand	6/7/2005	13:53	-0.07	330	330000			1.6	12.3
VMP-021M	Rand	6/21/2005	8:10	-0.17	0.00					
VMP-021M	Rand	7/19/2005	13:08	-0.26				0.00		
VMP-021M	Rand	8/2/2005	15:20	-0.04				0.00		
VMP-021M	Rand	9/15/2005	12:18	0.00	3.8	5.0	0.00	5.0	20.9	0.0
VMP-021M	Rand	7/18/2006	13:01	0.00						
VMP-021M	Rand	9/19/2006	8:45	-0.02						
VMP-021M	Rand	11/20/2006	11:10	-10.22	52.0	56360	54350	2010	1.0	6.7
VMP-021M	Rand	12/19/2006	11:14	0.00	108	13340	13050	290	5.2	5.2
VMP-021M	Rand	1/16/2007	14:33	-2.71	53.8	595	0.00	595	4.0	6.7
VMP-021M	Rand	2/21/2007	10:04	-0.63						
VMP-021M	Rand	3/20/2007	13:24	-2.49	0.20	3.6	0.00	3.6	20.5	0.1
VMP-021M	Rand	4/17/2007	11:38	-0.36	0.33	8.5	7.8	0.70	19.8	0.1
VMP-021M	Rand	5/15/2007	7:35	0.00	0.57	4.2	0.00	4.2	20.9	0.0
VMP-021M	Rand	6/19/2007	12:45	-0.01	7.2	35.0	3.2	31.8	6.1	5.4
VMP-021M	Rand	7/17/2007	17:00	-0.21						
VMP-021M	Rand	7/18/2007	15:07		4.7	91.6	4.0	87.6	3.8	6.3
VMP-021M	Rand	8/21/2007	12:45	-0.10	1.3	4.9	0.00	4.9	1.4	6.8
VMP-021M	Rand	9/18/2007	16:22	-0.02	0.72	3.8	0.00	3.8	4.7	7.4
VMP-021M	Rand	10/16/2007	10:44	-0.01	0.38	5.1	0.00	5.1	5.0	9.4
VMP-021M	Rand	1/18/2011	7:27	-0.01	59.3	1000000	1000000	0.00	1.2	9.8
VMP-021M	Rand	2/16/2011	7:57							
VMP-021S	A Clay	5/18/2005	10:41	0.00	4890	360000			2.3	10.1

Location	Stratum ID	Date	Time	Stabilized Vacuum / Pressure (in. of H2O)	PID (ppmv)	FID (ppmv)	CH4 (ppmv)	PHC (ppmv)	O2 (%)	CO2 (%)
VMP-021S	A Clay	5/24/2005	11:55	0.00	1050	490000			2.4	9.8
VMP-021S	A Clay	6/1/2005	9:35	-0.02	106	255000			2.9	10.6
VMP-021S	A Clay	6/7/2005	13:50	0.00	225	295000			1.6	10.9
VMP-021S	A Clay	6/21/2005	11:15	0.00	28.0	1550			20.8	0.1
VMP-021S	A Clay	7/15/2005	9:22	-0.01	60.7	2670			20.1	0.2
VMP-021S	A Clay	7/19/2005	13:06	-0.02	35.5	1260	998	262	20.9	0.2
VMP-021S	A Clay	8/2/2005	15:15	0.00	131	88500	63800	24700	3.1	12.0
VMP-021S	A Clay	8/16/2005	11:22	0.00	42.1	87450	61000	26450	1.2	14.5
VMP-021S	A Clay	8/31/2005	13:25	0.00	130	48200	2300	4590	0.5	15.7
VMP-021S	A Clay	9/15/2005	12:16	0.41	130	36900	26500	10400	1.4	15.3
VMP-021S	A Clay	9/27/2005	13:08	0.00	187	49000	38000	11000	0.2	16.2
VMP-021S	A Clay	10/11/2005	11:55	0.00	222	44800	37500	7300	1.6	15.4
VMP-021S	A Clay	10/26/2005	13:26	0.13	125	110000	73200	36800	0.5	16.0
VMP-021S	A Clay	11/9/2005	7:45	-0.55	130	150000	121000		0.6	15.5
VMP-021S	A Clay	11/21/2005	13:06	0.01	157	162000	97000	65000	1.1	14.9
VMP-021S	A Clay	12/6/2005	14:45	0.00	1550	32900	26670	6230	0.7	12.6
VMP-021S	A Clay	12/20/2005	13:54		298	2290	902	1388	0.6	12.4
VMP-021S	A Clay	1/4/2006	13:34		183	1920	559	1361	2.1	11.7
VMP-021S	A Clay	1/5/2006	9:42	0.00						
VMP-021S	A Clay	1/17/2006	10:14	-24.40	9.7	97.0	0.00	97.0	5.8	7.9
VMP-021S	A Clay	1/31/2006	10:37	0.00	1.7	8.0	0.00	8.0	0.4	10.7
VMP-021S	A Clay	2/14/2006	10:21	-28.20	0.60	1.7	0.00		1.7	9.2
VMP-021S	A Clay	2/28/2006	14:53		6.0	10.0	0.00	10.0	1.7	8.5
VMP-021S	A Clay	3/1/2006	10:55	-3.59						
VMP-021S	A Clay	3/14/2006	9:21	-0.15	0.00	2.5	0.00	2.5	6.4	6.8
VMP-021S	A Clay	3/28/2006	13:20	-0.02	0.50	1.8	0.00	1.8	4.1	8.0
VMP-021S	A Clay	4/11/2006	9:58	0.00	2.1	4.8	0.00	4.8	4.1	7.5
VMP-021S	A Clay	5/16/2006	8:02	-0.03	0.80	12.1	0.00	12.1	3.2	7.6
VMP-021S	A Clay	6/20/2006	11:38	0.00	1.1	1.9	0.00	1.9	4.1	6.1
VMP-021S	A Clay	7/18/2006	12:32	0.00	1.1	3.1	0.00	3.1	2.9	6.0
VMP-021S	A Clay	8/16/2006	8:09	-0.35	4.3	6.5	1.0	5.5	10.6	3.9
VMP-021S	A Clay	10/17/2006	12:23	-0.71	2.4	4.1	0.00	4.1	9.4	3.2
VMP-021S	A Clay	11/20/2006	10:55	0.02	1.0	1.9	0.00	1.9	9.0	2.8
VMP-021S	A Clay	12/19/2006	11:10	0.00	1.6	3.3	0.00	3.3	9.2	2.0
VMP-021S	A Clay	1/16/2007	14:32	-0.05	5.0	21.0	0.00	21.0	9.8	1.5
VMP-021S	A Clay	2/21/2007	9:57	-0.01	3.0	20.0	0.00	20.0	10.4	1.1
VMP-021S	A Clay	3/20/2007	13:22	0.00	0.40	2.5	0.00	2.5	11.0	0.9
VMP-021S	A Clay	4/17/2007	11:08	-0.04	0.60	11.1	0.00	11.1	11.4	0.8
VMP-021S	A Clay	5/15/2007	7:35	-0.02	2.3	4.6	0.00	4.6	11.7	1.0
VMP-021S	A Clay	9/18/2007	16:22	0.00	0.32	3.3	0.00	3.3	12.4	1.3
VMP-021S	A Clay	1/15/2008	11:09	0.00	0.63	6.7	0.00	6.7	18.0	0.2
VMP-021S	A Clay	4/15/2008	10:16	0.00	1.2	2.6	0.00	2.6	11.1	0.4
VMP-021S	A Clay	7/15/2008	9:27	0.00	3.2	3.2	0.00	3.2	8.1	0.8
VMP-021S	A Clay	10/21/2008	9:18	-0.81	0.45	2.3	0.00	2.3	18.0	0.5
VMP-021S	A Clay	5/19/2009	9:33	0.00	0.53	3.7	0.00	3.7	17.8	0.4
VMP-021S	A Clay	7/21/2009	7:18	0.00	1.9	0.92	0.00	0.92	11.5	1.7
VMP-021S	A Clay	10/20/2009	7:50	0.00	0.51	1.2	0.00	1.2	9.3	1.2
VMP-021S	A Clay	1/20/2010	7:33	0.00	1.6	3.3	0.00	3.3	10.5	1.4
VMP-021S	A Clay	4/19/2010	8:30	0.00	0.61	1.4	0.00	1.4	13.3	1.0
VMP-021S	A Clay	7/19/2010	7:53	0.00	0.63	0.80	0.00	0.80	13.5	1.4
VMP-021S	A Clay	10/18/2010	7:56	0.00	0.05	3.2	0.00	3.2	12.9	1.8
VMP-021S	A Clay	1/18/2011	7:26	-0.17	1.1	2.8	0.00	2.8	15.3	0.8
VMP-022D	Main	6/7/2005	15:51	3.51						
VMP-022D	Main	6/21/2005	14:46	0.58						
VMP-022D	Main	7/19/2005	10:40	0.13				0.00		
VMP-022D	Main	8/2/2005	15:45	0.27				0.00		
VMP-022D	Main	8/16/2005	11:01	-0.17						
VMP-022D	Main	8/30/2005	10:37	0.25						
VMP-022D	Main	9/13/2005	9:56	0.22						
VMP-022D	Main	9/27/2005	10:02	-0.01						
VMP-022D	Main	10/11/2005	10:10	0.19						
VMP-022D	Main	10/25/2005	10:11	0.01						
VMP-022D	Main	11/8/2005	10:58	0.00						
VMP-022D	Main	11/21/2005	10:51	0.38						
VMP-022D	Main	12/6/2005	11:28	-0.32						
VMP-022D	Main	12/20/2005	15:49	0.07						
VMP-022D	Main	1/4/2006	10:35	-0.47						
VMP-022D	Main	1/31/2006	8:55	-0.16						
VMP-022D	Main	2/14/2006	14:18	0.34						
VMP-022D	Main	2/28/2006	8:53	-0.55						
VMP-022D	Main	3/14/2006	11:49	-0.70						
VMP-022D	Main	3/28/2006	8:03	-1.21						
VMP-022D	Main	4/11/2006	8:22	-0.21						

Location	Stratum ID	Date	Time	Stabilized Vacuum / Pressure (In. of H2O)	PID (ppmv)	FID (ppmv)	CH4 (ppmv)	PHC (ppmv)	O2 (%)	CO2 (%)
VMP-026S	A Clay	5/18/2005	13:46	-0.24						
VMP-026S	A Clay	5/24/2005	10:47	4.22						
VMP-026S	A Clay	6/1/2005	12:42	-9.64						
VMP-026S	A Clay	6/7/2005	13:45	-0.02						
VMP-026S	A Clay	6/21/2005	14:01	5.60						
VMP-026S	A Clay	7/14/2005	14:10	0.01	0.83	0.00			11.9	1.9
VMP-026S	A Clay	7/19/2005	11:42	-0.11				0.00		
VMP-026S	A Clay	8/2/2005	7:59	-0.13				0.00		
VMP-026S	A Clay	9/27/2005	11:01	0.35	1.0	8.0	3.0	5.0	14.4	1.0
VMP-026S	A Clay	10/11/2005	9:26	0.00	0.20	0.60	0.00	0.60	13.2	1.0
VMP-026S	A Clay	12/6/2005	15:58	-9.96	1.6	2.4	0.00	2.4	12.2	0.4
VMP-026S	A Clay	1/4/2006	9:30	-4.57	0.33	1.2	0.00	1.2	12.8	0.2
VMP-026S	A Clay	1/17/2006	13:25	-13.45	0.60	1.1	0.00	1.1	12.2	0.4
VMP-026S	A Clay	1/31/2006	11:12	-9.89	0.16	0.90	0.00	0.90	12.1	0.4
VMP-026S	A Clay	2/14/2006	11:17	-7.88	0.50	1.7	0.00		12.5	0.4
VMP-026S	A Clay	2/28/2006	10:37	-3.15	0.00	1.0	0.00	1.0	13.9	0.3
VMP-026S	A Clay	3/14/2006	11:20	-19.83	2.0	58.0	43.0	15.0	14.2	0.3
VMP-026S	A Clay	3/28/2006	10:09	-14.29	0.00	1.0	0.00	1.0	13.5	0.3
VMP-026S	A Clay	4/11/2006	9:41	-4.26	0.73	2.4	0.00	2.4	14.8	0.3
VMP-026S	A Clay	5/16/2006	12:07	-5.94	0.18	0.80	0.00	0.80	13.1	0.2
VMP-026S	A Clay	6/20/2006	12:29	-0.86	1.2	2.9	0.00	2.9	11.4	0.2
VMP-026S	A Clay	7/18/2006	10:25	-2.98	1.1	2.6	0.00	2.6	10.8	0.3
VMP-026S	A Clay	8/15/2006	11:28	-4.54	1.6	1.4	0.00	1.4	10.9	0.2
VMP-026S	A Clay	9/19/2006	14:02	-7.45	0.94	3.5	0.00	3.5	10.6	0.3
VMP-026S	A Clay	10/17/2006	14:20	-7.33	0.24	3.3	0.00	3.3	20.9	0.0
VMP-026S	A Clay	11/20/2006	14:48	-9.79	0.40	1.4	0.00	1.4	11.1	0.2
VMP-026S	A Clay	12/19/2006	13:43	-10.83	1.3	3.5	0.00	3.5	13.3	0.1
VMP-026S	A Clay	1/17/2007	9:10	-3.18	0.20	1.1	0.00	1.1	13.5	0.0
VMP-026S	A Clay	2/21/2007	13:02	-11.07	0.50	1.0	0.00	1.0	13.6	0.0
VMP-026S	A Clay	3/20/2007	9:53		0.66	6.0	0.00	6.0	14.5	0.0
VMP-026S	A Clay	4/15/2008	11:07	-4.36	0.22	3.4	0.00	3.4	9.7	1.1
VMP-026S	A Clay	7/15/2008	10:17	0.00	1.4	2.8	0.00	2.8	6.6	0.1
VMP-026S	A Clay	10/21/2008	10:38	0.00	0.43	4.2	0.00	4.2	9.1	0.3
VMP-027D	Rand	5/19/2005	14:14	0.03						
VMP-027D	Rand	5/24/2005	11:22	0.00						
VMP-027D	Rand	6/1/2005	10:23	0.32						
VMP-027D	Rand	6/7/2005	9:44	0.34						
VMP-027D	Rand	6/21/2005	9:56	0.46						
VMP-027D	Rand	7/14/2005	15:30	0.71						
VMP-027D	Rand	7/19/2005	9:50	1.06				0.00		
VMP-027D	Rand	8/2/2005	10:52	0.01				0.00		
VMP-027D	Rand	8/16/2005	12:47	0.01						
VMP-027D	Rand	9/13/2005	9:08	0.05						
VMP-027D	Rand	9/27/2005	11:02	-0.01						
VMP-027D	Rand	10/11/2005	11:30	-0.02						
VMP-027D	Rand	10/25/2005	11:32	-0.01						
VMP-027D	Rand	11/8/2005	12:32	-0.08						
VMP-027D	Rand	11/22/2005	10:42	-3.06						
VMP-027D	Rand	12/6/2005	13:33	-0.50						
VMP-027D	Rand	12/20/2005	11:20	-0.15						
VMP-027D	Rand	1/4/2006	14:25	-1.02						
VMP-027D	Rand	2/28/2006	14:35	-1.54	154	1000000	375000	625000	0.7	8.1
VMP-027D	Rand	3/14/2006	12:59	-1.82	189	1000000	136000	864000	0.4	8.9
VMP-027D	Rand	3/28/2006	9:53	-0.99	388	645000	98800	546200	0.3	9.2
VMP-027D	Rand	4/11/2006	10:13		323	314000	55600	258400	0.5	9.0
VMP-027D	Rand	4/12/2006	11:07	-1.26						
VMP-027D	Rand	5/16/2006	8:30	-2.50	319	153000	33900	119100	1.0	8.8
VMP-027D	Rand	6/20/2006	12:21	-0.89	401	121000	28800	92200	0.3	8.2
VMP-027D	Rand	7/18/2006	13:09	-0.84	251	194000	38400	155600	1.6	8.4
VMP-027D	Rand	8/15/2006	12:18	-0.51	344	241000	56200	184800	1.0	8.5
VMP-027D	Rand	9/19/2006	14:33	-0.72	465	155000	42300	112700	0.6	9.4
VMP-027D	Rand	10/17/2006	11:37	-1.03	443	96720	36140	60580	0.6	9.7
VMP-027D	Rand	11/20/2006	10:38	-1.25	443	66820	30490	36330	0.5	10.4
VMP-027D	Rand	12/19/2006	10:53	-0.90	438	88020	34540	53480	2.1	9.8
VMP-027D	Rand	1/16/2007	14:17	-1.00	291	47400	9230	38170	0.9	10.4
VMP-027D	Rand	2/21/2007	9:43	-1.15	435	182000	73160	108840	0.6	10.6
VMP-027D	Rand	3/20/2007	13:08	-0.97	396	106000	49700	56300	0.7	10.2
VMP-027D	Rand	8/21/2007	11:10	-0.34	301	157000	80670	76330	0.2	9.1
VMP-027D	Rand	9/18/2007	15:36	-0.34	226	142000	107000	35000	0.7	10.4
VMP-027D	Rand	10/16/2007	11:25	-0.49	266	99500	56500	43000	2.4	10.0
VMP-027D	Rand	11/13/2007	16:39	-0.32	275	132000	65180	66820	1.4	10.4
VMP-027D	Rand	1/15/2008	9:57	-0.10	217	115000	67500	47500	6.5	9.2
VMP-027D	Rand	2/19/2008	12:12	0.01	158	123000	81300	41700	3.7	10.0

Location	Stratum ID	Date	Time	Stabilized Vacuum / Pressure (In. of H2O)	PID (ppmv)	FID (ppmv)	CH4 (ppmv)	PHC (ppmv)	O2 (%)	CO2 (%)
VMP-027D	Rand	3/18/2008	9:28	-2.53	196	149000	55600	93400	0.9	10.2
VMP-027D	Rand	3/19/2008	17:50	-0.68						
VMP-027D	Rand	2/15/2011	8:48							
VMP-027M	B Clay	5/19/2005	14:14	-2.67						
VMP-027M	B Clay	5/24/2005	11:22	-0.01						
VMP-027M	B Clay	6/1/2005	10:21	0.02						
VMP-027M	B Clay	6/7/2005	9:41	0.02						
VMP-027M	B Clay	6/21/2005	9:58	-6.20						
VMP-027M	B Clay	7/14/2005	15:31	-0.02						
VMP-027M	B Clay	7/19/2005	9:51	0.01				0.00		
VMP-027M	B Clay	8/2/2005	10:55	-0.38				0.00		
VMP-027M	B Clay	8/16/2005	12:51	0.00						
VMP-027M	B Clay	9/13/2005	9:06	-0.01						
VMP-027M	B Clay	9/27/2005	11:02	-0.01						
VMP-027M	B Clay	10/11/2005	11:32	-0.01						
VMP-027M	B Clay	10/25/2005	11:13	0.02						
VMP-027M	B Clay	11/8/2005	12:30	-0.25						
VMP-027M	B Clay	11/22/2005	10:40	-0.43						
VMP-027M	B Clay	12/6/2005	13:32	-0.57						
VMP-027M	B Clay	1/4/2006	14:24	-0.47						
VMP-027M	B Clay	1/17/2006	9:56	-0.71	79.6	785000	316000	469000	1.2	6.6
VMP-027M	B Clay	1/31/2006	10:17	0.01	75.3	831000	317000	514000	0.4	6.4
VMP-027M	B Clay	2/14/2006	9:14	-0.84	89.7	543000	254000		1.1	6.3
VMP-027M	B Clay	2/28/2006	14:32	-0.45	47.4	425	227	198	0.4	10.6
VMP-027M	B Clay	3/14/2006	12:57	-0.35	82.0	603	226	377	3.8	4.8
VMP-027M	B Clay	3/28/2006	9:52	-0.53	351	2700	1200	1500	0.4	5.5
VMP-027M	B Clay	4/11/2006	10:12		512	3490	864	2626	0.5	5.7
VMP-027M	B Clay	4/12/2006	11:06	-0.97						
VMP-027M	B Clay	5/16/2006	8:29	-1.97	352	1930	319	1611	0.8	3.6
VMP-027M	B Clay	6/20/2006	12:19	-0.26	75.6	645	121	524	1.6	2.5
VMP-027M	B Clay	7/18/2006	13:09	-0.66	47.8	268	58.0	210	2.0	3.1
VMP-027M	B Clay	8/15/2006	11:47	-0.63	3.5	25.0	8.0	17.0	2.2	3.9
VMP-027M	B Clay	9/19/2006	8:28	-0.74	0.63	4.6	0.00	4.6	6.8	4.5
VMP-027M	B Clay	10/17/2006	11:33	-0.81	0.36	2.5	0.00	2.5	8.5	3.5
VMP-027M	B Clay	11/20/2006	10:34	-0.90	0.20	1.2	0.00	1.2	11.8	3.8
VMP-027M	B Clay	12/19/2006	10:52	-0.86	0.24	3.2	0.00	3.2	14.6	4.1
VMP-027M	B Clay	1/16/2007	13:54	-0.75	0.18	2.1	0.00	2.1	6.7	4.2
VMP-027M	B Clay	2/21/2007	9:41	-0.40	0.20	1.7	0.00	1.7	14.6	2.6
VMP-027M	B Clay	3/20/2007	13:11	-0.12	0.42	3.1	0.00	3.1	12.6	3.0
VMP-027M	B Clay	4/17/2007	15:01	-0.20	0.87	2.1	0.00	2.1	12.0	3.3
VMP-027M	B Clay	5/15/2007	9:18	-0.56	4.9	5.8	0.00	5.8	17.4	1.4
VMP-027M	B Clay	6/19/2007	10:51	-0.34	0.00	0.10	0.00	0.10	9.5	3.7
VMP-027M	B Clay	7/17/2007	16:50	-0.31	0.00	1.0	0.00	1.0	12.1	2.9
VMP-027M	B Clay	8/21/2007	11:09	-0.25	0.80	1.4	0.00	1.4	12.1	4.3
VMP-027M	B Clay	9/18/2007	15:35	-0.25	0.27	3.8	0.00	3.8	14.7	3.8
VMP-027M	B Clay	10/16/2007	11:24	-0.35	0.20	2.3	0.00	2.3	18.1	2.4
VMP-027M	B Clay	11/13/2007	16:39	-0.22	0.33	3.3	0.00	3.3	17.1	2.4
VMP-027M	B Clay	1/15/2008	9:56	-0.51	0.97	8.1	0.00	8.1	12.4	2.0
VMP-027M	B Clay	2/19/2008	12:11	0.00	0.30	3.6	0.00	3.6	4.8	3.3
VMP-027M	B Clay	2/20/2008	15:11	-0.07						
VMP-027M	B Clay	3/18/2008	9:28	-0.08	0.60	4.2	0.00	4.2	4.1	3.8
VMP-027M	B Clay	4/15/2008	10:48	-0.11	0.60	3.5	0.00	3.5	9.4	2.5
VMP-027M	B Clay	5/20/2008	11:08	-0.03	6.0	25.5	11.5	14.0	3.0	3.7
VMP-027M	B Clay	6/17/2008	9:53	-0.10	21.4	2190	1870	320	3.6	3.2
VMP-027M	B Clay	7/15/2008	9:00	0.00	7.3	68.0	2.5	65.5	2.5	3.4
VMP-027M	B Clay	8/18/2008	8:22	-0.05	2.1	12.3	0.00	12.3	11.9	2.2
VMP-027M	B Clay	9/16/2008	10:39	-0.02	0.65	0.55	0.00	0.55	1.3	5.6
VMP-027M	B Clay	10/21/2008	9:04	-0.17	0.68	1.9	0.00	1.9	13.4	3.4
VMP-027M	B Clay	11/18/2008	9:13	0.00	0.40	2.1	0.00	2.1	17.0	4.9
VMP-027M	B Clay	2/17/2009	9:25	0.11	0.11	1.6	0.00	1.6	17.1	2.5
VMP-027M	B Clay	3/17/2009	9:32	-0.05	0.51	2.9	0.00	2.9	18.7	0.9
VMP-027M	B Clay	5/19/2009	9:12	0.00	0.37	1.8	0.00	1.8	19.5	0.6
VMP-027M	B Clay	6/16/2009	13:12	0.00	0.17	1.1	0.00	0.00	14.9	1.6
VMP-027M	B Clay	7/21/2009	7:55	0.01	3.6	4050	3710	340	0.7	4.3
VMP-027M	B Clay	8/18/2009	8:13	0.00	52.1	49500	35632	13868	17.6	1.0
VMP-027M	B Clay	9/15/2009	8:05	-0.16	20.6	3411	32.7	3378	17.8	1.4
VMP-027M	B Clay	10/20/2009	8:19	-0.19	33.4	15630	14390	1240	1.5	8.3
VMP-027M	B Clay	1/20/2010	8:10	-0.62	0.78	2.1	0.00	2.1	3.2	8.7
VMP-027M	B Clay	4/19/2010	9:46	0.00	0.59	3.8	0.00	3.8	20.9	0.0
VMP-027M	B Clay	5/18/2010	12:40	0.00	12.8	200	188	12.0	7.8	0.7
VMP-027M	B Clay	6/15/2010	7:37	-0.64	26.5	285000	205000	80000	0.6	8.9
VMP-027M	B Clay	7/19/2010	8:23	-0.08	23.3	69150	62350	6800	3.0	8.2
VMP-027M	B Clay	8/17/2010	7:12	-0.80	55.4	223000	176000	47000	5.7	6.9

SVE Data Thru Week Ending February 18, 2011
Hartford, Illinois

Location	Stratum ID	Date	Time	Stabilized Vacuum / Pressure (in. of H2O)	PID (ppmv)	FID (ppmv)	CH4 (ppmv)	PHC (ppmv)	O2 (%)	CO2 (%)
VMP-027M	B Clay	9/21/2010	7:28	-0.75	70.2	99490	71330	28160	2.5	10.5
VMP-027M	B Clay	10/18/2010	8:30	0.00	0.07	3.7	0.00	3.7	8.3	10.6
VMP-027M	B Clay	11/16/2010	7:35	-0.29	0.62	3.2	0.00	3.2	14.3	8.8
VMP-027M	B Clay	1/18/2011	8:07	-0.69	0.33	1.5	0.00	1.5	16.7	4.5
VMP-027M	B Clay	2/15/2011	8:47	-0.63	1.2	3.8	0.00	3.8	11.2	5.1
VMP-027S	A Clay	5/18/2005	10:20	0.00	3570	270000			1.9	6.2
VMP-027S	A Clay	5/24/2005	13:21	-0.14	0.00					
VMP-027S	A Clay	6/1/2005	9:04	11.81	90.5	320000			2.9	11.8
VMP-027S	A Clay	6/7/2005	14:15	0.60	181	366000			1.1	12.0
VMP-027S	A Clay	6/21/2005	8:25	-0.33	106	232500			3.4	11.8
VMP-027S	A Clay	7/14/2005	15:32	-0.01	0.00					
VMP-027S	A Clay	7/19/2005	12:53	-0.58	125	223000	163000	60000	1.8	14.9
VMP-027S	A Clay	8/2/2005	15:25	0.00	73.8	110000	56400	53600	20.0	0.7
VMP-027S	A Clay	8/16/2005	11:16	-1.75	27.3	215000	34700	180300	3.1	14.8
VMP-027S	A Clay	8/31/2005	13:45	-0.03	102	190000	160000	30000	1.2	17.0
VMP-027S	A Clay	9/15/2005	12:01	0.03	129	199000	147000	52000	0.7	18.9
VMP-027S	A Clay	9/27/2005	13:25	0.14	129	195000	154000	41000	0.7	19.7
VMP-027S	A Clay	10/11/2005	11:44	0.01	156	160000	109000	51000	0.8	19.7
VMP-027S	A Clay	10/26/2005	13:00	-0.20	107	191000	161000	30000	0.6	19.4
VMP-027S	A Clay	11/8/2005	13:20	-0.34	88.9	180000	138000	42000	4.8	13.9
VMP-027S	A Clay	11/21/2005	12:50	0.00	105	233000	180000	53000	0.8	18.1
VMP-027S	A Clay	12/6/2005	14:20	-2.03	501	672000	485000	187000	1.1	17.0
VMP-027S	A Clay	1/4/2006	12:53	-0.28	101	166000	124000	42000	2.6	14.2
VMP-027S	A Clay	1/17/2006	9:56	-0.98	87.6	88900	79200	9700	0.8	13.6
VMP-027S	A Clay	2/1/2006	10:08	0.03	91.9	84500	68700		2.2	10.6
VMP-027S	A Clay	2/14/2006	9:13	-0.49	123	45340	38610		0.5	12.3
VMP-027S	A Clay	2/28/2006	14:33	-0.15	166	19660	15320	4340	0.6	11.9
VMP-027S	A Clay	3/28/2006	9:51	-0.02	270	9750	6800	2950	0.7	6.9
VMP-027S	A Clay	4/11/2006	10:12	0.00	189	4040	1840	2200	1.8	4.4
VMP-027S	A Clay	5/16/2006	8:28	-0.28	10.8	70.0	0.00	70.0	11.9	1.5
VMP-027S	A Clay	6/20/2006	12:18	0.00	13.3	42.0	0.00	42.0	6.4	1.9
VMP-027S	A Clay	7/18/2006	13:08	-0.02	12.6	51.0	0.00	51.0	6.0	2.3
VMP-027S	A Clay	8/15/2006	11:46	-0.66	89.4	670	0.00	670	0.3	2.8
VMP-027S	A Clay	10/17/2006	11:33	-1.36	15.8	186	5.0	181	4.5	1.4
VMP-027S	A Clay	11/20/2006	10:34	-3.47	0.70	1.8	0.00	1.8	6.7	0.7
VMP-027S	A Clay	12/19/2006	10:51	-2.13	0.54	3.4	0.00	3.4	4.8	0.5
VMP-027S	A Clay	1/16/2007	13:33		0.28	1.8	0.00	1.8	8.3	0.3
VMP-027S	A Clay	1/18/2007	8:59	-0.37						
VMP-027S	A Clay	2/21/2007	9:10	-1.72	0.30	15.0	10.0	5.0	8.2	0.2
VMP-027S	A Clay	3/20/2007	13:10		1.4	3.0	0.00	3.0	8.5	0.2
VMP-027S	A Clay	3/21/2007	9:52	-0.35						
VMP-027S	A Clay	4/17/2007	15:00	0.00	1.1	1.6	0.00	1.6	2.4	0.4
VMP-027S	A Clay	5/15/2007	9:18	-0.01	3.5	4.8	0.00	4.8	0.5	0.5
VMP-027S	A Clay	6/19/2007	10:51	0.00	0.00	0.90	0.00	0.90	0.8	0.6
VMP-027S	A Clay	7/17/2007	16:50	-0.01	0.00	1.0	0.00	1.0	4.4	0.7
VMP-027S	A Clay	8/21/2007	11:09	-0.57	3.0	1.8	0.00	1.8	0.0	1.1
VMP-027S	A Clay	9/18/2007	15:35	0.00						
VMP-027S	A Clay	10/16/2007	12:49	-0.02	0.77	2.1	0.00	2.1	2.7	1.4
VMP-027S	A Clay	11/13/2007	16:39	0.00	0.36	2.1	0.00	2.1	2.0	1.2
VMP-027S	A Clay	1/15/2008	9:56	0.00	1.1	1.3	0.00	1.3	5.6	0.6
VMP-027S	A Clay	2/19/2008	12:11	-0.73	0.70	4.7	0.00	4.7	1.3	0.5
VMP-027S	A Clay	2/20/2008	15:11	0.00						
VMP-027S	A Clay	3/18/2008	9:27	0.06	0.53	3.2	0.00	3.2	2.2	0.4
VMP-027S	A Clay	4/15/2008	10:47	0.00	0.54	2.7	0.00	2.7	17.0	2.1
VMP-027S	A Clay	5/20/2008	11:08	0.00	1.5	2.6	0.00	2.6	6.7	0.4
VMP-027S	A Clay	6/17/2008	9:53	-0.01	0.51	0.95	0.00	0.95	0.5	0.7
VMP-027S	A Clay	7/15/2008	9:00	0.00	1.2	2.9	0.00	2.9	1.0	1.0
VMP-027S	A Clay	8/18/2008	8:22	0.00	0.58	0.40	0.00	0.40	2.1	1.5
VMP-027S	A Clay	9/16/2008	10:39	-0.01	0.58	0.49	0.00	0.49	6.5	1.3
VMP-027S	A Clay	10/21/2008	9:04	0.00	0.79	2.1	0.00	2.1	2.8	1.8
VMP-027S	A Clay	11/18/2008	9:13	-0.12						
VMP-027S	A Clay	11/19/2008	10:01		1.1	1.8	0.00	1.8	5.5	1.3
VMP-027S	A Clay	2/17/2009	9:25	0.00	0.18	3.8	0.00	3.8	9.2	0.4
VMP-027S	A Clay	3/17/2009	9:32	-0.02	0.46	2.4	0.00	2.4	18.5	0.0
VMP-027S	A Clay	5/20/2009	14:52	-0.20	0.40	1.7	0.00	1.7	3.5	0.5
VMP-027S	A Clay	6/16/2009	13:12	-0.01	0.17	2.6	0.00	0.00	6.0	0.7
VMP-027S	A Clay	7/21/2009	7:55	0.00	0.43	2.1	0.00	2.1	2.8	1.4
VMP-027S	A Clay	8/18/2009	8:12	0.00	0.55	3.2	0.00	3.2	2.2	1.8
VMP-027S	A Clay	9/15/2009	8:05	-0.01	0.45	3.5	0.00	3.5	1.2	2.3
VMP-027S	A Clay	10/20/2009	8:18	0.00	0.72	2.7	0.00	2.7	3.1	1.3
VMP-027S	A Clay	11/17/2009	7:27	-0.14	1.7	1.1	0.00	1.1	2.5	1.3
VMP-027S	A Clay	12/15/2009	7:48	0.00	0.79	2.6	0.00	2.6	3.0	1.2
VMP-027S	A Clay	1/20/2010	8:09	-0.02	0.80	2.3	0.00	2.3	2.4	0.8

SVE Data Thru Week Ending February 18, 2011
Hartford, Illinois

Location	Stratum ID	Date	Time	Stabilized Vacuum / Pressure (In. of H2O)	PID (ppmv)	FID (ppmv)	CH4 (ppmv)	PHC (ppmv)	O2 (%)	CO2 (%)
VMP-027S	A Clay	3/16/2010	7:23	0.00	0.27	3.7	0.00	3.7	3.0	0.5
VMP-027S	A Clay	4/19/2010	9:45	0.00	0.71	2.9	0.00	2.9	7.7	0.5
VMP-027S	A Clay	5/18/2010	7:53	-2.76	0.55	1.9	0.00	1.9	5.6	0.8
VMP-027S	A Clay	6/15/2010	7:36	0.20	1.4	4.3	0.00	4.3	3.0	0.9
VMP-027S	A Clay	7/19/2010	8:22	-0.33	0.92	1.3	0.00	1.3	2.5	1.3
VMP-027S	A Clay	8/17/2010	7:11	0.00	0.63	3.2	0.00	3.2	2.8	1.7
VMP-027S	A Clay	9/21/2010	7:27	0.15	1.1	2.9	0.00	2.9	0.6	2.0
VMP-027S	A Clay	10/18/2010	8:29	-0.02	0.11	3.9	0.00	3.9	4.4	2.1
VMP-027S	A Clay	11/16/2010	7:35	0.00	0.91	3.5	0.00	3.5	4.8	1.7
VMP-027S	A Clay	1/18/2011	8:06	-0.11	0.67	3.6	0.00	3.6	4.4	0.6
VMP-027S	A Clay	2/15/2011	8:46							
VMP-029M	A Clay	5/18/2005	15:04	-0.01	220	340			4.4	15.9
VMP-029M	A Clay	5/24/2005	12:06	0.03	4.6	5.7			5.3	15.9
VMP-029M	A Clay	6/1/2005	11:30	-0.11	5.4	140			6.5	12.9
VMP-029M	A Clay	6/7/2005	10:45	-0.12	7.4	15.0			3.6	16.9
VMP-029M	A Clay	6/21/2005	11:40	0.01	3.8	8.0			10.3	12.5
VMP-029M	A Clay	7/14/2005	13:55	-0.02	1.9	0.00			2.1	15.9
VMP-029M	A Clay	7/19/2005	9:37	-0.16	1.3	3.6	0.00	3.6	17.0	3.6
VMP-029M	A Clay	8/2/2005	11:40	-0.01	4.7	23.2	13.1	10.1	1.6	17.7
VMP-029M	A Clay	8/16/2005	10:46	-0.59	2.6	5.1	0.00	5.1	1.2	19.0
VMP-029M	A Clay	10/11/2005	11:10	-1.22	9.8	236	189	47.0	1.3	19.4
VMP-029M	A Clay	10/25/2005	10:58	-0.78	1.9	32.0	24.0	8.0	0.5	19.3
VMP-029M	A Clay	11/8/2005	11:40	-0.44	1.1	2.6	0.00		0.5	17.8
VMP-029M	A Clay	11/21/2005	11:16	-0.78	0.68	1.6	0.00	1.6	0.9	17.0
VMP-029M	A Clay	12/6/2005	11:10	-0.94	3.1	4.2	0.00	4.2	0.9	15.7
VMP-029M	A Clay	12/20/2005	9:25	-0.39	0.18	1.8	0.00	1.8	1.2	14.6
VMP-030D	Main	5/18/2005	9:44	-0.02						
VMP-030D	Main	5/24/2005	14:45	0.01						
VMP-030D	Main	6/1/2005	8:10	0.02						
VMP-030D	Main	6/7/2005	11:38	0.02						
VMP-030D	Main	6/21/2005	8:15	-0.04						
VMP-030D	Main	7/19/2005	8:11	-0.04				0.00		
VMP-030D	Main	8/2/2005	8:42	-0.01				0.00		
VMP-030D	Main	8/16/2005	10:57	-0.14						
VMP-030D	Main	8/30/2005	10:26	0.01	0.20	10.0	0.00	10.0	12.6	7.8
VMP-030D	Main	9/15/2005	11:15	-0.01	1.9	2.2	0.00	2.2	10.5	8.2
VMP-030D	Main	9/27/2005	9:13	-0.01	0.30	0.60	0.00	0.60	10.1	8.3
VMP-030D	Main	10/11/2005	10:15	-0.06	0.30	0.50	0.00	0.50	10.5	8.3
VMP-030D	Main	10/25/2005	10:35	-0.06	0.22	0.60	0.00	0.60	10.5	8.7
VMP-030D	Main	11/8/2005	9:09	0.24	0.80	1.5	0.00	1.5	9.8	8.6
VMP-030D	Main	11/21/2005	8:39	0.09	0.41	0.90	0.00	0.90	10.8	8.9
VMP-030D	Main	12/6/2005	13:00	0.22	1.6	2.1	0.00	2.1	10.1	9.0
VMP-030D	Main	12/20/2005	9:45	0.05	0.13	1.2	0.00	1.2	10.9	8.8
VMP-030D	Main	1/4/2006	9:15	-0.32	0.21	1.5	0.00	1.5	10.1	8.9
VMP-030D	Main	1/17/2006	9:24	-5.06	0.60	1.8	0.00	1.8	9.7	9.1
VMP-030D	Main	1/31/2006	9:04	-2.92	0.16	0.61	0.00	0.61	10.6	8.5
VMP-030D	Main	2/14/2006	12:25	-2.03	0.10	1.0	0.00		10.2	9.1
VMP-030D	Main	2/28/2006	9:50	-1.23	0.00	1.1	0.00	1.1	10.6	8.6
VMP-030D	Main	3/14/2006	14:49	0.00	0.00	1.0	0.00	1.0	9.8	9.5
VMP-030D	Main	3/28/2006	8:03	-0.10						
VMP-030D	Main	4/11/2006	7:51	-0.06	1.2	1.6	0.00	1.6	10.0	9.2
VMP-030D	Main	5/16/2006	12:23	0.00	0.51	2.9	0.00	2.9	9.6	9.3
VMP-030D	Main	6/20/2006	15:35		1.1	2.8	0.00	2.8	9.3	8.9
VMP-030D	Main	7/18/2006	12:08	-0.04	1.0	3.8	0.00	3.8	9.5	8.6
VMP-030D	Main	8/15/2006	15:22	0.04	1.4	2.4	0.00	2.4	10.0	9.2
VMP-030D	Main	9/19/2006	12:40	0.00	0.35	2.2	0.00	2.2	9.4	9.7
VMP-030D	Main	10/17/2006	12:52	0.00	0.30	2.4	0.00	2.4	9.4	9.2
VMP-030D	Main	11/20/2006	14:02	0.00	0.10	1.3	0.00	1.3	8.7	10.5
VMP-030D	Main	12/19/2006	13:39	0.06	0.18	1.9	0.00	1.9	8.7	10.3
VMP-030D	Main	1/16/2007	16:01	-0.01	0.15	1.2	0.00	1.2	7.9	10.9
VMP-030D	Main	2/21/2007	14:33	0.00	0.00	1.0	0.00	1.0	8.5	12.4
VMP-030D	Main	3/20/2007	13:46		0.15	2.8	0.00	2.8	8.2	11.2
VMP-030D	Main	3/21/2007	13:10	-0.04						
VMP-030D	Main	4/17/2007	11:34	0.01	0.61	1.5	0.00	1.5	8.2	10.1
VMP-030D	Main	5/15/2007	16:30	0.05	0.19	2.2	0.00	2.2	8.8	10.4
VMP-030D	Main	6/20/2007	9:07	0.00	0.20	1.0	0.00	1.0	8.0	10.1
VMP-030D	Main	9/18/2007	15:37	0.00	0.54	1.9	0.00	1.9	8.5	11.2
VMP-030D	Main	1/15/2008	16:01	0.00	0.31	5.9	0.00	5.9	19.8	10.2
VMP-030D	Main	1/16/2008	14:04	-0.02						
VMP-030D	Main	4/15/2008	8:31	0.06	0.14	1.0	0.00	1.0	9.9	10.5
VMP-030D	Main	10/21/2008	15:24	-0.13						
VMP-030D	Main	1/20/2009	15:36	-0.01	0.13	1.7	0.00	1.7	13.9	9.5
VMP-030D	Main	10/21/2009	13:22	0.09	0.18	1.1	0.00	1.1	13.6	7.5

Location	Stratum ID	Date	Time	Stabilized Vacuum / Pressure (in. of H2O)	PID (ppmv)	FID (ppmv)	CH4 (ppmv)	PHC (ppmv)	O2 (%)	CO2 (%)
MP-030B	Rand	4/15/2008	14:20	-0.82	476	146000	49690	96310	4.0	11.8
MP-030B	Rand	4/16/2008	13:18	-0.07						
MP-030B	Rand	10/22/2008	11:13	-1.10	295	304000	186000	118000	3.5	12.2
MP-030B	Rand	11/18/2008	11:57	0.00	261	622000	282000	340000	0.6	12.7
MP-030B	Rand	1/21/2009	15:26	0.00	426	426000	202000	224000	0.7	14.7
MP-030B	Rand	2/17/2009	16:01	-0.35	255	307000	171000	136000	3.3	13.0
MP-030B	Rand	3/17/2009	13:08	0.11	370	620000	215000	405000	2.7	12.7
MP-030B	Rand	7/21/2009	10:10	0.00	111	32430	27020	5410	5.1	8.8
MP-030B	Rand	8/19/2009	10:47	0.00	265	572000	283000	289000	0.7	12.7
MP-030B	Rand	9/16/2009	7:12	0.00	306	869000	313000	556000	1.4	11.9
MP-030B	Rand	10/20/2009	13:34	0.00	292	360000	188000	172000	2.0	11.8
MP-030B	Rand	2/15/2011	10:56							
MP-030C	Main	2/23/2005	0:00	0.15						
MP-030C	Main	5/6/2005	13:30	0.00						
MP-030C	Main	5/10/2005	14:13	0.03						
MP-030C	Main	5/11/2005	14:05	0.00						
MP-030C	Main	5/12/2005	14:17	0.00						
MP-030C	Main	5/16/2005	14:10	0.01						
MP-030C	Main	5/17/2005	9:36	0.01						
MP-030C	Main	5/18/2005	14:44	0.00	150	1070			20.7	0.0
MP-030C	Main	5/24/2005	13:36	0.00	907	11560			21.2	0.0
MP-030C	Main	6/1/2005	10:55	-0.12	119	400000			15.7	3.2
MP-030C	Main	6/7/2005	9:00	0.36	2.2	6.0			21.2	0.0
MP-030C	Main	6/21/2005	8:50	0.00	160	75000			18.7	1.9
MP-030C	Main	7/14/2005	16:04	-0.12	0.00					
MP-030C	Main	7/19/2005	11:40	0.00	115	92000	47000	45000	12.4	33.5
MP-030C	Main	8/2/2005	10:53	-0.01	130	610000	181000	429000	12.8	11.4
MP-030C	Main	8/16/2005	10:37	0.00	51.9	558000	210000	348000	12.8	5.3
MP-030C	Main	8/31/2005	11:01	0.15	235	1000000	270000	730000	5.2	8.7
MP-030C	Main	9/15/2005	10:22	0.01	235	329000	105000	224000	14.1	5.1
MP-030C	Main	9/27/2005	11:51	0.00	206	609000	160000	449000	11.1	6.4
MP-030C	Main	10/11/2005	11:27	0.00	273	433000	128000	305000	10.2	7.6
MP-030C	Main	10/25/2005	11:30	0.70	224	198000	60200	137800	15.6	6.0
MP-030C	Main	11/8/2005	12:08	6.75	64.6	2870	2115	755	20.8	0.1
MP-030C	Main	11/21/2005	11:25	-0.01	146	83900	55500	28400	17.6	2.3
MP-030C	Main	12/6/2005	13:35	1.63	155	1000000	486000	514000	8.9	8.6
MP-030C	Main	12/20/2005	13:17	0.57	201	1000000	252000	748000	1.9	13.5
MP-030C	Main	1/4/2006	11:45	0.07	297				1.6	12.0
MP-030C	Main	1/17/2006	16:37	-0.43	185	826000	146000	680000	9.8	7.3
MP-030C	Main	1/31/2006	13:30	0.42	0.17	1.3	0.00	1.3	20.9	0.0
MP-030C	Main	2/14/2006	9:20	-0.30	126	1000000	239000	761000	1.5	12.5
MP-030C	Main	2/28/2006	8:34	-0.53						
MP-030C	Main	3/14/2006	13:24	0.02	141	1000000	1000000	0.00	0.6	9.4
MP-030C	Main	3/28/2006	8:03	-0.02						
MP-030C	Main	4/11/2006	14:07	-0.04	155	1000000	391000	609000	3.5	8.3
MP-030C	Main	5/16/2006	10:51		210	124000	58000	66000	17.1	2.8
MP-030C	Main	6/20/2006	8:02		183	227000	91300	135700	16.1	3.1
MP-030C	Main	7/18/2006	8:19		163	205000	81500	123500	16.4	3.5
MP-030C	Main	8/15/2006	13:14	-0.35	176	1000000	232000	768000	3.4	10.8
MP-030C	Main	9/19/2006	12:51	-0.19						
MP-030C	Main	10/17/2006	13:50	-0.14	156	1000000	1000000	0.00	0.9	9.1
MP-030C	Main	11/20/2006	7:52	-0.65	173	1000000	414000	586000	6.0	7.8
MP-030C	Main	12/19/2006	7:56	-0.56	99.8	1000000	1000000	0.00	1.1	9.2
MP-030C	Main	1/16/2007	15:12		192	1000000	92000	908000	9.6	3.5
MP-030C	Main	1/17/2007	15:17	0.01						
MP-030C	Main	2/21/2007	7:44	-0.44	177	1000000	1000000	0.00	1.2	10.0
MP-030C	Main	3/20/2007	10:41	-0.06	41.5	466	111	355	20.9	0.0
MP-030C	Main	1/16/2008	13:44	0.02						
MP-030C	Main	2/15/2011	10:57							
MP-031A	A Clay	2/23/2005	0:00	0.45						
MP-031A	A Clay	5/6/2005	13:36	0.00						
MP-031A	A Clay	5/10/2005	14:26	0.00						
MP-031A	A Clay	5/11/2005	14:18	-0.01						
MP-031A	A Clay	5/12/2005	15:55	0.02						
MP-031A	A Clay	5/16/2005	14:27	-0.03						
MP-031A	A Clay	5/17/2005	9:51	-0.02						
MP-031A	A Clay	5/19/2005	10:13	0.00	1.7	3.2			17.0	2.8
MP-031A	A Clay	5/24/2005	12:39	0.00	0.97	5.0			17.6	2.7
MP-031A	A Clay	6/1/2005	11:14	-0.02	3.0	12.0			17.6	2.8
MP-031A	A Clay	6/7/2005	8:00	-0.03	2.9	8.0			17.9	2.9
MP-031A	A Clay	6/21/2005	11:15	-0.02	4.5	22.0			18.5	2.4
MP-031A	A Clay	7/14/2005	16:37	-0.07	0.00					
MP-031A	A Clay	7/19/2005	9:42	0.00	0.84	1.6	0.00	1.6	17.7	3.4

Location	Stratum ID	Date	Time	Stabilized Vacuum / Pressure (In. of H2O)	PID (ppmv)	FID (ppmv)	CH4 (ppmv)	PHC (ppmv)	O2 (%)	CO2 (%)
MP-031A	A Clay	8/2/2005	9:05	-0.09	194	912	21.0	891	17.0	3.7
MP-031A	A Clay	8/16/2005	8:11	-0.08	1.1	4.1	0.00	4.1	17.4	3.7
MP-031A	A Clay	8/30/2005	9:50	-0.06	1.2	2.6	0.00	2.6	15.4	3.9
MP-031A	A Clay	9/27/2005	7:43	0.01	0.50	0.90	0.00	0.90	17.2	3.2
MP-031A	A Clay	10/11/2005	9:50	-0.04	0.50	2.2	0.00	2.2	17.7	3.0
MP-031A	A Clay	10/25/2005	10:03	-0.05	0.31	1.3	0.00	1.3	18.7	2.7
MP-031A	A Clay	11/8/2005	10:35	-0.08	1.2	1.5	0.00	1.5	19.1	2.2
MP-031A	A Clay	11/21/2005	9:51	0.01	0.77	1.3	0.00	1.3	19.4	2.0
MP-031A	A Clay	12/6/2005	11:14	-0.05	23.4	240	10.0	230	20.0	1.5
MP-031A	A Clay	12/20/2005	8:53	-0.08	7.0	32.0	3.0	29.0	20.9	1.2
MP-031A	A Clay	1/4/2006	15:41	-0.09	26.3	200	29.0		20.7	0.9
MP-031A	A Clay	1/31/2006	8:50	-0.09	97.5	206	0.00	206	20.5	0.7
MP-031A	A Clay	2/15/2006	8:48	-0.07	26.0	40.4	0.00	40.4	20.7	0.6
MP-031A	A Clay	2/28/2006	10:54	-0.06	0.00	1.0	0.00	1.0	20.9	0.6
MP-031A	A Clay	3/14/2006	11:34	-0.10	0.00	5.3	0.00	5.3	20.4	0.6
MP-031A	A Clay	3/28/2006	10:39	-0.08	0.50	1.0	0.00	1.0	20.5	0.5
MP-031A	A Clay	5/16/2006	9:42	-0.11	0.80	5.2	0.00	5.2	20.1	0.6
MP-031A	A Clay	6/20/2006	10:20		1.1	2.6	0.00	2.6	18.5	0.9
MP-031A	A Clay	6/21/2006	11:12	-0.10						
MP-031A	A Clay	8/15/2006	14:52	0.00	26.9	70.6	0.00	70.6	17.2	2.1
MP-031A	A Clay	9/19/2006	9:50	0.01	0.44	1.6	0.00	1.6	19.4	1.3
MP-031A	A Clay	10/17/2006	15:37	-0.07	0.11	2.4	0.00	2.4	18.8	2.2
MP-031A	A Clay	4/17/2007	13:02	0.02	0.56	3.8	0.00	3.8	19.9	0.5
MP-031A	A Clay	5/15/2007	14:46	-0.11	0.37	4.4	0.00	4.4	19.3	0.6
MP-031A	A Clay	6/19/2007	11:54	-0.01	0.00	1.0	0.00	1.0	17.6	0.9
MP-031A	A Clay	9/18/2007	13:40	0.00	0.68	2.1	0.00	2.1	16.6	3.0
MP-031A	A Clay	1/15/2008	9:06	0.00	0.19	3.5	0.00	3.5	20.3	1.3
MP-031A	A Clay	4/15/2008	15:03	0.00	29.8	221	14.7	206	19.7	0.9
MP-031A	A Clay	7/16/2008	7:16	0.09	2.0	2.8	0.00	2.8	17.0	1.7
MP-031A	A Clay	1/21/2009	9:30	0.00	0.21	0.84	0.00	0.84	19.0	1.6
MP-031A	A Clay	10/22/2008	13:09	0.00	0.45	2.0	0.00	2.0	17.1	2.5
MP-031A	A Clay	5/20/2009	13:29	0.00	0.20	1.1	0.00	1.1	16.0	1.5
MP-031A	A Clay	7/22/2009	7:07	0.00	0.98	1.9	0.00	1.9	12.2	3.2
MP-031A	A Clay	10/20/2009	14:18	-0.03	0.67	3.6	0.00	3.6	4.6	3.7
MP-031A	A Clay	1/21/2010	12:25	0.00	0.12	2.2	0.00	2.2	17.5	2.3
MP-031A	A Clay	4/19/2010	8:35	0.00	0.39	1.8	0.00	1.8	3.8	1.9
MP-031A	A Clay	7/22/2010	10:16	0.00	24.9	930	430	500	12.5	3.9
MP-031A	A Clay	10/21/2010	10:19	-0.02	0.40	3.9	0.00	3.9	13.8	5.1
MP-031B	North Olive	2/23/2005	0:00	0.05						
MP-031B	North Olive	5/6/2005	13:36	0.00						
MP-031B	North Olive	5/10/2005	14:26	-0.02						
MP-031B	North Olive	5/11/2005	14:18	-0.01						
MP-031B	North Olive	5/12/2005	15:55	0.01						
MP-031B	North Olive	5/16/2005	14:27	-0.04						
MP-031B	North Olive	5/17/2005	9:51	-0.04						
MP-031B	North Olive	5/19/2005	10:19	0.00	1.4	3.7			16.1	2.3
MP-031B	North Olive	5/24/2005	12:38	0.00	1.1	1.3			17.0	2.0
MP-031B	North Olive	6/1/2005	11:15	-0.05	7.1	15.0			17.0	2.1
MP-031B	North Olive	6/7/2005	8:04	-0.06	2.9	7.6			17.5	2.0
MP-031B	North Olive	6/21/2005	11:15	-0.06	2.1	7.0			16.9	2.4
MP-031B	North Olive	7/14/2005	16:36	-0.09	0.00					
MP-031B	North Olive	7/19/2005	9:45	-0.14	0.76	2.7	0.00	2.7	16.0	3.1
MP-031B	North Olive	8/2/2005	9:06	-0.11	2.5	5.1	2.1	3.0	16.1	3.4
MP-031B	North Olive	8/16/2005	8:45	-0.11	3.4	7.1	0.00	7.1	16.2	3.6
MP-031B	North Olive	8/30/2005	9:51	-0.15	0.40	0.90	0.00	0.90	17.0	3.7
MP-031B	North Olive	9/27/2005	7:44	-0.12	0.70	1.2	0.00	1.2	16.7	3.6
MP-031B	North Olive	10/11/2005	9:52	-0.11	0.80	3.5	0.00	3.5	16.2	3.7
MP-031B	North Olive	10/25/2005	10:05	-0.06	0.30	1.8	0.00	1.8	16.4	3.8
MP-031B	North Olive	11/8/2005	10:36	-0.12	1.1	1.2	0.00	1.2	17.1	3.7
MP-031B	North Olive	11/21/2005	9:50	0.01	0.58	1.1	0.00	1.1	18.6	3.7
MP-031B	North Olive	12/6/2005	11:14	-0.09	3.1	3.8	0.00	3.8	18.6	3.5
MP-031B	North Olive	12/20/2005	8:53	-0.12	1.1	3.0	0.00	3.0	20.0	3.2
MP-031B	North Olive	1/4/2006	8:30	-0.14	0.54	2.8	0.00	2.8	19.4	2.9
MP-031B	North Olive	1/17/2006	10:28	-0.13	0.00	1.8	0.00	1.8	19.6	2.6
MP-031B	North Olive	1/31/2006	8:52	-0.08	0.10	1.1	0.00	1.1	20.1	1.7
MP-031B	North Olive	2/14/2006	10:18	-0.10	0.10	0.90	0.00	0.90	20.9	0.0
MP-031B	North Olive	2/28/2006	10:55	-0.09	47.0	213	0.00	213	20.5	2.0
MP-031B	North Olive	3/14/2006	11:35	-0.14	0.00	1.0	0.00	1.0	19.8	1.9
MP-031B	North Olive	3/28/2006	10:39	-0.11	0.50	1.0	0.00	1.0	19.5	1.8
MP-031B	North Olive	4/11/2006	11:41	-0.09	3.4	5.1	0.00	5.1	19.4	1.5
MP-031B	North Olive	5/16/2006	9:43	-0.15	0.58	3.6	0.00	3.6	18.6	1.5
MP-031B	North Olive	6/20/2006	10:20		1.0	4.5	0.00	4.5	17.9	1.4
MP-031B	North Olive	6/21/2006	11:14	-0.15						

Location	Stratum ID	Date	Time	Stabilized Vacuum / Pressure (In. of H2O)	PID (ppmv)	FID (ppmv)	CH4 (ppmv)	PHC (ppmv)	O2 (%)	CO2 (%)
MP-031B	North Olive	8/15/2006	14:51	-0.02	22.6	102	0.00	102	16.9	1.7
MP-031B	North Olive	9/19/2006	9:51	0.02	0.34	3.3	0.00	3.3	17.8	1.5
MP-031B	North Olive	10/17/2006	15:38	-0.01	0.14	3.6	0.00	3.6	17.4	2.3
MP-031B	North Olive	11/20/2006	10:20	-0.06	0.10	1.8	0.00	1.8	18.5	2.3
MP-031B	North Olive	12/19/2006	10:25	-0.06	18.0	104	0.00	104	19.0	2.1
MP-031B	North Olive	1/16/2007	11:20	-0.03	0.12	1.3	0.00	1.3	18.9	1.9
MP-031B	North Olive	2/21/2007	9:11	0.00	0.06	4.0	0.00	4.0	19.4	1.6
MP-031B	North Olive	4/17/2007	13:02	0.01	12.9	22.5	0.00	22.5	18.0	1.2
MP-031B	North Olive	5/15/2007	14:46		0.38	3.9	0.00	3.9	17.7	1.1
MP-031B	North Olive	5/16/2007	14:43	-0.02						
MP-031B	North Olive	6/19/2007	11:55	-0.05						
MP-031B	North Olive	6/20/2007	15:30		0.00	1.0	0.00	1.0	16.8	1.0
MP-031B	North Olive	7/17/2007	15:29	0.02	0.77	3.2	0.00	3.2	16.4	1.2
MP-031B	North Olive	8/21/2007	13:06	-0.03	0.70	2.7	0.00	2.7	15.4	1.6
MP-031B	North Olive	9/18/2007	13:40	-0.02	0.13	2.8	0.00	2.8	15.4	2.1
MP-031B	North Olive	10/17/2007	8:39	0.01	0.96	2.5	0.00	2.5	17.0	2.6
MP-031B	North Olive	11/13/2007	12:05	-0.01	0.29	4.2	0.00	4.2	17.0	2.7
MP-031B	North Olive	1/15/2008	9:07	0.00	1.7	5.1	0.00	5.1	19.5	2.1
MP-031B	North Olive	2/19/2008	11:00	0.00	1.3	8.0	0.00	8.0	20.0	2.0
MP-031B	North Olive	3/18/2008	13:03	1.73	0.69	4.5	0.00	4.5	2.7	1.7
MP-031B	North Olive	3/19/2008	16:17	-0.01						
MP-031B	North Olive	9/17/2008	8:35	0.00	10.8	25.6	0.00	25.6	15.0	1.6
MP-031B	North Olive	10/22/2008	13:10	0.00	0.99	2.6	0.00	2.6	15.8	1.7
MP-031B	North Olive	11/19/2008	10:30	0.00	0.83	3.3	0.00	3.3	16.0	1.8
MP-031B	North Olive	1/21/2009	10:30	0.02	0.16	1.4	0.00	1.4	18.1	1.9
MP-031B	North Olive	3/18/2009	10:05	0.01	0.88	1.8	0.00	1.8	18.3	1.5
MP-031B	N. Olive	5/20/2009	13:29	0.00	0.55	1.8	0.00	1.8	16.1	1.4
MP-031B	N. Olive	6/16/2009	15:18	0.03	3.1	0.97	0.00	0.00	15.2	1.6
MP-031B	N. Olive	7/22/2009	7:07	0.00	1.4	2.2	0.00	2.2	14.5	1.9
MP-031B	N. Olive	8/18/2009	15:26	0.00	2.3	3.8	0.00	3.8	11.9	2.2
MP-031B	N. Olive	9/16/2009	9:06	0.00	0.16	3.5	0.00	3.5	12.8	2.3
MP-031B	N. Olive	10/20/2009	14:18	0.02	0.68	3.1	0.00	3.1	13.0	1.9
MP-031B	N. Olive	11/18/2009	11:20	0.10	0.69	3.1	0.00	3.1	12.9	2.0
MP-031B	N. Olive	3/16/2010	12:40	0.00	7.3	28.7	0.00	28.7	16.2	2.7
MP-031B	N. Olive	4/19/2010	15:48	0.00	0.54	8.2	2.6	5.6	19.9	0.7
MP-031B	N. Olive	9/23/2010	15:39	0.04	1.5	3.4	0.00	3.4	12.2	2.7
MP-031B	N. Olive	10/21/2010	10:20	0.00	0.10	2.9	0.00	2.9	12.7	2.9
MP-031B	N. Olive	11/18/2010	7:23	0.00	0.60	1.5	0.00	1.5	16.0	3.2
MP-031B	N. Olive	2/15/2011	10:11							
MP-031C	Main	2/23/2005	0:00	2.00						
MP-031C	Main	5/6/2005	13:36	-0.78						
MP-031C	Main	5/10/2005	14:26	-1.58						
MP-031C	Main	5/11/2005	14:18	-1.22						
MP-031C	Main	5/12/2005	15:55	-0.33						
MP-031C	Main	5/16/2005	14:27	-0.04						
MP-031C	Main	5/17/2005	9:51	-0.10						
MP-031C	Main	5/19/2005	10:25	0.00	430	16000			11.1	1.0
MP-031C	Main	5/24/2005	12:42	-0.68	2.7	79.4			21.0	0.0
MP-031C	Main	6/1/2005	11:20	-0.46	1.7	13.7			21.0	0.0
MP-031C	Main	6/7/2005	7:58	-0.79	183	7140			21.0	0.1
MP-031C	Main	6/21/2005	11:26	-0.71	1.4	4.0			21.0	0.0
MP-031C	Main	7/14/2005	16:38	-1.70	0.00					
MP-031C	Main	7/19/2005	9:55	-4.01	0.83	1.3	0.00	1.3	20.9	0.0
MP-031C	Main	8/2/2005	9:17	-1.24	44.8	2910	1430	1480	20.7	0.1
MP-031C	Main	8/16/2005	8:51	-1.39	17.4	2215	1021	1194	20.9	0.2
MP-031C	Main	8/30/2005	9:55	-0.01	125	16700	10150	6550	8.9	2.1
MP-031C	Main	9/27/2005	7:54	-1.64	205	43300	18000	25300	1.5	5.3
MP-031C	Main	10/11/2005	10:00	-0.44	448	206000	37400	168600	2.2	8.1
MP-031C	Main	10/25/2005	10:10	-0.39	271	637000	61300	575700	1.6	9.7
MP-031C	Main	11/8/2005	10:36	-1.75	335	518000	54100	463900	0.7	9.5
MP-031C	Main	11/21/2005	9:50	0.00	260	610000	54600	555400	0.9	9.9
MP-031C	Main	12/6/2005	11:14	-1.47	254	428000	90450	337550	0.9	10.5
MP-031C	Main	12/20/2005	8:53	-0.61	276	530000	56700	529433	0.9	10.5
MP-031C	Main	1/4/2006	8:31	-0.27	384	1000000	147000	853000	1.1	9.9
MP-031C	Main	1/17/2006	10:31	-0.90	2.2	1000000	71800	928200	1.8	10.0
MP-031C	Main	1/31/2006	8:59	-0.84	99.0	1000000	75200	924800	1.1	10.5
MP-031C	Main	2/14/2006	10:20	-0.48	246	1000000	79800	920200	0.8	9.9
MP-031C	Main	3/1/2006	9:47	-0.14						
MP-031C	Main	3/14/2006	11:37	-0.91	278	1000000	75120	924880	2.7	8.7
MP-031C	Main	3/28/2006	10:39	-1.20						
MP-031C	Main	5/16/2006	9:44	-0.80	236	1000000	95000	905000	1.2	9.1
MP-031C	Main	6/21/2006	10:38	-0.91	258	251000	48200	202800	0.8	9.8
MP-031C	Main	8/15/2006	14:50	-0.36	430	185000	17600	167400	13.2	3.6

Location	Stratum ID	Date	Time	Stabilized Vacuum / Pressure (In. of H2O)	PID (ppmv)	FID (ppmv)	CH4 (ppmv)	PHC (ppmv)	O2 (%)	CO2 (%)
MP-031C	Main	9/19/2006	9:51	0.62	282	83400	23097	60303	15.9	2.7
MP-031C	Main	10/17/2006	15:39	-0.91	312	441000	75230	365770	2.8	8.1
MP-031C	Main	11/20/2006	10:21	-0.67						
MP-031C	Main	12/19/2006	10:25	-0.29	181	903000	95000	808000	1.1	9.0
MP-031C	Main	1/16/2007	11:17	-0.92	248	1000000	109000	891000	0.9	9.4
MP-031C	Main	2/21/2007	9:12	-0.74	313	1000000	184000	816000	2.0	9.2
MP-031C	Main	5/15/2007	14:46		190	1000000	112000	888000	0.4	8.6
MP-031C	Main	7/17/2007	15:30		179	1000000	264000	736000	2.1	6.2
MP-031C	Main	8/21/2007	13:07	-0.24	295	1000000	112000	888000	0.0	5.9
MP-031C	Main	9/18/2007	13:41	-0.56	225	247000	64350	182650	0.6	7.0
MP-031C	Main	10/17/2007	8:39	0.08	323	320000	56600	263400	6.2	6.2
MP-031C	Main	11/13/2007	12:05	-0.18	282	208000	5760	202240	0.3	7.5
MP-031C	Main	1/15/2008	9:04	-1.45	413	812000	59600	752400	2.2	11.2
MP-031C	Main	1/16/2008	13:48	-0.75						
MP-031C	Main	2/19/2008	11:00	-0.95	321	441000	43600	397400	10.0	8.0
MP-031C	Main	3/18/2008	13:03	1.31	352	640000	55880	584120	1.9	11.0
MP-031C	Main	3/19/2008	16:17	0.19						
MP-031C	Main	11/19/2008	10:30	-0.17	80.2	1000000	1000000	0.00	2.2	5.5
MP-031C	Main	1/21/2009	10:30	-0.13	21.2	1050	564	486	20.7	0.1
MP-031C	Main	3/18/2009	10:05	3.89	180	370000	95000	275000	1.2	8.1
MP-031C	Main	9/16/2009	9:06	-3.02	163	524999	145000	379999	0.7	6.2
MP-031C	Main	10/20/2009	14:18	0.05	151	230000	134000	96000	0.8	6.3
MP-031C	Main	11/18/2010	7:23	0.00	108	72890	41960	30930	19.1	0.5
MP-031C	Main	2/15/2011	10:12							
MP-032A	North Olive	2/23/2005	0:00	0.00						
MP-032A	North Olive	5/6/2005	13:40	0.04						
MP-032A	North Olive	5/10/2005	14:34	0.00						
MP-032A	North Olive	5/11/2005	16:13	-0.03						
MP-032A	North Olive	5/12/2005	15:46	0.00						
MP-032A	North Olive	5/16/2005	14:45	0.11						
MP-032A	North Olive	5/17/2005	10:03	-0.04						
MP-032A	North Olive	5/19/2005	14:22	-0.02						
MP-032A	North Olive	5/24/2005	11:37	-0.02						
MP-032A	North Olive	6/1/2005	10:14	-0.03						
MP-032A	North Olive	6/7/2005	10:01	-0.08						
MP-032A	North Olive	6/21/2005	9:48	-0.04						
MP-032A	North Olive	7/14/2005	16:11	-0.06						
MP-032A	North Olive	7/19/2005	8:31	-0.11				0.00		
MP-032A	North Olive	8/2/2005	8:05	-0.03				0.00		
MP-032A	North Olive	8/30/2005	7:57	0.00						
MP-032A	North Olive	9/13/2005	14:21	0.02						
MP-032A	North Olive	9/27/2005	15:04	-0.02						
MP-032A	North Olive	10/11/2005	15:45	-0.04						
MP-032A	North Olive	10/25/2005	15:12	-0.01						
MP-032A	North Olive	11/8/2005	14:08	-0.06						
MP-032A	North Olive	11/21/2005	14:30	0.05						
MP-032A	North Olive	12/6/2005	15:30	-0.06						
MP-032A	North Olive	12/20/2005	9:58	-0.10						
MP-032A	North Olive	1/17/2006	13:27	-0.10	4.1	46.6	34.0	12.6	13.5	6.2
MP-032A	North Olive	1/31/2006	13:59	-0.08	0.04	43.0	22.0	21.0	13.9	5.4
MP-032A	North Olive	2/15/2006	11:32	-0.05	1.0	4.3	0.00	4.3	14.9	5.3
MP-032A	North Olive	2/28/2006	13:16		633	95270	32760	62510	1.3	15.8
MP-032A	North Olive	3/1/2006	8:43	-0.17						
MP-032A	North Olive	3/14/2006	13:43	0.07	398	68290	31570	36720	5.1	10.2
MP-032A	North Olive	3/28/2006	10:22	-0.33	571	100000	60100	39900	3.2	12.6
MP-032A	North Olive	4/11/2006	11:07		411	207000	63400	143600	0.7	15.3
MP-032A	North Olive	4/12/2006	8:30	-0.26						
MP-032A	North Olive	5/16/2006	9:25	-0.16	432	195000	56500	138500	0.7	16.0
MP-032A	North Olive	7/18/2006	9:53	-0.06	17.8	87.0	0.00	87.0	14.9	4.8
MP-032A	North Olive	11/20/2006	10:01	-0.02	0.40	50.0	0.30	49.7	13.1	6.1
MP-032A	North Olive	12/19/2006	10:11	-0.04	49.4	308	63.0	245	8.0	6.6
MP-032A	North Olive	1/16/2007	11:40	-0.14	0.42	2.8	0.00	2.8	11.1	4.8
MP-032A	North Olive	2/21/2007	14:07	-0.09						
MP-032A	North Olive	4/17/2007	13:14	-0.04	0.74	3.1	0.00	3.1	2.8	9.0
MP-032A	North Olive	5/15/2007	14:17	-0.54	0.37	3.7	0.00	3.7	13.2	7.3
MP-032A	North Olive	6/19/2007	15:22	-0.03	0.80	1.0	0.00	1.0	15.1	5.7
MP-032A	North Olive	7/17/2007	14:23	0.12	0.99	3.6	0.00	3.6	15.3	5.6
MP-032A	North Olive	8/21/2007	13:42	-0.07	1.6	2.2	0.00	2.2	15.0	4.9
MP-032A	North Olive	9/18/2007	14:10	-0.02	0.18	2.7	0.00	2.7	14.9	6.4
MP-032A	North Olive	10/17/2007	9:07	-0.02	0.40	18.0	0.00	18.0	13.5	6.4
MP-032A	North Olive	11/13/2007	13:25	-0.08	0.55	4.1	0.00	4.1	12.1	7.1
MP-032A	North Olive	2/19/2008	12:34	0.18	0.70	7.0	0.00	7.0	8.0	6.8
MP-032A	North Olive	2/20/2008	13:58	0.00						

Location	Stratum ID	Date	Time	Stabilized Vacuum / Pressure (in. of H2O)	PID (ppmv)	FID (ppmv)	CH4 (ppmv)	PHC (ppmv)	O2 (%)	CO2 (%)
VMP-043S	A Clay	6/1/2005	7:40	0.45						
VMP-043S	A Clay	6/7/2005	13:09	-0.07						
VMP-043S	A Clay	6/21/2005	7:42	0.00						
VMP-043S	A Clay	7/19/2005	8:48	0.65				0.00		
VMP-043S	A Clay	8/2/2005	9:50	0.02				0.00		
VMP-043S	A Clay	8/16/2005	13:12	0.36						
VMP-043S	A Clay	8/30/2005	8:33	0.88	0.30	0.50	0.00	0.50	2.3	7.4
VMP-043S	A Clay	9/27/2005	10:37	-0.30	0.30	3.0	0.00	3.0	0.7	8.4
VMP-043S	A Clay	10/11/2005	11:30	0.02	0.40	0.60	0.00	0.60	1.1	8.3
VMP-043S	A Clay	10/25/2005	12:25		0.66	1.5	0.00	1.5	0.7	8.1
VMP-043S	A Clay	11/8/2005	13:52		0.81	1.8	0.00	1.8	0.8	7.9
VMP-043S	A Clay	11/21/2005	15:25	-1.40	0.56	1.0	0.00	1.0	1.2	8.0
VMP-043S	A Clay	12/7/2005	11:01	-1.38	1.0	1.7	0.00	1.7	1.1	7.4
VMP-043S	A Clay	1/17/2006	9:49	-30.94	0.40	0.90	0.00	0.90	2.8	5.1
VMP-043S	A Clay	1/31/2006	14:28	-6.78	0.41	1.1	0.00	1.1	0.3	5.3
VMP-043S	A Clay	2/14/2006	15:35	-1.89	0.10	1.1	0.00		2.6	5.3
VMP-043S	A Clay	2/28/2006	12:02	-7.01	1.5	3.0	0.00	3.0	1.4	5.2
VMP-043S	A Clay	3/14/2006	13:18	-18.73	0.00	1.5	0.00	1.5	3.0	4.8
VMP-043S	A Clay	3/28/2006	8:58	-4.64	0.00	1.1	0.00	1.1	1.8	5.2
VMP-043S	A Clay	4/11/2006	13:43	-1.30						
VMP-043S	A Clay	4/12/2006	12:39		2.2	3.7	0.00	3.7	2.5	5.2
VMP-043S	A Clay	5/16/2006	11:12	-6.90	0.93	3.2	0.00	3.2	0.8	6.0
VMP-043S	A Clay	6/20/2006	7:40	-9.53	0.51	2.7	0.00	2.7	0.6	7.3
VMP-043S	A Clay	8/15/2006	13:57	-8.61	1.7	2.2	0.00	2.2	0.9	9.1
VMP-043S	A Clay	9/19/2006	11:33	-1.98	0.46	2.6	0.00	2.6	0.6	9.7
VMP-043S	A Clay	10/17/2006	10:47		0.26	4.0	0.00	4.0	0.5	9.4
VMP-043S	A Clay	11/20/2006	15:23	-0.82	0.20	1.3	0.00	1.3	0.7	8.5
VMP-043S	A Clay	12/19/2006	14:20	-0.98	0.20	1.9	0.00	1.9	2.6	6.8
VMP-043S	A Clay	1/16/2007	15:20	-4.95	0.20	1.7	0.00	1.7	0.7	6.8
VMP-043S	A Clay	4/17/2007	11:13	-4.96	0.45	2.5	0.00	2.5	0.5	6.0
VMP-043S	A Clay	5/15/2007	10:54		0.19	1.6	0.00	1.6	7.0	6.6
VMP-043S	A Clay	6/20/2007	7:56	-0.10	0.60	4.0	0.00	4.0	1.3	7.7
VMP-043S	A Clay	9/18/2007	9:56	0.00	0.60	2.5	0.00	2.5	0.4	10.8
VMP-043S	A Clay	1/15/2008	7:30	-0.01	0.08	8.5	0.00	8.5	2.6	8.6
VMP-043S	A Clay	4/15/2008	16:18	-0.16	0.26	1.9	0.00	1.9	1.0	6.9
VMP-043S	A Clay	7/15/2008	9:48	0.35	1.2	2.9	0.00	2.9	0.0	8.7
VMP-043S	A Clay	7/16/2008	9:41	0.00						
VMP-043S	A Clay	10/21/2008	10:13	-0.26	0.55	3.5	0.00	3.5	2.7	9.9
VMP-043S	A Clay	1/21/2009	10:53	-0.43	0.24	2.0	0.00	2.0	1.3	8.7
VMP-043S	A Clay	5/20/2009	14:46	0.00	0.38	4.0	0.00	4.0	17.0	1.5
VMP-043S	A Clay	7/22/2009	11:05	-0.26	1.1	2.9	0.00	2.9	3.3	8.2
VMP-043S	A Clay	10/21/2009	8:03	0.00	0.25	3.8	0.00	3.8	10.5	9.1
VMP-043S	A Clay	1/21/2010	14:55	-0.47	0.24	3.5	0.00	3.5	0.6	8.2
VMP-043S	A Clay	4/19/2010	9:28	0.00	0.52	2.0	0.00	2.0	0.5	7.1
VMP-043S	A Clay	7/20/2010	8:50	-0.08	0.43	1.9	0.00	1.9	0.4	10.9
VMP-043S	A Clay	10/18/2010	9:18	0.00	0.88	3.4	0.00	3.4	0.6	14.1
VMP-043VS	A Clay	5/18/2005	9:15	0.00						
VMP-043VS	A Clay	5/24/2005	14:35	-0.47						
VMP-043VS	A Clay	6/1/2005	7:40	0.24						
VMP-043VS	A Clay	6/7/2005	13:09	0.02						
VMP-043VS	A Clay	6/21/2005	7:42	0.01						
VMP-043VS	A Clay	7/19/2005	8:49	0.01				0.00		
VMP-043VS	A Clay	8/2/2005	9:50	0.02				0.00		
VMP-043VS	A Clay	8/16/2005	13:13	-0.71						
VMP-043VS	A Clay	8/30/2005	8:34	0.30	0.90	2.5	0.00	2.5	4.5	11.8
VMP-043VS	A Clay	9/15/2005	14:15	0.78	1.8	2.0	0.00	2.0	1.5	7.6
VMP-043VS	A Clay	9/27/2005	10:36	0.68	0.30	9.0	6.5	2.5	3.2	11.4
VMP-043VS	A Clay	10/11/2005	11:30	0.32	0.20	4.0	0.00	4.0	4.2	10.9
VMP-043VS	A Clay	10/26/2005	12:20		0.49	1.8	0.00	1.8	3.6	10.0
VMP-043VS	A Clay	11/8/2005	13:51		1.4	58.0	4.0	54.0	4.9	8.2
VMP-043VS	A Clay	11/21/2005	15:23	-0.45	0.36	1.2	0.00	1.2	7.0	7.7
VMP-043VS	A Clay	12/7/2005	10:59	-0.01	1.2	2.1	0.00	2.1	6.6	6.9
VMP-043VS	A Clay	12/20/2005	10:35	-0.01	0.16	10.1	4.5	5.6	10.3	5.9
VMP-043VS	A Clay	1/4/2006	10:35		0.45	3.7	0.00	3.7	5.6	5.6
VMP-044D	Main Silt (Rand Horizon)	5/19/2005	14:19	0.03						
VMP-044D	Main Silt (Rand Horizon)	5/24/2005	11:31	-0.01						
VMP-044D	Main Silt (Rand Horizon)	6/1/2005	10:16	-0.01						
VMP-044D	Main Silt (Rand Horizon)	6/7/2005	9:56	0.01						
VMP-044D	Main Silt (Rand Horizon)	6/21/2005	7:51	0.04						
VMP-044D	Main Silt (Rand Horizon)	7/19/2005	8:35	0.00				0.00		
VMP-044D	Main Silt (Rand Horizon)	8/2/2005	7:45	-0.01				0.00		
VMP-044D	Main Silt (Rand Horizon)	8/16/2005	8:19	0.00						
VMP-044D	Main Silt (Rand Horizon)	8/30/2005	9:17	0.00						

Location	Stratum ID	Date	Time	Stabilized Vacuum / Pressure (in. of H2O)	PID (ppmv)	FID (ppmv)	CH4 (ppmv)	PHC (ppmv)	O2 (%)	CO2 (%)
VMP-044D	Main Silt (Rand Horizon)	9/13/2005	14:15	0.02						
VMP-044D	Main Silt (Rand Horizon)	9/27/2005	14:51	0.08						
VMP-044D	Main Silt (Rand Horizon)	10/11/2005	15:38	0.01						
VMP-044D	Main Silt (Rand Horizon)	10/25/2005	15:06	0.05						
VMP-044D	Main Silt (Rand Horizon)	11/8/2005	14:05	-0.01						
VMP-044D	Main Silt (Rand Horizon)	11/21/2005	14:18	0.11						
VMP-044D	Main Silt (Rand Horizon)	12/6/2005	15:25	-0.21						
VMP-044D	Main Silt (Rand Horizon)	12/20/2005	8:55	-0.15						
VMP-044D	Main Silt (Rand Horizon)	1/4/2006	13:37	-0.35						
VMP-044D	Main Silt (Rand Horizon)	1/17/2006	10:01	-0.60	27.2	6640	5560	1080	0.8	10.9
VMP-044D	Main Silt (Rand Horizon)	1/31/2006	13:45	0.29	54.6	9380	8110		0.6	10.8
VMP-044D	Main Silt (Rand Horizon)	2/14/2006	9:49	-0.11	0.00	1.5	0.00		20.9	0.0
VMP-044D	Main Silt (Rand Horizon)	6/20/2006	0:00	0.00	0.00	0.00	0.00	0.00	0.0	0.0
VMP-044M	Main Silt (Rand Horizon)	5/18/2005	13:24	-0.12	330	4040			1.6	9.2
VMP-044M	Main Silt (Rand Horizon)	5/24/2005	13:00	-0.04	110	6910			1.2	9.1
VMP-044M	Main Silt (Rand Horizon)	6/1/2005	11:36	0.01	82.0	3240			6.2	7.3
VMP-044M	Main Silt (Rand Horizon)	6/7/2005	7:38	-0.06	95.0	3150			1.7	9.2
VMP-044M	Main Silt (Rand Horizon)	6/21/2005	12:26	0.00	80.0	4250			6.5	8.5
VMP-044M	Main Silt (Rand Horizon)	7/19/2005	10:03	-0.19	85.4	2860	2310	550	2.8	7.9
VMP-044M	Main Silt (Rand Horizon)	8/2/2005	9:56	-0.09	60.2	2010	1323	687	3.2	8.8
VMP-044M	Main Silt (Rand Horizon)	8/16/2005	9:22	-0.04	38.7	1862	715	1147	1.9	8.7
VMP-044M	Main Silt (Rand Horizon)	8/31/2005	10:11	0.02	87.8	638	340	298	0.6	9.2
VMP-044M	Main Silt (Rand Horizon)	9/27/2005	8:18	-0.06	87.0	710	300	410	1.6	9.5
VMP-044M	Main Silt (Rand Horizon)	10/11/2005	10:20	0.00	83.8	529	260	269	1.2	9.2
VMP-044M	Main Silt (Rand Horizon)	10/25/2005	10:37	-0.05	73.0	670	410	260	0.4	9.8
VMP-044M	Main Silt (Rand Horizon)	11/8/2005	11:01	0.03	95.0	525	290	235	3.6	8.5
VMP-044M	Main Silt (Rand Horizon)	11/21/2005	10:11	0.00	97.9	404	256	148	0.4	10.0
VMP-044M	Main Silt (Rand Horizon)	12/6/2005	11:36	-0.07	86.8	580	240	340	0.8	9.9
VMP-044M	Main Silt (Rand Horizon)	12/20/2005	9:25	-0.08	67.5	437	140	297	0.3	10.0
VMP-044M	Main Silt (Rand Horizon)	1/4/2006	8:58	-0.51	53.9	570	235	335	1.4	9.5
VMP-044M	Main Silt (Rand Horizon)	1/17/2006	9:59	-0.55	54.6	397	157	240	2.5	10.2
VMP-044M	Main Silt (Rand Horizon)	1/31/2006	13:45	0.22	47.5	403	136	267	0.9	9.9
VMP-044M	Main Silt (Rand Horizon)	2/14/2006	9:47	-0.01	38.8	346	153		0.5	9.9
VMP-044M	Main Silt (Rand Horizon)	2/28/2006	11:09	-0.01	40.5	327	112	215	0.4	9.8
VMP-044M	Main Silt (Rand Horizon)	3/14/2006	10:48	-0.21	44.0	214	82.0	132	1.9	9.2
VMP-044M	Main Silt (Rand Horizon)	3/28/2006	10:51	-0.35	31.9	386	290	96.0	1.8	9.5
VMP-044M	Main Silt (Rand Horizon)	4/11/2006	13:18		33.3	703	498	205	0.2	9.8
VMP-044M	Main Silt (Rand Horizon)	4/12/2006	8:26	-0.18						
VMP-044M	Main Silt (Rand Horizon)	5/16/2006	9:57	0.03	41.8	9150	8310	840	0.7	9.8
VMP-044M	Main Silt (Rand Horizon)	6/20/2006	10:03	-0.03	59.8	5250	4620	630	0.5	10.0
VMP-044M	Main Silt (Rand Horizon)	7/18/2006	11:35	0.01	83.5	1300	70.0	1230	0.6	9.4
VMP-044M	Main Silt (Rand Horizon)	8/15/2006	11:31	-0.04	65.0	802	347	455	0.8	10.3
VMP-044M	Main Silt (Rand Horizon)	9/19/2006	9:36	0.01	76.8	1100	676	424	1.1	10.8
VMP-044M	Main Silt (Rand Horizon)	10/17/2006	7:24	-0.25	50.9	1620	1330	290	0.1	11.2
VMP-044M	Main Silt (Rand Horizon)	11/20/2006	10:35	0.00	64.0	2380	1770	610	0.4	11.5
VMP-044M	Main Silt (Rand Horizon)	12/19/2006	10:41	0.02	82.6	3510	2970	540	0.5	11.2
VMP-044M	Main Silt (Rand Horizon)	1/16/2007	11:04	-0.13	52.7	6740	5760	980	1.7	11.3
VMP-044M	Main Silt (Rand Horizon)	2/21/2007	9:28	-0.11	102	8940	7430	1510	0.6	12.2
VMP-044M	Main Silt (Rand Horizon)	3/20/2007	8:15	-0.07	62.6	13960	12400	1560	1.2	11.8
VMP-044M	Main Silt (Rand Horizon)	4/17/2007	8:47	-0.01	79.2	29180	24150	5030	1.1	10.5
VMP-044M	Main Silt (Rand Horizon)	5/15/2007	18:36	-0.02	90.8	36180	33320	2860	0.5	12.0
VMP-044M	Main Silt (Rand Horizon)	6/20/2007	9:17	0.02	80.0	45380	38000	7380	1.5	11.1
VMP-044M	Main Silt (Rand Horizon)	7/18/2007	7:27	0.04	103	35410	28860	6550	0.5	11.5
VMP-044M	Main Silt (Rand Horizon)	8/22/2007	8:09	-0.12	166	202000	200000	2000	0.0	12.4
VMP-044M	Main Silt (Rand Horizon)	9/18/2007	8:06	-0.04	116	12800	7720	5080	1.7	10.4
VMP-044M	Main Silt (Rand Horizon)	10/16/2007	12:33	0.12						
VMP-044M	Main Silt (Rand Horizon)	11/13/2007	14:54	0.01	154	10920	9650	1270	0.7	13.3
VMP-044M	Main Silt (Rand Horizon)	1/15/2008	11:49	0.04	169	2370	910	1460	1.8	13.1
VMP-044M	Main Silt (Rand Horizon)	2/19/2008	8:10	-0.06	157	1840	578	1262	4.4	13.1
VMP-044M	Main Silt (Rand Horizon)	3/18/2008	9:13	-0.18	113	2690	2420	270	1.6	12.3
VMP-044M	Main Silt (Rand Horizon)	9/16/2008	11:26	0.00	61.5	7800	6800	1000	1.4	11.5
VMP-044M	Main Silt (Rand Horizon)	10/21/2008	9:48	-0.33	67.8	3690	3030	660	0.8	11.6
VMP-044M	Main Silt (Rand Horizon)	11/18/2008	8:22	-0.18	45.6	4010	3800	210	0.8	11.4
VMP-044M	Main Silt (Rand Horizon)	1/20/2009	8:40	-0.24	55.9	5250	4290	960	3.1	11.9
VMP-044M	Main Silt (Rand Horizon)	2/17/2009	9:05	0.22	99.9	2870	2500	370	3.3	10.3
VMP-044M	Main Silt (Rand Horizon)	3/17/2009	9:31	0.19	81.0	4650	3560	1090	0.7	10.7
VMP-044M	Main Silt	8/18/2009	8:28	0.00	70.2	9050	82.8	8967	0.8	9.1
VMP-044M	Main Silt	9/15/2009	8:13	-0.07	93.4	6190	5060	1130	0.9	9.4
VMP-044M	Main Silt	10/20/2009	8:49	-0.01	117	4430	3150	1280	1.0	9.9
VMP-044M	Main Silt	11/18/2009	7:32	0.03	0.02	3.6	0.00	3.6	20.9	0.0
VMP-044M	Main Silt	12/15/2009	7:59	4.71	63.7	6380	5450	930	1.3	9.1
VMP-044M	Main Silt	1/20/2010	8:38	0.00	25.9	3260	2800	460	2.0	9.7
VMP-044M	Main Silt	2/23/2010	8:35	0.00	31.5	5300	4850	450	3.6	10.0

Location	Stratum ID	Date	Time	Stabilized Vacuum / Pressure (In. of H2O)	PID (ppmv)	FID (ppmv)	CH4 (ppmv)	PHC (ppmv)	O2 (%)	CO2 (%)
VMP-044M	Main Silt	3/16/2010	8:25	0.09	60.9	4500	4100	400	2.8	8.6
VMP-044M	Main Silt	2/15/2011	7:45							
VMP-044S	North Olive	5/18/2005	13:17	-0.04	3.6	9.4			13.4	4.7
VMP-044S	North Olive	5/24/2005	12:54	0.28	1.2	2.1			13.7	4.7
VMP-044S	North Olive	6/1/2005	11:31	0.05	4.0	14.0			13.2	4.7
VMP-044S	North Olive	6/7/2005	7:42	0.00	1.2	2.0			14.7	5.6
VMP-044S	North Olive	6/21/2005	12:20	0.00	0.90	3.0			13.0	4.3
VMP-044S	North Olive	7/19/2005	10:05	-0.02	0.66	1.3	0.00	1.3	11.2	5.3
VMP-044S	North Olive	8/2/2005	9:45	-0.05	2.5	5.2	0.00	5.2	12.3	5.2
VMP-044S	North Olive	8/16/2005	9:08	-0.34	1.6	4.9	0.00	4.9	12.2	5.8
VMP-044S	North Olive	8/31/2005	10:08	0.00	0.60	1.7	0.00	1.7	12.0	6.1
VMP-044S	North Olive	9/27/2005	8:09	-0.01	0.40	1.0	0.00	1.0	10.5	6.6
VMP-044S	North Olive	10/11/2005	10:17	0.00	0.30	0.70	0.00	0.70	10.3	6.4
VMP-044S	North Olive	10/25/2005	10:31	-0.31	0.23	1.0	0.00	1.0	10.6	6.7
VMP-044S	North Olive	11/8/2005	11:01	-0.01	1.0	1.5	0.00	1.5	11.1	6.4
VMP-044S	North Olive	11/21/2005	10:11	0.00	0.54	0.60	0.00	0.60	13.2	6.4
VMP-044S	North Olive	12/6/2005	11:36	-0.43	2.7	3.4	0.00	3.4	13.3	6.2
VMP-044S	North Olive	12/20/2005	9:22	-0.45	0.25	2.2	0.00	2.2	14.9	5.8
VMP-044S	North Olive	1/4/2006	8:57	0.00	0.17	2.7	0.00	2.7	16.1	5.4
VMP-044S	North Olive	1/17/2006	9:56	-0.04	0.00	0.80	0.00	0.80	15.7	5.2
VMP-044S	North Olive	1/31/2006	13:45	0.02	0.00	0.60	0.00	0.60	15.7	5.0
VMP-044S	North Olive	2/14/2006	9:46	-0.02	0.00	0.80	0.00		16.7	4.2
VMP-044S	North Olive	2/28/2006	11:08	0.29	0.00	1.0	0.00	1.0	16.6	4.8
VMP-044S	North Olive	3/14/2006	10:47	-0.22	0.00	1.0	0.00	1.0	15.5	4.7
VMP-044S	North Olive	3/28/2006	10:51	0.02	0.00	1.7	0.00	1.7	15.0	4.7
VMP-044S	North Olive	4/11/2006	13:16		1.8	2.7	0.00	2.7	14.3	4.5
VMP-044S	North Olive	4/12/2006	8:26	-0.06						
VMP-044S	North Olive	5/16/2006	9:57	-0.23	0.45	3.8	0.00	3.8	12.3	4.7
VMP-044S	North Olive	6/20/2006	10:02		1.0	1.4	0.00	1.4	15.7	3.9
VMP-044S	North Olive	6/21/2006	9:02	-0.05						
VMP-044S	North Olive	7/18/2006	11:33	0.00	0.41	1.1	0.00	1.1	13.0	4.8
VMP-044S	North Olive	8/15/2006	11:30	0.01	0.85	1.8	0.00	1.8	11.8	5.5
VMP-044S	North Olive	9/19/2006	9:36	0.00	0.45	2.3	0.00	2.3	10.8	5.7
VMP-044S	North Olive	10/17/2006	7:23	-0.03	0.14	2.3	0.00	2.3	11.2	5.9
VMP-044S	North Olive	11/20/2006	10:35	-0.11	0.00	1.4	0.00	1.4	12.6	5.4
VMP-044S	North Olive	12/19/2006	10:41	-0.20	0.17	0.71	0.00	0.71	13.0	4.6
VMP-044S	North Olive	1/16/2007	11:02	-0.02	0.08	3.2	0.00	3.2	11.9	4.6
VMP-044S	North Olive	2/21/2007	9:27	-0.20	0.20	0.80	0.00	0.80	13.6	4.6
VMP-044S	North Olive	3/20/2007	8:14	0.00	1.0	4.0	0.00	4.0	11.4	4.3
VMP-044S	North Olive	4/17/2007	8:46	0.01	0.45	13.0	0.00	13.0	4.6	4.7
VMP-044S	North Olive	5/15/2007	18:36	0.00	0.71	1.4	0.00	1.4	4.1	5.5
VMP-044S	North Olive	6/20/2007	9:17	-0.09	0.00	1.0	0.00	1.0	6.8	5.7
VMP-044S	North Olive	7/18/2007	7:26	0.00	0.31	2.2	0.00	2.2	9.6	5.8
VMP-044S	North Olive	8/22/2007	8:09	-0.04	0.70	2.2	0.00	2.2	11.1	6.2
VMP-044S	North Olive	9/18/2007	8:06	0.00	0.34	2.5	0.00	2.5	6.8	7.0
VMP-044S	North Olive	10/16/2007	12:33	0.00						
VMP-044S	North Olive	11/13/2007	14:54	0.00	0.28	1.4	0.00	1.4	11.6	7.6
VMP-044S	North Olive	1/15/2008	11:49	0.00	0.18	2.8	0.00	2.8	16.9	5.7
VMP-044S	North Olive	2/19/2008	8:10	-0.02	0.20	1.7	0.00	1.7	18.0	4.6
VMP-044S	North Olive	3/18/2008	9:13	-0.09	0.43	1.5	0.00	1.5	15.0	4.7
VMP-044S	North Olive	9/16/2008	11:26	0.00	0.73	0.25	0.00	0.25	10.5	6.2
VMP-044S	North Olive	10/21/2008	9:48	0.00						
VMP-044S	North Olive	10/22/2008	15:09		0.60	1.0	0.00	1.0	10.0	6.1
VMP-044S	North Olive	11/18/2008	8:22	-0.01	0.18	4.9	0.00	4.9	12.8	6.0
VMP-044S	North Olive	1/20/2009	8:40	-0.02	0.24	1.7	0.00	1.7	13.2	5.4
VMP-044S	North Olive	2/17/2009	9:05	-0.12	0.10	2.0	0.00	2.0	17.5	3.6
VMP-044S	North Olive	3/17/2009	8:31	-0.12	0.22	0.58	0.00	0.58	13.6	4.6
VMP-044S	N. Olive	5/19/2009	8:42	-0.07	0.15	3.5	0.00	3.5	8.6	5.0
VMP-044S	N. Olive	6/16/2009	13:32	0.00	0.19	4.5	0.00	0.00	8.2	5.4
VMP-044S	N. Olive	7/21/2009	8:04	0.00	0.35	1.4	0.00	1.4	9.5	5.6
VMP-044S	N. Olive	8/18/2009	8:28	-0.07	0.15	1.1	0.00	1.1	10.5	5.8
VMP-044S	N. Olive	9/15/2009	8:13	-0.01	0.12	3.2	0.00	3.2	10.5	6.3
VMP-044S	N. Olive	10/20/2009	8:49	-0.01	0.62	2.2	0.00	2.2	8.5	6.2
VMP-044S	N. Olive	11/18/2009	7:32	0.00	0.02	3.1	0.00	3.1	4.7	6.1
VMP-044S	N. Olive	12/15/2009	7:59	0.01	0.54	2.9	0.00	2.9	6.2	5.8
VMP-044S	N. Olive	1/20/2010	8:38	0.00	0.23	3.5	0.00	3.5	12.4	5.0
VMP-044S	N. Olive	2/23/2010	8:35	0.00	0.25	0.17	0.00	0.17	16.0	4.2
VMP-044S	N. Olive	3/16/2010	8:25	0.06	0.93	4.1	0.00	4.1	15.5	4.5
VMP-044S	N. Olive	4/19/2010	11:18	-0.18	0.55	2.2	0.00	2.2	11.0	4.7
VMP-044S	N. Olive	5/18/2010	9:22	-1.86	0.02	1.2	0.00	1.2	15.0	3.6
VMP-044S	N. Olive	6/15/2010	8:06	0.00	0.55	0.90	0.00	0.90	4.2	12.6
VMP-044S	N. Olive	7/19/2010	8:20	-0.05	1.2	1.2	0.00	1.2	11.1	5.0
VMP-044S	N. Olive	2/15/2011	7:45							

Location	Stratum ID	Date	Time	Stabilized Vacuum / Pressure (In. of H2O)	PID (ppmv)	FID (ppmv)	CH4 (ppmv)	PHC (ppmv)	O2 (%)	CO2 (%)
VMP-044VS	A Clay	5/18/2005	13:11	-0.08	8.9	14.7			14.8	4.9
VMP-044VS	A Clay	5/24/2005	12:54	0.00	0.94	1.7			14.7	5.0
VMP-044VS	A Clay	6/1/2005	11:28	0.00	5.0	14.0			14.3	5.3
VMP-044VS	A Clay	6/7/2005	7:35	0.00	3.5	7.5			13.9	4.8
VMP-044VS	A Clay	6/21/2005	12:20	0.00	1.5	4.0			13.5	5.6
VMP-044VS	A Clay	7/19/2005	10:07	-0.02	0.81	1.1	0.00	1.1	11.8	7.1
VMP-044VS	A Clay	8/2/2005	10:32	-0.05	2.8	10.0	0.00	10.0	11.3	7.6
VMP-044VS	A Clay	8/16/2005	9:16	0.00	3.1	4.4	0.00	4.4	12.0	7.5
VMP-044VS	A Clay	8/31/2005	10:07	0.01	0.60	1.4	0.00	1.4	11.5	7.3
VMP-044VS	A Clay	9/27/2005	8:09	-0.01	0.50	1.2	0.00	1.2	12.5	7.3
VMP-044VS	A Clay	10/11/2005	10:23	0.00	0.30	0.70	0.00	0.70	12.8	6.5
VMP-044VS	A Clay	10/25/2005	10:30	-0.24	0.71	1.3	0.00	1.3	13.0	6.1
VMP-044VS	A Clay	11/8/2005	11:00	0.00	0.96	1.6	0.00	1.6	14.3	5.2
VMP-044VS	A Clay	11/21/2005	10:10	0.00	0.30	0.90	0.00	0.90	16.2	4.6
VMP-044VS	A Clay	12/6/2005	11:36	0.00	1.0	1.8	0.00	1.8	17.1	3.7
VMP-044VS	A Clay	12/20/2005	9:22	0.00	0.15	0.90	0.00	0.90	18.1	3.1
VMP-044VS	A Clay	1/4/2006	8:55	0.00	0.18	1.2	0.00	1.2	18.4	2.9
VMP-044VS	A Clay	1/17/2006	9:55	-0.04	0.00	1.2	0.00	1.2	18.3	2.8
VMP-044VS	A Clay	1/31/2006	13:45	0.02	0.00	1.3	0.00	1.3	18.9	2.7
VMP-044VS	A Clay	2/14/2006	9:45	-0.02	0.00	1.3	0.00		18.9	2.5
VMP-044VS	A Clay	2/28/2006	11:08	0.00	0.00	1.0	0.00	1.0	19.6	2.4
VMP-044VS	A Clay	3/14/2006	10:46	0.03	0.00	1.0	0.00	1.0	18.6	2.6
VMP-044VS	A Clay	3/28/2006	10:50	0.02	0.50	1.1	0.00	1.1	18.8	2.5
VMP-044VS	A Clay	4/11/2006	13:14	0.02	1.4	6.5	0.00	6.5	19.2	1.9
VMP-044VS	A Clay	5/16/2006	9:57	0.01	0.53	3.1	0.00	3.1	18.0	2.5
VMP-044VS	A Clay	6/20/2006	10:01	0.00	1.0	2.6	0.00	2.6	15.7	3.0
VMP-044VS	A Clay	7/18/2006	11:33	-0.01	0.60	1.7	0.00	1.7	13.9	2.7
VMP-044VS	A Clay	8/15/2006	11:28	0.01	0.83	1.9	0.00	1.9	10.8	5.1
VMP-044VS	A Clay	9/19/2006	9:35	0.00	0.42	2.0	0.00	2.0	11.5	5.1
VMP-044VS	A Clay	10/17/2006	7:22	-0.02						
VMP-044VS	A Clay	10/18/2006	11:52		0.34	3.8	0.00	3.8	15.3	3.5
VMP-044VS	A Clay	11/20/2006	10:34	0.00	0.00	1.2	0.00	1.2	15.9	3.0
VMP-044VS	A Clay	12/19/2006	10:41	-0.11	0.10	0.69	0.00	0.69	16.8	2.6
VMP-044VS	A Clay	1/16/2007	11:00	-0.01	0.04	2.3	0.00	2.3	17.1	2.2
VMP-044VS	A Clay	2/21/2007	9:26	0.00	0.10	0.70	0.00	0.70	18.4	1.8
VMP-044VS	A Clay	3/20/2007	8:13	0.00	0.12	2.1	0.00	2.1	17.2	2.0
VMP-044VS	A Clay	4/17/2007	8:46	0.01	0.26	2.1	0.00	2.1	14.6	2.3
VMP-044VS	A Clay	5/15/2007	18:35	0.00	0.30	1.5	0.00	1.5	12.0	3.5
VMP-044VS	A Clay	6/20/2007	9:17	0.02	0.00	1.0	0.00	1.0	12.2	4.3
VMP-044VS	A Clay	9/18/2007	8:05	0.00	0.09	0.67	0.00	0.67	11.4	6.3
VMP-044VS	A Clay	1/15/2008	11:49	0.00	0.21	1.8	0.00	1.8	19.5	2.5
VMP-044VS	A Clay	10/21/2008	9:48	0.00	0.46	1.6	0.00	1.6	13.0	5.0
VMP-044VS	A Clay	1/20/2009	8:40	-0.02	0.23	1.4	0.00	1.4	18.5	2.8
VMP-044VS	A Clay	5/19/2009	8:42	0.00	0.12	2.3	0.00	2.3	14.4	3.6
VMP-044VS	A Clay	7/21/2009	8:04	0.00	0.26	1.9	0.00	1.9	11.2	5.4
VMP-044VS	A Clay	10/20/2009	8:49	-0.02	0.44	1.3	0.00	1.3	12.8	4.7
VMP-044VS	A Clay	1/20/2010	8:38	0.00	0.32	1.9	0.00	1.9	17.8	2.4
VMP-044VS	A Clay	4/19/2010	11:18	0.00	0.57	1.6	0.00	1.6	16.4	3.2
VMP-044VS	A Clay	7/19/2010	8:20	-0.01	1.1	1.6	0.00	1.6	11.2	5.7
VMP-045S	North Olive	5/19/2005	16:55	-1.27						
VMP-045S	North Olive	5/24/2005	18:33	-1.49						
VMP-045S	North Olive	6/1/2005	12:46	-0.02						
VMP-045S	North Olive	6/7/2005	7:58	-0.01						
VMP-045S	North Olive	6/21/2005	11:37	0.41						
VMP-045S	North Olive	7/19/2005	9:17	-0.50				0.00		
VMP-045S	North Olive	8/2/2005	16:18	-0.17				0.00		
VMP-045S	North Olive	8/16/2005	10:49	0.00						
VMP-045S	North Olive	8/30/2005	10:56	-0.01						
VMP-045S	North Olive	9/13/2005	9:44	-0.01						
VMP-045S	North Olive	9/27/2005	10:17	-0.01						
VMP-045S	North Olive	10/11/2005	10:27	0.01						
VMP-045S	North Olive	10/25/2005	10:22	-0.01						
VMP-045S	North Olive	11/8/2005	11:46	-0.13						
VMP-045S	North Olive	11/21/2005	11:04	-0.10						
VMP-045S	North Olive	12/6/2005	12:48	0.04						
VMP-045S	North Olive	12/21/2005	11:54	0.04						
VMP-045S	North Olive	1/4/2006	10:54	-0.20						
VMP-045VS	A Clay	5/19/2005	16:56	-0.02						
VMP-045VS	A Clay	5/24/2005	18:32	-0.01						
VMP-045VS	A Clay	6/1/2005	12:49	-0.02						
VMP-045VS	A Clay	6/7/2005	7:58	-0.24						
VMP-045VS	A Clay	6/21/2005	11:35	0.01						
VMP-045VS	A Clay	7/19/2005	9:17	0.00				0.00		

APPENDIX C

Standard Operating Procedures

1.0 INTRODUCTION

The purpose of this Standard Operating Procedure (SOP) is to provide a consistent methodology for the collection of soil vapor samples at the Hartford Hydrocarbon Plume Site (Site). Samples collected as part of Regional Effectiveness Monitoring (REM) will be screened within 24-hours of sample collection. This SOP details the procedures for collection of soil vapor samples associated with the REM program. These procedures are applicable to any soil vapor sample collected at the site.

2.0 REQUIRED MATERIALS FOR SAMPLE COLLECTION

- Dwyer Series 475 Mark III Digital manometer
- 1-liter Tedlar® bags
- Tygon® or silicone tubing cut to length
- ¼-inch O.D. Teflon, Polyethylene, or PVC tubing, cut to length
- Peristaltic pump
- BIOS DC-LITE flow calibrator or calibrated rotometer
- 60-mL syringe
- Stainless-steel manual pump
- Clean expandable adapters for connection of sampling apparatus to MP wells
- Crescent wrench (or equivalent hand tools)
- Solinst Model Mini 102 Water Level Indicator or equivalent
- Solinst Model 122 Interface Probe or equivalent
- Clean (dedicated) 3/16-Inch hose barb, chrome-plated brass, non-valved, in-line, female coupling body (herein referred to as "coupling body")
- New or dedicated 4-way valves for purging and sampling
- Toughbook[1]
- Monitoring location maps.

[1] Field forms will be used if technical complications with electronic data entry methods occur.

3.0 INITIAL VACUUM/PRESSURE MEASUREMENT

Using a Dwyer Series 475 Mark III digital manometer, the initial vacuum/pressure is measured. At VMP monitoring locations the manometer is to be turned on and zeroed using the "zero" button or by adjusting the knob located on top of the instrument. The positive fitting of the manometer shall be connected to the 4-way valve, previously installed to the well riser, using small diameter silicone (or equivalent) tubing. The negative fitting on the manometer shall remain open to the atmosphere. The pressure is immediately read and recorded to the nearest hundredth of an inch (or tenth of an inch if using 0-200 manometer) of water column in the Toughbook. Immediately following the recording of the vacuum/pressure measurement, the 4-way valve shall be closed to the well and open to the atmosphere and the manometer detached from the silicone (or equivalent) tubing and 4-way valve.

At MP monitoring locations the manometer is to be turned on and zeroed as described above. The positive fitting on the manometer shall be connected to the dedicated coupling body using silicone (or equivalent) tubing. The negative fitting on the manometer shall remain open to the atmosphere. The coupling body shall then be connected to the coupling insert located on the expandable well cap (for MP wells with 1" or 2" PVC well risers) or located at the tip of the 0.5" nylon riser tubing (for the MP wells with nylon risers). The pressure is immediately read and recorded to the nearest hundredth of an inch (or tenth of an inch if using 0-200 manometer) of water column on the SVE System Effectiveness Monitoring Form. Immediately following the recording of the vacuum/pressure measurement, the coupling body shall be disconnected from the coupling insert, which closes the well to the manometer and the atmosphere.

4.0 WELL PURGING

After obtaining the initial vacuum / pressure measurements and prior to soil vapor sample collection, each monitoring location shall be purged a predetermined amount based on the volume of the well riser and screen. The purge volume shall be equivalent to a minimum of three well volumes. The actual purge volume removed shall be recorded on the appropriate field form. If the well does not yield the purge volume or if water and/or product are encountered during purging, this observation shall be documented in the "additional comments" portion of the appropriate field form. The well screen is presumed to be submerged when this condition is encountered. No sample is to be collected and no stabilized reading is required.

To purge VMP monitoring locations, a 60-mL plastic syringe is attached to the 4-way valve, previously installed to the top of the well riser, and the valve configured (opened to the well and closed to the atmosphere) to allow the removal of the required purge volume. The syringe plunger shall be drawn back to evacuate a purge volume. The valve is then configured (closed to

the well and opened to the atmosphere) and the syringe plunger pushed allowing the purged volume to be expelled to atmosphere. This process shall continue until a minimum designated purge volume for the well has been removed. At the completion of purging, the 4-way valve shall remain attached to the monitoring location with the valve configured so that the well is closed to atmosphere.

Purging MP monitoring locations requires the use of a stainless-steel hand pump in conjunction with silicone (or equivalent) tubing and a dedicated coupling body. The hand pump should be tested prior to each sampling event by attaching a 1-liter Tedlar® test bag to the hand pump outlet. The inlet of the hand pump shall remain open to atmosphere. Two strokes of a properly working hand pump should fill a 1-liter bag to approximately 75-percent of capacity. The 1-liter bag should not be completely filled because the bags are typically oversized in order to allow for expansion of the sample during shipment, storage, etc. The hand pump should be rebuilt in accordance with manufacturer specifications if the hand pump fails to adequately fill the test bag.

The vacuum side of the hand pump shall be attached to a dedicated coupling body using silicone (or equivalent) tubing. The dedicated coupling body shall then be connected to the coupling insert located on the expandable well cap (for MP wells with PVC well risers) or located at the tip of the nylon riser tubing (for MP wells with nylon well risers), which will allow for the removal of purge volumes from the well. The purged volume is expelled to atmosphere from the positive side of the hand pump with every downward stroke of the pump handle (piston). Every upward stroke of the pump handle should remove approximately ½-liter of the purge volume from the well. Care must be taken to fully extend the hand pump handle on each pump stroke to ensure that the appropriate volume is removed from the well. When the minimum designated purge volume has been removed from the well, the coupling body shall be disconnected from the coupling insert, which closes the well to atmosphere.

5.0 WELL SAMPLING

Upon completion of well purging, soil vapor sample collection using a Tedlar® bag may commence. If water and/or product are encountered during sample collection, this observation shall be documented on the "additional comments" portion of the appropriate field form. Note samples which indicate the presence of water and/or product shall not be analyzed.

Tedlar® Bag Samples

Soil vapor samples for on-site screening shall be collected using a Tedlar® bag and a peristaltic pump. For VMP monitoring locations, the peristaltic pump is attached to a 4-way plastic micro valve using a combination of Tygon® and silicone (or equivalent) tubing. For PVC monitoring wells, the peristaltic pump is attached to the dedicated coupling body using a combination of

Tygon® and silicone (or equivalent) tubing. This also applies to monitoring wells with nylon well risers. The outlet of the peristaltic pump shall be attached to the inlet side of the flow calibrator (or rotometer) using a combination of Tygon® and silicone (or equivalent) tubing. Prior to flow-rate adjustment and sample collection, the sample identification, date, time of initial vacuum reading, and initial vacuum/pressure reading (if applicable) shall be clearly marked on the Tedlar® bag.

Flow Rate Adjustment

The rotometer shall be used to adjust the flow rate of the peristaltic pump to allow a flow rate of 200 mL/minute. For VMP wells, this adjustment shall be performed by: 1) configuring the micro valve to allow for sample removal from the well; 2) observe the flow rate indicated by the ball height; and, 3) adjusting the peristaltic pump to allow a flow rate of approximately 200-mL/minute. For MP wells this adjustment shall be performed by: 1) connecting the coupling body to the coupling insert to allow for sample removal from the well; 2) observe the flow rate indicated by the ball height; and, 3) adjusting the peristaltic pump to allow a flow rate of approximately 200-mL/minute. *Note: The initial settings on the pump should be set to allow for the minimum flow possible. It is important to set the flow rate as quickly as possible in order to minimize the amount of additional sample purge.* After setting the sample flow, sample collection shall be immediately initiated. Care shall be taken at this time to avoid unintentionally adjusting (by bumping or handling) the pump speed control.

Sample Collection

After setting the sample flow, the rotometer shall be removed from the sample train and a new, clean, pre-labeled; one-liter Tedlar® bag shall be connected to the tubing exiting from the positive-pressure (output) side of the peristaltic pump. A wire tie or zip tie shall be used, if necessary, to make the connection between the bag and the pump leak-proof. Immediately open the valve on the Tedlar® bag approximately one turn. *Note: The sample time is the same time as the acquisition of the initial vacuum /pressure reading. If a vacuum /pressure reading was not collected before sample collection, the sample start time shall be documented in the Toughbook.* Based on the flow rate to collect a 1-liter vapor sample, the peristaltic pump shall be allowed approximately five (5) minutes to collect the sample. Total sample collection time, which may exceed five (5) minutes, is dependent on the soil characteristics of the stratum from which the sample is being collected. Upon retrieval of the one-liter sample volume, close the valve on the Tedlar® bag, turn off the peristaltic pump, and configure the micro valve such that the valve is closed to the well and open to the atmosphere (VMP wells) or disconnect the coupling body from the coupling insert (MP wells). Place the sample bag in a black trash bag or container that will minimize exposure to sunlight.

Duplicate samples shall be collected by repeating the procedure detailed above. The duplicate sample shall be collected immediately after the first sample (original sample) has been collected. Due to the nature of the coarse-adjustment valves that are typically installed on Tedlar® bags, the use of a sample splitter is not recommended because the collection of unequal sample volumes could occur. Duplicate samples shall be obtained at a frequency of one per every twenty original samples collected.

Dismantle the sample train and dispose of all non-dedicated lines used for sample collection. New sample lines at each sample location shall be used, except for dedicated equipment (4-way micro valves, fittings, and coupling bodies, etc.). The micro valve can remain attached to the VMP wells; however, the valve should be configured so that the monitoring location is closed to atmosphere. For MP wells, the vinyl slip cap shall be fitted over the coupling insert on the expandable well cap following sampling collection. The dedicated equipment (coupling body) used for the MP wells shall be placed into a labeled, re-sealable bag. Non-dedicated, reusable equipment shall be cleaned / decontaminated after each use with an Alconox® and water solution followed by a deionized water rinse, and then allowed to air dry.

6.0 VENTING

VMP and MP wells are vented (opened to atmosphere) for 15 minutes to allow the well to stabilize. For VMP wells the 4-way valve is left open both to the well and to the atmosphere for 15 minutes after Tedlar® collection.

For MP monitoring locations with PVC risers the dedicated, expandable well cap above the well riser is removed (remove top section, twist counter-clockwise with cap-removal tool, once loose pull out cap) for 15 minutes after Tedlar® collection. For MP locations with nylon well risers the dedicated, coupling insert is removed (turn counter-clockwise until it is removed) from the tip of the nylon well riser for 15 minutes after Tedlar® collection.

7.0 WATER/PRODUCT LEVEL MEASUREMENT

Due to their construction, water/product level measurements are not collected at VMP wells. For MP monitoring locations with PVC well risers, a liquid-level measurement shall be obtained using a Solinst 122 Interface Probe (or equivalent). Prior to obtaining the measurement, the expandable well cap shall be removed and the well vented for 15 minutes. The depth to water and/or product shall be recorded in the Toughbook. Replace the well cap after obtaining the measurement.

If a measurement cannot be obtained, the Toughbook shall reflect the field condition with the notation “NM” for not measured, and this observation and explanation shall be documented in

the "additional comments" portion of the Toughbook. If measurement can be made, but no water and/or product is present, the Toughbook shall reflect the field condition with the notation "NE" for not encountered.

For wells with product, non-dedicated, reusable equipment shall be cleaned / decontaminated after each use using the following steps:

- Perform initial equipment cleaning using a paper towel that is saturated with isopropyl alcohol
- Measuring tape and probe will be wiped clean as removed from the monitoring well where gauging activities are being performed.
- Care will be taken to replace saturated paper towel if gross contamination is observed or it becomes dry.
- Probe will also be sprayed off with isopropyl alcohol after wiping.
- Allow equipment to air dry.

For MP monitoring locations with nylon well risers, a liquid-level measurement will be obtained using a Solinst Model Mini 102 Water Level Indicator (or equivalent) water level indicator. Prior to obtaining the measurement, the coupling body shall be removed and the well vented for 15 minutes. The depth the water level indicator reaches should be noted in the Toughbook.

If a measurement cannot be obtained, the Toughbook shall reflect the field condition with the notation "NM" for not measured, and this observation and explanation shall be documented in the "additional comments" portion of the field form. If measurement can be made, but no water and/or product is present, the Toughbook shall reflect the field condition with the notation "NE" for not encountered. Decontamination is the same as in the section above.

8.0 FINAL (STABILIZED) VACUUM/PRESSURE MEASUREMENT

A pressure is considered to be stabilized when it does not fluctuate more than 5% in one minute. The manometer shall be allowed a maximum of thirty (30) minutes to stabilize before the vacuum/pressure is recorded. If the manometer does not stabilize within the 30-minute period, the range in which the vacuum/pressure fluctuates over an additional one (1) minute period will be documented on the "additional comments" portion of the appropriate field form. The highest reading observed within the observed range will be recorded on the main portion of the appropriate field form. (*Note: If the manometer reading fluctuates between two vacuums, the lowest/weakest vacuum observed will be recorded in the Toughbook. If the manometer reading fluctuates between a vacuum and a pressure, the highest pressure observed will be recorded in*

the Toughbook. If the manometer reading fluctuates between two pressures, the highest/strongest pressure observed will be recorded in the Toughbook. In all cases, the range in the manometer readings over the additional one-minute period will be recorded in the Toughbook.

At VMP monitoring locations the 4-way valve should be closed to the atmosphere so that the positive end of the manometer is open to the well. The manometer should be turned on, zeroed, and connected to the well as it was for the initial pressure. Once the pressure is stabilized the reading should be taken. The manometer can then be removed and the valve can be shut off to the well (original valve position when well cover was opened).

At MP monitoring locations the dedicated, expandable well cap should be placed back on the well riser and tightened (for MP wells with PVC risers) or the dedicated, coupling insert should be replaced and threaded into the end of the flex tubing (for MP wells with Nylon risers). The manometer should be turned on, zeroed, and connected to the well as it was for the initial pressure. Once the pressure is stabilized the reading should be taken. The manometer and coupling body can then be removed.

Note: Any monitoring location where water/product is encountered during purge or Tedlar collection, where the requisite volume cannot be purged, or where the well screen is submerged will not have a stabilized pressure collected.

1.0 INTRODUCTION

The purpose of this Standard Operating Procedure (SOP) is to provide a consistent methodology for the screening of soil vapor samples at the Hartford Working Group (HWG) site. Whenever possible, the soil vapor samples collected throughout the Village of Hartford (Village) for the various work tasks will be screened on the same day of collection. If same-day screening is not possible due to time constraints, instrument problems, etc., the samples will be screened within 24 hours of sample collection. This SOP details the necessary procedures to follow in order to ensure that valid total vapor phase hydrocarbons, oxygen, methane and carbon dioxide concentration data is collected and adequately documented. These procedures are applicable to any vapor sample collected at the HWG site, but are particularly useful for samples collected from vapor monitoring ports (VMPs), monitoring ports (MPs), and sub-slab (SS) ports that are located throughout the Village. Important uses of these data include:

- Evaluation of indoor air or sub-slab methane concentrations
- Screening of indoor air or sub-slab petroleum hydrocarbon concentrations
- Evaluation of the performance of the Village-wide soil vapor extraction system performance
- Ambient air samples can either be collected and analyzed on-location using real-time instrumentation (TVA 1000, GEM 2000, etc.), or collected in Tedlar™ sample media and analyzed at a dedicated sample analysis station.

2.0 PROCEDURE

The following instruments will be used to screen soil vapor samples:

- TVA-1000 or performance equivalent for volatile organic compounds (VOCs) and methane by flame ionization detector (FID) and for VOCs by photoionization detector (PID)
- PPbRAE or performance equivalent for VOCs by PID for low-concentration samples
- LANDTEC GEM-2000 or performance equivalent for oxygen and carbon dioxide.

Immediately prior to use, each instrument will undergo a calibration check. In the event that instrument accuracy is not within 15-percent of the designated calibration check standard concentration, the instrument will be recalibrated. Field personnel will follow applicable instrument operation SOPs and/or manufacturer's recommended procedures for the calibration and operation of the instruments. Calibration data will be documented on the appropriate calibration forms for each instrument.

3.0 REQUIRED MATERIALS FOR SCREENING SAMPLES

The following materials will be used to perform sample screening, either on-site or at a dedicated sample screening station:

- TVA-1000, PPbRAE, and LANDTEC GEM-2000 real-time monitors;
- Calibration gas cylinders, including:
  - Methane in air at concentrations of 50; 500; 5,000; and 32,500 ppmv
  - Isobutylene in air at concentrations of 10, 50 and 1,000 ppmv
  - Hydrocarbon-free air
  - 35 percent by volume concentration CO2
- Regulators for calibration gas cylinders
- SKC sorbent tubes (part # 226-09) used for methane determination
- ¼-inch O.D. Teflon™ or Tygon™ tubing cut to length
- 10-to-1 dilution probe (Thermo Environmental Instruments Part #CR010MR)
- Disposable 4-way plastic valves used to switch the sample between methane and total hydrocarbon analyses.

4.0 CALIBRATION AND QUALITY CONTROL

4.1 Calibration Procedures Applicable to All Field Screening Analyses

Instruments will be calibrated in accordance with applicable SOPs and/or manufacturer's recommended procedures at the beginning of the day. If the screening instruments are to be used throughout the work day, mid-day and end-day calibration checks will be performed. Further, the TVA 1000 instrument detectors and associated dilution probe will be bump checked (1-point accuracy check) approximately every two hours in order to document instrument stability. In the event that a bump check indicates a deviation greater than ± 15 percent from the designated bump-gas concentration, a full instrument calibration will be performed. Due to negligible (<5-percent) instrument drift throughout the day, the LANDTEC GEM-2000 and PPbRAE will not undergo bi-hourly bump checks. Instead, calibration accuracy checks will be conducted at approximately midday, and again at the conclusion of the sample event.

As stated above, calibration of the Landtec GEM-2000, TVA-1000, and PPbRAE will be performed in accordance with applicable SOPs and/or manufacturer recommended procedures. However, the wide range of petroleum hydrocarbons and methane concentrations present at the

site (i.e., greater than four orders of magnitude) may be outside of the linear range of the TVA-1000 FID. To meet a primary data quality objective of the project (i.e., to quickly and accurately determine whether a potentially explosive condition is present at a sampling location), the FID calibration will be based on a calibration standard that is approximately 10% of the lower explosive limit (LEL) for methane (5,000 ppmv). However, additional QC procedures will be implemented to ensure quality data for both hydrocarbon and methane concentrations.

The linearity of instrument response will be verified by using 50 ppmv, 500-ppmv methane standards. If significant non-linear response (i.e., greater than 15% relative root mean square error) is observed, a nonlinear calibration curve will be developed. The relative response factor for isobutylene (which is used here as a surrogate for petroleum vapors) will be determined by using a 1,000 ppmv (nominal) isobutylene calibration standard. (1,000 ppmv is approximately 10% of the LEL for gasoline.)

Calibration shall be considered adequate when check standards are within +/- 15%. If the calibration check standards are outside that range, a second check standard will be run and if the check standard fails again, the instrument will be recalibrated and data obtained since the last check standard was successfully run will be flagged as estimated values.

4.2 Analysis of Concentrated Samples Utilizing a Dilution Probe

Because samples will need to be analyzed which are above the measurement range of the FID or which may not have sufficient oxygen content to analyze reliably, dilution of some samples will be required prior to analysis. The 10:1 dilution probe will be calibrated using the 32,500 ppmv methane standard. Calibration of the dilution probe is considered complete when the FID response to this standard is within ± 15 percent of 3,250 ppmv.

The critical orifice in the dilution probe is density-dependent. As it will be calibrated using a 3.25% methane standard that has a density of 98.6% that of air, samples that have a density significantly different from that will be subject to some level of deterministic error. Samples that have extremely high hydrocarbon or methane concentrations have the potential to have significantly varying densities, which can introduce significant error when the analysis relies on the dilution probe. For example, error in excess of 10% will be present at concentrations of methane above 40% (if significant concentrations of petroleum hydrocarbons are not present).

Because the average density of petroleum hydrocarbon vapors is variable, the error is not as readily quantified for elevated concentrations of petroleum hydrocarbons. Assuming an average density of 2.5 times that of air (i.e., density equivalent to isopentane), error in excess of 10% will be present at concentrations of petroleum hydrocarbon above 17% (if significant concentrations

of methane are not present).

The density error associated with methane and heavier hydrocarbons have the potential to offset each other. Because the average density of measured hydrocarbon will not be known, data associated with an estimated error greater than 10% due to the presence of hydrocarbon or methane will be flagged as estimated, rather than corrected for an assumed density. As the concentrations at which significant error is introduced are well above project action levels, estimated concentrations at these ranges are considered adequate to meet project data quality objectives.

4.3 Analysis of Samples Utilizing a Charcoal Scrubber Tube to Filter Heavy Hydrocarbons

Use of the sorbent tube to screen out hydrocarbons other than methane affects the function of the FID instrument by lessening the flow of air through the detector. Preliminary testing indicates that a 25% to 30% reduction in instrument response occurs over the linear calibration range of the instrument. To calibrate the instrument for use of the sorbent tube, the 50, 500 and 5,000-ppmv methane standards will be run with the sorbent tube to determine the relative response of the instrument to methane passed through the sorbent tube. The relative response factor (RRF) for each calibration standard will be calculated as:

$$FID_{RRF} = FID_{sorb} / FID_{raw}$$

Where;

FID_{RRF} = relative response factor;

FID_{sorb} = Instrument response with sorbent tube (ppmv); and

FID_{raw} = Instrument response to calibration standard without sorbent tube (ppmv)

The average RRF shall be used as a correction factor for samples analyzed using the sorbent tube. It is not necessary to correct instrument response (other than multiplying the displayed value by 10) when using the 10:1 dilution probe in conjunction with the sorbent tube. When using the dilution probe, the majority (approximately 90-percent) of the sample that is analyzed is actually dilution air that does not pass through the sorbent tube.

5.0 SAMPLE SCREENING

Most soil vapor samples collected in Tedlar ™ bags will be screened at a fixed location using the instrumentation noted above. The fixed location facilitates the use of the instrumentation, allows for a more stable environment in which to screen the samples, and provides adequate space in which to perform the screening and complete the associated documentation. However, to allow rapid screening of indoor air and sub-slab soil vapor, such samples can be analyzed on site, using

the same field instrumentation. The calibration of these instruments, as outlined in Section 4.0, will be performed in such a way that instrument response is most accurate in the concentration range that corresponds to project action levels.

The TVA-1000 has been configured with a switching device (disposable valve) to allow sample to be passed through an SKC carbon sorbent tube to remove petroleum hydrocarbons (i.e., site data indicate that the remainder will be primarily methane).

5.1 Procedures for Sample Screening On Site

- Screen air sample with LANDTEC Model GEM-2000 landfill gas analyzer. Oxygen and carbon dioxide concentration data will be entered into the Toughbook;
- Screen sample with the TVA 1000 PID or PPbRAE PID instrument and quickly document the concentration on the appropriate data sheet; and
- Set the TVA-1000 to sample through the SKC sorbent tube used in conjunction with the FID.
- Calculate the methane concentration as:

$$C_{meth} = FID_{sorb} / FID_{RRF}$$

Where;

C_{meth} = methane concentration (ppmv);

FID_{sorb} = Instrument response with sorbent tube with sample Tedlar (ppmv); and

FID_{RRF} = relative response factor

Switch the TVA-1000 to sample without the sorbent tube. Screen the sample with the TVA-1000 and enter the FID vapor concentration data into the Toughbook; and

- The petroleum hydrocarbon concentration (PHC) portion of the FID response should be calculated as:

$$PHC = C_{raw} - C_{meth}$$

Where;

PHC = petroleum hydrocarbon concentration (ppmv);

C_{raw} = FID reading without sorbent tube (ppmv); and

C_{meth} = methane concentration (ppmv)

5.2 Procedures for Sample Screening at a Dedicated Sample Analysis Station

The sampling instrumentation for the dedicated sample analysis station has been configured such that the TVA-1000 can be operated with a 10:1 dilution valve, if concentrations are outside the operational range of the FID (i.e., if there is insufficient oxygen to support the FID flame or if the sample is above the linear range of the instrument).

- Open the valve on the Tedlar™ bag sample approximately one turn and attach to the inlet of the LANDTEC Model GEM-2000 landfill gas analyzer. Oxygen and carbon dioxide concentration data will be entered into the Toughbook;
- Immediately connect the sample bag to the PPbRAE PID instrument and quickly document the concentration on the appropriate data sheet. If the instrument registers over range, the VOC concentration by PID will be completed using the TVA-1000 PID;
- If the oxygen concentration in the sample is less than 16-percent, configure the TVA-1000 for use with a 10-to-1 dilution probe. The dilution probe will allow for the sample to be screened by FID without flameout associated with low oxygen concentration samples. The dilution probe must be separately calibrated and should be used for sample analysis by FID only;
- Set the TVA-1000 to sample through the SKC sorbent tube. Record the reading as the methane concentration. If the 10-to-1 dilution probe is used, the displayed concentration (FID) must be multiplied by 10;
- Switch the TVA-1000 to sample without the sorbent tube. Immediately connect the sample bag to the TVA-1000 probe inlet and enter the FID vapor concentration data into the Toughbook. If the 10-to-1 dilution probe is used, the displayed concentration (FID) must be multiplied by 10; and
- The PHC portion of the FID response should be calculated as:

  $$PHC = C_{raw} - C_{meth}$$

5.3 Procedures Applicable to All Sample Screening

Because concentrations of hydrocarbons in some samples are elevated, the carbon in the sorbent tube can be saturated with hydrocarbon relatively quickly. Therefore, the following protocols are in place to assure quality data:

- The sorbent tube will be replaced at least every 10 samples;
- The sorbent tube will also be replaced if breakthrough is observed (readily apparent) or if

concentrations do not go to zero after sample is removed from analyzer inlet; and

- Associated sample lines (Teflon™ or Tygon™ tubing), valves, etc. will be replaced if concentrations do not return to zero after sample is removed from analyzer inlet.

6.0 CONCLUSION

The screening of soil gas samples must be conducted in an organized and precise manner. The resultant data will be valid only if proper procedure and associated QA/QC is followed. It is imperative that personnel conducting the sample screening strictly adhere to the protocol detailed above. Because the samples are collected in 1-liter bags, the samples must be removed from the instrument inlets as soon as a stable reading can be documented. Failure to do so will result in an inadequate amount of sample volume to complete all the screening parameters. Larger bags cannot be used due to time constraints during sample collection.

1.0 INTRODUCTION TO THE DWYER DIGITAL MANOMETER

The Dwyer Series 475 Mark III Digital Manometer is used by personnel in the field to measure vacuum/pressure at wells throughout the Village of Hartford. Personnel responsible for using a manometer are required to read the manufacturer's instruction manual and be trained in the operation of the instrument.

2.0 ZEROING THE MANOMETER

The manometer is zeroed before each measurement. This is done by either depressing the "zero" button located on the front of the manometer, or adjusting the knob ("zero adjust knob") on the top of the manometer (depending on which model is being used) while both positive and negative connections are open to the atmosphere. The "zero" button will automatically zero the instrument.

3.0 VACUUM / PRESSURE MEASUREMENT

The manometer shall be set on the "inches of water column" unit setting which can be done by depressing the "E/M" button and scrolling until "in/H2O" is found.

The positive fitting of the manometer shall be connected to the appropriate vacuum measurement fitting located on the well using small diameter silicone (or equivalent) tubing. The negative fitting on the manometer shall remain open to the atmosphere. The pressure is immediately read and recorded to the nearest hundredth of an inch (or tenth of an inch if using 0-200 manometer) of water. The manometer can then be removed from the vacuum measurement fitting.

4.0 MAINTENANCE AND CALIBRATION

If the "low bat" indicator is lit on the manometer display, the battery needs to be replaced. A weak battery can cause improper operation or inaccurate measurements. The battery is changed by unscrewing the flathead screws located on the bottom of the manometer and removing the battery plate. The 9 volt alkaline battery will slide out and can then be unclipped from the wiring. Install a fresh battery and secure the battery plate. When replacing the cover be sure the rubber sealing gasket is properly seated in the gasket channel of the end cap. Note the end cap will only fit one way.

In the event that the manometer comes in contact with water or other conditions which cause the display to either not power on, or to read incorrectly, the manometer should be sent back to the manufacturer for calibration.

Exceeding the range of the manometer will not damage it or affect calibration if the maximum pressure is not exceeded. Exceeding the maximum pressure will cause permanent damage to the sensor and may rupture the housing and/or cause injury. The maximum pressure is shown on the rear label of the manometer.

Manometers should be sent back to the manufacturer annually for calibration. Calibration and maintenance records as well as calibration certificates are maintained on site.

1.0 DECONTAMINATION

The overall objective of multimedia sampling programs is to obtain samples that accurately depict the chemical, physical, and/or biological conditions at the sampling site. Extraneous contaminants can be brought onto the sampling location and/or introduced into the medium of interest during the sampling program (e.g., using sampling equipment that is not properly or fully decontaminated). Trace quantities of contaminants can consequently be captured in a sample and lead to false positive analytical results and, ultimately, to an incorrect assessment of the contaminant conditions associated with the site. Decontamination of sampling equipment (e.g., all non-disposable equipment that will come in direct contact with samples) and field support equipment (e.g., drill rigs, vehicles) is, therefore, required prior to, between, and after uses to ensure that sampling cross-contamination is prevented, and that on-site contaminants are not carried off-site.

1.1 Equipment

The following is a list of equipment that may be needed to perform decontamination:

- Brushes
- Buckets
- Scrapers
- Paper towels
- Liquinox detergent (or equivalent)
- Distilled water
- Isopropyl alcohol
- Water sprayers.
- Plastic sheeting or trash bags

1.2 Personnel

A temporary personnel decontamination line will be set up around each exclusion zone. If contamination is not encountered, a dry decontamination station may be established which consists of discarding of disposable personal protective equipment (PPE).

If real-time monitoring instruments indicate that contamination has been encountered, (i.e. action levels are exceeded requiring an upgrade from initial PPE levels), a complete personnel decontamination station will be established.

The temporary decontamination line should provide space to wash and rinse boots, gloves, and all sampling or measuring equipment prior to placing the equipment into a vehicle. A container should be available to dispose of used disposable items such as gloves, tape, or tyvek (if used).

The decontamination procedure for field personnel will include:

- Glove and boot wash in an Liquinox solution
- Glove and boot rinse
- Duct tape removal
- Outer glove removal
- Coverall removal
- Respirator removal (if used)
- Inner glove removal

1.2 Sampling Equipment

The following steps will be used to decontaminate sampling equipment:

1. Personnel will dress in suitable safety equipment to reduce personal exposure as required by the site Health and Safety Plan (HASP).
2. Gross contamination on equipment will be scraped off at the sampling or construction site.
3. Equipment that cannot be damaged by water will be placed in a bucket containing Alconox or detergent along with potable water and scrubbed with a bristle brush or similar utensil. Equipment will be rinsed with tap water in a second wash tub followed by a distilled water rinse.
4. Equipment that may be damaged by water will be carefully wiped clean using paper towels and detergent water and rinsed with distilled water. Care will be taken to prevent equipment damage.
5. Rinse and detergent water will be replaced with new solutions as necessary.

Following decontamination, equipment will be placed in a clean area or on clean plastic sheeting to prevent contact with contaminated soil. If the equipment is not used immediately after decontamination, the equipment will be covered or wrapped in plastic sheeting or heavy-duty trash bags to minimize potential contact with contaminants.

1.3 Water Level / Interface Probes

The following steps will be used to decontaminate water level meters and water/product interface probes:

1. Personnel will dress in suitable personal protective equipment (PPE) to reduce personal exposure as required by the HASP.
2. Paper towel will be saturated with isopropyl alcohol.
3. Measuring tape and probe will be wiped clean as removed from the monitoring well where gauging activities are being performed.
4. Care will be taken to replace saturated paper towel if gross contamination is observed or it becomes dry.
5. Probe will also be sprayed off with isopropyl alcohol after wiping.

Following decontamination, equipment will be placed in a clean area or on clean plastic sheeting to prevent contact with contaminated media.

1.3 Drilling and Heavy Equipment

Drilling rigs will be decontaminated at a decontamination station located near a central staging area. The decontamination station may consist of a temporary or permanent structure capable of collecting all decontamination fluids. Mobile decontamination trailers may be used to decontaminate heavy equipment at each site. The following steps will be used to decontaminate drilling and heavy equipment:

1. Review JSA for drilling and heavy equipment decontamination.
2. Personnel will dress in suitable PPE to reduce personal exposure as required by the HASP.
3. Equipment showing gross contamination or having caked-on drill cuttings will be scraped with a scraper at the sampling or construction site.
4. Equipment that cannot be damaged by water, such as drill rigs, augers, drill bits, and shovels, will be washed with a hot water, high-pressure sprayer then rinsed with potable

water. Care will be taken to adequately clean the insides of backhoe buckets, hollow-stem augers, and other tubular goods.

5. Following decontamination, drilling equipment will be placed on the clean drill rig and moved to a clean area. If the equipment is not used immediately, it should be stored in a designated clean area.

1.4 Equipment Leaving the Site

Vehicles used for activities in non-contaminated areas shall be cleaned on an as-needed basis, as determined by the Site Safety Officer, using soap and water on the outside and vacuuming the inside. On-site cleaning will be required for very dirty vehicles leaving the area. Construction equipment such as trucks, drilling rigs, backhoes, trailers, etc., will be pressure washed before the equipment is removed from the site to limit exposure of off-site personnel to potential contaminants.

1.5 Wastewater

Liquid wastewater from decontamination, well development and purging will be containerized and left at the site where it originated pending disposal arrangements, unless otherwise specified.

2.0 DOCUMENTATION

Sampling personnel will be responsible for documenting the decontamination of sampling and drilling equipment. The documentation will be recorded with waterproof ink in the sampler's field notebook with consecutively numbered pages. The information entered in the field book concerning decontamination should include the following:

- Decontamination personnel
- Date and start and end times
- Decontamination observations
- Weather conditions.

3.0 QUALITY ASSURANCE REQUIREMENTS

Equipment rinsate samples of the decontaminated sampling equipment may be taken to verify the effectiveness of the decontamination procedures. The rinsate sampling procedure will include rinsing distilled water through or over a decontaminated sampling tool (such as a split spoon) and collecting the rinsate water into the appropriate sample bottles. The rinsate sampling procedure, including the sample number, will be recorded in the field notebook.

1.0 CALIBRATION AND MAINTENANCE OF FIELD INSTRUMENTS

This section defines the standard operating procedure for calibration and maintenance of field instruments frequently used during environmental field activities. This section gives descriptions of the most commonly used of these instruments and field procedures necessary to calibrate and maintain them. Calibration and maintenance records for all equipment are maintained on site.

1.1 Equipment

The following equipment is required during field instrument calibration and maintenance activities.

- Latex/Nitrile gloves
- Site logbook
- Field data sheets and Toughbook
- Equipment Calibration Record forms
- Distilled water
- Decontamination equipment
- Health and Safety Equipment
- Field Instrument Operations Manual
- Calibration gases for Air Monitoring Equipment
- Calibration solutions for Water Monitoring Equipment.

1.2 Types of Field Instruments Commonly used during Environmental Investigations

The following are some of the more commonly used instruments during environmental investigations.

- Flame Ionization Detector (FID)
- Photoionization Detector (PID)
- Multi-gas Meter (usually includes Lower Explosive Limit (LEL), Hydrogen Sulfide detector, Oxygen sensor, and Carbon Monoxide meter)
- Groundwater Level Indicator
- Petroleum/Groundwater Interface Probe

- Groundwater pH, Temperature, Conductivity, ORP, DO, Turbidity Meter

1.3 Maintenance

Maintenance of field instruments should be performed on a regular basis to ensure instruments are in proper working order at all times and to prolong instrument life. General maintenance such as regular cleaning of the instrument, battery checks and replacement, and ensuring the instrument is handled and stored properly can easily be performed by URS employees. Other maintenance items such as sensor repair, annual calibrations and repair of malfunctioning equipment should be performed by the instrument manufacturer or licensed dealer and should not be performed by URS employees. Contact the manufacturer to determine where the instrument should be submitted for these maintenance tasks. The vast range of instruments available for use by the environmental professional have an equally vast maintenance regime and therefore maintenance guidelines specified in the manual for each piece of equipment should be referred to and followed at all times.

1.4 Calibration

Due to the vast number of field instruments available, various parameters potentially monitored, and the wide range of functions potentially performed by each instrument, a description of the calibration of every type of instrument available is not feasible. However, a generalized SOP for general types of field equipment calibration is presented and should be followed while performing calibrations of field instruments.

1.4.1 Air Monitoring Instruments (PID, FID, Multi-gas Meters, H_2S Detectors, etc.)

1. Calibration should be conducted every morning prior to commencing field activities.
2. Turn the instrument on. The on/off switch may be a toggle switch, knob, or button to be depressed depending on the type and brand of instrument being used.
3. Allow the instrument to “warm up” and progress through the startup diagnostic routine.
4. Apply the calibration gas (isobutylene, methane, multi-gas mixtures, etc.) to the instrument to get an initial instrument reading.
5. Record the initial reading on the proper equipment calibration field form and in the site logbook. Also record the calibration standard and concentration of that standard on the field form and in the logbook.
6. If the initial reading is greater than +/-5% of the calibration standard proceed with instrument calibration as specified in the equipment operator’s manual. If the initial

reading is within this +/- 5% window of the calibration gas standard, the instrument should be considered calibrated and additional calibration is not required at this time. At periodic intervals throughout the day the calibration of the instrument should be check and re-evaluated.

7. Apply the calibration gas and proceed as directed in the operator's manual.
8. After calibration is complete, record the final calibrated reading on the field equipment calibration forms and in the field logbook. Calibration forms are maintained on site. At periodic intervals throughout the day the calibration of the instrument should be checked and re-evaluated.

1.4.2 Groundwater Parameter Instrument (i.e. Troll 9500)

Frequently one instrument will have multiple sensors for measuring various parameters in water. Sensors for pH, temperature, conductivity, oxidation reduction potential (ORP), dissolved oxygen (DO), and turbidity shall be calibrated daily according to the following procedures:

1. Click START in the upper left corner of the screen.
2. Select POCKET SITU 4 from the drop down menu.
3. Select COM1-19200 in the list in the upper half of the screen.
4. Click FIND at the bottom.
5. Select PARAMETERS in the list in the upper half of the screen.
6. Fill the dented calibration cup to the bottom of the dent with the Quick Cal Solution.
7. Slide the cup over all (including the wire) but the DO probe (long, flat sensor).
8. Remove the small plastic bottle from the pH sensor (cap stays on sensor) and Set the assembly in the flow-thru cell so that it can stand up. (Attempt to save the bottle and solution contained within.
9. Click QUIKCAL at the bottom of the screen.
10. Verify pH, ORP, Conductivity and DO are checked.
11. Click NEXT at the bottom.
12. Click RUN (status on all parameters says "Unstable").
13. Once the status on all says "Stable", Click ACCEPT (unless the unit advances itself).
14. Click FINISH.

15. Select YES when asked if you want to view the calibration report.
16. Scroll down through the report. Write down the "Stimulus" values as the calibration standards and the "Final Reading" values as the corrected readings.
17. When finished, Click "X" in the upper right corner to close the report.
18. If unit does not automatically go to DO calibration, expand the Parameters list in the upper half of the screen and Select RUGGED DISSOLVED OXYGEN.
19. Click CALIBRATE at the bottom.
20. Select NO when it asks if you want to edit the barometric pressure.
21. Select NEXT for Calibrate Only.
22. Remove the previous calibration cup.
23. Rinse sensors with distilled water.
24. Fill the cup attached to the air pump about half full with distilled water.
25. Set the sensors into this cup with the DO sensor near the white aerator.
26. Turn on the air pump and let it run for about 5 to 10 minutes.
27. Click RUN on the Rugged Reader (status at the top says "Unstable").
28. Once the status on both says "Stable", Click ACCEPT or NEXT (whichever allowed).
29. Turn off air pump.
30. Remove sensors from cup.
31. Fill undented calibration cup about 1/3 full of the DO Sodium Sulfite solution.
32. Place DO sensor only in cup (may have to hold unit up if it won't balance anywhere).
33. Click RUN (status says "Unstable").
34. Once the status on both says "Stable", Click ACCEPT (unless unit advances itself).
35. Click FINISH.
36. Select YES when asked if you want to view the calibration report.
37. Scroll down through the report. Write down the mg/L and temperature under "Saturation Point" and "Zero Point".
38. When finished, Click "X" in the upper right corner to close the report.

1.4.3 Water Level Indicator and Petroleum/Water Interface Probe

Field calibration of this instrument is not required. Rather a series of field checks to ensure the instrument is in proper working order will be described.

1. Turn the instrument on. The on/off switch is usually a knob located on the side of the reel in which the measuring tape is rolled onto.
2. Push the "test" button to ensure that the batteries are in working order. If the batteries are working, an audible tone will be heard and a visible light located on the side of the reel will illuminate.
3. Immerse the sensor probe in potable water to ensure the audible tone is heard and visible light illuminates when the electrical circuit is completed when the probe enters the water. Make an observation of where the water level is at on the probe when the circuit is completed. Repeat this step several times to familiarize yourself with this contact point. By performing this step, the chance of submersing the probe to a greater depth than necessary is reduced. Over-submersion of the probe will result in a greater amount of the probe and measuring tape to be cleaned and decontaminated prior to collection of another groundwater measurement.

   After collection of every water level measurement, decontaminate all portions of the water level meter or petroleum/water interface probe that came in contact with the groundwater as outlined in HWG SOP-5 – Decontamination.

APPENDIX D

Manufacturers' Equipment Manuals

TVA-1000 Series

Instruction Manual
Response Factors
Part Number 50039
20Dec2007

Thermo
SCIENTIFIC

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Specifications, terms and pricing are subject to change. Not all products are available in all countries. Please consult your local sales representative for details.

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PART ONE

INTRODUCTION

FLAME IONIZATION DETECTION (FID)

An FID, or Flame Ionization Detector, measures organic compounds by utilizing a flame produced by the combustion of hydrogen and oxygen (air). When hydrocarbons in the sample are introduced to the detection zone, ions are produced by the following reaction:

$$RH + O = RHO^{+} + e^{-} = H_20 + CO_2$$

A collector electrode with a polarizing voltage is also located within the detector chamber, and the ions produced by this reaction are attracted to it. As the ions migrate towards the collector, a current is produced which is directly proportional to the concentration of hydrocarbons introduced to the flame. This current is then amplified and sent to a microprocessor or analog readout device.

The FID has a wide dynamic range (0-50,000 ppm for the TVA-1000). This dynamic range can be further expanded by use of a dilutor kit which reduces very high VOC concentrations to within the dynamic range (or even linear range) of the analyzer. The dilutor kit can also be used to enrich oxygen deficient samples by adding ambient air that is rich in oxygen (20.9 % usually). Low oxygen can affect the characteristics of the hydrogen flame, causing readings to be artificially elevated and possibly extinguishing the flame. As a general rule of thumb, greater than 14 % oxygen is required to support the flame. If high concentrations of hydrocarbons or inert gas samples with low oxygen concentrations are to be measured by an FID, it is advised that a dilutor kit be used to combat the problem.

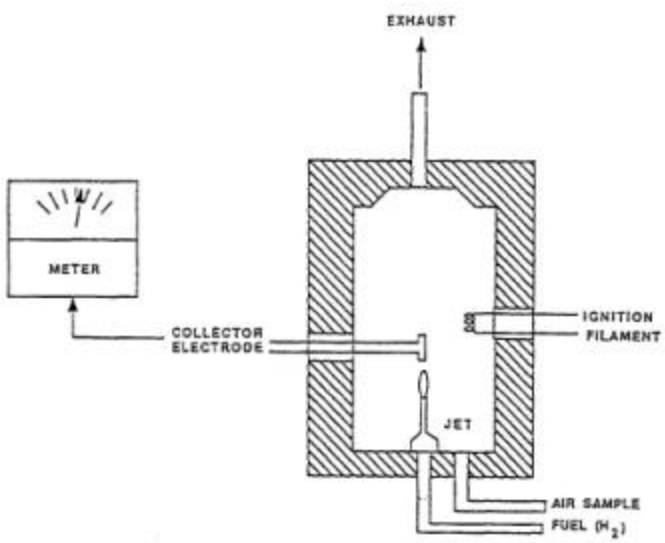


Figure 1-1. Typical Flame Ionization Detector

Benefits Of Flame Ionization Detection:

?? Wide dynamic and linear range
?? High sensitivity to most hydrocarbons
?? Very stable and repeatable response
?? Ability to measure methane
?? Virtually unaffected by CO, $C0_2$, and water vapor

PHOTOIONIZATION DETECTION (PID)

A PID, or Photoionization Detector, consists of a UV lamp of a specific energy and an ionization chamber.. Compounds passing through the chamber are excited by photons of UV energy from the lamp and ionized according to the following equation:

$$R + h? = R^+ + e^-$$

These ions are attracted to a collecting electrode, producing a current proportional to the concentration of the compound.

Whether or not a compound can be detected by a PID depends upon the lamp energy and the energy required to remove an electron from the compound (its *ionization potential).* If the lamp energy is greater than the compound's ionization potential, the PID will detect it. The standard lamp in the TVA is 10.6 eV, however other lamps are also available (9.6, 10 ·0, and 11.8 eV). The 11.8 eV lamp permits detection of many compounds not ionized by the standard lamp, while the lower energy lamps allow more selectivity by not responding to undesired compounds with a higher ionization potential.

Because of its smaller dynamic range (0-2000 ppm), the PID would not be the detector of choice for measuring high concentrations of vapors (unless a dilutor kit is used). A PID is also more susceptible to interference from water vapor than an FID. However, a PID does not require hydrogen or oxygen, so it would be the detector of choice when fuel is limited or unavailable, or when ambient oxygen concentrations are low. The PID is also more sensitive to aromatic and chlorinated compounds, and can measure some inorganic compounds that the FID does not detect at all (Ammonia, Carbon Disulfide, Carbon Tetrachioride, Chloroform, Ethylamine, Formaldehyde, and Hydrogen Sulfide, to name a few).

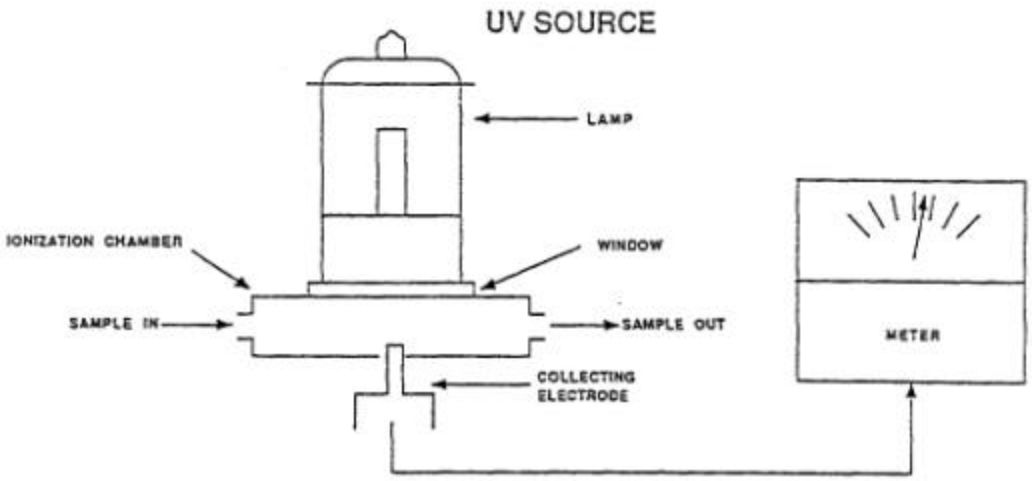


Figure 1-2. Typical Photoionization Detector

Benefits Of Photoionization Detection:

?? High sensitivity to aromatics, unsaturated hydrocarbons and chlorinated hydrocarbons
?? Ability to measure some inorganic gases
?? Very simple operation
?? No support gases required
?? Non—destructive detector allows sample to be recovered

DUAL DETECTORS

The TVA-1000 is the first of its kind. Never before has an over-the-shoulder portable vapor analyzer offered both a photoionization detector (PID) and flame ionization detector (FID) operating simultaneously in a single instrument. The benefits of each individual detector are very clear: both the FID and the PID have their advantages and disadvantages. However, with either detector alone the number of vapors that one can detect is limited by that detector's measurement capabilities.

Before the TVA-1000, for truly complete survey monitoring of total vapors, two separate analyses with an FID and a PID were imperative. That could be inconvenient, time consuming, and expensive. With the TVA-1000, users can obtain complete information about organic and inorganic vapors quickly and easily. Most important of all, the TVA-1000 eliminates the need to purchase, learn, operate, and maintain two separate instruments - one analyzer does it all!

Also, since both detectors are displayed and logged simultaneously, the relative response of the two detectors can give some clues about the identity of the compound being measured. For instance, the PID does not respond to methane at all, but the FID responds very well. A high FID reading with virtually no PID response might indicate the presence of naturally occuring methane, commonly found at excavation sites. Consequently, PID's respond very well to some inorganic gases that FID's won't detect. A high PID reading with no FID reading might suggest the presence of an inorganic compound. With readings from both detectors readily available, the TVA-1000 can help a user make some decisions about the type of compound present and which detector reading to use.

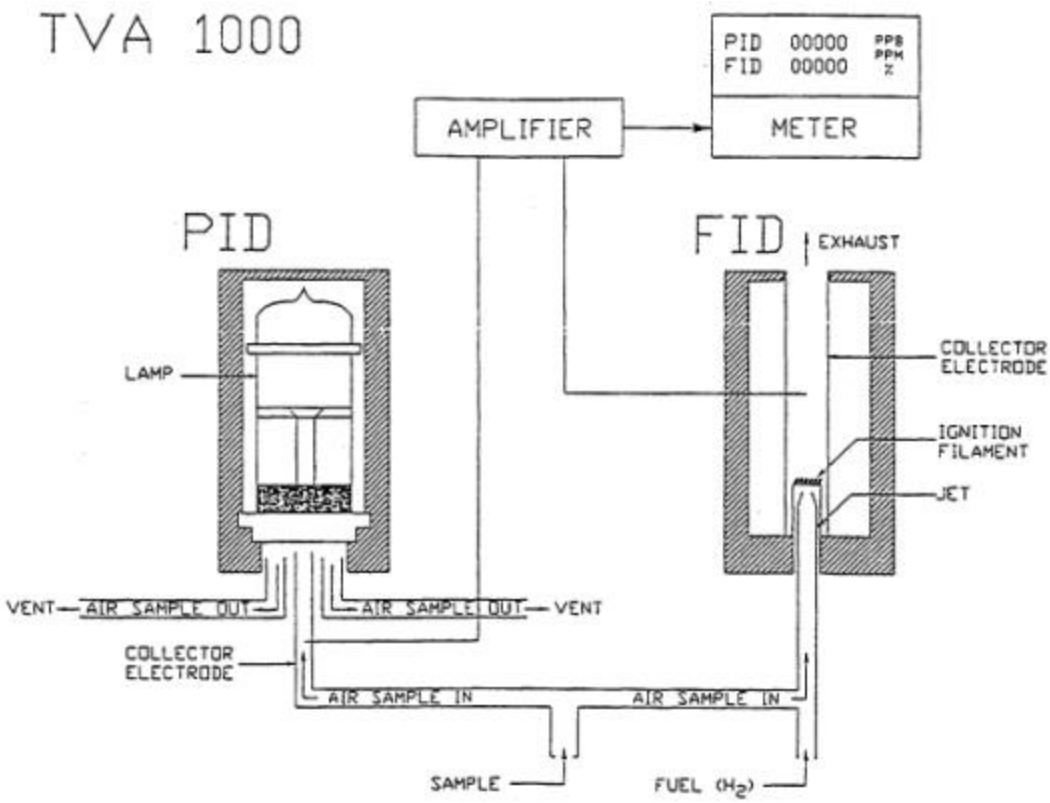


Figure 1-3. TVA-1000 Dual Detector Configuration

Benefits Of Dual Detectors:

?? Excellent Value for FID/PID/Datalogger
?? Twice as much information as each detector alone
?? Distinguish Methane from non-Methane hydrocarbons
?? Detector response ratios can help characterize compounds
?? No need to carry two analyzers, both detectors are run and logged simultaneously in a single package

RESPONSE FACTORS

The TVA-1000 is a portable vapor analyzer for gas survey monitoring. Each unit is factory calibrated with Methane (in the case of the FID) and Isobutylene (in the case of the PID). However, both detectors respond to many different compounds with differing levels of sensitivity. In order to adjust the analyzer reading from "ppm of Methane" or "ppm of Isobutylene" to ppm of the compound of interest, a correction factor must be applied to the reading. This correction factor is also known as a "Response Factor."

Response factors can be expressed in several different formats. When you acquire a response factor from any source, it is important that you understand the format in which the response factor is expressed so that it can be applied properly. Following are the two most common response factor formats:

1. Response Factor Multiplier

The response factor multiplier is the most commonly used and most widely recognized response factor format. This type of response factor is calculated by dividing the actual concentration of a compound introduced to the analyzer by the detector response.

$$\text{Response Factor Multiplier} \quad ? \frac{\text{Actual Concentration}}{\text{Measured Response}}$$

For example, if 100 ppm of a compound produces a 50 ppm FID reading on an analyzer calibrated with methane, then the FID response factor for that compound would be 2.00 (100 divided by 50).

When a using a response factor multiplier to correct a TVA reading, simply multiply the analyzer measured response by the response factor. As in the example given above, if a 50 ppm reading is achieved, multiply 50 times 2.00 to get the actual concentration (100 ppm).

2. Relative Response Factor

In some cases, a response factor may be expressed as a percent or a ratio of a compound's response to that of the calibration gas. This type of response factor is calculated by dividing the detector response by the actual concentration of a compound of interest.

$$\text{Relative Response Factor} \; ? \frac{\text{Measured Response}}{\text{Actual Concentration}}$$

(Multiply by 100 to express as a percent)

Note that the relative response is the reciprocal of the response factor multiplier. (i.e. 1/RR = RFM). As in our example above, if 100 ppm of a compound of interest produces a response of 50 ppm, the relative response would be 50 divided by 100 (0.50 or 50 %).

When using a relative response factor to correct a TVA-1000 reading, simply divide the analyzer measured response by the relative response factor expressed as a decimal. As in the example given above, if a 50 ppm reading is achieved, divide 50 by 0.50 to get the actual concentration (100 ppm).

Like any FID or PID, the TVA-1000 will respond to many different compounds, producing a survey reading of all detectable compounds present. If a single compound is present, a response factor can be applied to correct for the response of that compound. If a mixture of compounds is present, the TVA-1000 will respond to all components of the mixture, and will not differentiate between them. In general, response factors are not available for mixtures of compounds. However, if the composition of the mixture is known, a response factor can be calculated by adding weighted fractions of the response factors of the individual compounds. For instance, if a 75 % Benzene, 25 % Toluene mixture is to be measured, multiply the Benzene response factor by 0.75, the Toluene response factor by 0.25 and add them together to achieve the "weighted" response factor.

The data from a survey analysis may be expressed in a number of different forms:

1. Relative to the calibration gas

If the compound with which the TVA was calibrated is an acceptable standard, then results may be expressed in terms of that compound. For example, an FID reading of 100 ppm could be expressed as "100 ppm of Methane" if the calibration gas used was Methane. Please note that the TVA detectors can be calibrated with gases other than the factory standards as long as the detector has adequate response to that compound.

2. Response factor corrected

If the TVA is used to measure a **single known compound**, a response factor from this set of response curves can be applied to correct the TVA reading for that compound. For example, if a survey of Acetone vapors yields a PID reading of 100 ppm, the response factor multiplier from the Acetone curve (1.417) could be applied to the reading to obtain the result of 141.7 ppm Acetone.

3. Relative to a standard other than the calibration gas

If a regulatory agency requires that data be referenced to a standard other than the calibration gas, the response factor for that standard can be applied to the reading. For example, suppose that a survey of total volatile organics must be measured, but the results must be reported in equivalents of benzene. The FID calibrated with methane can be used and the benzene response factor applied to correct the reading.

USING TVA RESPONSE FACTOR DATA

Before choosing a response factor, you must know the following information:

- ?? The name of the compound being measured
- ?? The appropriate detector (FID or PID) and the appropriate lamp energy (if a PID is being used)
- ?? The calibration gas used
- ?? The concentration range

Every compound has its own unique response factor. This response factor is dependent upon the detector and the calibration gas used. All TVA response factors were determined using **Methane** as an FID calibration gas and **Isobutylene** as the PID calibration gas (single point calibration between approximately 100 to 500 ppm). If a different calibration gas is used, a new response factor must be generated. Also, response factors can change as the concentration changes, so the same factor that is applied to a 10000 ppm reading would not be the same factor applied to a 500 ppm reading.

The data in this book is in the form of response curves. The data used to create each response curve is also included for various challenge concentrations (usually starting at 10 ppm and going up to 10000 ppm unless the compound's maximum achievable vapor concentration prohibits). For each challenge concentration, the expected detector response is shown for both the FID and the PID, as well as response factors in both formats. In order to choose the appropriate response factor, refer to the curve data for the compound being monitored, and choose the factor which corresponds to the appropriate detector and the nearest concentration value. If the "EPA Format Response Factor" is chosen, **multiply** the TVA reading by the response factor to obtain the corrected concentration value. If the "Thermo Environmental Instruments Inc. Relative Response Factor" is chosen, **divide** the TVA reading by the response factor to obtain the corrected concentration value.

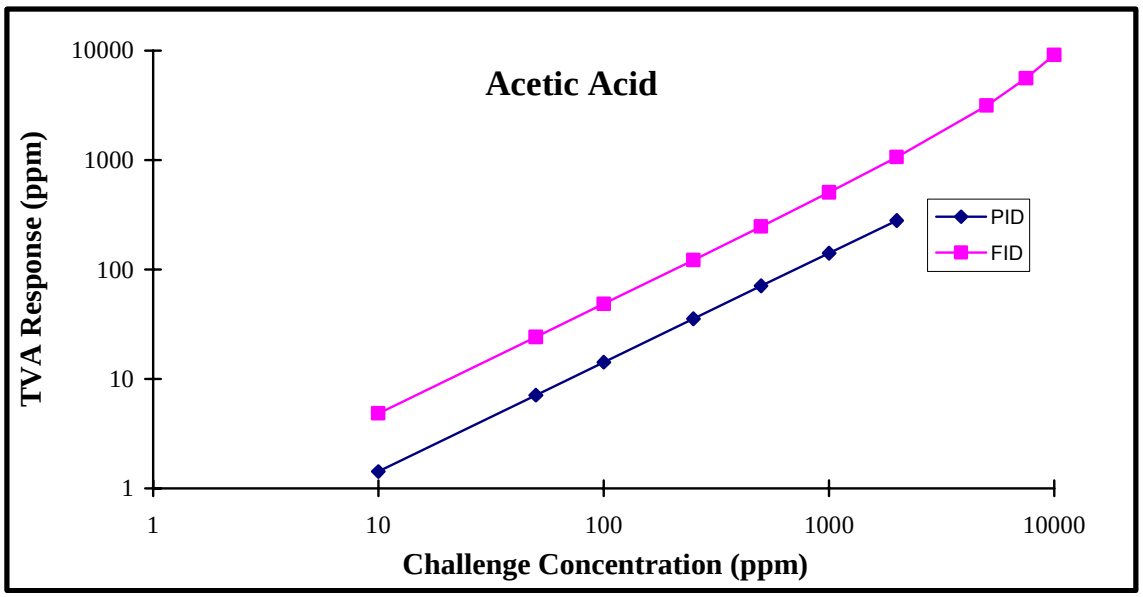
The TVA-1000 allows you to enter a response factor so that display readings are automatically corrected. Early versions of the TVA-1000 require use of a relative response factor. Newer versions allow the user to choose the format. If you are unsure about which response factor format to use in your TVA-1000, refer to your instruction manual or contact TEI. If you choose not to use this feature, the response factor must be set to 1.00 so that no correction is applied to the reading.

PART TWO

RESPONSE FACTORS

Acetic Acid

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.170	0.339	7.021	2.071
50	0.185	0.453	7.024	2.067
100	0.187	0.467	7.026	2.062
250	0.187	0.477	7.035	2.047
500	0.184	0.482	7.049	2.023
1000	0.179	0.488	7.076	1.974
2000	0.168	0.498	7.132	1.876
5000		0.525		1.582
7500		0.548		1.338
10000		0.571		1.093

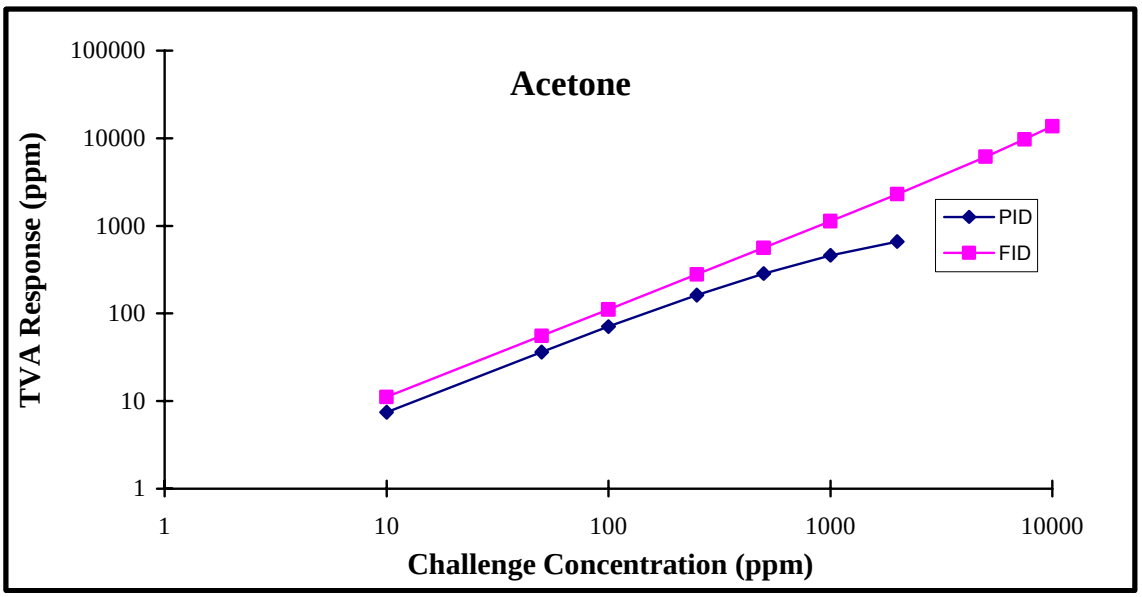


PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:		A	B
	PID	7.02	-0.56
	FID	2.07	0.98

Acetone

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.748	1.230	1.342	0.901
50	0.731	1.231	1.375	0.900
100	0.711	1.233	1.417	0.899
250	0.658	1.237	1.544	0.897
500	0.585	1.244	1.754	0.892
1000	0.479	1.258	2.174	0.884
2000	0.352	1.286	3.015	0.866
5000		1.371		0.815
7500		1.442		0.772
10000		1.513		0.728

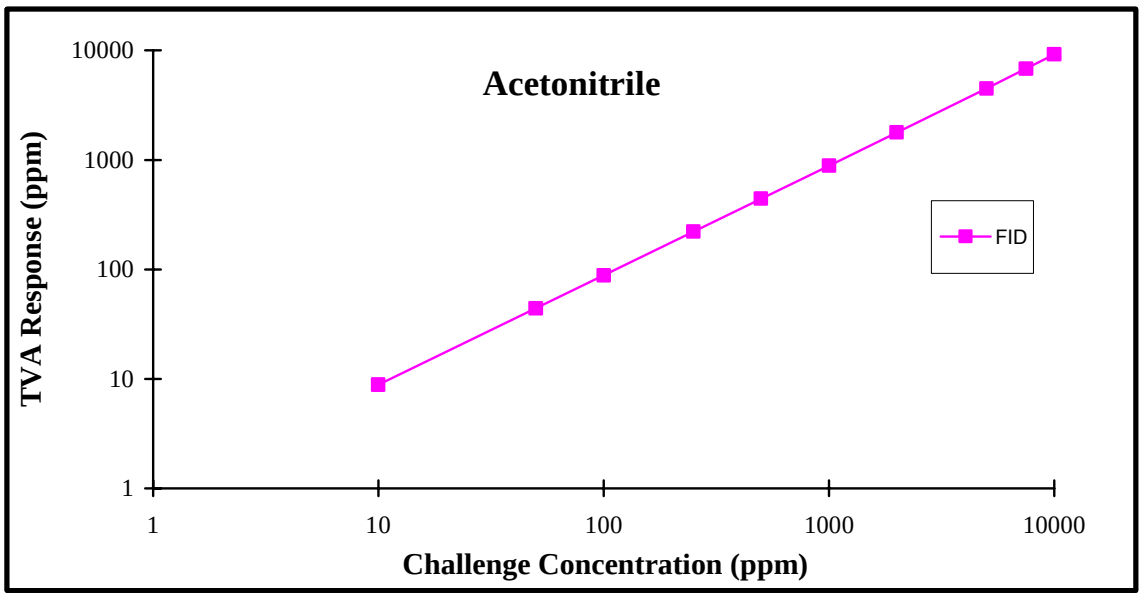


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	1.33	-8.41
	FID	0.90	0.17

Acetonitrile

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10			NF	1.134
50			NF	1.134
100			NF	1.134
250			NF	1.133
500			NF	1.132
1000			NF	1.129
2000			NF	1.125
5000				1.110
7500				1.098
10000				1.086

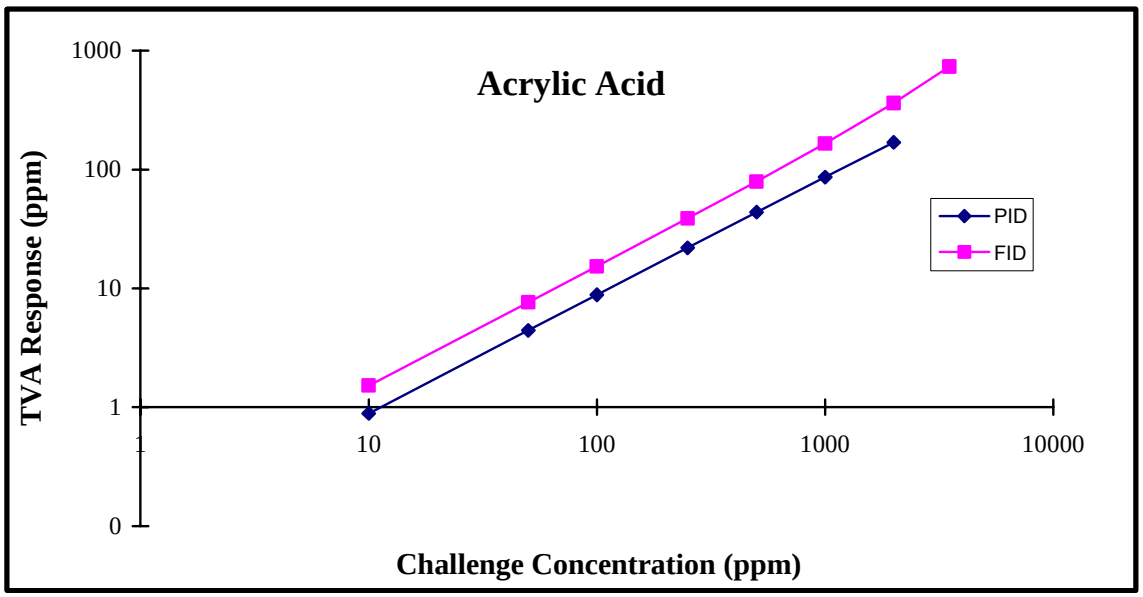


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	NF	NF
	FID	1.13	0.05

Acrylic Acid

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10			11.308	6.557
50			11.318	6.536
100			11.330	6.510
250			11.368	6.433
500			11.431	6.303
1000			11.558	6.044
2000			11.811	5.526
3500				4.749

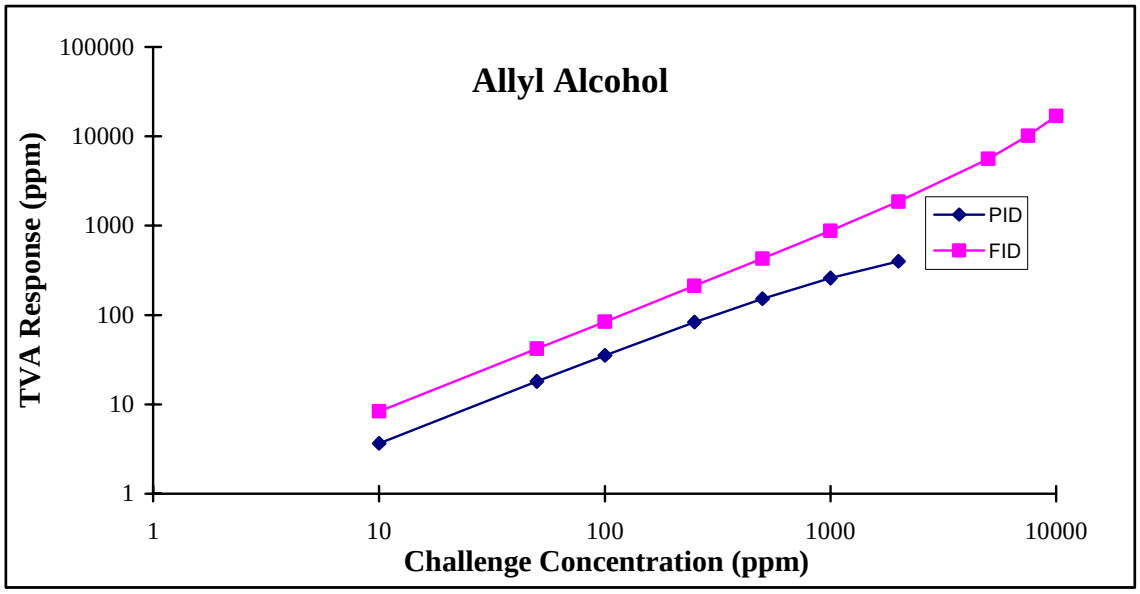


PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:		A	B
	PID	11.31	-2.53
	FID	6.56	5.18

Allyl Alcohol

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.303	0.676	2.723	1.193
50			2.768	1.190
100	0.298	0.681	2.825	1.187
250			2.995	1.178
500	0.250	0.701	3.278	1.163
1000	0.205	0.727	3.845	1.133
2000	0.155	0.778	4.979	1.073
5000		0.822		0.891
7500		0.935		0.740
10000		1.048		0.589

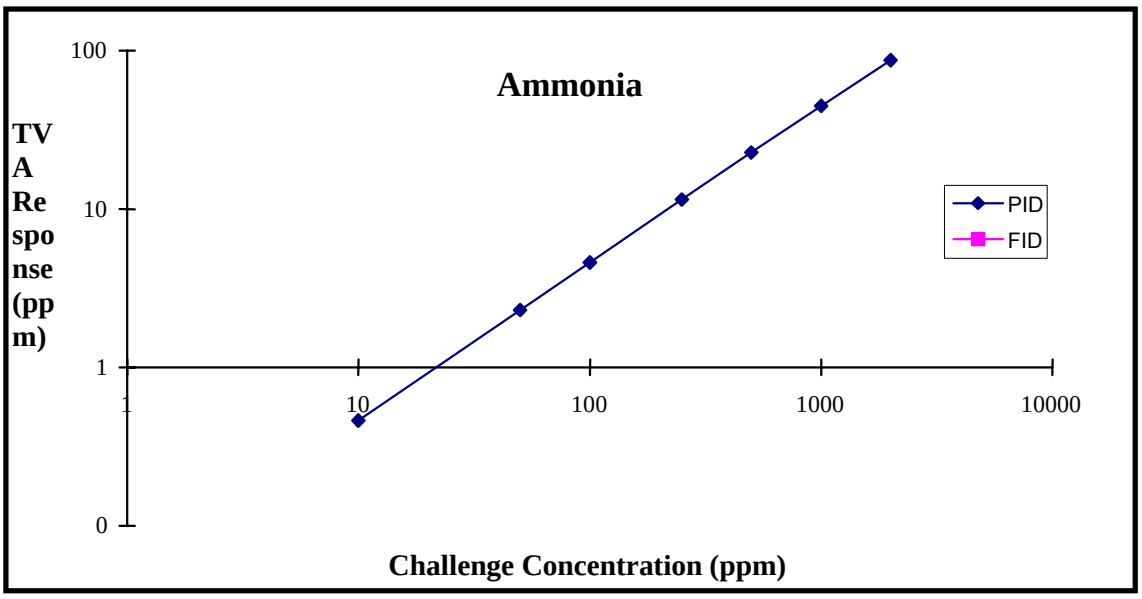


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	2.71	-11.34
	FID	1.19	0.61

Ammonia

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.200	NF	21.666	NF
50	0.199	NF	21.692	NF
100	0.198	NF	21.725	NF
250	0.196	NF	21.824	NF
500	0.173	NF	21.989	NF
1000	0.149	NF	22.319	NF
2000	0.122	NF	22.980	NF
5000		NF		NF
7500		NF		NF
10000		NF		NF

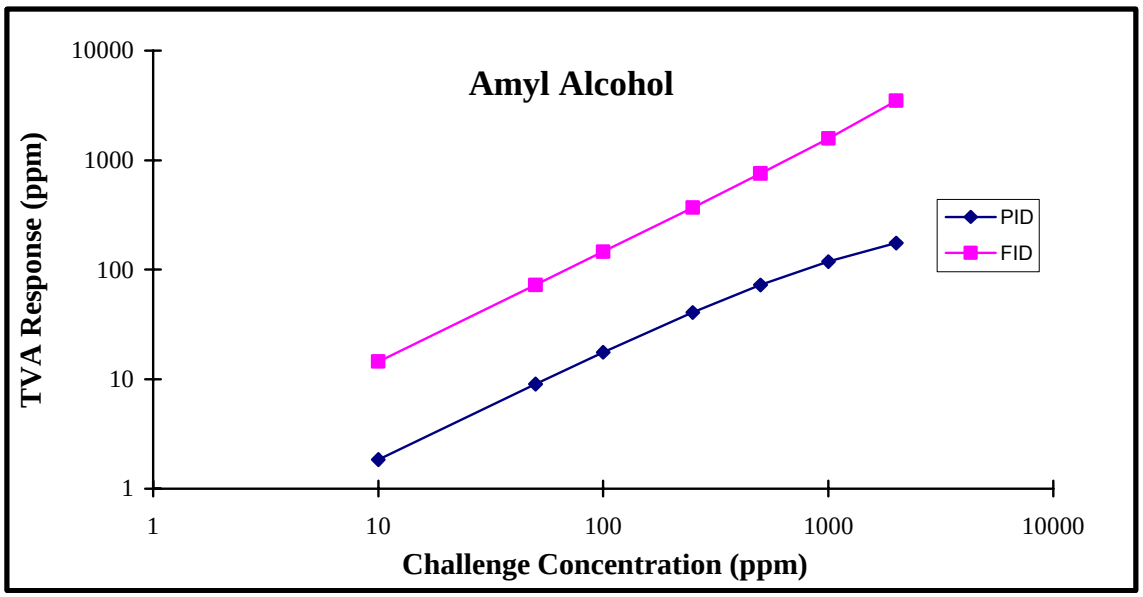


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	21.66	-6.60
	FID	NF	NF

Amyl Alcohol

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.172	0.716	5.424	0.692
50			5.545	0.689
100	0.166	0.714	5.696	0.686
250			6.150	0.677
500	0.128	0.703	6.906	0.662
1000	0.096	0.689	8.419	0.632
2000	0.064	0.662	11.444	0.572
5000		0.511		
7500				
10000				

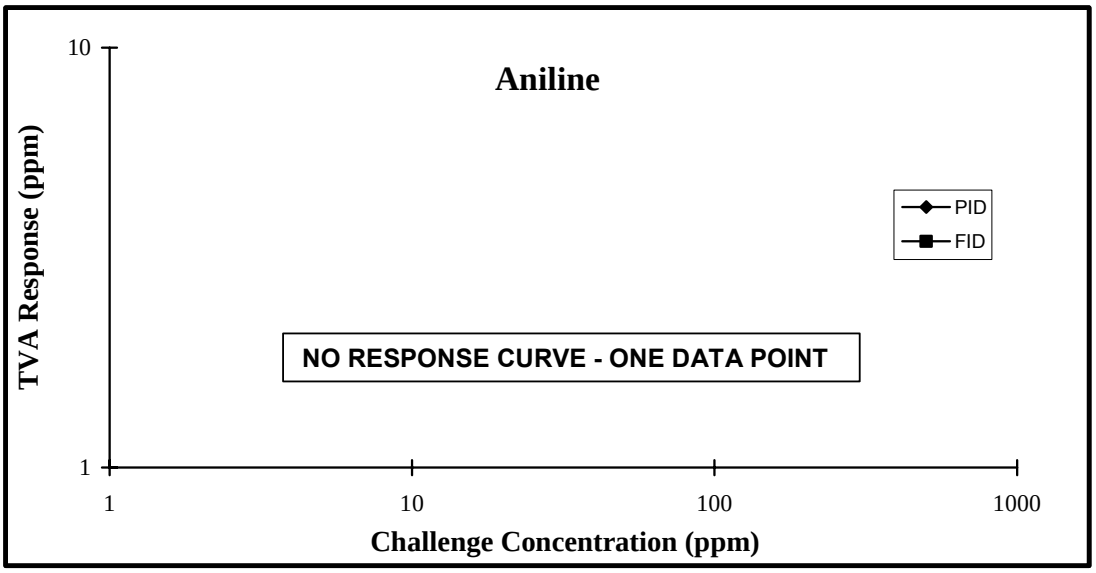


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	5.39	-30.26
	FID	0.69	0.60

Aniline

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor		EPA/TVA-1000B (or equivalent) Response Factor Multiplier	
	PID	FID	PID	FID
789.5	N/A	N/A	4.900	6.400

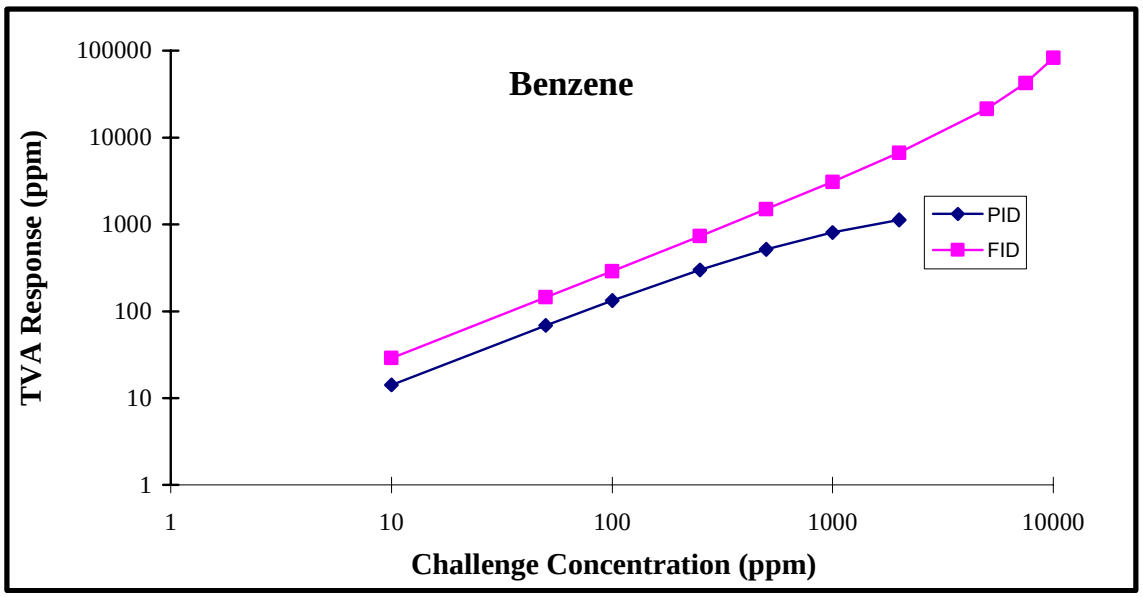


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	N/A	N/A
	FID	N/A	N/A

Benzene

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	1.795	3.400	0.702	0.346
50	1.744	3.420	0.724	0.345
100	1.684	3.430	0.751	0.344
250	1.527	3.480	0.833	0.340
500	1.322	3.558	0.968	0.335
1000	1.041	3.713	1.239	0.323
2000	0.731	4.023	1.781	0.301
5000		4.953		0.233
7500		5.728		0.177
10000		6.503		0.121

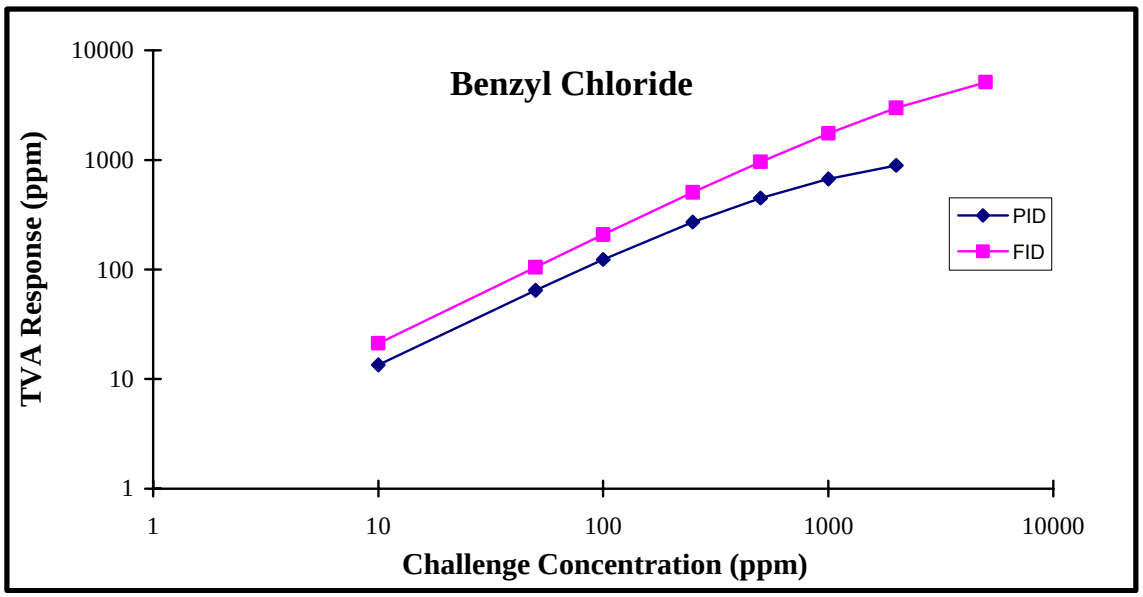


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	0.70	-5.42
	FID	0.35	0.23

Benzyl Chloride

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.341	0.693	0.743	0.472
50			0.773	0.476
100	0.327	0.684	0.811	0.481
250			0.924	0.496
500	0.248	0.647	1.113	0.521
1000	0.184	0.606	1.492	0.571
2000	0.121	0.538	2.248	0.672
5000				0.974
7500				
10000				

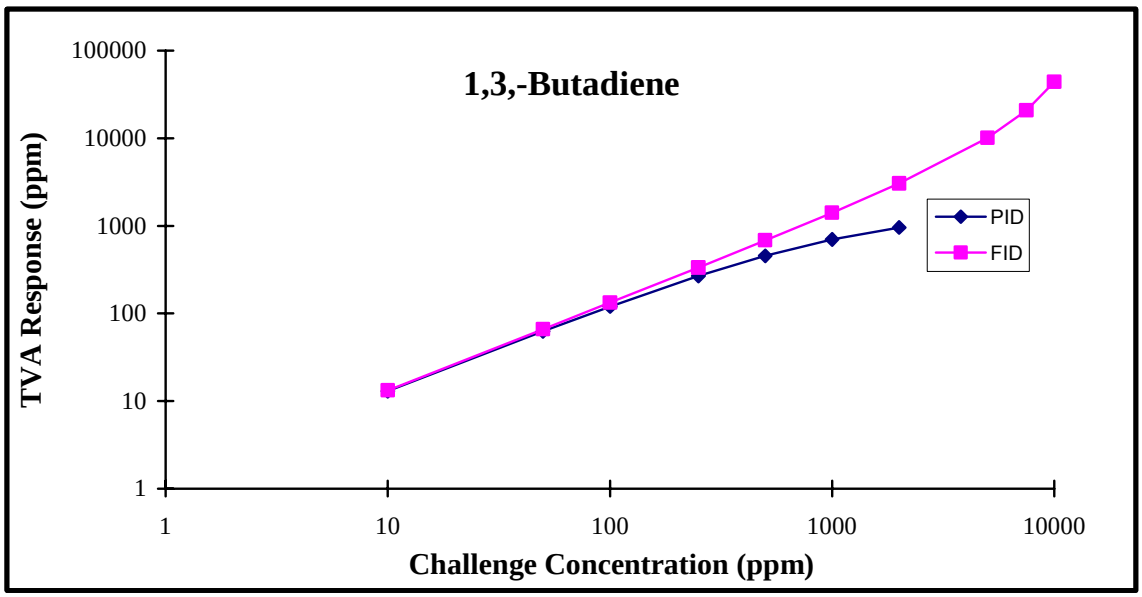


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	0.74	-7.57
	FID	0.47	-1.01

1,3,-Butadiene

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	1.281	1.466	0.773	0.758
50	1.243	1.474	0.799	0.756
100	1.198	1.484	0.832	0.754
250	1.082	1.514	0.932	0.746
500	0.931	1.565	1.097	0.732
1000	0.727	1.667	1.428	0.706
2000	0.506	1.871	2.091	0.653
5000		2.482		0.493
7500		2.991		0.360
10000		3.500		0.227

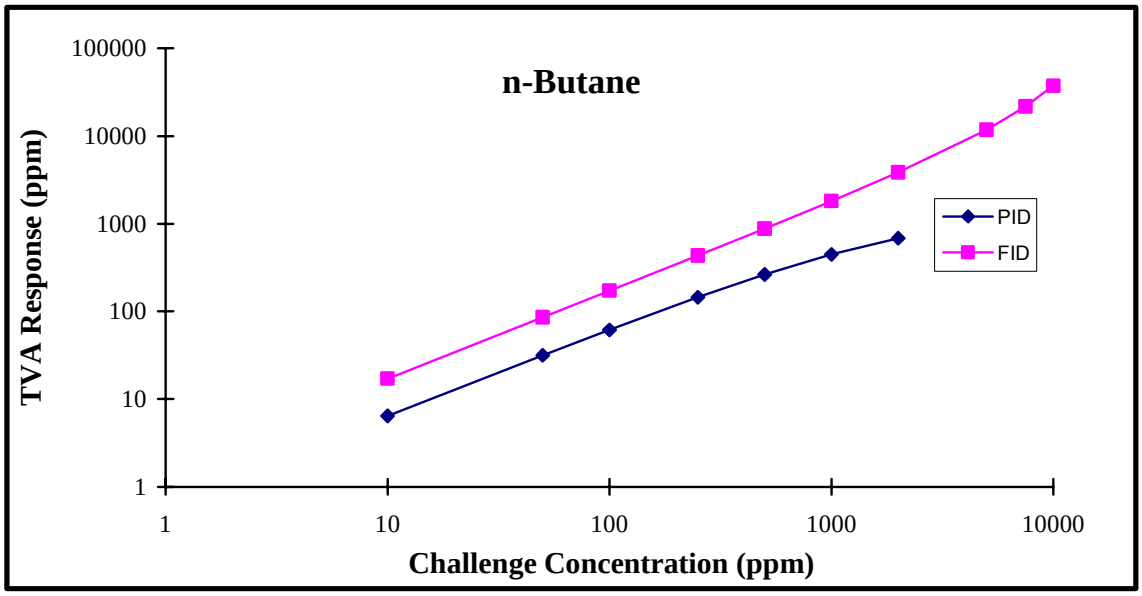


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	0.77	-6.62
	FID	0.76	0.53

n-Butane

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.624	1.721	1.555	0.583
50	0.617	1.729	1.583	0.582
100	0.609	1.738	1.617	0.580
250	0.586	1.767	1.721	0.576
500	0.496	1.814	1.893	0.568
1000	0.394	1.909	2.238	0.552
2000	0.284	2.098	2.928	0.520
5000		2.497		0.425
7500		2.940		0.346
10000		3.384		0.267

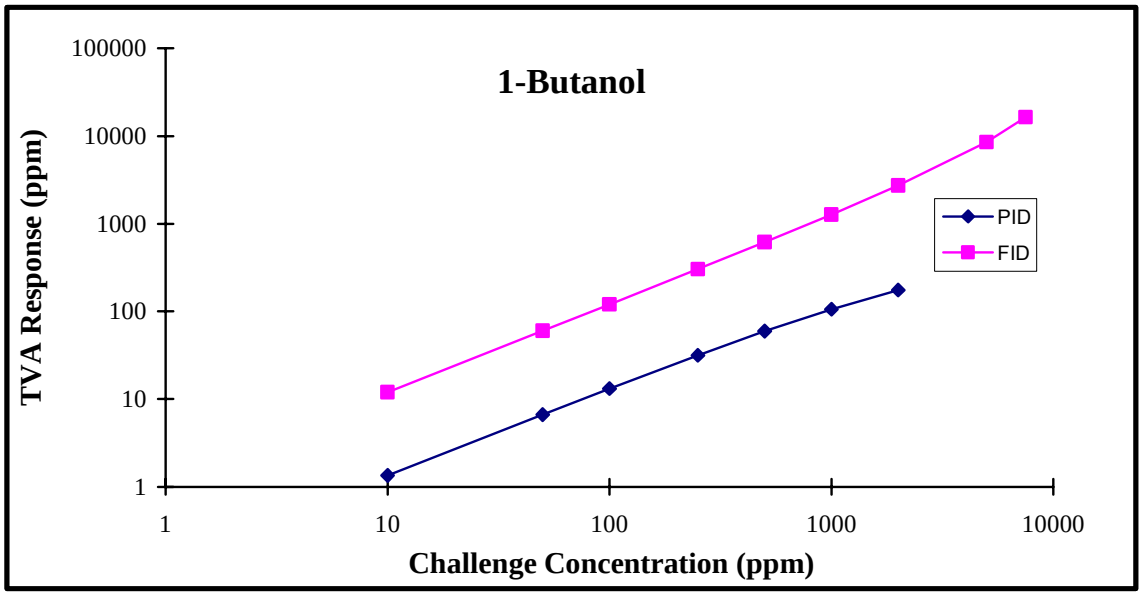


PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:		A	B
	PID	1.55	-6.90
	FID	0.58	0.32

1-Butanol

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.114	1.179	7.408	0.835
50	0.113	1.181	7.489	0.833
100	0.112	1.184	7.590	0.831
250	0.107	1.191	7.891	0.823
500	0.101	1.203	8.394	0.811
1000	0.089	1.228	9.401	0.786
2000	0.073	1.277	11.413	0.736
5000		1.424		0.585
7500		1.546		0.460
10000				

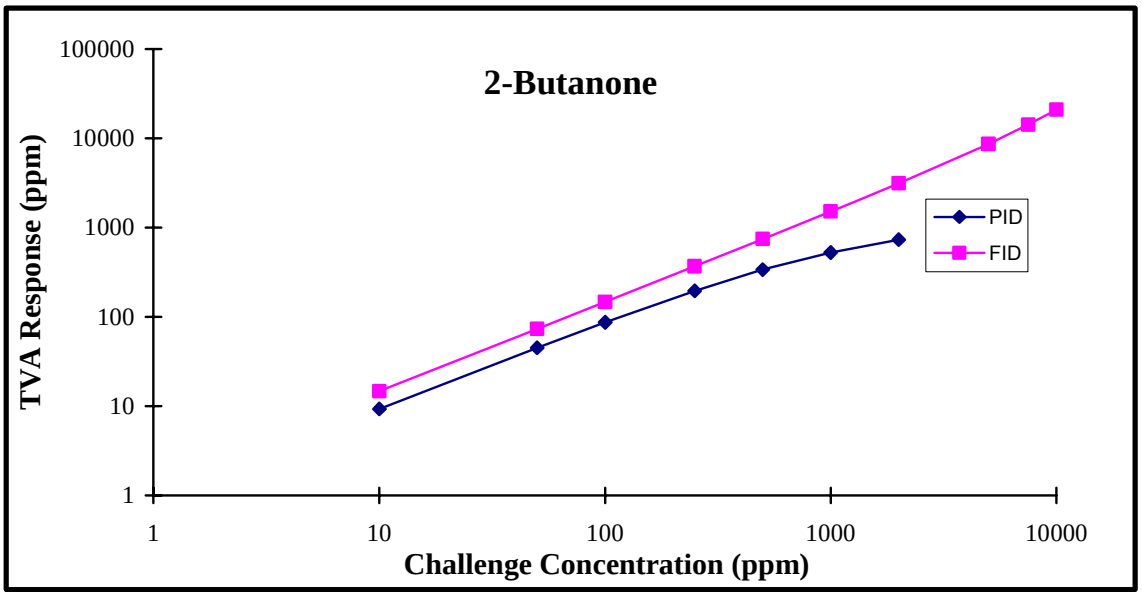


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	7.39	-20.12
	FID	0.84	0.50

2-Butanone

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	1.034	1.856	1.075	0.680
50	1.005	1.859	1.108	0.679
100	0.971	1.863	1.149	0.678
250	0.882	1.874	1.273	0.675
500	0.765	1.893	1.480	0.670
1000	0.604	1.930	1.893	0.660
2000	0.426	2.005	2.719	0.639
5000		2.223		0.578
7500		2.416		0.527
10000		2.603		0.475

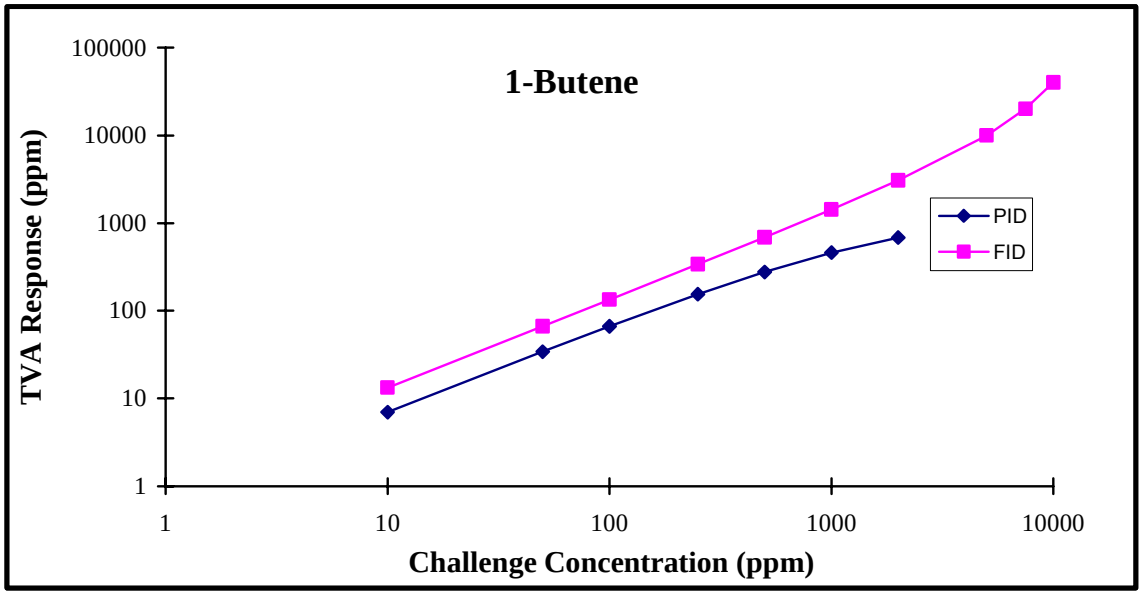


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	1.07	-8.26
	FID	0.68	0.21

1-Butene

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.812	1.570	1.438	0.750
50			1.468	0.748
100	0.791	1.592	1.505	0.745
250			1.616	0.738
500	0.641	1.692	1.802	0.725
1000	0.506	1.816	2.173	0.700
2000	0.362	2.065	2.916	0.650
5000		2.480		0.500
7500		3.028		0.374
10000		3.577		0.249

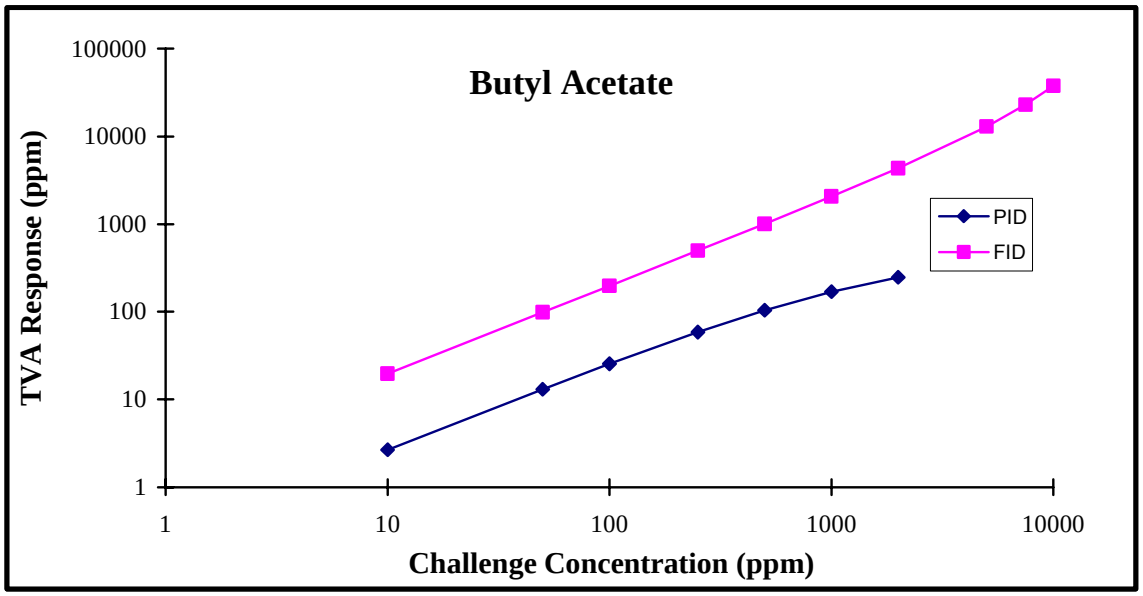


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	1.43	-7.42
	FID	0.75	0.50

Butyl Acetate

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.223	1.529	3.732	0.508
50	0.219	1.532	3.820	0.507
100	0.214	1.535	3.930	0.506
250	0.202	1.545	4.258	0.502
500	0.166	1.561	4.806	0.496
1000	0.125	1.594	5.902	0.484
2000	0.084	1.660	8.094	0.460
5000		1.739		0.387
7500		1.894		0.327
10000		2.048		0.266

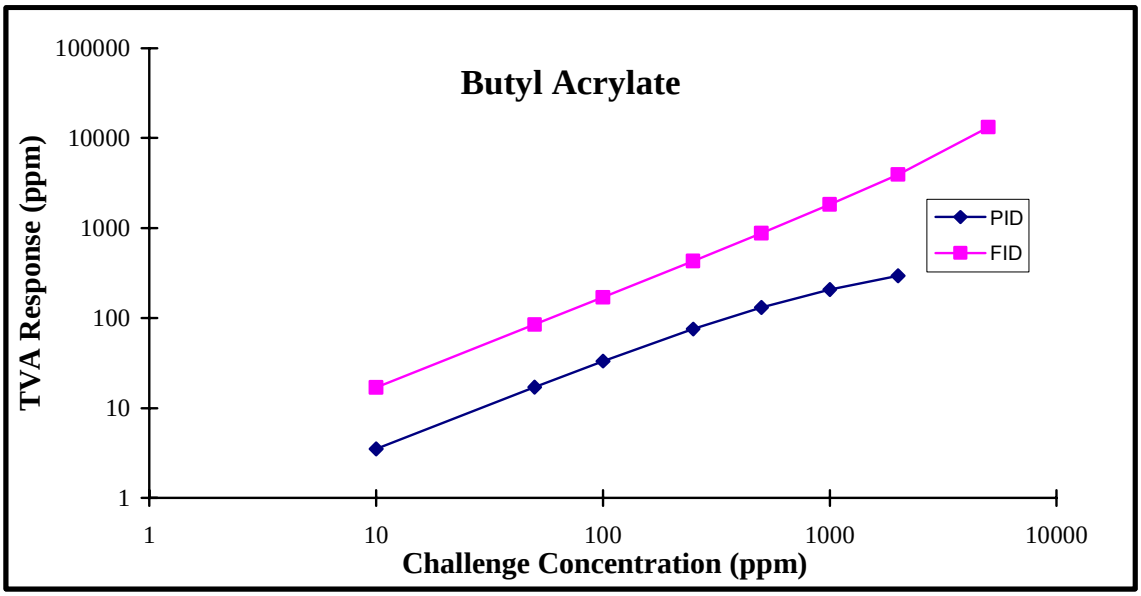


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	3.71	-21.92
	FID	0.51	0.24

Butyl Acrylate

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.114	1.179	2.843	0.591
50	0.113	1.181	2.923	0.589
100	0.112	1.184	3.022	0.587
250	0.107	1.191	3.320	0.580
500	0.101	1.203	3.816	0.570
1000	0.089	1.228	4.808	0.549
2000	0.073	1.277	6.792	0.506
5000		1.424		0.379

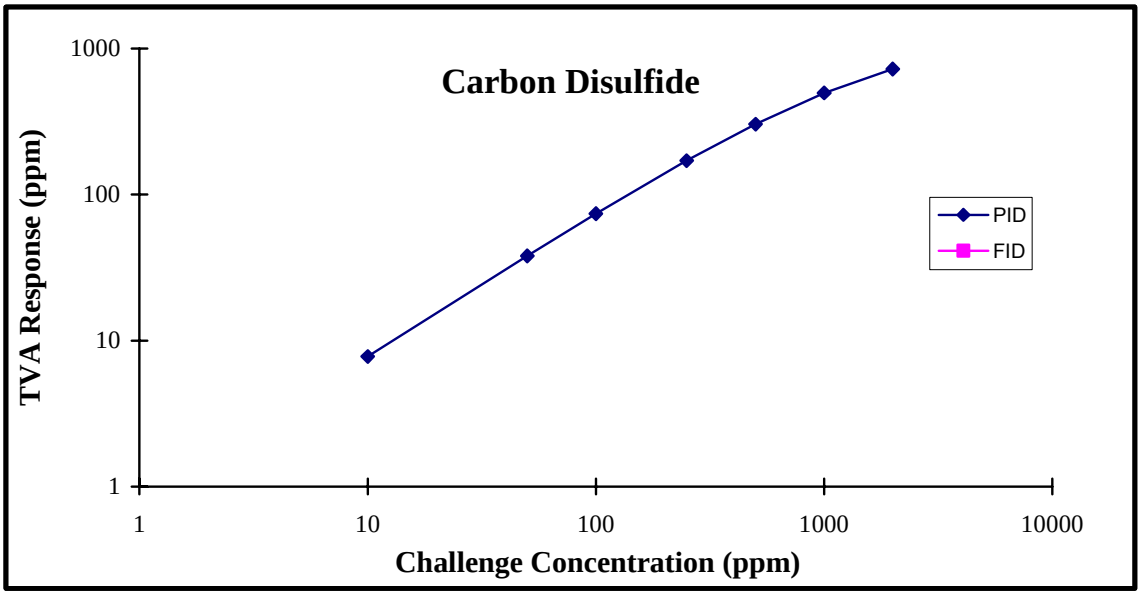


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	2.82	-19.84
	FID	0.59	0.42

Carbon Disulfide

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.822		1.285	
50	0.812		1.314	
100	0.792		1.351	
250	0.740		1.462	
500	0.666		1.646	
1000	0.556		2.015	
2000	0.417		2.752	
5000				
7500				
10000				

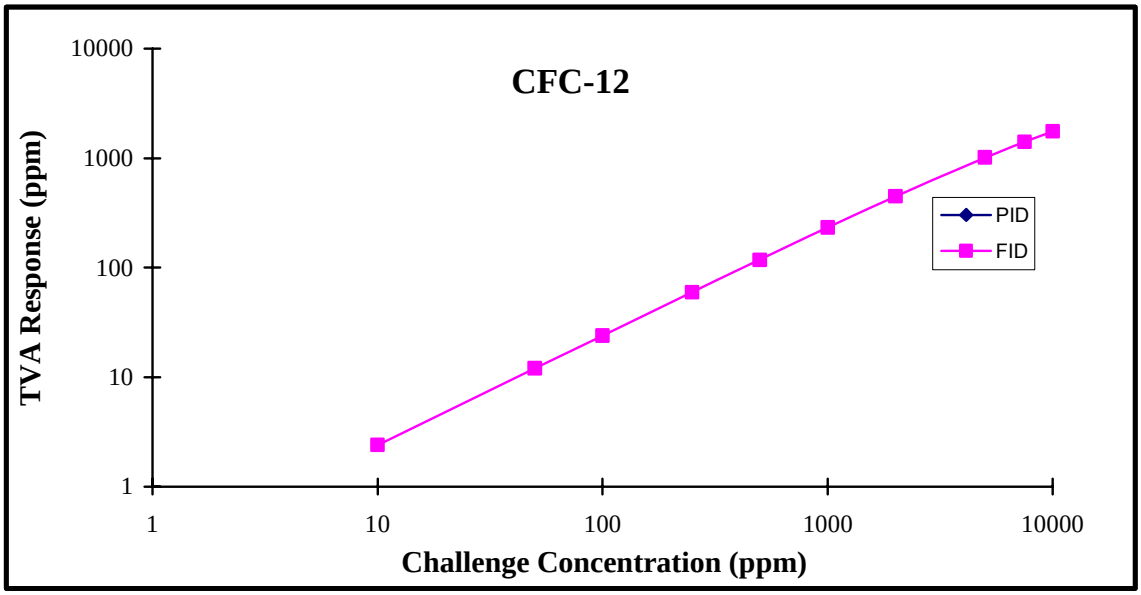


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	1.28	-7.37
	FID	NF	NF

CFC-12

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	NF	0.508	NF	4.157
50	NF	0.262	NF	4.163
100	NF	0.231	NF	4.170
250	NF	0.212	NF	4.194
500	NF	0.206	NF	4.232
1000	NF	0.203	NF	4.309
2000	NF	0.202	NF	4.463
5000		0.188		4.925
7500		0.188		5.310
10000		0.188		5.696

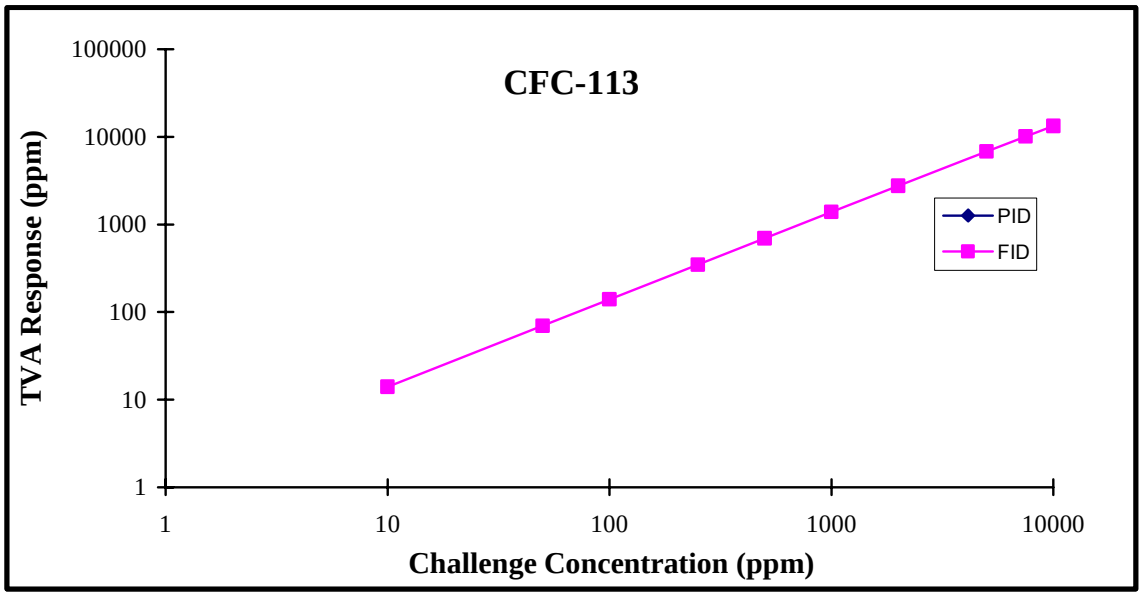


PID Lamp (eV): 0

TVA-1000B Response Curve Coefficients:		A	B
	PID	NF	NF
	FID	4.16	-1.54

CFC-113

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	NF	1.395	NF	0.717
50	NF	1.394	NF	0.717
100	NF	1.392	NF	0.717
250	NF	1.388	NF	0.718
500	NF	1.381	NF	0.719
1000	NF	1.366	NF	0.720
2000	NF	1.338	NF	0.723
5000		1.173		0.733
7500		1.106		0.740
10000		1.039		0.748

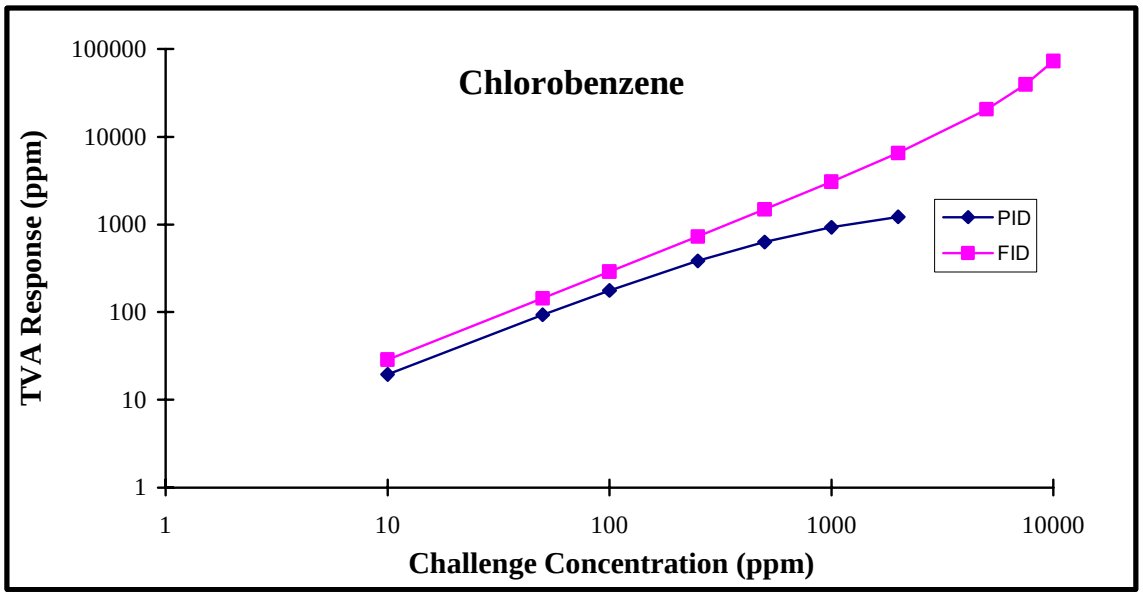


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	NF	NF
	FID	0.72	-0.03

Chlorobenzene

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	2.210	3.152	0.513	0.347
50	2.110	3.161	0.536	0.346
100	1.987	3.173	0.564	0.345
250	1.690	3.209	0.649	0.342
500	1.353	3.269	0.791	0.337
1000	0.967	3.389	1.074	0.326
2000	0.616	3.630	1.640	0.305
5000		4.351		0.242
7500		4.951		0.189
10000		5.552		0.137

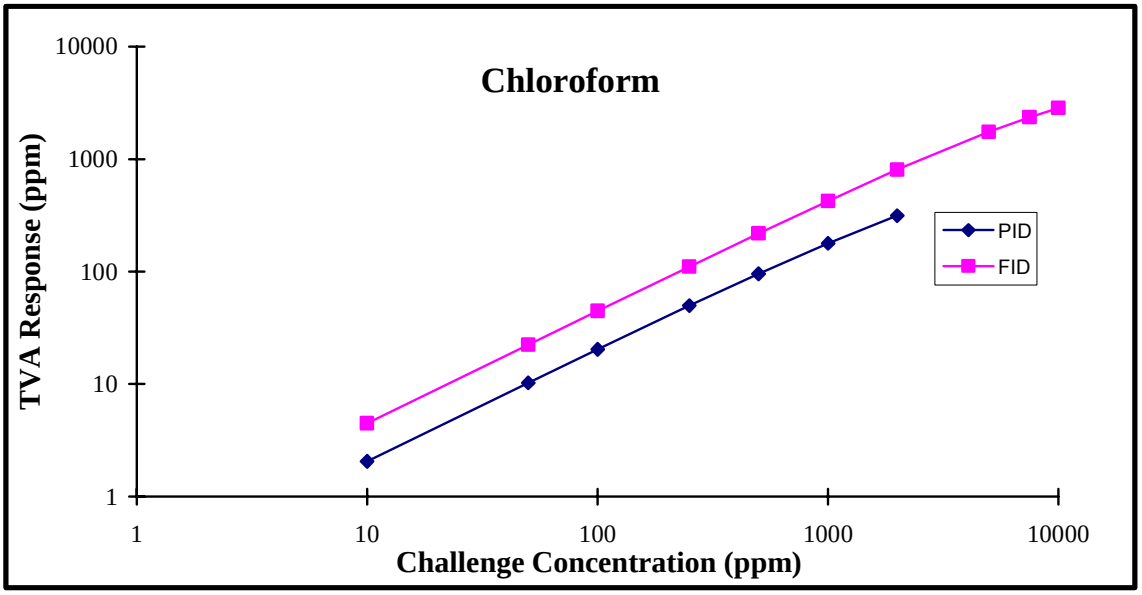


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	0.51	-5.66
	FID	0.35	0.21

Chloroform

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.343	0.817	4.838	2.229
50	0.339	0.616	4.870	2.234
100	0.334	0.545	4.909	2.241
250	0.321	0.464	5.026	2.260
500	0.271	0.411	5.221	2.292
1000	0.215	0.364	5.612	2.356
2000	0.154	0.322	6.393	2.484
5000		0.257		2.869
7500		0.239		3.190
10000		0.228		3.510

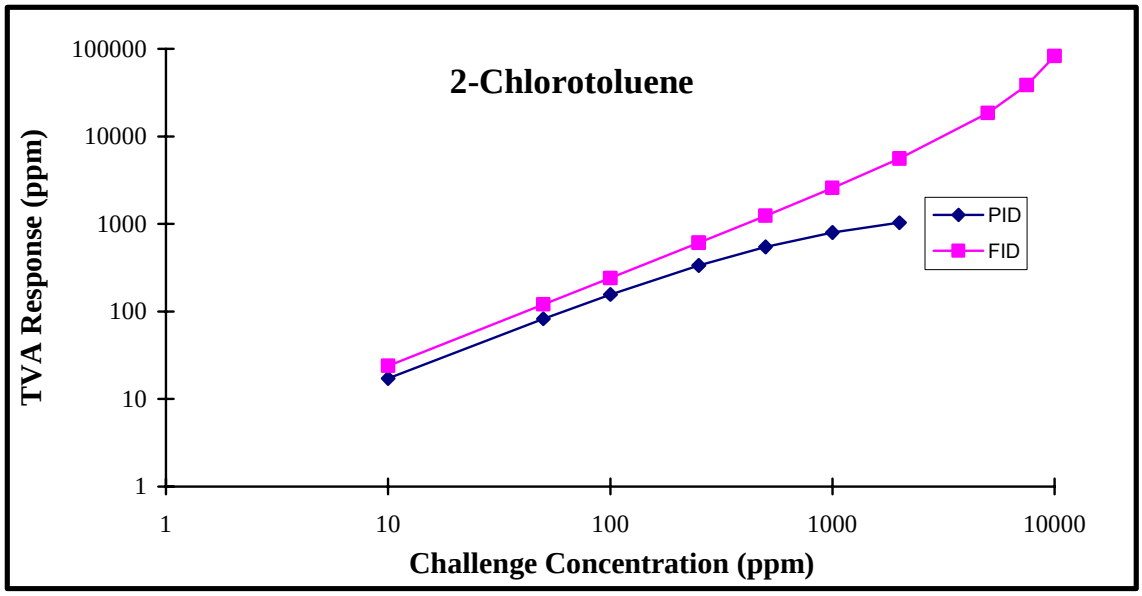


PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:		A	B
	PID	4.83	-7.81
	FID	2.23	-1.28

2-Chlorotoluene

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	1.868	4.912	0.580	0.417
50	1.782	4.912	0.607	0.416
100	1.685	4.930	0.641	0.414
250	1.449	4.989	0.744	0.410
500	1.174	5.098	0.914	0.402
1000	0.851	5.309	1.256	0.387
2000	0.549	5.735	1.938	0.358
5000		7.011		0.269
7500				
10000				

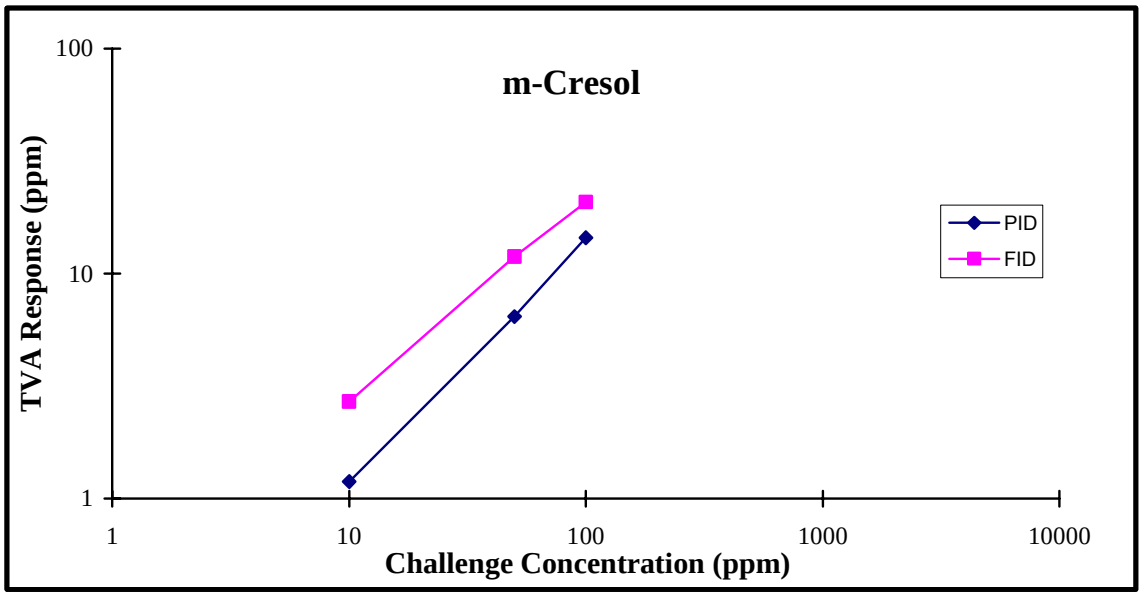


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	0.57	-6.83
	FID	0.42	0.30

m-Cresol

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10			8.399	3.708
50			7.751	4.200
100			6.941	4.816
250				
500				
1000				
2000				
5000				
7500				
10000				

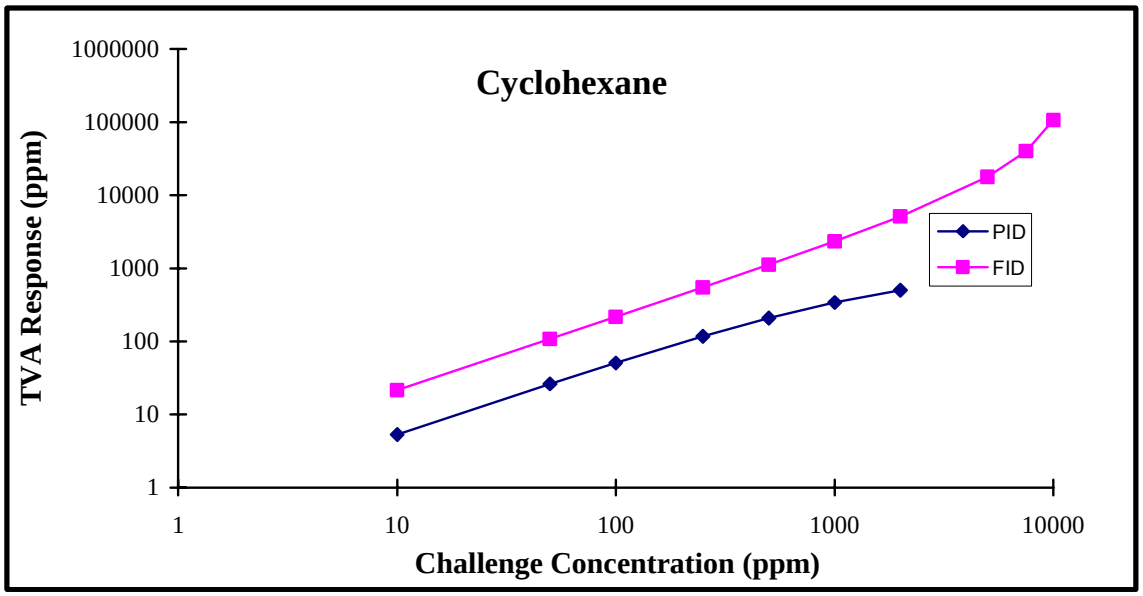


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	8.56	161.93
	FID	3.58	-123.10

Cyclohexane

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.546	2.395	1.875	0.467
50	0.531	2.411	1.917	0.465
100	0.513	2.431	1.970	0.463
250	0.467	2.491	2.128	0.458
500	0.406	2.590	2.392	0.448
1000	0.321	2.790	2.920	0.430
2000	0.227	3.190	3.975	0.392
5000		4.389		0.281
7500		5.388		0.187
10000		6.387		0.094

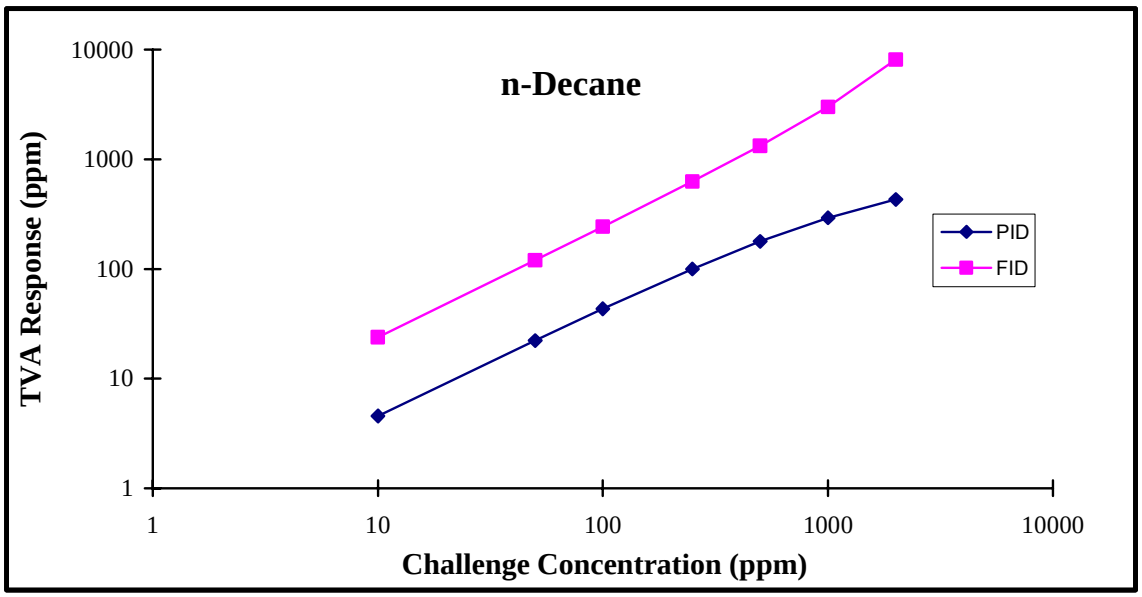


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	1.86	-10.55
	FID	0.47	0.37

n-Decane

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.408	2.495	2.201	0.420
50	0.396	2.472	2.250	0.417
100	0.382	2.443	2.312	0.413
250	0.345	2.359	2.495	0.399
500	0.267	2.233	2.802	0.377
1000	0.185	2.016	3.415	0.333
2000	0.113	1.688	4.640	0.245
5000		1.063		
7500				
10000				

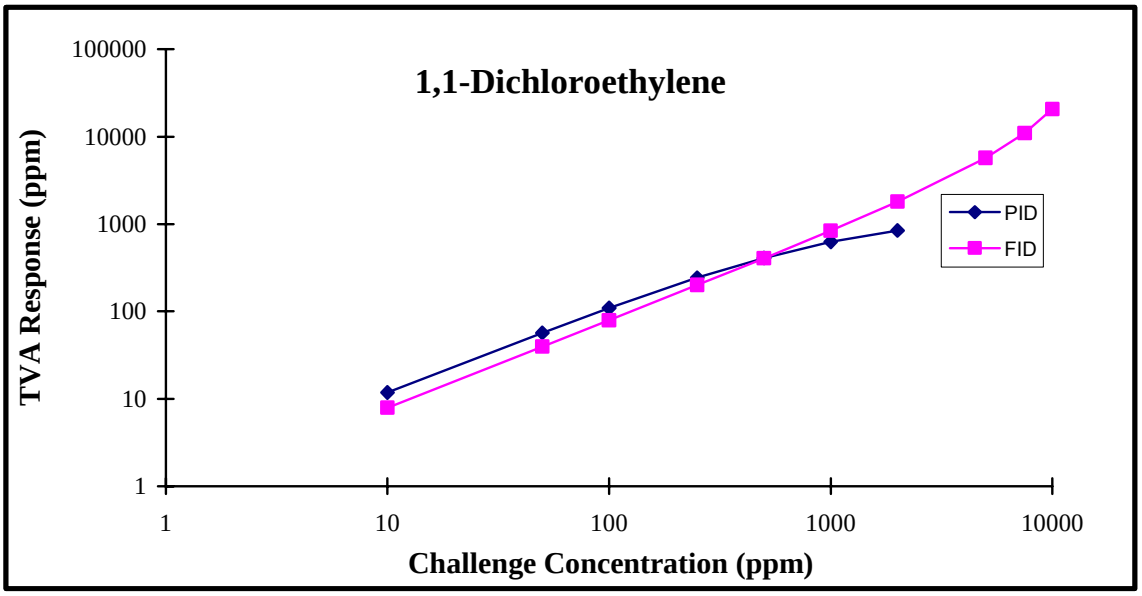


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	2.19	-12.26
	FID	0.42	0.88

1,1-Dichloroethylene

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	N/A	N/A	0.849	1.267
50			0.879	1.264
100			0.918	1.260
250			1.032	1.249
500			1.222	1.229
1000			1.603	1.190
2000			2.365	1.111
5000				0.877
7500				
10000				

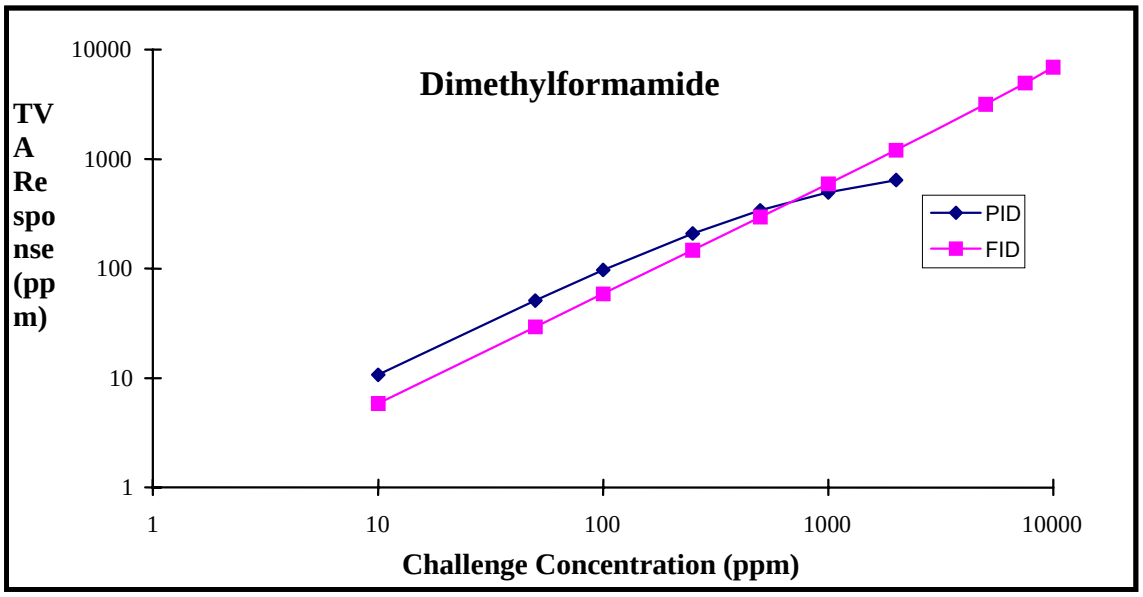


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	0.84	-7.62
	FID	1.27	0.78

Dimethylformamide

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.419	0.228	0.936	1.710
50			0.980	1.709
100	0.412	0.228	1.035	1.707
250			1.200	1.704
500	0.345	0.226	1.474	1.697
1000	0.282	0.223	2.023	1.684
2000	0.212	0.218	3.122	1.659
5000		0.179		1.582
7500				
10000				

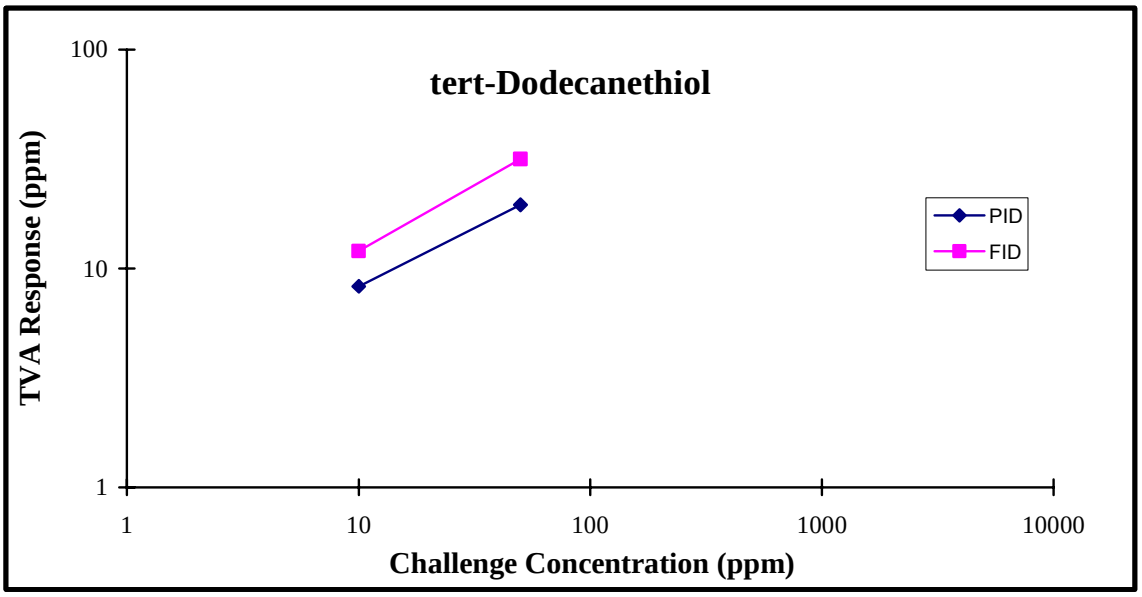


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	0.93	-10.98
	FID	1.71	0.26

tert-Dodecanethiol

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10			1.205	0.831
50			2.558	1.582
100				
250				
500				
1000				
2000				
5000				
7500				
10000				

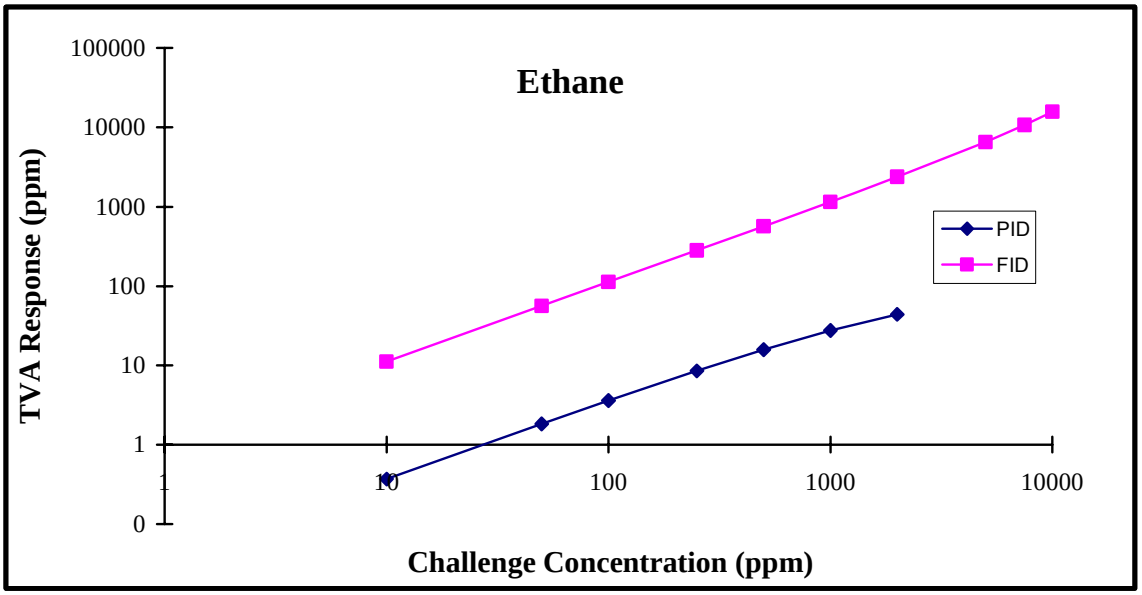


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	0.87	-338.18
	FID	0.64	-187.76

Ethane

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.042	1.069	27.069	0.895
50	0.042	1.070	27.441	0.894
100	0.042	1.072	27.906	0.892
250	0.041	1.078	29.301	0.889
500	0.036	1.087	31.626	0.882
1000	0.030	1.106	36.275	0.869
2000	0.023	1.145	45.573	0.843
5000		1.179		0.765
7500		1.268		0.700
10000		1.358		0.635

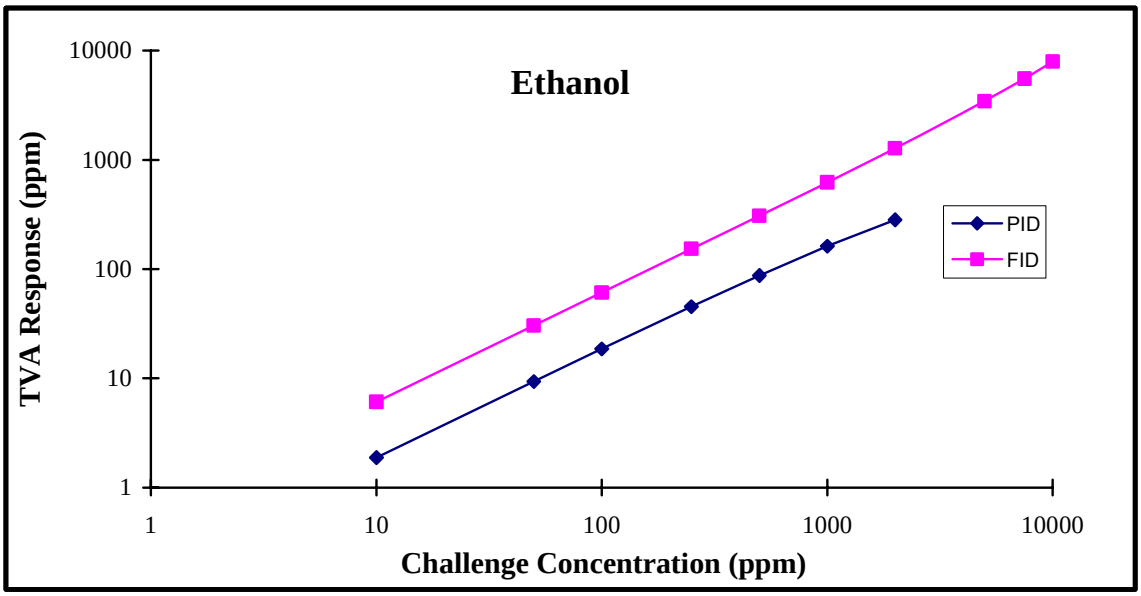


PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:		A	B
	PID	26.98	-92.98
	FID	0.90	0.26

Ethanol

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.234	0.591	5.303	1.644
50	0.232	0.591	5.339	1.643
100	0.230	0.592	5.383	1.641
250	0.225	0.595	5.516	1.635
500	0.195	0.600	5.737	1.625
1000	0.161	0.609	6.180	1.606
2000	0.123	0.627	7.066	1.568
5000		0.638		1.454
7500		0.681		1.359
10000		0.724		1.264

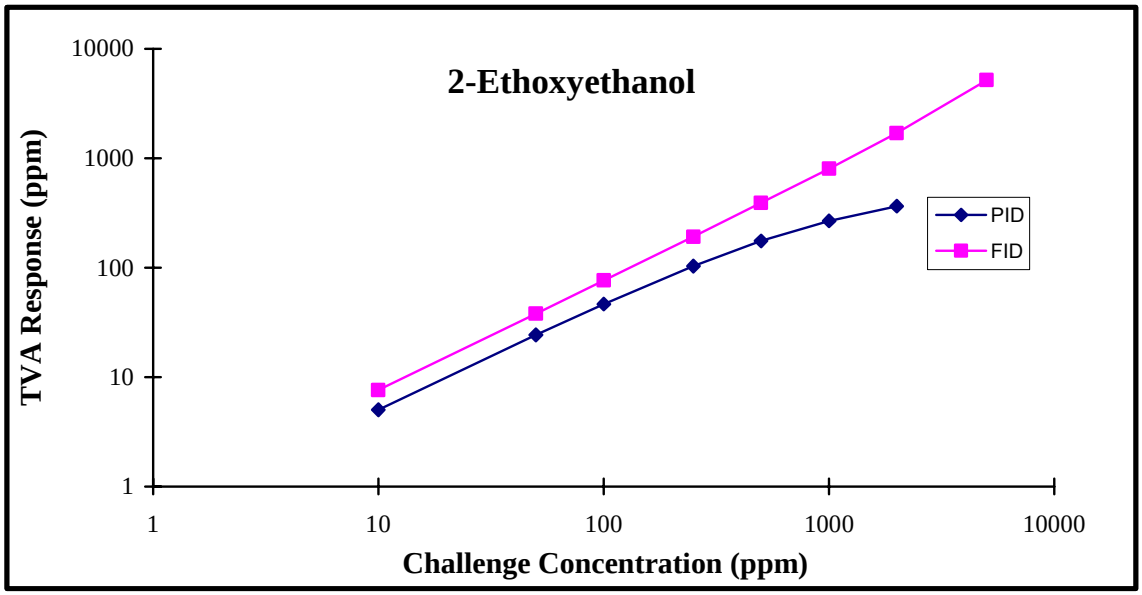


PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:		A	B
	PID	5.29	-8.86
	FID	1.64	0.38

2-Ethoxyethanol

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.189	0.323	1.992	1.315
50			2.062	1.312
100	0.188	0.325	2.150	1.309
250			2.412	1.298
500	0.166	0.335	2.848	1.281
1000	0.143	0.347	3.721	1.246
2000	0.118	0.370	5.468	1.175
5000		0.389		0.964
7500		0.442		
10000		0.494		

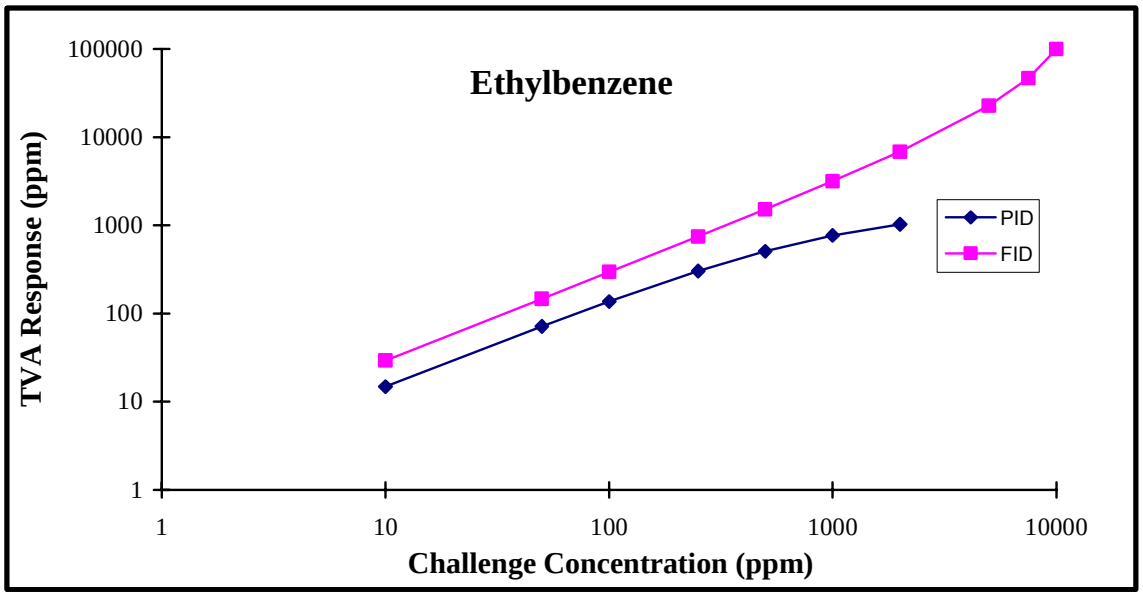


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	1.98	-17.46
	FID	1.32	0.71

Ethylbenzene

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.147	1.419	0.675	0.341
50	0.145	1.419	0.700	0.340
100	0.142	1.420	0.732	0.339
250	0.136	1.421	0.828	0.335
500	0.126	1.423	0.987	0.329
1000	0.110	1.427	1.306	0.317
2000	0.088	1.436	1.944	0.293
5000		1.462		0.221
7500		1.483		0.161
10000		1.505		0.101

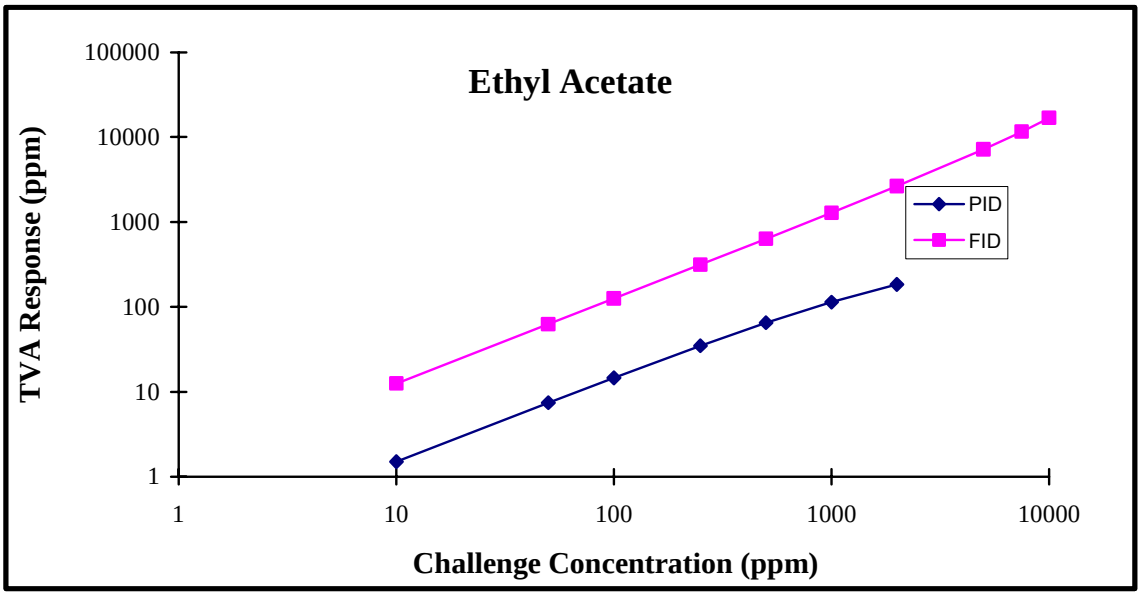


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	0.67	-6.38
	FID	0.34	0.24

Ethyl Acetate

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.147	1.419	6.639	0.799
50	0.145	1.419	6.724	0.799
100	0.142	1.420	6.831	0.798
250	0.136	1.421	7.152	0.794
500	0.126	1.423	7.687	0.789
1000	0.110	1.427	8.757	0.779
2000	0.088	1.436	10.896	0.758
5000		1.462		0.696
7500		1.483		0.644
10000		1.505		0.592

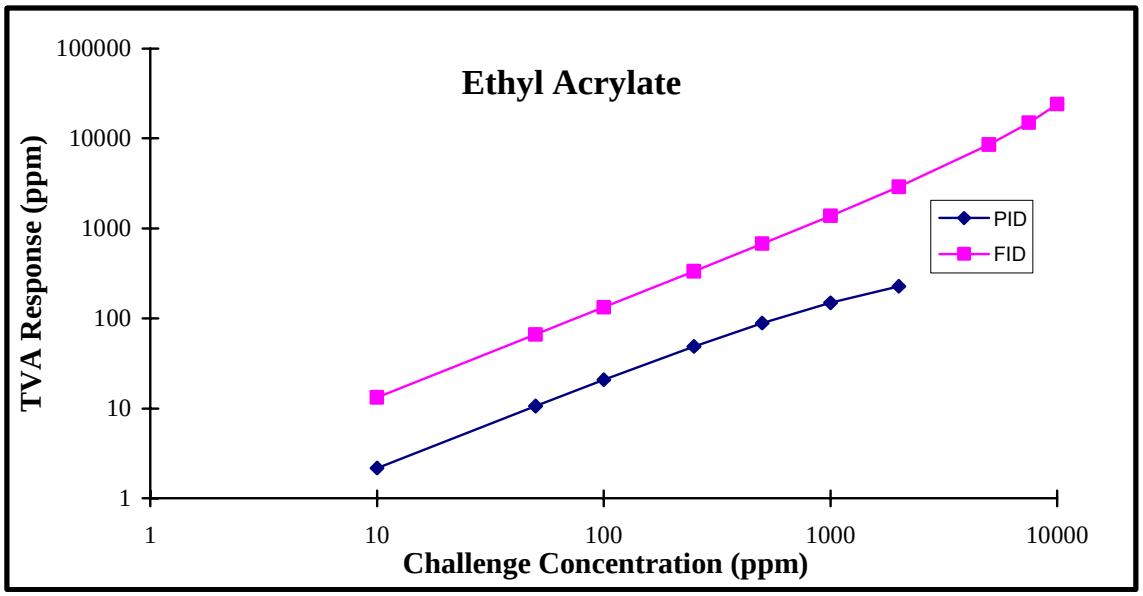


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	6.62	-21.40
	FID	0.80	0.21

Ethyl Acrylate

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.289	1.492	4.628	0.758
50			4.712	0.756
100	0.279	1.501	4.818	0.755
250			5.134	0.749
500	0.216	1.540	5.661	0.741
1000	0.164	1.589	6.716	0.724
2000	0.111	1.687	8.824	0.690
5000		1.747		0.588
7500		1.963		0.502
10000		2.179		0.417

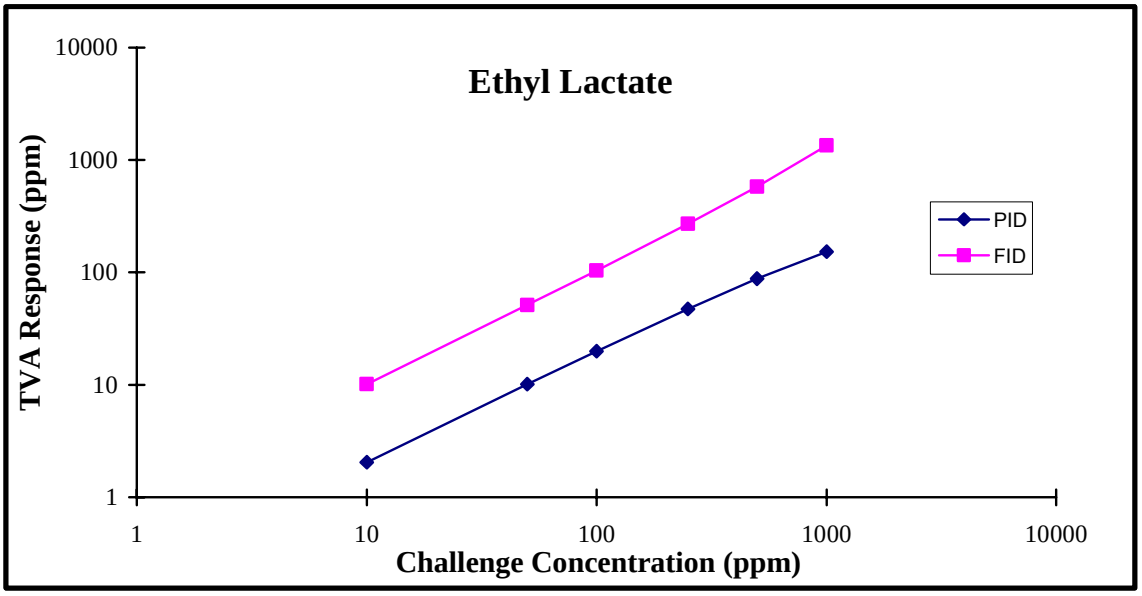


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	4.61	-21.09
	FID	0.76	0.34

Ethyl Lactate

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10			4.867	0.984
50			4.935	0.974
100			5.020	0.962
250			5.274	0.925
500			5.697	0.864
1000			6.544	0.741
2000				
5000				
7500				
10000				

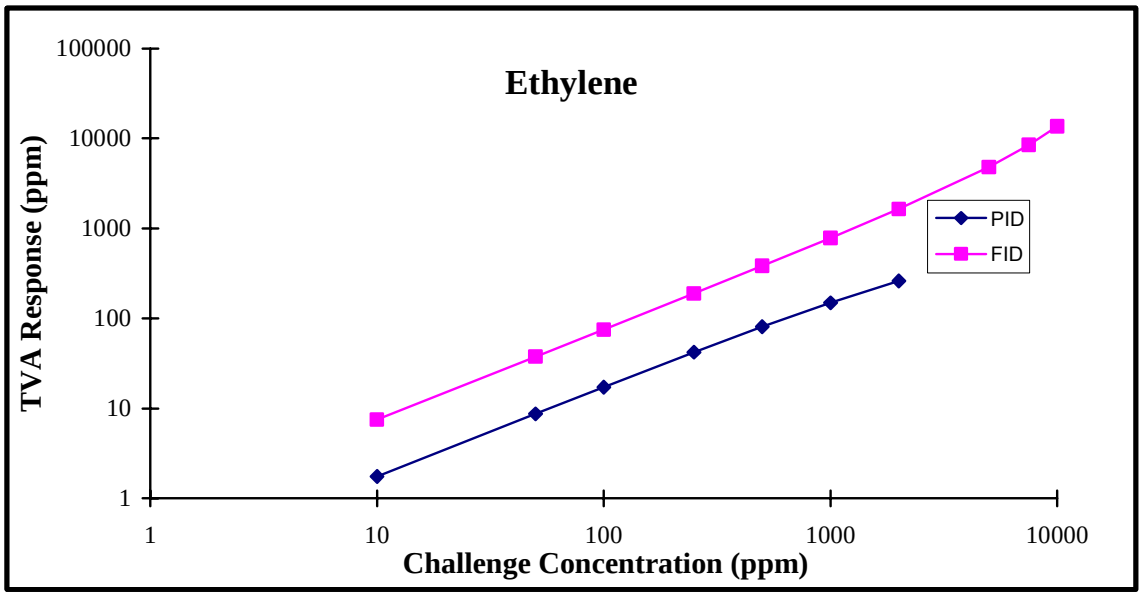


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	4.85	-16.93
	FID	0.99	2.46

Ethylene

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.174	0.834	5.715	1.337
50			5.754	1.334
100	0.172	0.838	5.804	1.331
250			5.951	1.322
500	0.147	0.856	6.198	1.307
1000	0.123	0.879	6.690	1.277
2000	0.097	0.924	7.675	1.217
5000		0.993		1.037
7500		1.099		0.886
10000		1.205		0.736

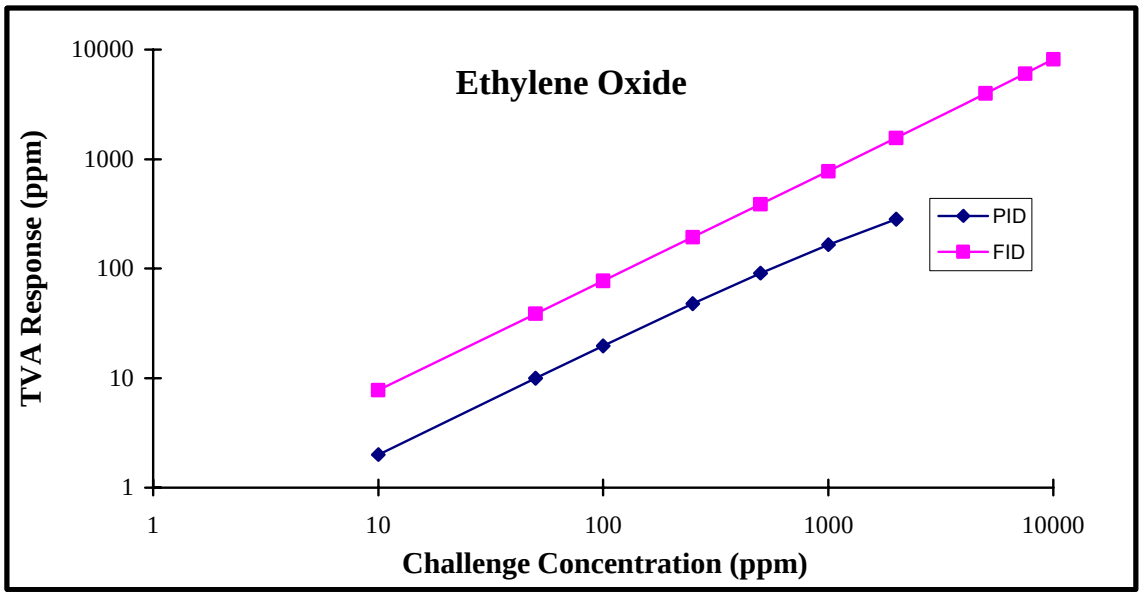


PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:		A	B
	PID	5.71	-9.85
	FID	1.34	0.60

Ethylene Oxide

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.300	1.000	4.986	1.294
50	0.280	0.800	5.028	1.294
100	0.280	0.770	5.080	1.293
250	0.272	0.760	5.238	1.292
500	0.260	0.756	5.500	1.290
1000	0.238	0.753	6.025	1.287
2000	0.204	0.753	7.075	1.280
5000		0.752		1.258
7500		0.751		1.240
10000		0.751		1.222

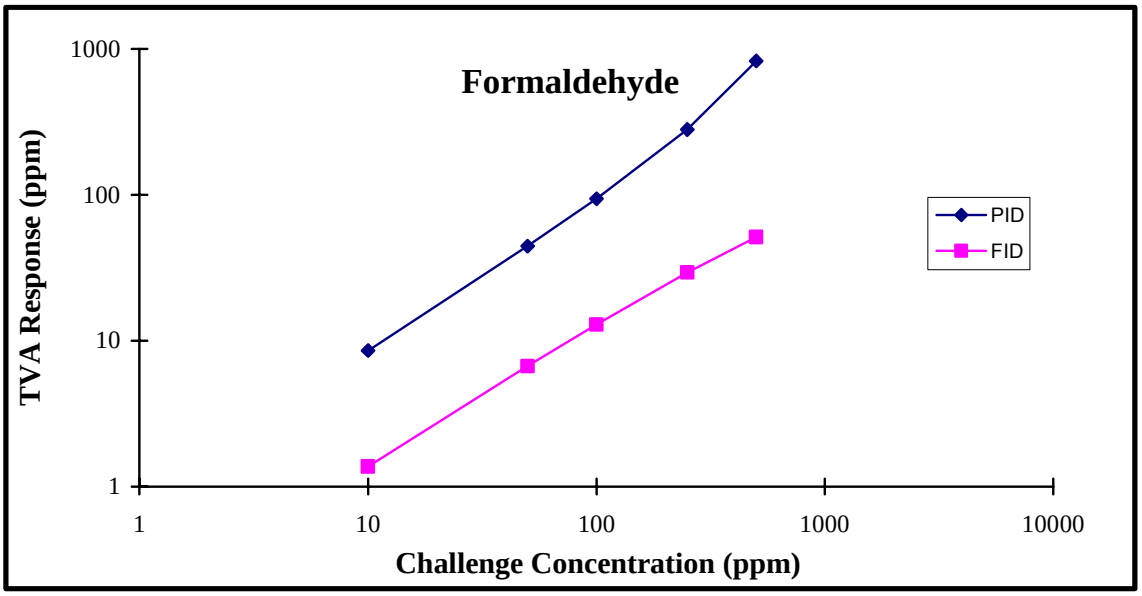


PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:		A	B
	PID	4.98	-10.50
	FID	1.29	0.07

Formaldehyde

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	1.160	25.000	1.169	7.286
50			1.123	7.488
100			1.065	7.740
250			0.893	8.497
500			0.605	9.760
1000				
2000				
5000				
7500				
10000				

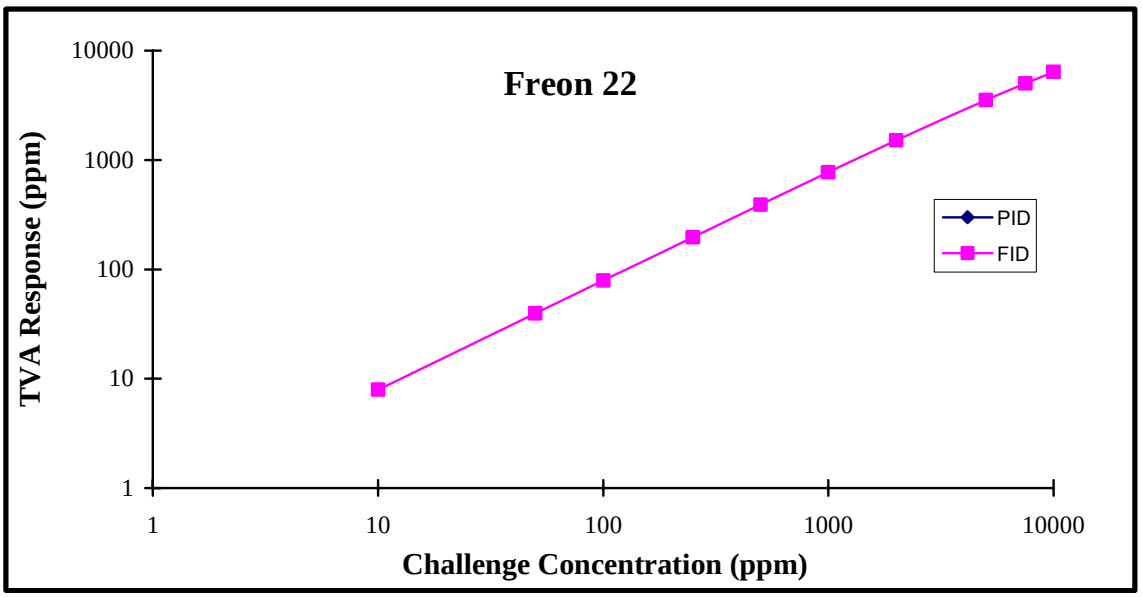


PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:		A	B
	PID	1.18	11.50
	FID	7.24	-50.49

Freon 22

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	N/A	1.375	N/A	1.263
50		1.374		1.264
100		1.373		1.266
250		1.369		1.270
500		1.364		1.278
1000		1.353		1.293
2000		1.332		1.323
5000		1.267		1.413
7500		1.213		1.488
10000		1.159		1.563

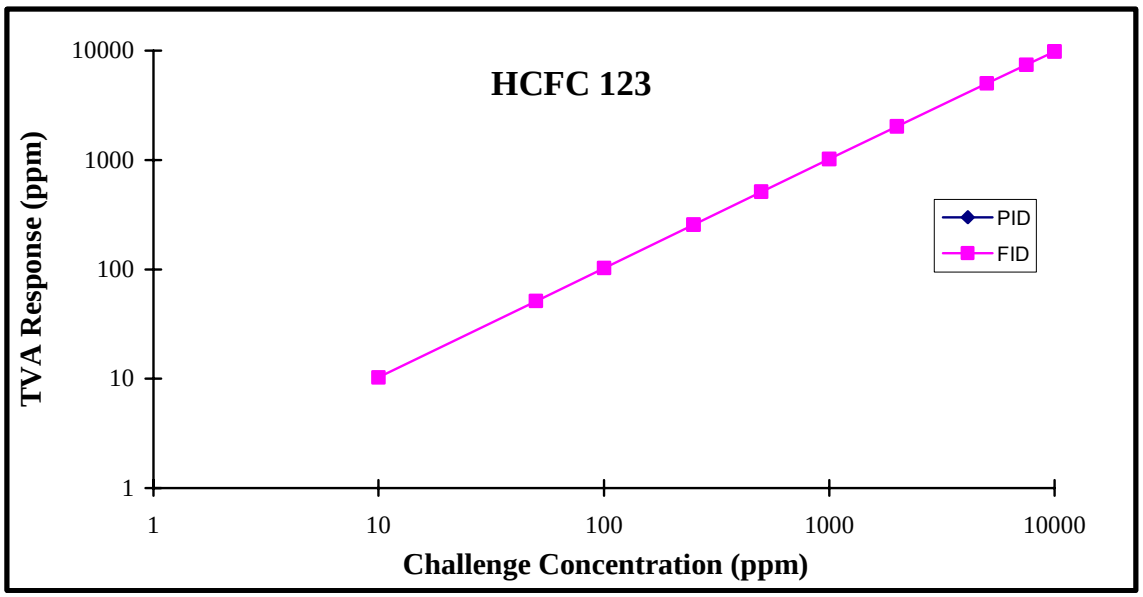


PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:		A	B
	PID	N/A	N/A
	FID	1.26	-0.30

HCFC 123

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	N/A	N/A	N/A	0.974
50				0.975
100				0.975
250				0.975
500				0.977
1000				0.979
2000				0.984
5000				0.998
7500				1.009
10000				1.021

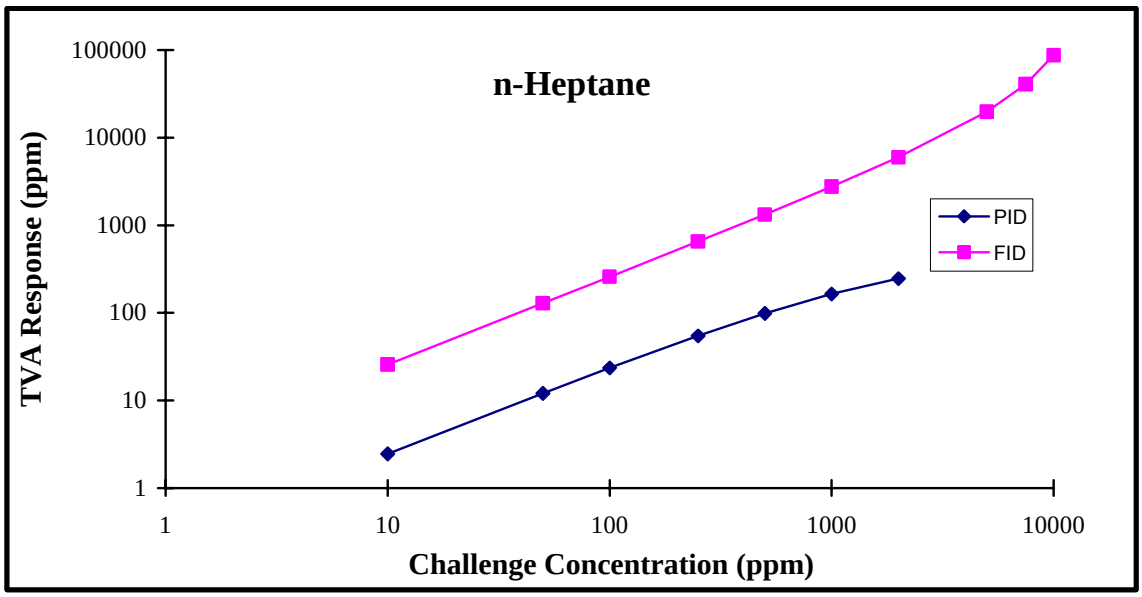


PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:		A	B
	PID	N/A	N/A
	FID	0.97	-0.05

n-Heptane

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.276	2.639	4.074	0.390
50	0.270	2.658	4.156	0.389
100	0.262	2.681	4.258	0.388
250	0.243	2.752	4.564	0.384
500	0.195	2.871	5.074	0.377
1000	0.142	3.107	6.094	0.363
2000	0.092	3.580	8.133	0.335
5000		4.681		0.253
7500		5.788		0.183
10000		6.896		0.114

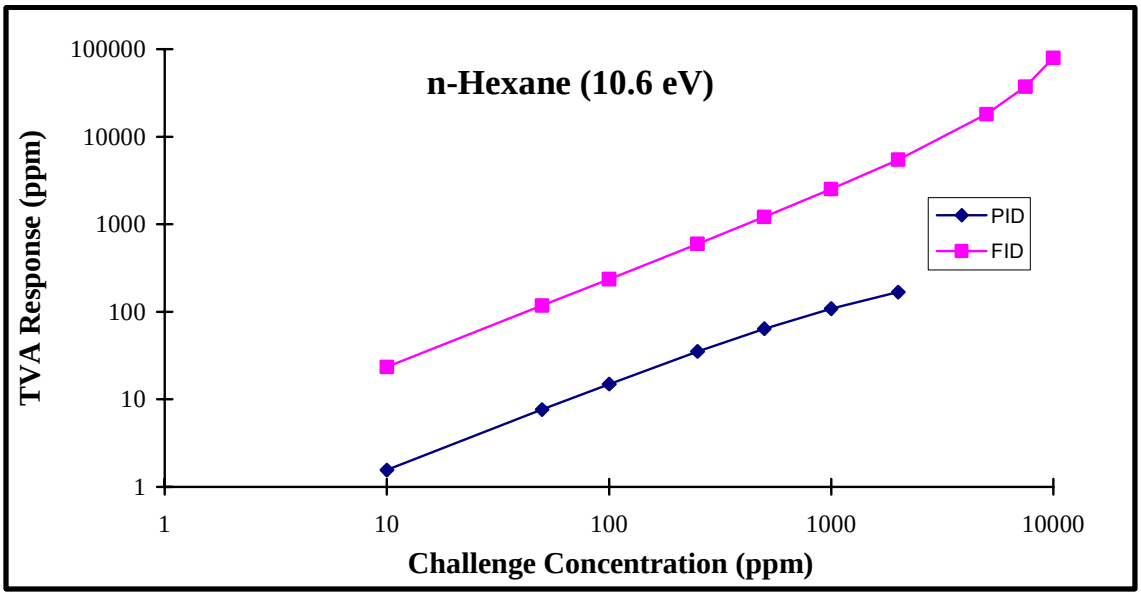


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	4.05	-20.40
	FID	0.39	0.28

n-Hexane (10.6 eV)

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.151	2.321	6.434	0.426
50	0.148	2.336	6.545	0.425
100	0.144	2.354	6.683	0.424
250	0.135	2.411	7.097	0.419
500	0.121	2.504	7.787	0.412
1000	0.101	2.692	9.167	0.397
2000	0.075	3.067	11.926	0.367
5000		4.192		0.276
7500		5.130		0.201
10000		6.068		0.126

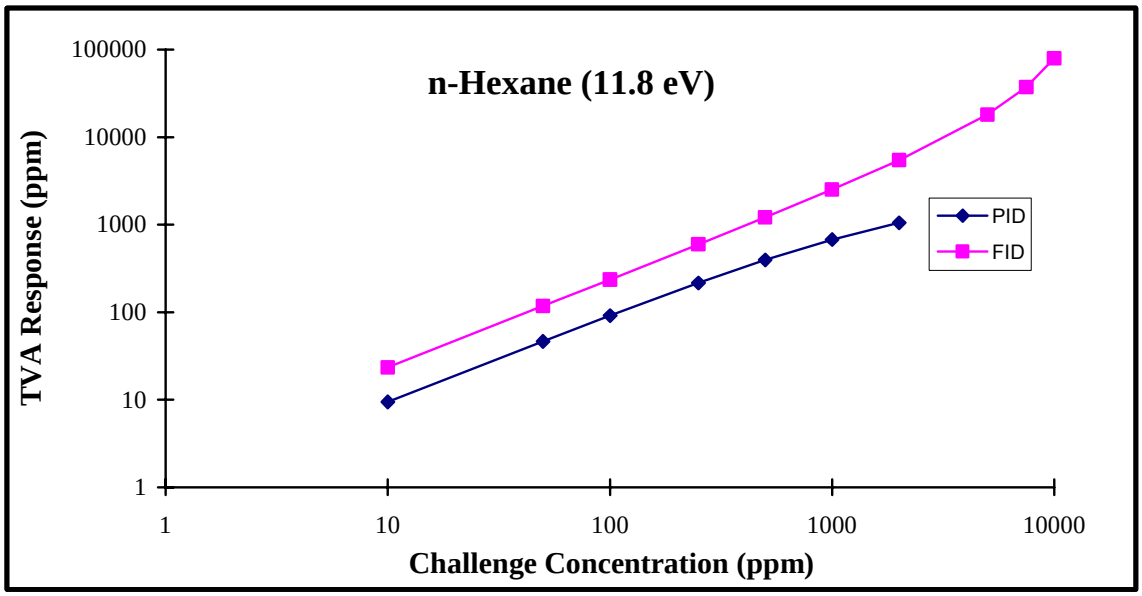


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	6.41	-27.60
	FID	0.43	0.30

n-Hexane (11.8 eV)

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	1.199	2.321	1.058	0.426
50	1.182	2.336	1.075	0.425
100	1.161	2.354	1.096	0.424
250	1.102	2.411	1.159	0.419
500	0.914	2.504	1.264	0.412
1000	0.703	2.692	1.474	0.397
2000	0.484	3.067	1.895	0.367
5000		4.192		0.276
7500		5.130		0.201
10000		6.068		0.126

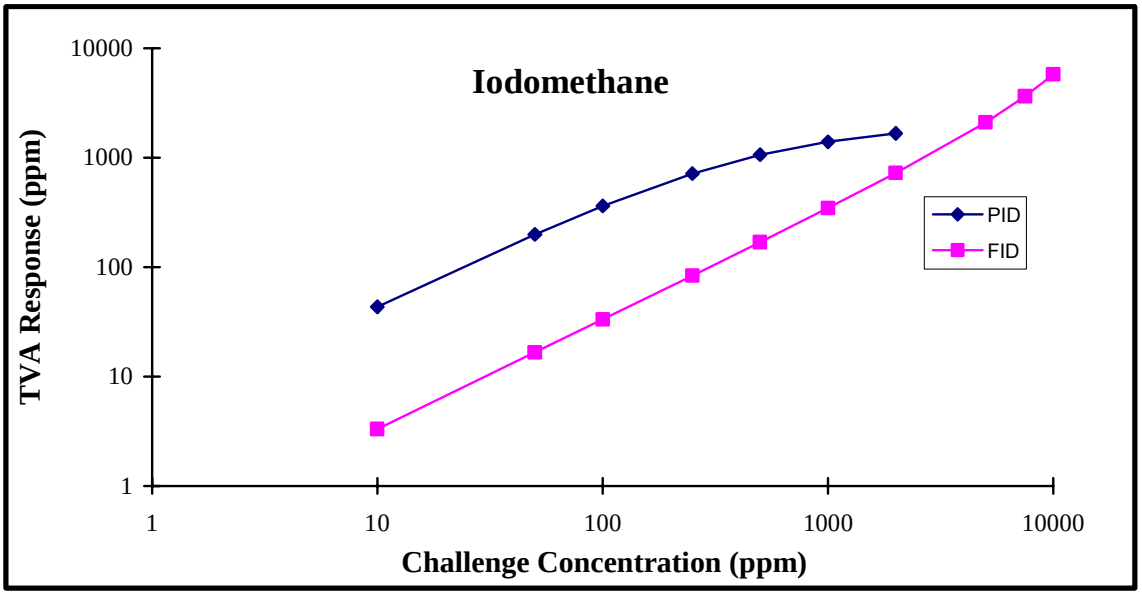


PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:		A	B
	PID	1.05	-4.20
	FID	0.43	0.30

Iodomethane

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10			0.231	3.014
50			0.250	3.009
100			0.275	3.002
250			0.348	2.983
500			0.470	2.951
1000			0.714	2.887
2000			1.201	2.758
5000				2.373
7500				2.052
10000				1.731

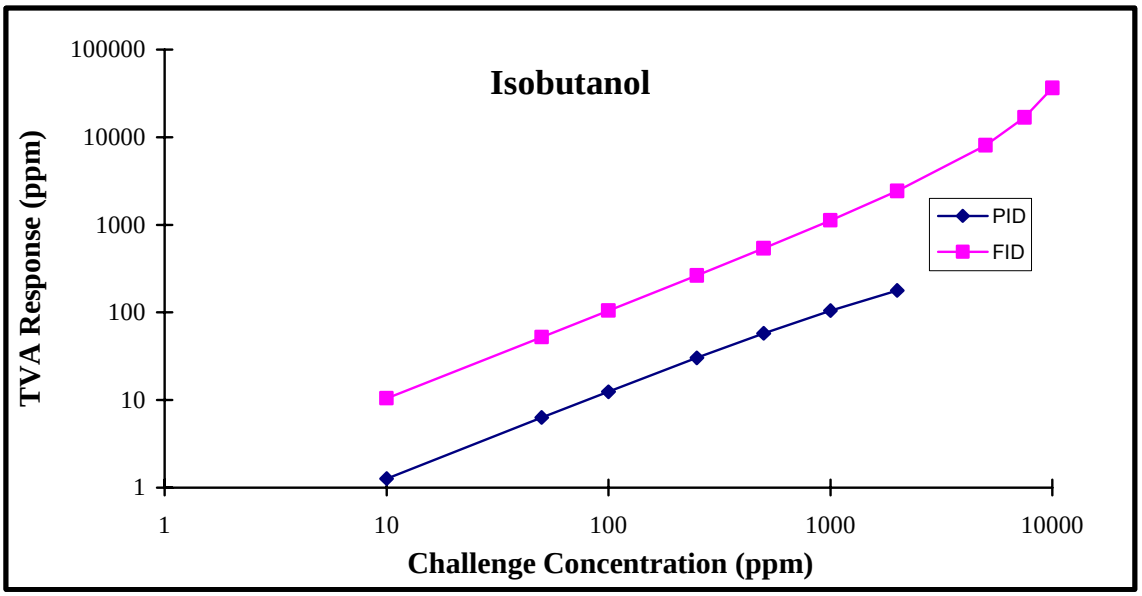


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	0.23	-4.88
	FID	3.02	1.28

Isobutanol

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.140	1.449	7.867	0.960
50	0.138	1.452	7.934	0.958
100	0.136	1.457	8.018	0.954
250	0.129	1.492	8.269	0.944
500	0.120	1.536	8.688	0.927
1000	0.104	1.623	9.526	0.892
2000	0.083	1.886	11.202	0.824
5000		2.105		0.618
7500		2.324		0.446
10000				0.274

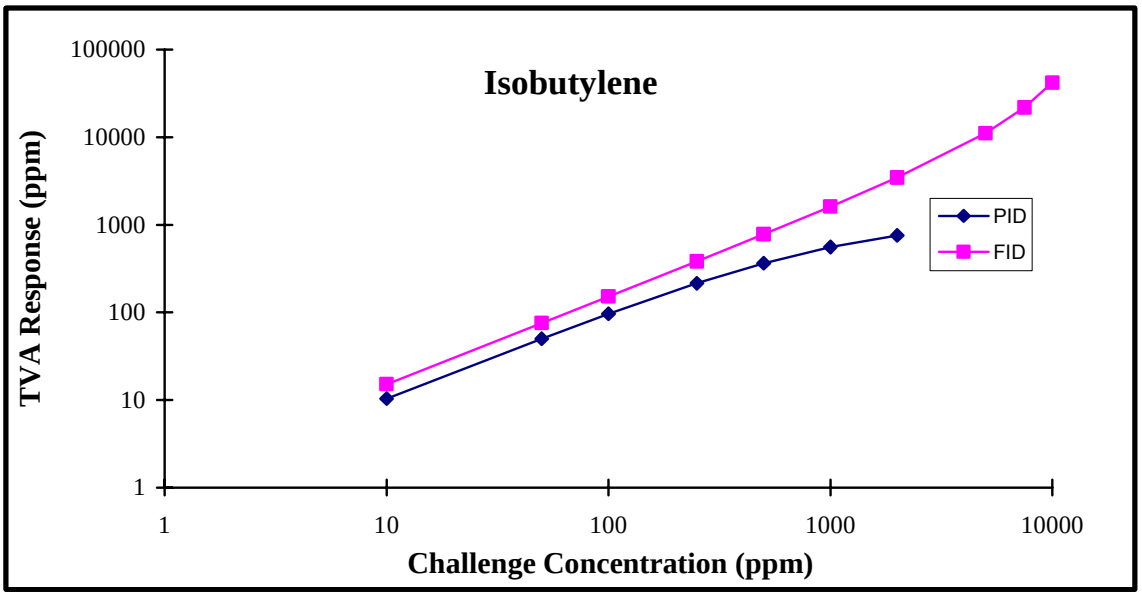


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	7.85	-16.76
	FID	0.96	0.69

Isobutylene

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10			1.000	0.663
50			1.000	0.661
100			1.000	0.659
250			1.164	0.652
500			1.374	0.642
1000			1.795	0.620
2000			2.635	0.578
5000				0.450
7500				0.344
10000				0.238

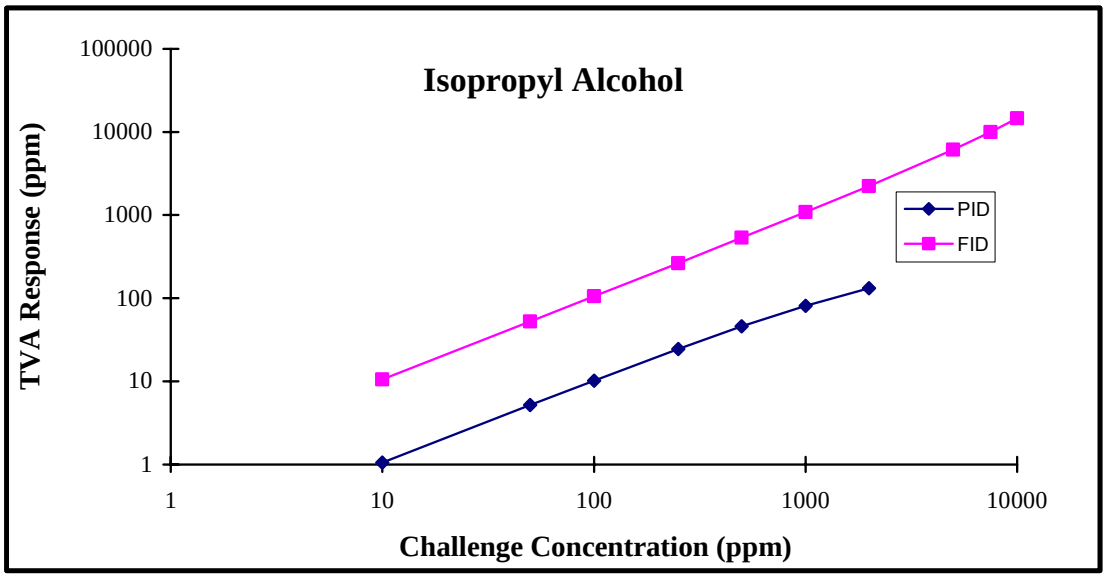


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	0.95	-8.40
	FID	0.66	0.43

Isopropyl Alcohol

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.120	1.240	9.555	0.950
50	0.119	1.242	9.669	0.949
100	0.117	1.245	9.811	0.948
250	0.112	1.252	10.237	0.944
500	0.104	1.264	10.949	0.937
1000	0.091	1.287	12.371	0.924
2000	0.073	1.335	15.215	0.898
5000		1.477		0.820
7500		1.596		0.755
10000		1.715		0.690

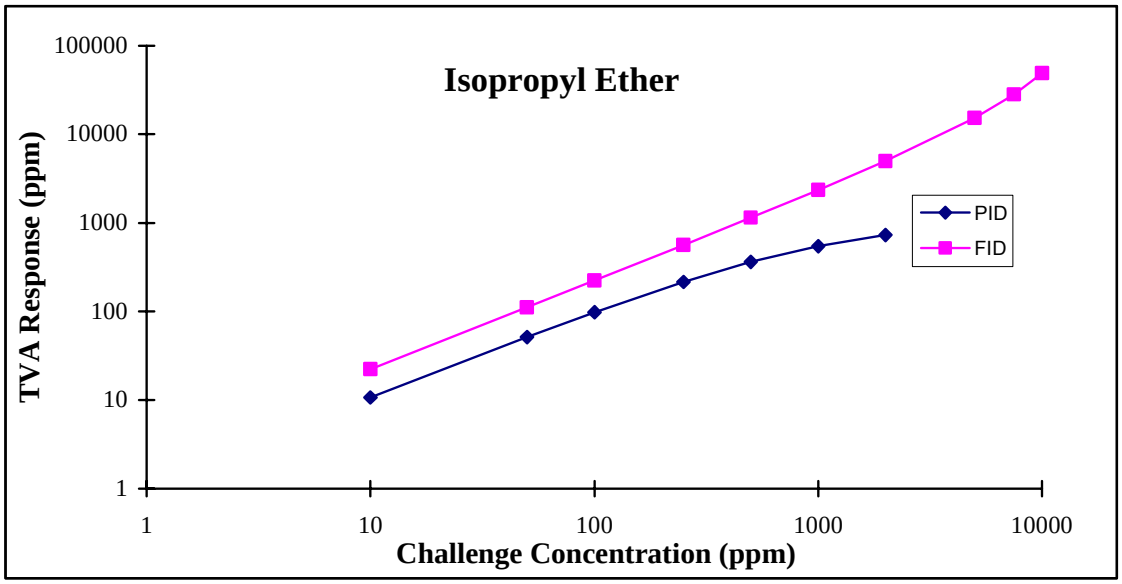


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	9.53	-28.44
	FID	0.95	0.26

Isopropyl Ether

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10			0.939	0.449
50			0.975	0.448
100			1.020	0.447
250			1.156	0.443
500			1.382	0.437
1000			1.834	0.425
2000			2.739	0.401
5000				0.327
7500				0.266
10000				0.205

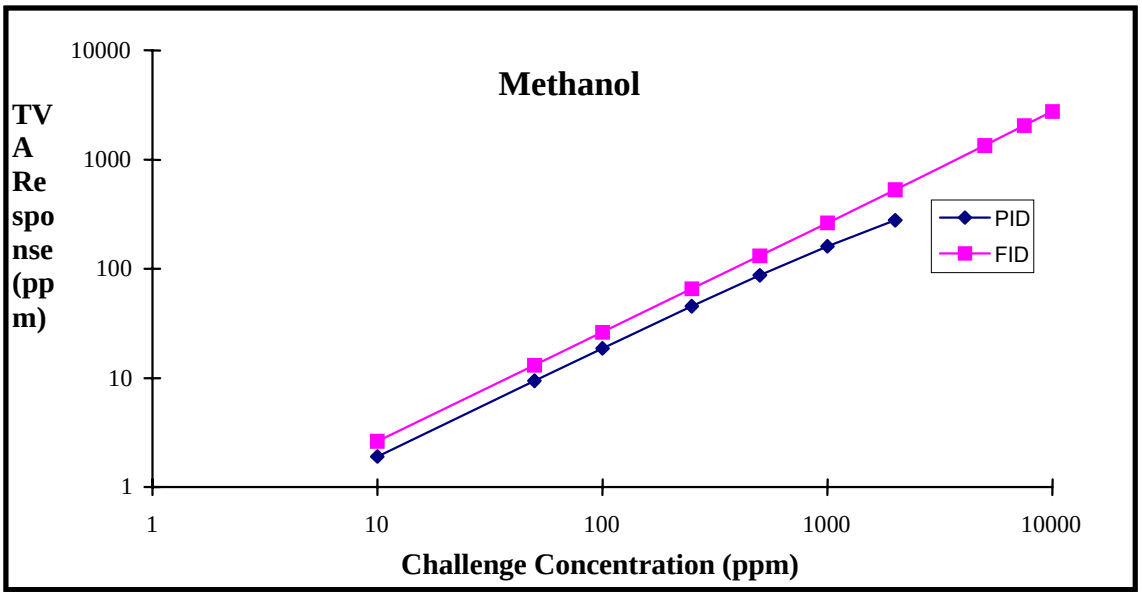


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	0.93	-9.04
	FID	0.45	0.25

Methanol

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.229	0.448	5.265	3.815
50	0.228	0.299	5.303	3.814
100	0.227	0.280	5.351	3.813
250	0.222	0.269	5.494	3.810
500	0.194	0.265	5.733	3.805
1000	0.163	0.263	6.211	3.796
2000	0.128	0.262	7.167	3.776
5000		0.245		3.718
7500		0.245		3.670
10000		0.245		3.622

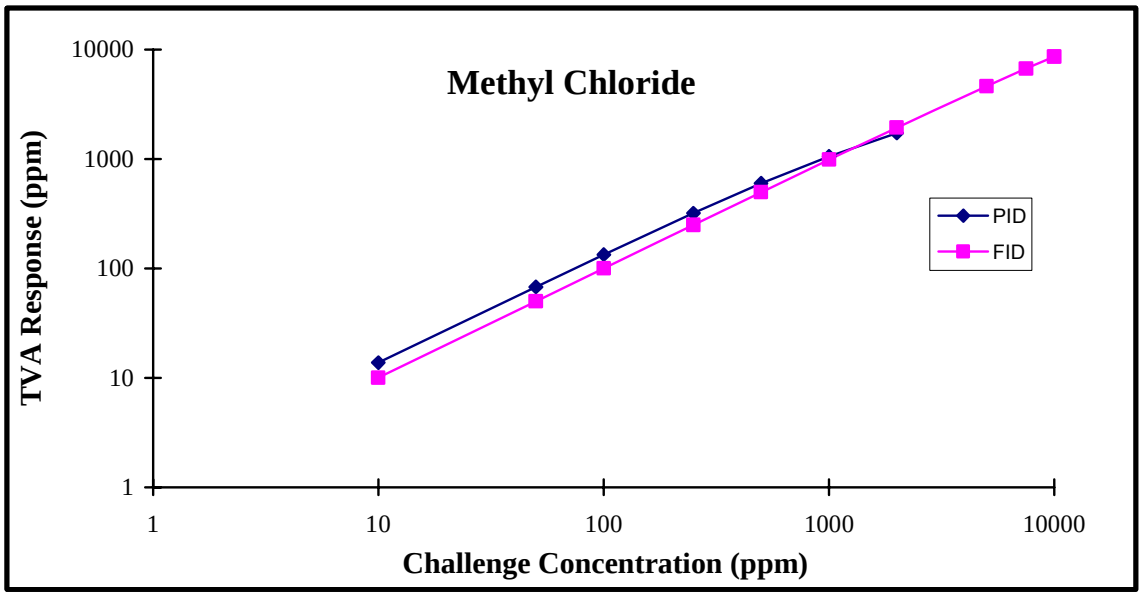


PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:		A	B
	PID	5.26	-9.56
	FID	3.82	0.19

Methyl Chloride

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	1.291	0.839	0.728	0.997
50	1.302	1.191	0.736	0.997
100	1.316	1.257	0.747	0.998
250	1.359	1.300	0.779	1.000
500	1.558	1.315	0.833	1.004
1000	1.963	1.323	0.941	1.012
2000	2.648	1.327	1.157	1.028
5000		1.420	1.805	1.076
7500		1.420		1.116
10000		1.421		1.156

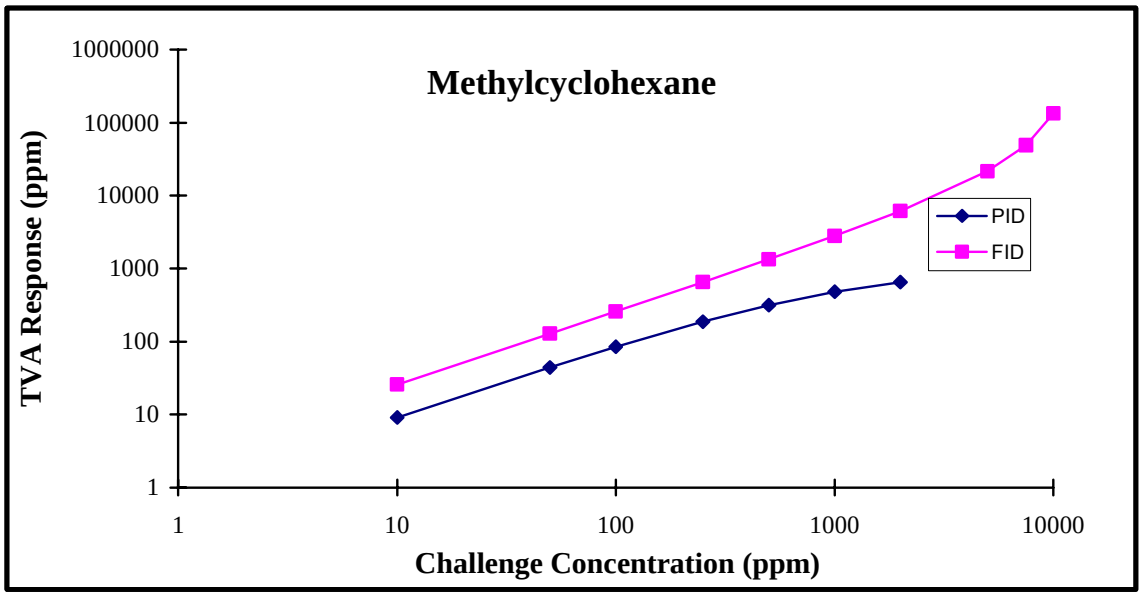


PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:		A	B
	PID	0.73	-2.16
	FID	1.00	-0.16

Methylcyclohexane

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.738	2.244	1.094	0.389
50			1.133	0.388
100	0.709	2.304	1.182	0.386
250			1.330	0.382
500	0.545	2.568	1.576	0.374
1000	0.410	2.898	2.068	0.358
2000	0.274	3.558	3.053	0.327
5000		4.883		0.232
7500		6.338		0.153
10000		7.792		0.075

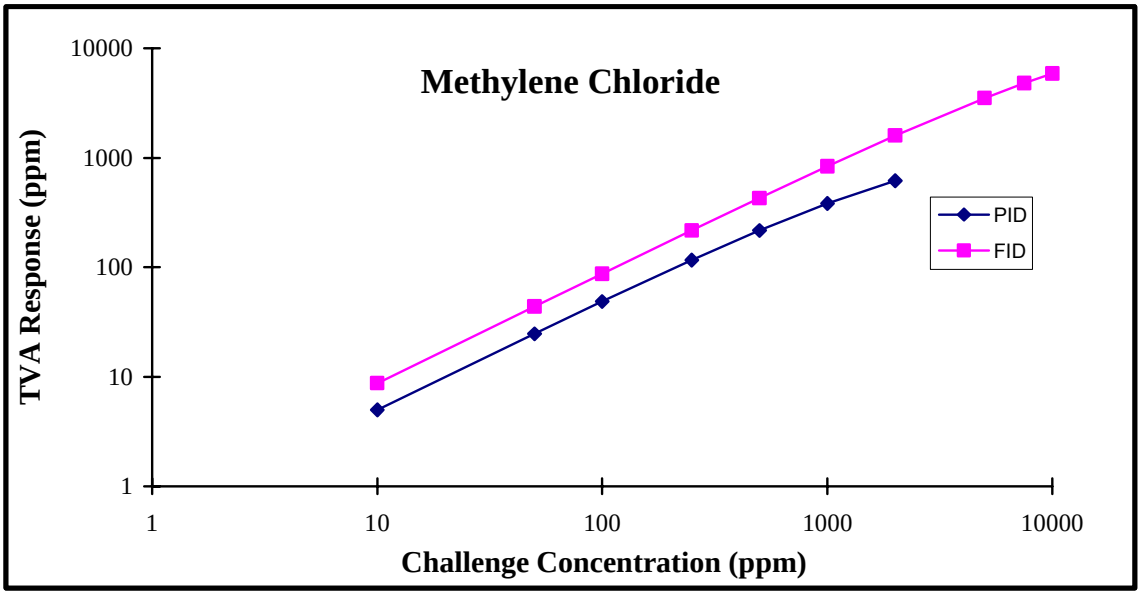


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	1.08	-9.84
	FID	0.39	0.32

Methylene Chloride

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.614	1.384	2.001	1.142
50	0.607	1.093	2.026	1.144
100	0.600	0.987	2.057	1.147
250	0.577	0.863	2.150	1.155
500	0.489	0.780	2.304	1.169
1000	0.388	0.705	2.614	1.197
2000	0.281	0.637	3.233	1.253
5000		0.521		1.421
7500		0.491		1.560
10000		0.471		1.700



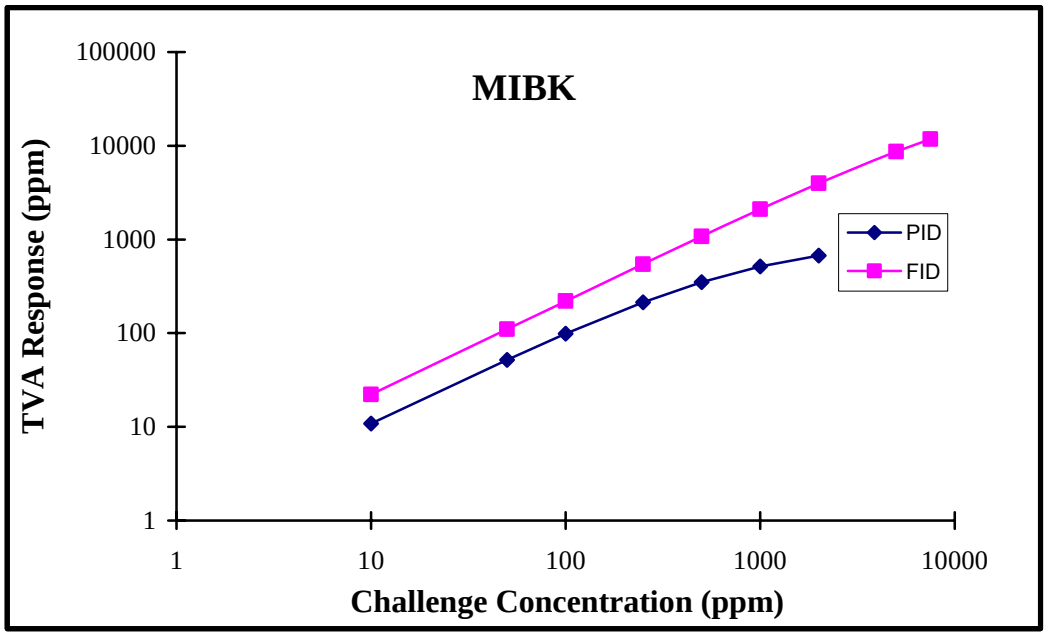
PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:		A	B
	PID	2.00	-6.19
	FID	1.14	-0.56

MIBK

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.864	1.763	0.921	0.452
50			0.962	0.453
100	0.832	1.777	1.014	0.455
250			1.169	0.458
500	0.644	1.840	1.427	0.464
1000	0.487	1.919	1.944	0.477
2000			2.977	0.501
5000		2.387		0.575
7500		2.755		0.636
10000				

Maximum Concentration at 25°C is 9800 ppm

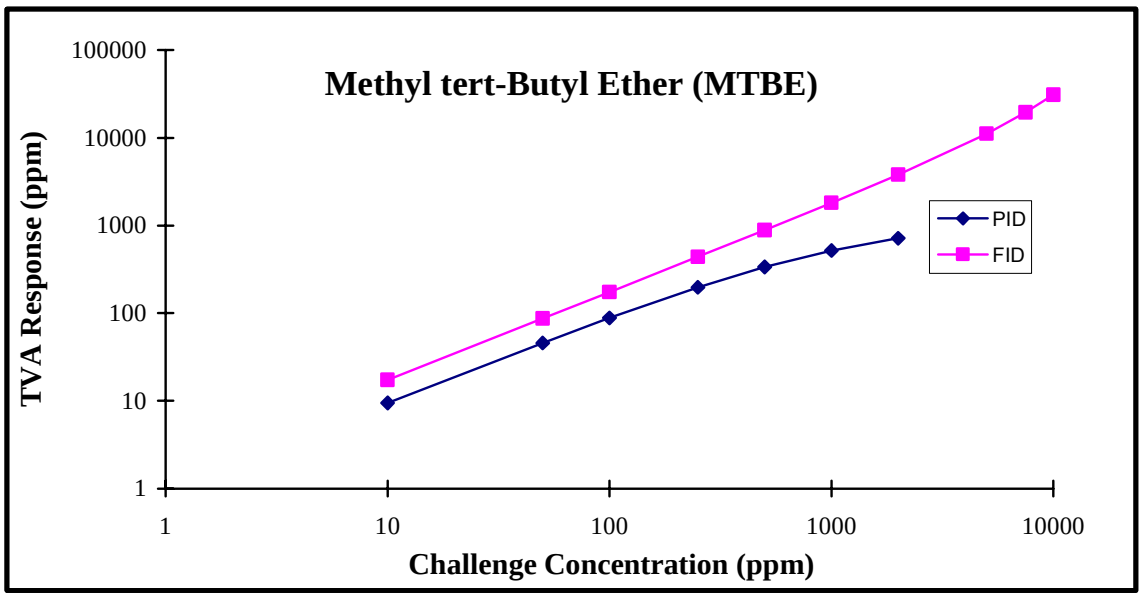


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	0.91	-10.33
	FID	0.45	-0.25

Methyl tert-Butyl Ether (MTBE)

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	1.077	1.863	1.055	0.576
50			1.090	0.575
100	1.030	1.881	1.134	0.574
250			1.265	0.570
500	0.777	1.963	1.484	0.564
1000	0.574	2.065	1.921	0.551
2000	0.376	2.270	2.796	0.526
5000		2.543		0.450
7500		2.994		0.386
10000		3.445		0.323

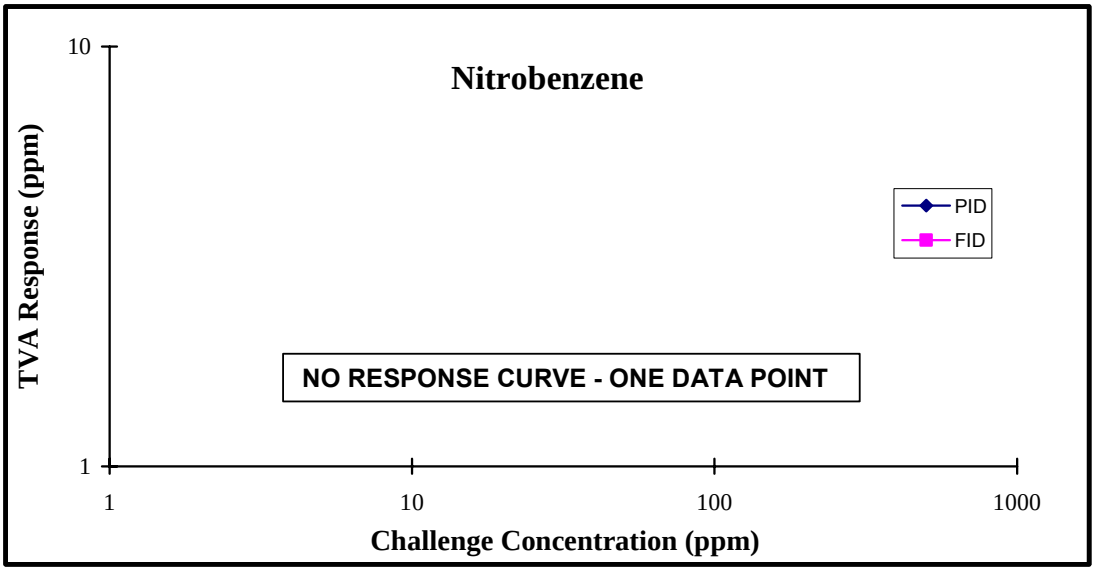


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	1.05	-8.75
	FID	0.58	0.25

Nitrobenzene

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
394.7	N/A	N/A	13.100	4.600

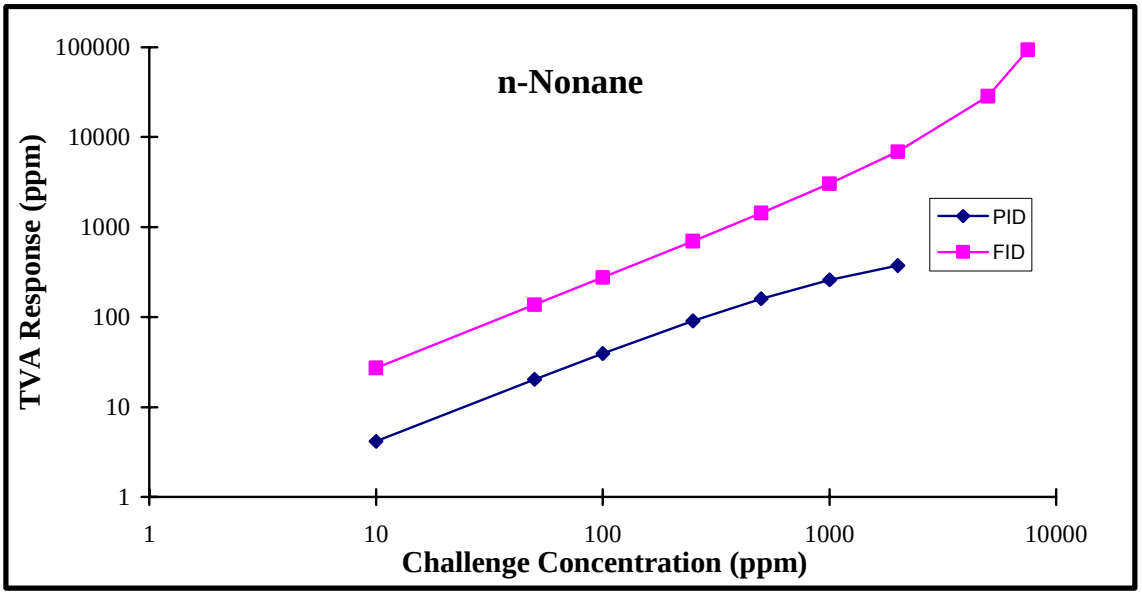


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	N/A	N/A
	FID	N/A	N/A

n-Nonane

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.386	2.623	2.404	0.367
50	0.378	2.626	2.463	0.365
100	0.368	2.629	2.536	0.364
250	0.340	2.640	2.757	0.358
500	0.272	2.657	3.125	0.348
1000	0.198	2.691	3.861	0.329
2000	0.127	2.759	5.334	0.291
5000		2.775		0.176
7500				
10000				

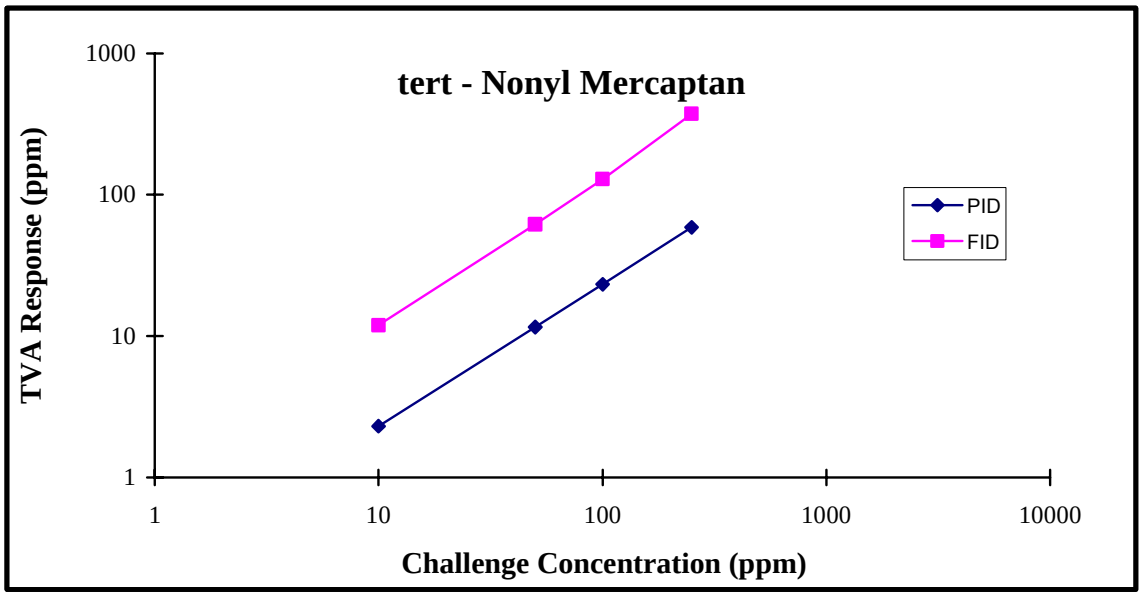


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	2.39	-14.72
	FID	0.37	0.38

tert - Nonyl Mercaptan

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	N/A	N/A	4.338	0.838
50			4.325	0.810
100			4.310	0.775
250			4.262	0.669
500				
1000				
2000				
5000				
7500				
10000				

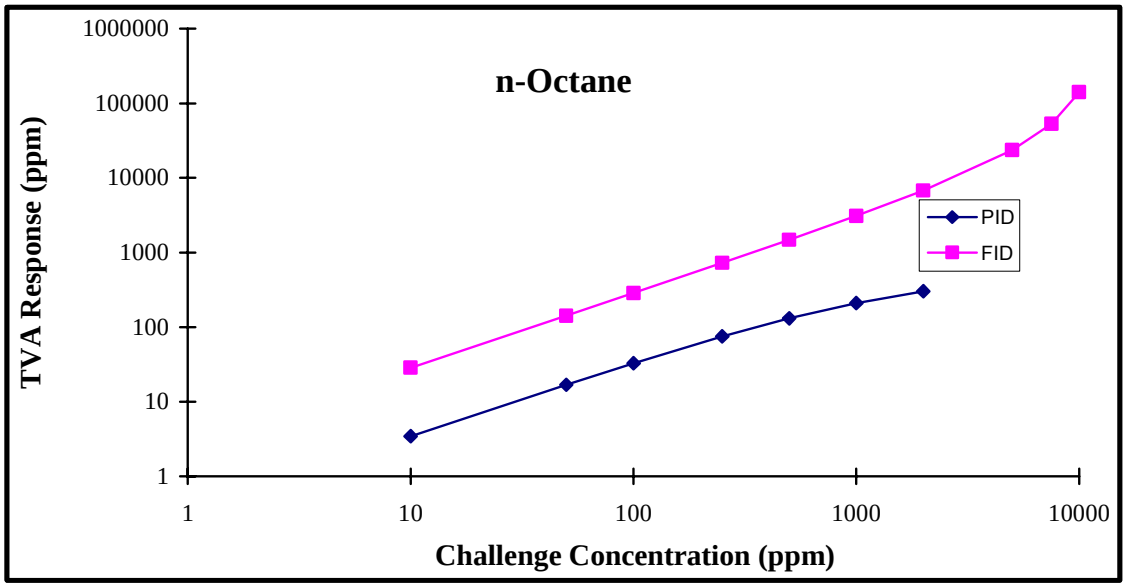


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	4.34	3.19
	FID	0.85	7.05

n-Octane

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.369	2.888	2.883	0.351
50	0.360	2.905	2.957	0.350
100	0.350	2.926	3.051	0.349
250	0.323	2.988	3.331	0.344
500	0.258	3.092	3.799	0.337
1000	0.187	3.300	4.734	0.323
2000	0.119	3.715	6.603	0.295
5000		4.646		0.211
7500		5.619		0.141
10000		6.592		0.071

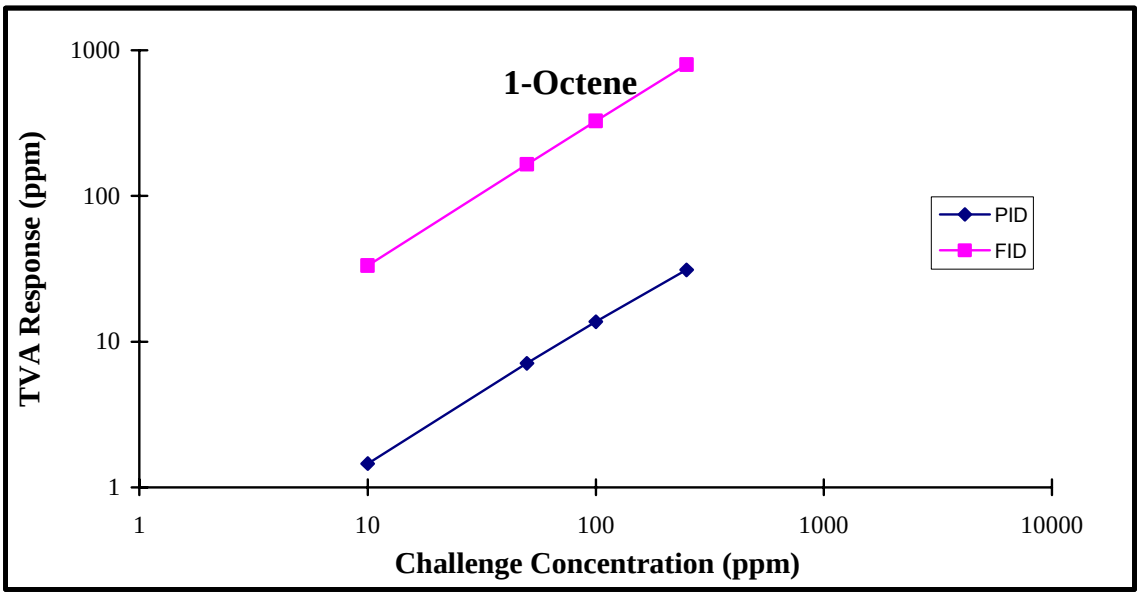


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	2.86	-18.70
	FID	0.35	0.28

1-Octene

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	N/A	N/A	6.865	0.301
50			7.058	0.303
100			7.300	0.306
250			8.024	0.314
500				
1000				
2000				
5000				
7500				
10000				

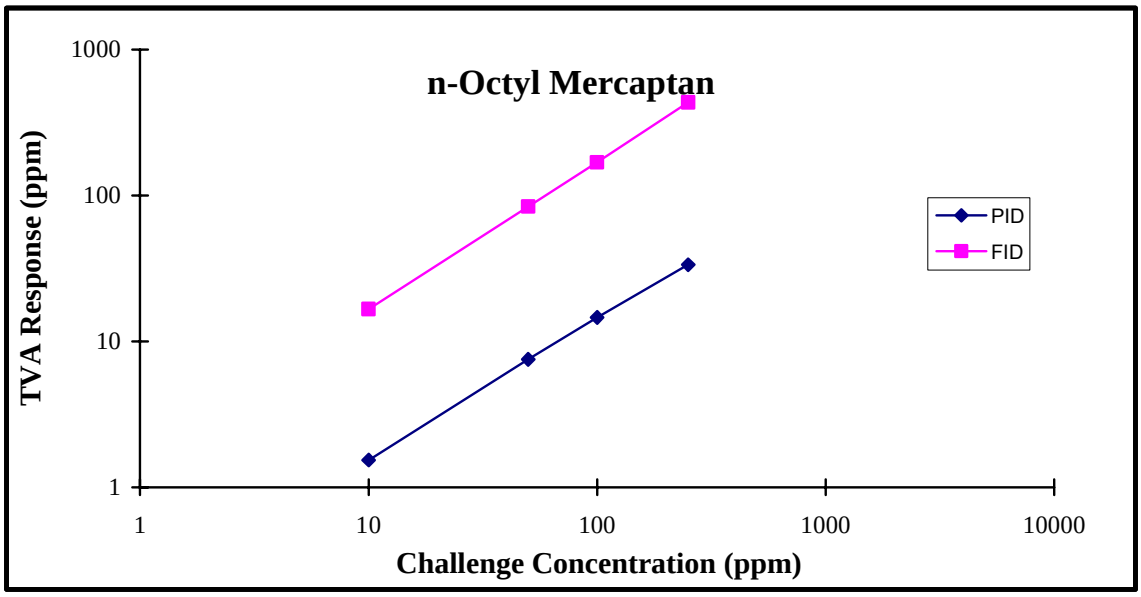


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	6.82	-48.32
	FID	0.30	-0.54

n-Octyl Mercaptan

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	N/A	N/A	6.492	0.600
50			6.650	0.596
100			6.847	0.591
250			7.439	0.575
500				
1000				
2000				
5000				
7500				
10000				

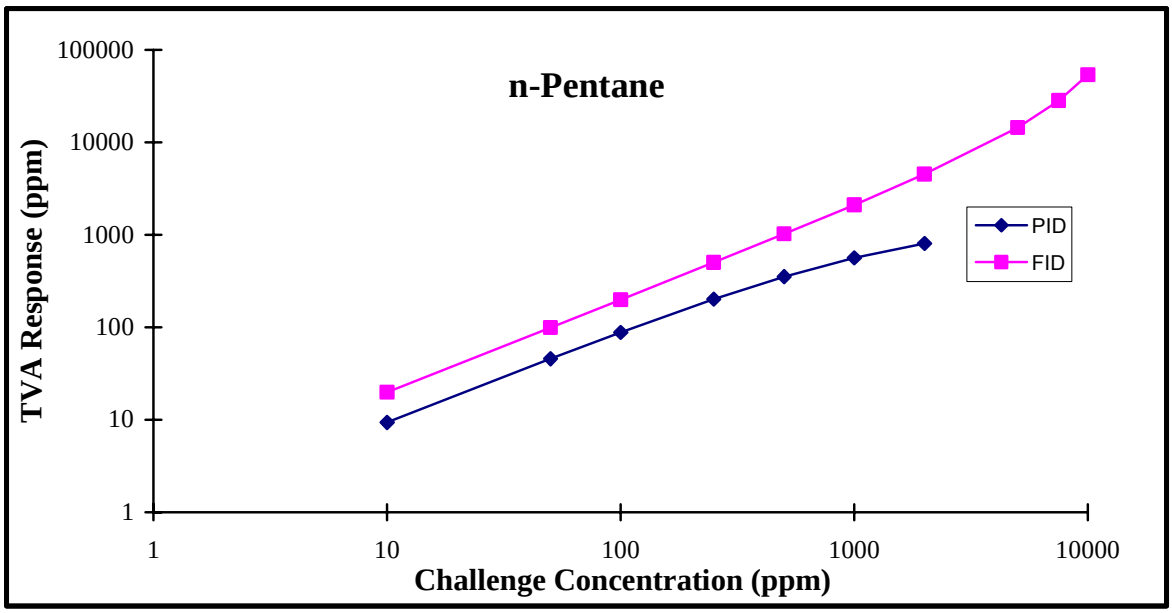


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	6.45	-39.44
	FID	0.60	1.06

n-Pentane

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	1.017	1.929	1.068	0.505
50	1.005	1.940	1.096	0.504
100	0.990	1.953	1.132	0.502
250	0.948	1.993	1.238	0.498
500	0.796	2.060	1.415	0.490
1000	0.625	2.195	1.770	0.474
2000	0.443	2.463	2.479	0.442
5000		3.060		0.346
7500		3.689		0.266
10000		4.317		0.186

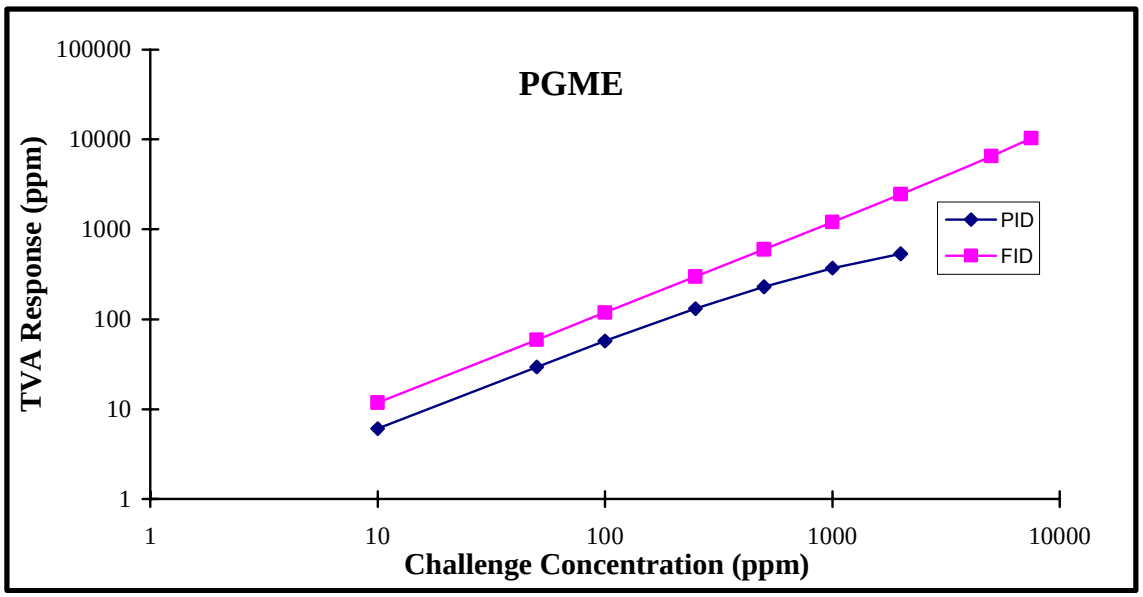


PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:		A	B
	PID	1.06	-7.09
	FID	0.51	0.32

PGME

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10			1.650	0.844
50			1.692	0.843
100			1.745	0.842
250			1.903	0.840
500			2.167	0.836
1000			2.695	0.828
2000			3.750	0.813
5000				0.767
7500				0.728
10000				

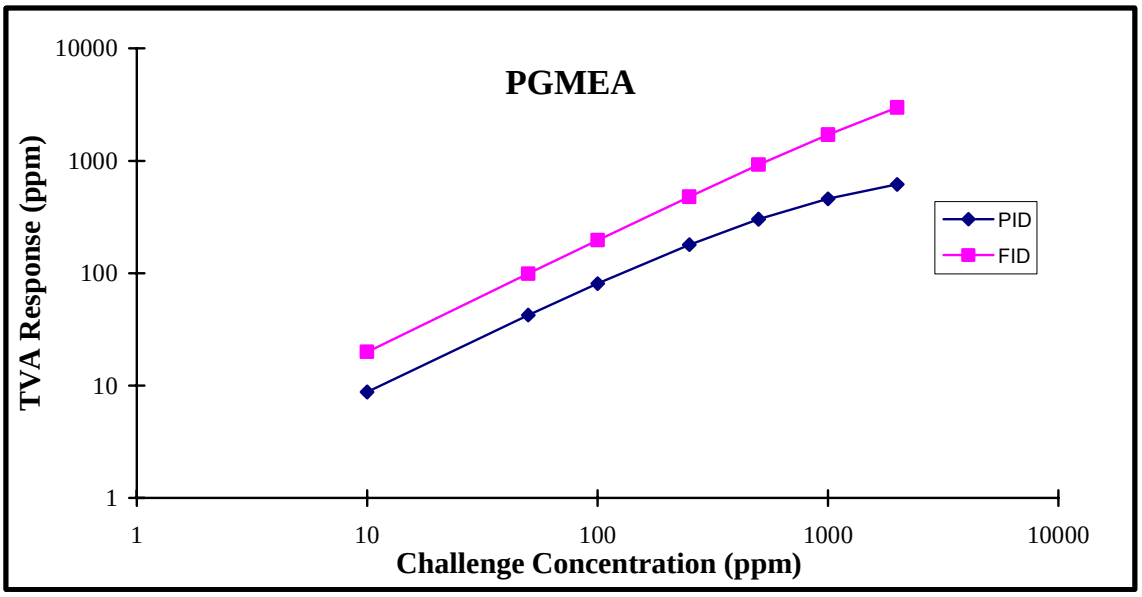


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	1.64	-10.55
	FID	0.84	0.15

PGMEA

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10			1.141	0.502
50			1.183	0.506
100			1.236	0.510
250			1.395	0.523
500			1.661	0.545
1000			2.191	0.588
2000			3.252	0.674
5000				
7500				
10000				

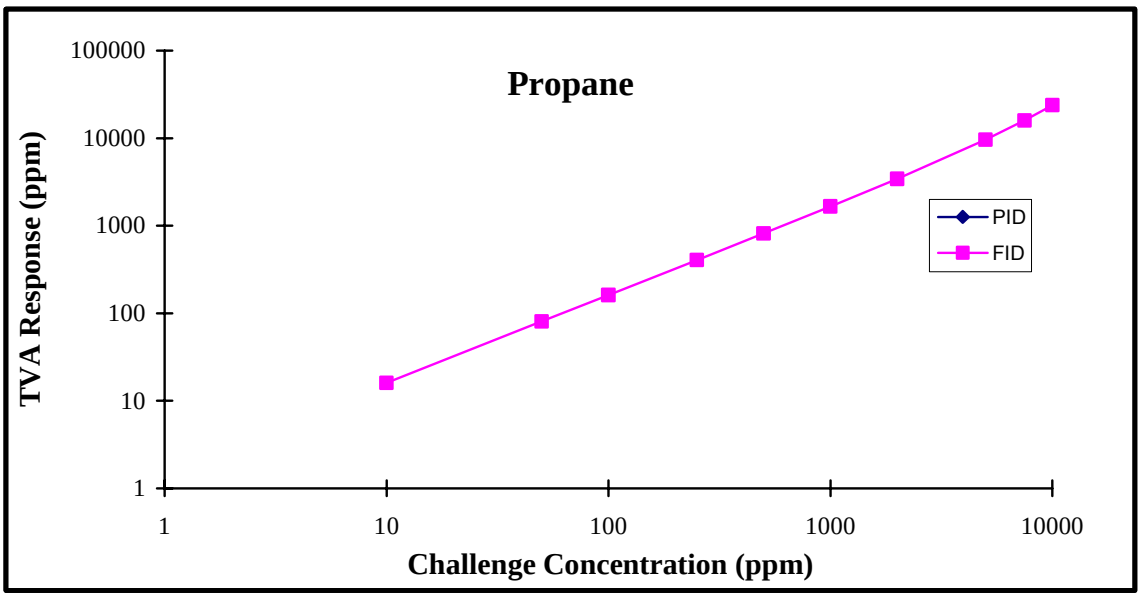


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	1.13	-10.61
	FID	0.50	-0.86

Propane

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.316	1.385		0.623
50	0.314	1.389		0.623
100	0.311	1.394		0.622
250	0.302	1.409		0.618
500	0.259	1.434		0.613
1000	0.212	1.485		0.603
2000	0.159	1.587		0.583
5000		1.772		0.521
7500		2.010		0.469
10000		2.248		0.418

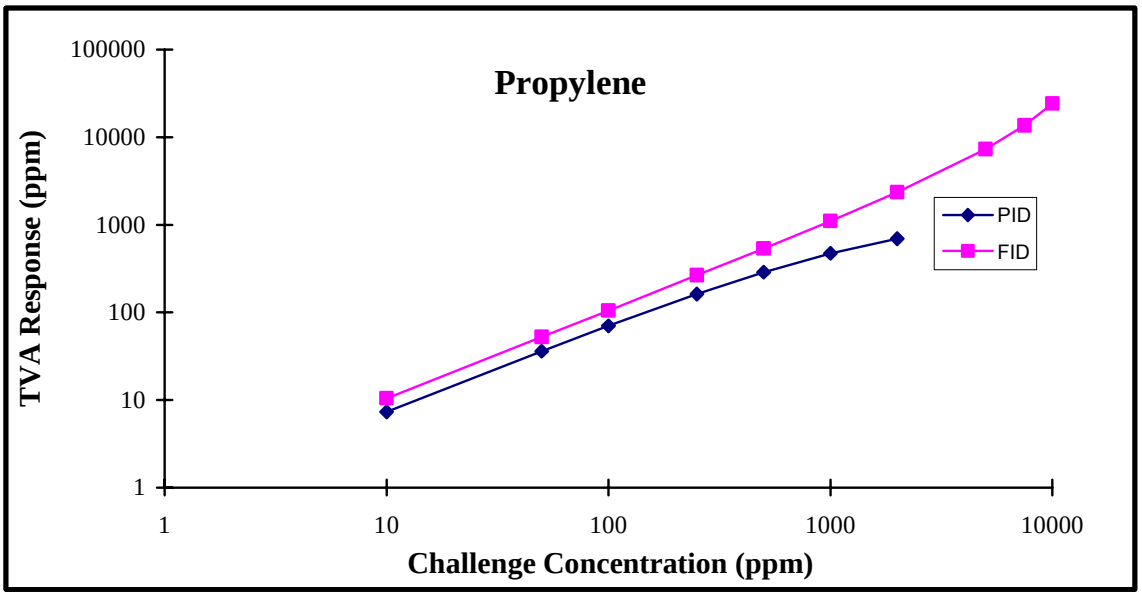


PID Lamp (eV): 11.8

TVA-1000B Response Curve Coefficients:		A	B
	PID	N/A	N/A
	FID	0.62	0.21

Propylene

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.711	1.074	1.359	0.957
50			1.389	0.955
100	0.695	1.085	1.428	0.952
250			1.542	0.944
500	0.568	1.136	1.732	0.930
1000	0.453	1.199	2.113	0.903
2000	0.329	1.326	2.875	0.848
5000		1.504		0.685
7500		1.782		0.549
10000		2.061		0.413

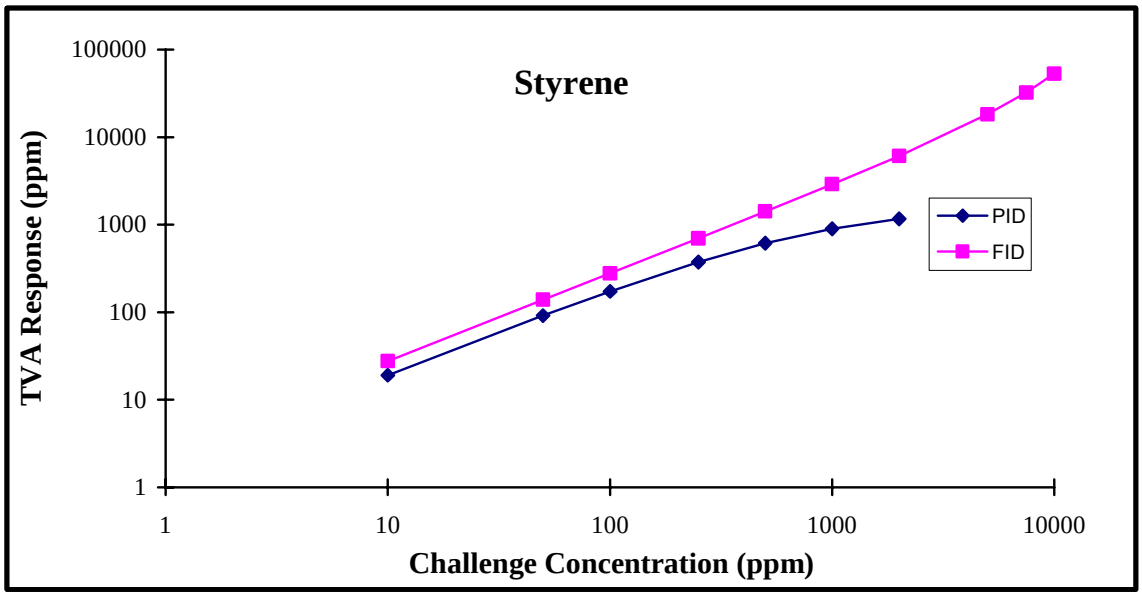


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	1.35	-7.62
	FID	0.96	0.54

Styrene

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	2.511	3.275	0.523	0.362
50	2.375	3.289	0.547	0.361
100	2.225	3.306	0.577	0.360
250	1.871	3.356	0.666	0.358
500	1.478	3.441	0.815	0.353
1000	1.041	3.611	1.114	0.345
2000	0.654	3.951	1.710	0.327
5000		4.969		0.275
7500		5.818		0.232
10000				0.188

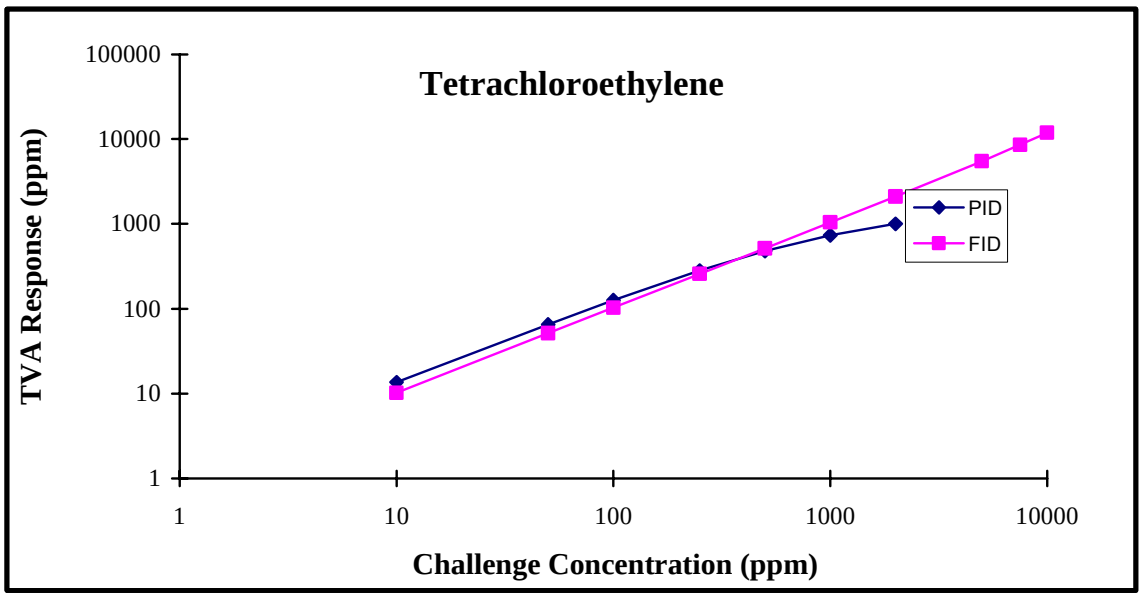


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	0.52	-5.97
	FID	0.36	0.17

Tetrachloroethylene

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	1.582	1.060	0.738	0.974
50	1.524	1.058	0.763	0.973
100	1.458	1.059	0.795	0.972
250	1.290	1.060	0.889	0.970
500	1.082	1.062	1.046	0.967
1000	0.818	1.063	1.361	0.961
2000	0.550	1.068	1.990	0.948
5000		1.081		0.909
7500		1.091		0.876
10000		1.102		0.843

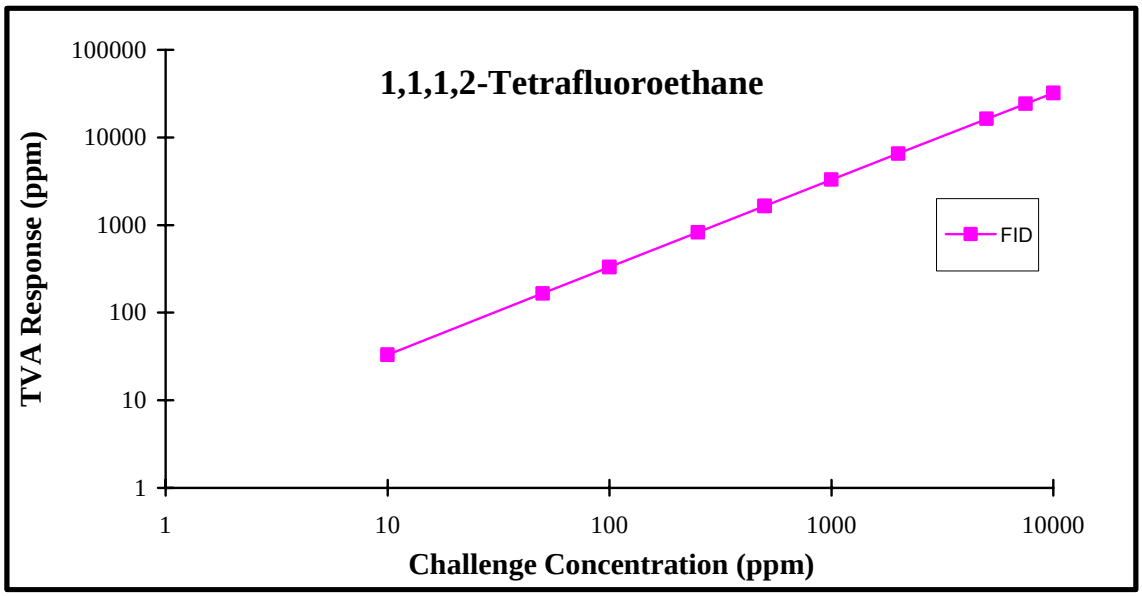


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	0.73	-6.29
	FID	0.97	0.13

1,1,1,2-Tetrafluoroethane

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	NF	not available	NF	0.302
50	NF	not available	NF	0.302
100	NF	not available	NF	0.302
250	NF	not available	NF	0.302
500	NF	not available	NF	0.303
1000	NF	not available	NF	0.303
2000	NF	not available	NF	0.304
5000	NF	not available	NF	0.307
7500	NF	not available	NF	0.310
10000	NF	not available	NF	0.312

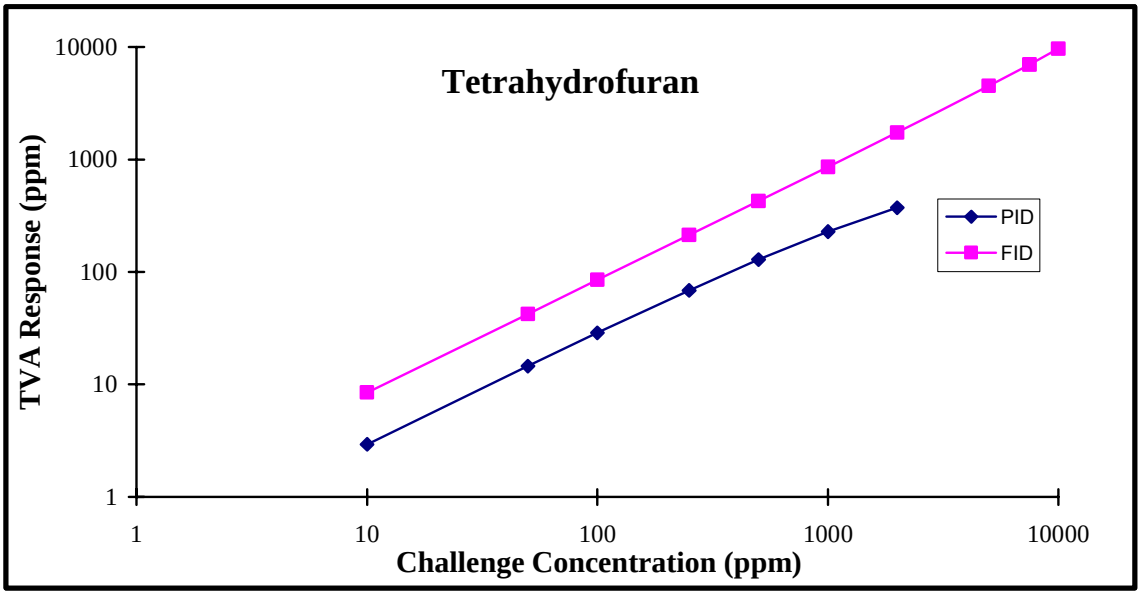


PID Lamp (eV): 0

TVA-1000B Response Curve Coefficients:		A	B
	PID	NF	NF
	FID	0.30	-0.01

Tetrahydrofuran

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.611	1.255	3.400	1.180
50	0.601	1.258	3.439	1.179
100	0.589	1.260	3.489	1.179
250	0.554	1.269	3.636	1.177
500	0.505	1.283	3.883	1.173
1000	0.430	1.314	4.375	1.166
2000	0.330	1.378	5.360	1.152
5000		1.617		1.110
7500		1.889		1.075
10000		2.273		1.040

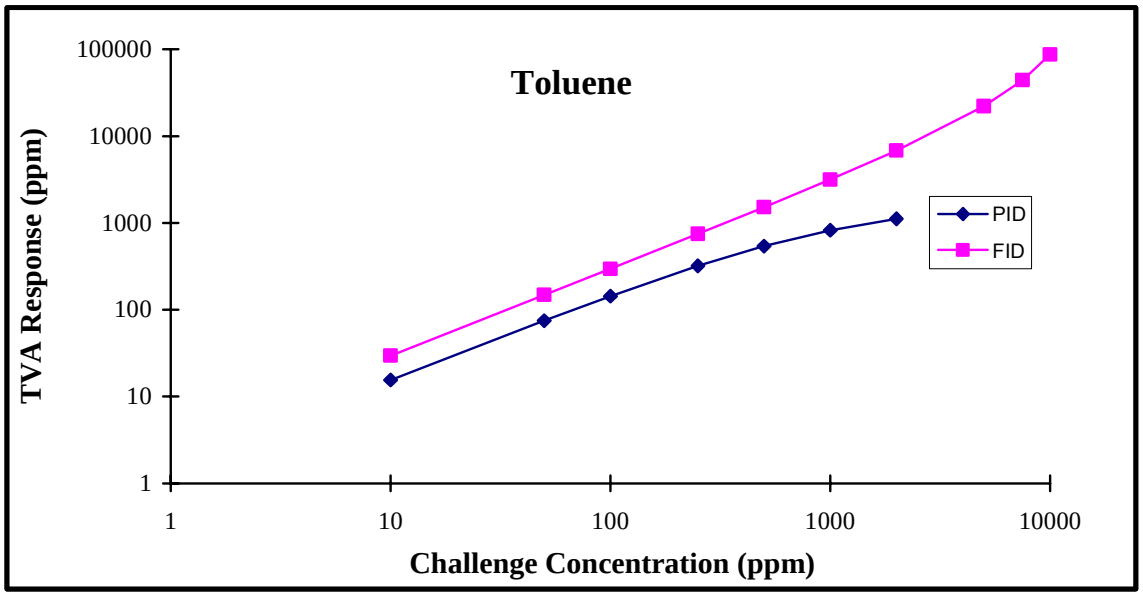


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	3.39	-9.85
	FID	1.18	0.14

Toluene

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	1.813	2.771	0.644	0.339
50	1.748	2.787	0.668	0.338
100	1.674	2.808	0.696	0.337
250	1.484	2.870	0.783	0.334
500	1.249	2.972	0.928	0.328
1000	0.948	3.178	1.217	0.317
2000	0.640	3.589	1.795	0.294
5000		4.822		0.227
7500		5.850		0.171
10000		6.878		0.114

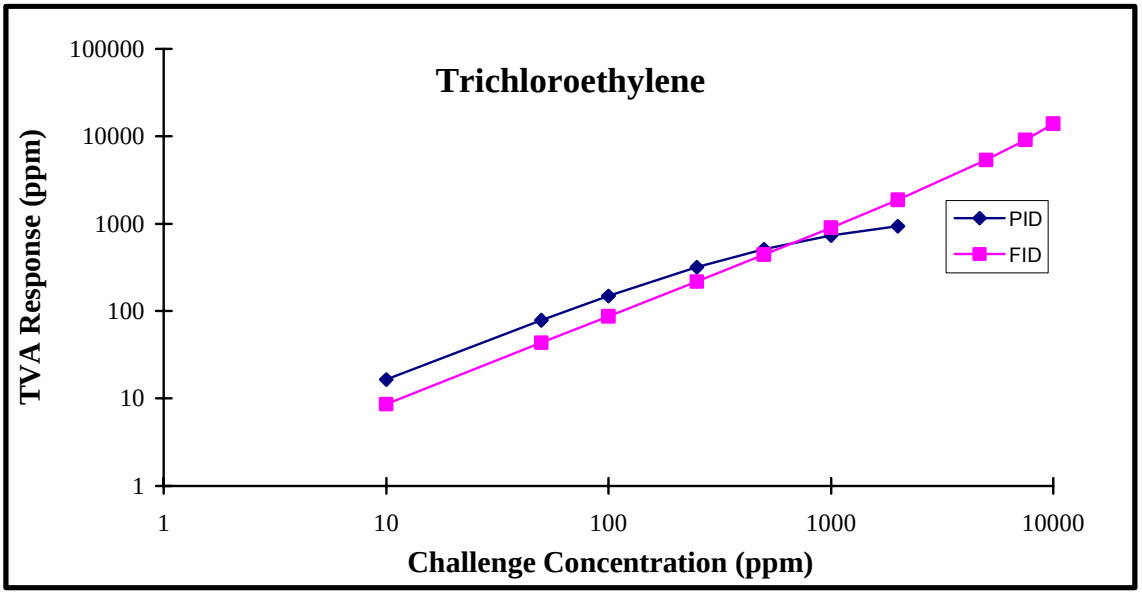


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	0.64	-5.78
	FID	0.34	0.23

Trichloroethylene

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	1.820	0.931	0.605	1.156
50	1.731	0.932	0.636	1.154
100	1.632	0.933	0.674	1.152
250	1.392	0.936	0.789	1.146
500	1.118	0.940	0.980	1.135
1000	0.803	0.950	1.363	1.113
2000	0.513	0.969	2.129	1.069
5000		1.025		0.938
7500		1.072		0.828
10000		1.119		0.719

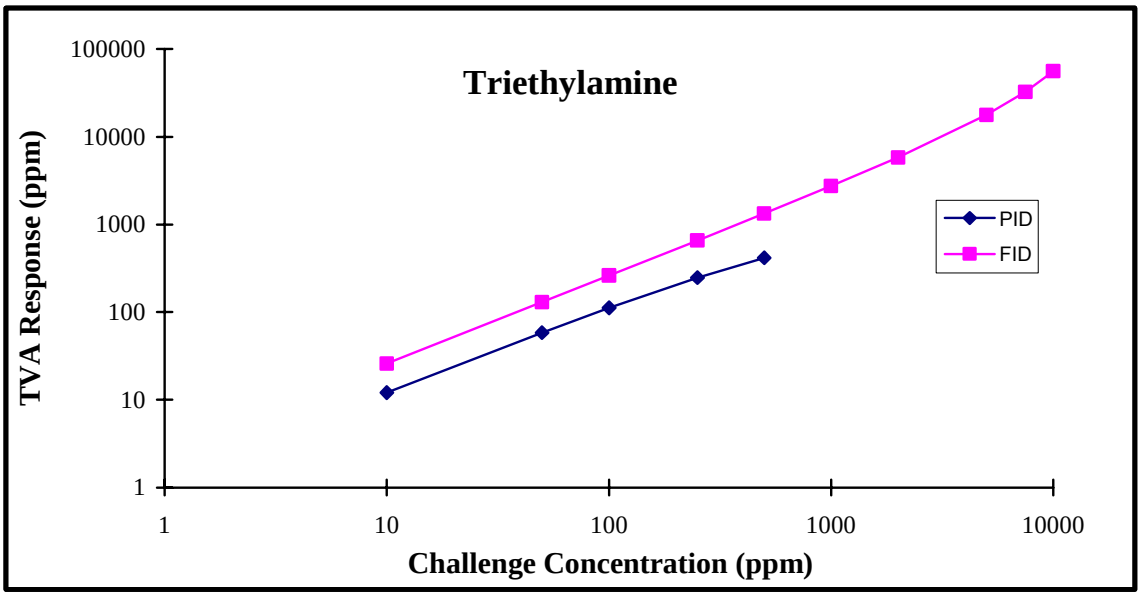


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	0.60	-7.66
	FID	1.16	0.44

Triethylamine

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.538	1.139	0.825	0.385
50			0.856	0.384
100	0.535	1.168	0.894	0.383
250			1.007	0.380
500	0.468	1.295	1.197	0.375
1000	0.402	1.453		0.365
2000	0.327	1.771		0.344
5000		2.401		0.282
7500		3.101		0.231
10000		3.800		0.179

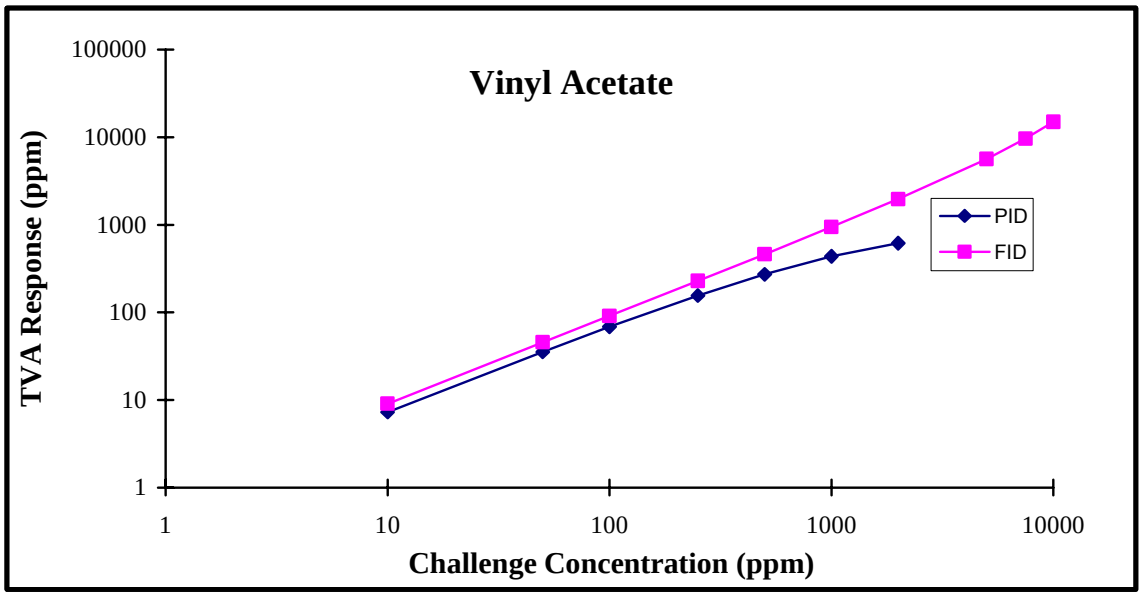


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	0.82	-7.59
	FID	0.39	0.21

Vinyl Acetate

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.746	0.824	1.377	1.102
50			1.414	1.100
100	0.725	0.829	1.461	1.098
250			1.600	1.091
500	0.581	0.849	1.832	1.080
1000	0.454		2.297	1.059
2000	0.320	0.925	3.227	1.015
5000		0.950		0.886
7500		1.061		0.777
10000		1.173		0.669

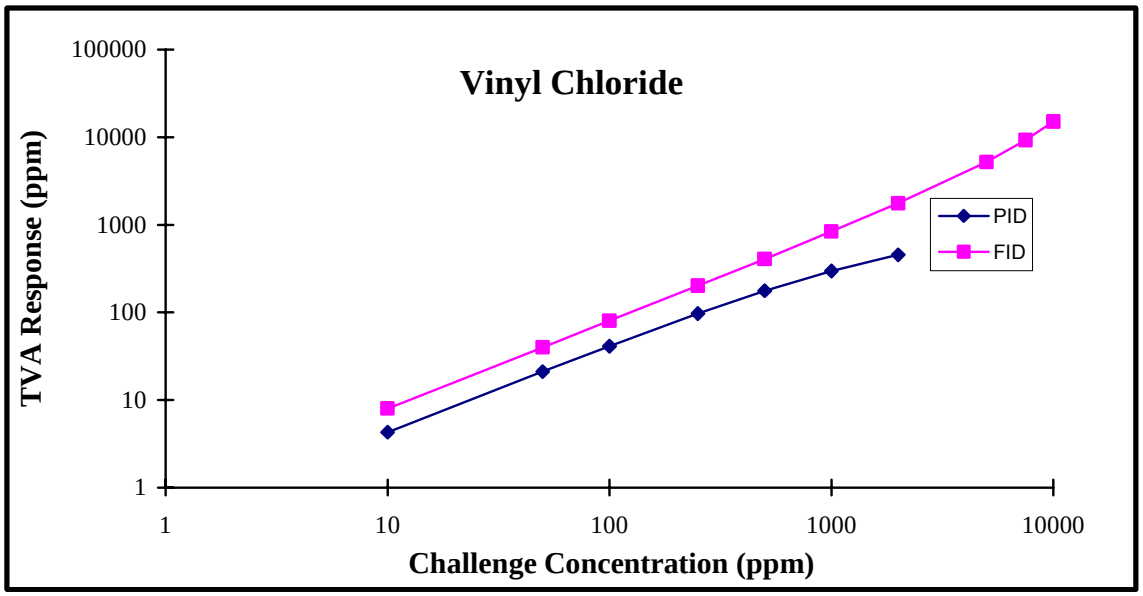


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	1.37	-9.30
	FID	1.10	0.43

Vinyl Chloride

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	0.513	0.835	2.334	1.253
50			2.376	1.251
100	0.496	0.841	2.428	1.248
250			2.583	1.239
500	0.389	0.871	2.842	1.224
1000	0.298	0.908	3.360	1.195
2000	0.204	0.983	4.397	1.135
5000		1.063		0.958
7500		1.228		0.809
10000		1.392		0.661

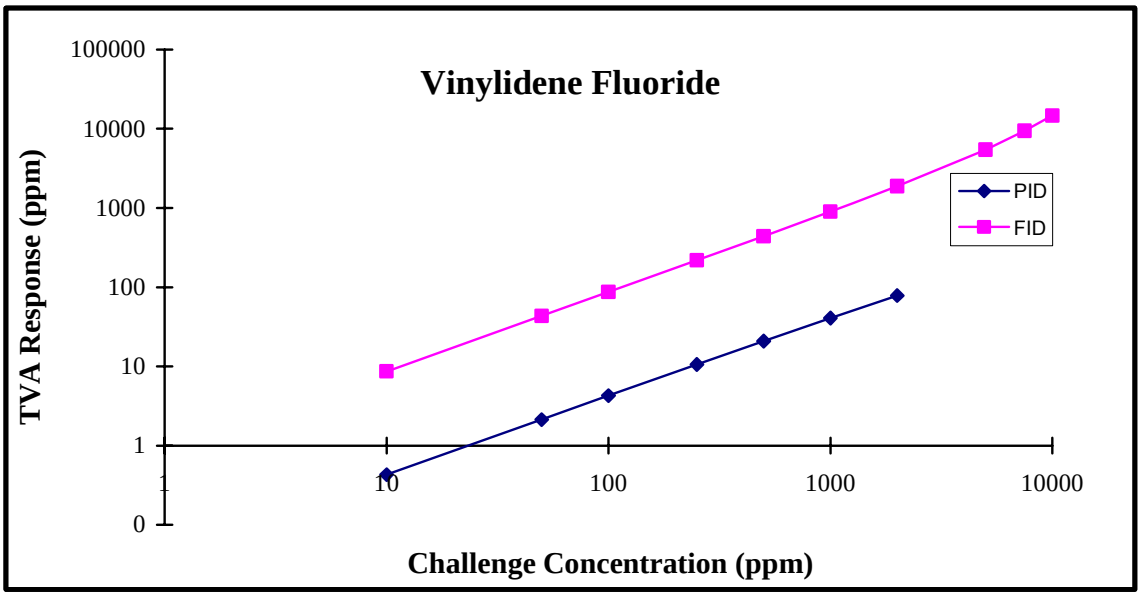


PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	2.32	-10.36
	FID	1.25	0.59

Vinylidene Fluoride

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	N/A	N/A	23.387	1.157
50	N/A	N/A	23.431	1.156
100	N/A	N/A	23.485	1.153
250	N/A	N/A	23.650	1.146
500	N/A	N/A	23.924	1.134
1000	N/A	N/A	24.473	1.110
2000	N/A	N/A	25.570	1.062
5000	N/A	N/A		0.918
7500	N/A	N/A		0.798
10000	N/A	N/A		0.678

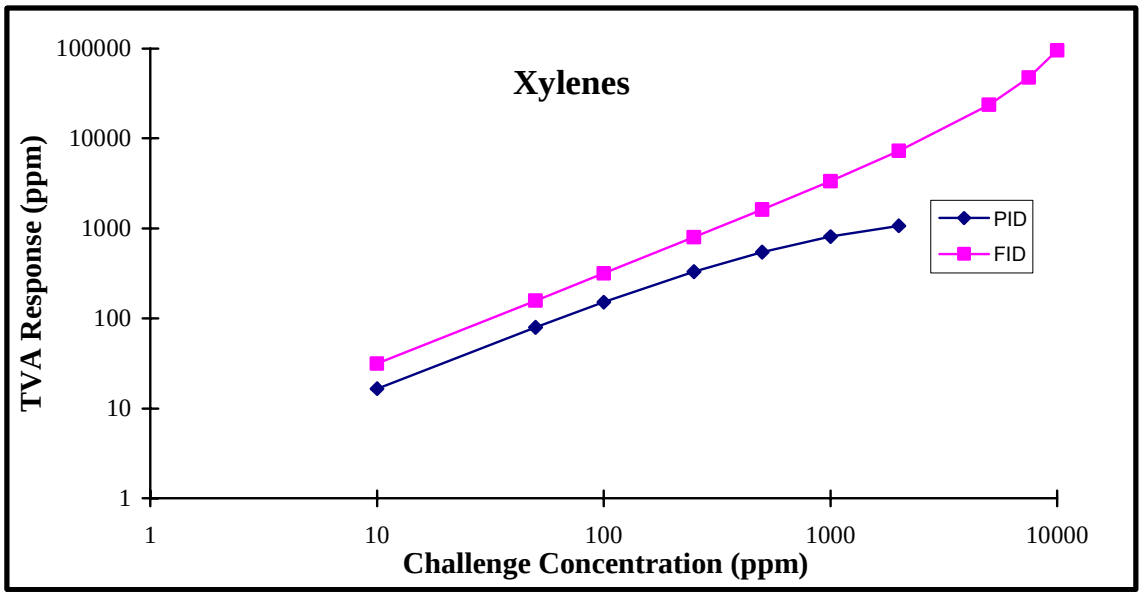


PID Lamp (eV): 10.8

TVA-1000B Response Curve Coefficients:		A	B
	PID	23.38	-10.97
	FID	1.16	0.48

Xylenes

Challenge Concentration (ppm)	Thermo/TVA-1000A (or equivalent) Relative Response Factor PID	FID	EPA/TVA-1000B (or equivalent) Response Factor Multiplier PID	FID
10	1.603	2.790	0.605	0.319
50	1.569	2.802	0.630	0.318
100	1.529	2.817	0.662	0.317
250	1.420	2.860	0.758	0.314
500	1.269	2.933	0.917	0.308
1000	1.046	3.079	1.236	0.298
2000	0.774	3.371	1.873	0.276
5000		4.246		0.212
7500		4.975		0.158
10000		5.704		0.104



PID Lamp (eV): 10.6

TVA-1000B Response Curve Coefficients:		A	B
	PID	0.60	-6.38
	FID	0.32	0.21

Interface Meter Operating Instructions

Model 122

Operating Principle

The Solinst Model 122 Interface Meter has a narrow 5/8" (16 mm) diameter probe. It is CSA approved for use in hazardous locations Class 1, Groups C & D. It has an infra-red circuit which detects the presence of a liquid. A conductivity circuit differentiates between conductive liquid (water) and non-conductive liquid (LNAPL or DNAPL product).

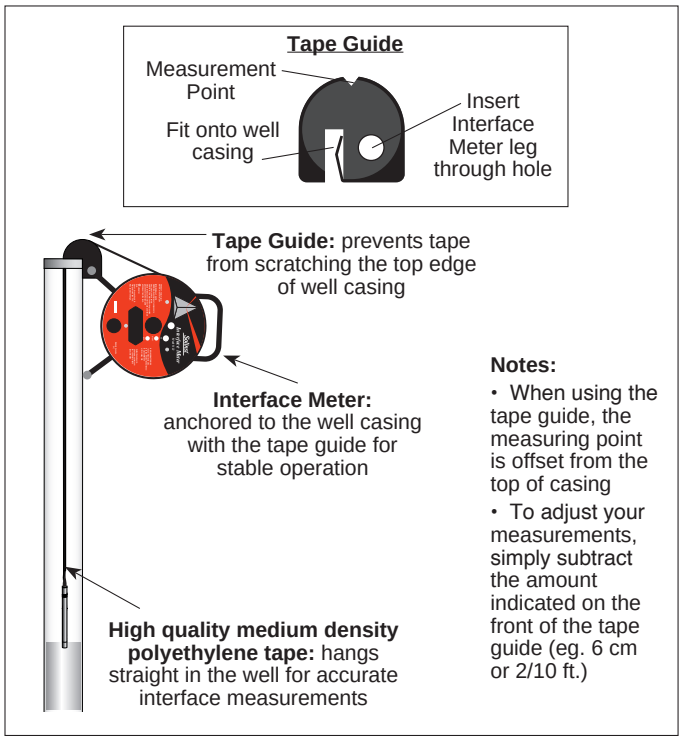
Equipment Check

Before beginning any measurements, check the electronics and battery condition by pushing the 'Start' button. A brief tone and red light indicate that the meter is functional.

A flashing green light indicates the meter is on. It will automatically turn off after 10 minutes to preserve battery life.

Using the Tape Guide

1. The tape guide has been designed to: improve accuracy when reading interface measurements; to prevent tape being cut by well casing; and to allow the tape and probe to hang straight from the side of the well.
2. If interface measurements are being taken in a 2" dia well then simply fit the small end of the tape guide onto the edge of the well casing.
3. The small end must be inserted if the Interface Meter is to be suspended from the tape guide.
4. Insert the leg of the Interface Meter into the hole on the Tape Guide.
5. Once inserted, rest the Interface Meter on the side of the well casing.



Field Measurements

IMPORTANT

1. To meet safety requirements and to protect the electronics from damage, always ground the meter by attaching the grounding clip to the metal well casing or to a suitable ground rod.

2. Push the 'Start' button. A brief tone and light indicate that the meter is functional and the flashing green light indicates that the meter is on. The meter automatically turns off after 10 minutes. Press the 'Start' button as necessary during operation to turn the meter back on.
3. Place the slotted part of the tape guide onto the edge of the well casing. Lay the Interface Meter tape into the groove on the top of the tape guide. Measurements will be read at the apex of the V-notch on the tape guide.

Note: When using the tape guide, remember to subtract the compensation factor stamped onto the side of the guide from each measurement.

4. A steady tone and light indicates a non-conductive liquid (eg. product). An intermittent tone and light indicates a conductive liquid (eg. water).
5. For floating product (LNAPL), take the air/product interface measurement on the way into the liquid, and the water/product interface on the way up. When passing through product into water, some product may adhere to the probe sensors due to surface tension. Therefore, when water is detected below product, the probe should be raised and lowered rapidly in a short vertical motion to remove any product that may have been carried down with the probe.
6. The water/product interface should then be measured as the probe is raised very slowly back up. Once the interface is detected the probe can be raised and lowered in small increments to precisely determine the interface.
7. Repeat measurements to confirm water/product interface.
8. To determine the thickness of product, subtract the water/product interface from the product/air interface.
9. To determine if there is any sinking product (DNAPL) in the well, continue lowering the probe slowly. If steady signals activate, determine the top of the sinking layer by reading directly from the tape. Continue lowering the probe slowly until the tape slackens when the well bottom is reached. Read the level directly from the tape and subtract one from the other to determine thickness.
10. Upon completion of readings clean the tape and probe; as described overleaf.

Cleaning and Maintenance

After each use, the tape should be wiped clean and carefully rewound onto the reel.

The probe should be cleaned as follows:

- Wash probe thoroughly with a non-abrasive mild detergent. **DO NOT USE ANY SOLVENTS**. Use a soft cloth around the pins on the end of the probe to remove all product. **For the P2 Probe** use the brush provided through side and base holes to remove all product from inner part of the probe.

  USE LUKE-WARM, NOT HOT WATER. DAMAGE TO PROBE MAY RESULT.
- Rinse probe thoroughly with distilled water, wipe dry
- Return the probe to the holder

Other suitable cleaning method:

- Steam clean tape only

Battery Replacement

Push battery drawer in and up and then release. The battery drawer should eject slightly, allowing it to be pulled out. Replace the 9V alkaline batteries.

Other General Tips:

1. Probe should be cleaned after each use.
2. Always use grounding cable
3. Do not drop probe: damage to probe tip may result.
4. If batteries are weak, the start tone will not sound, and flashing "green" light will be off. Replace both batteries.
5. Before storage, make sure the meter is turned off.

Troubleshooting

Instruments will not turn on:

1. Replace batteries.
2. Check the polarity of the batteries are correct in the battery drawer.
3. Check 12-pin connector inside reel for loose wire/pin. Access by removing three screws on faceplate. Ensure instrument is laying on its back frame so the tape does not unwind.
4. Push button could be faulty, please contact Solinst.

Instrument turns on, but immediately shuts off, or instrument does not shut-off, except after 10 min, automatic shutdown:

1. Check batteries, replace if necessary.
2. Dirt or debris may be causing the on/off buttons to stick. Use short blast of air to try to free up buttons.
3. Check 12-pin connector inside reel for loose wire/pin. Access by removing three screws on faceplate. Ensure instrument is laying on its back frame so the tape does not unwind.
4. Push button could be faulty, please contact Solinst.

Instrument does not detect liquid:

1. Check batteries, replace if necessary.
2. Clean probe tip-follow Cleaning/Maintenance Instructions.
3. Reel or probe circuitry could be damaged, please contact Solinst.

When instrument is turned on, it immediately sounds product tone or water tone:

1. Probe optical sensor may be dirty. Clean according to Cleaning and Maintenance instructions.
2. Possible weak batteries, replace both.
3. Water has leaked into the probe. Remove three small screws and slide the probe down from the tape portion (remember polarity of the green and white wire). Dry out probe, wipe and inspect o-ring, replace if necessary and/or lubricate with silicon grease. Replace probe remembering polarity.
4. Check 12-pin connector inside reel for loose wire/pin. Access by removing three screws on faceplate. Ensure instrument is laying on its back frame so the tape does not unwind.
5. Reel or probe circuitry could be damaged, please contact Solinst.

Chirping or 'Warbling' sound being emitted:

1. Clean probe.
2. Possible water in probe (see troubleshooting under 'When instrument turned on, instrument emits product or water tone').
3. Reel or probe circuitry could be damaged, please contact Solinst.

Instrument detects "product" as "water".

1. Thoroughly dry the stainless steel shroud covering the probe tip.
2. Product may have degraded; if it has a detectable level of conductivity it will read water. This can be checked by placing the probe in pure phase product, a steady tone & light should be observed.

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Solinst®

ppbRAE 3000
User's Guide

Rev. C
August 2010
P/N 059-4021-000

FCC Information

Contains FCC ID: PI4411B

The enclosed device complies with part 15 of the FCC rules. Operation is subject to the following conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

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Read Before Operating

This manual must be carefully read by all individuals who have or will have the responsibility of using, maintaining, or servicing this product. The product will perform as designed only if it is used, maintained, and serviced in accordance with the manufacturer's instructions. The user should understand how to set the correct parameters and interpret the obtained results.

CAUTION!

To reduce the risk of electric shock, turn the power off before removing the instrument cover. Disconnect the battery before removing sensor module for service. Never operate the instrument when the cover is removed. Remove instrument cover and sensor module only in an area known to be non-hazardous.

Special Notes

When the instrument is taken out of the transport case and turned on for the first time, there may be some residual organic or inorganic vapor trapped inside the detector chamber. The initial PID sensor reading may indicate a few ppm. Enter an area known to be free of any organic vapor and turn on the instrument. After running for several minutes, the residual vapor in the detector chamber will be cleared and the reading should return to zero.

The battery of the instrument discharges slowly even if it is turned off. If the instrument has not been charged for 5 to 7 days, the battery voltage will be low. Therefore, it is a good practice to always charge the instrument before using it. It is also recommended to fully charge the instrument for *at least 10 hours* before first use. Refer to this User Guide's section on battery charging for more information on battery charging and replacement.

WARNINGS

STATIC HAZARD: Clean only with damp cloth.

For safety reasons, this equipment must be operated and serviced by qualified personnel only. Read and understand instruction manual completely before operating or servicing.

Use only RAE Systems battery packs, part numbers 059-3051-000, 059-3052-000, and 059-3054-000. This instrument has not been tested in an explosive gas/air atmosphere having an oxygen concentration greater than 21%. Substitution of components may impair intrinsic safety. Recharge batteries only in non-hazardous locations.

Do not mix old and new batteries or batteries from different manufacturers.

The calibration of all newly purchased RAE Systems instruments should be tested by exposing the sensor(s) to known concentration calibration gas before the instrument is put into service.

For maximum safety, the accuracy of the instrument should be checked by exposing it to a known concentration calibration gas before each day's use.

Do not use USB/PC communication in hazardous locations.

AVERTISSEMENT

DANGER RISQUE D'ORIGINE ELECTROSTATIQUE: Nettoyer uniquement avec un chiffon humide.

Pour des raisons de sécurité, cet équipment doit être utilisé, entretenu et réparé uniquement par un personnel qualifié. Étudier le manuel d'instructions en entier avant d'utiliser, d'entretenir ou de réparer l'équipement.

Utiliser seulement l'ensemble de batterie RAE Systems, la reference 059-3051-000 au 059-3052-000 au 059-3054-000. Cet instrument n'a pas été essayé dans une atmosphère de gaz/air explosive ayant une concentration d'oxygène plus élevée que 21%. La substitution de composants peut compromettre la sécurité intrinsique. Ne charger les batteries que dans emplacements désignés non-dangereuse.

Ne pas melanger les anciennes et les nouvelles batteries, ou bien encore les batteries de differents fabriquants.

La calibration de toute instruments de RAE Systems doivent être testé en exposant l'instrument a une concentration de gaz connue par une procédure diétalonnage avant de mettre en service l'instrument pour la première fois.

Pour une securite maximale, la sensibilité du l'instrument doit être verifier en exposant l'instrument a une concentration de gaz connue par une procédure diétalonnage avant chaque utilisation journalière.

Ne pas utiliser de connection USB/PC en zone dangereuse.

Standard Contents

Instrument
Calibration Kit
Charging Cradle
AC/DC Adapter
Alkaline Battery Adapter
Data Cable
CD-ROM With User's Guide, Quick Start Guide, and related materials

General Information

The compact instrument is designed as a broadband VOC gas monitor and datalogger for work in hazardous environments. It monitors Volatile Organic Compounds (VOC) using a photoionization detector (PID) with a 9.8 eV, 10.6 eV, or 11.7 eV gas-discharge lamp. Features are:

Lightweight and Compact

- Compact, lightweight, rugged design
- Built-in sample draw pump

Dependable and Accurate

- Up to 16 hours of continuous monitoring with rechargeable battery pack
- Designed to continuously monitor VOC vapor at parts-per-billion (ppb) levels

User-friendly

- Preset alarm thresholds for STEL, TWA, low- and high-level peak values.
- Audio buzzer and flashing LED display are activated when the limits are exceeded.

Datalogging Capabilities

- 260,000-point datalogging storage capacity for data download to PC

The instrument consists of a PID with associated microcomputer and electronic circuit. The unit is housed in a rugged case with a backlit LCD and 3 keys to provide easy user interface. It also has a built-in flashlight for operational ease in dark locations.

Physical Description

The main components of the portable VOC monitoring instrument include:

- Three keys for user to interact with the instrument: 3 operation/programming keys for normal operation or programming
- LCD display with back light for direct readout and calculated measurements
- Built-in flashlight for illuminating testing points in dark environments
- Buzzer and red LEDs for alarm signaling whenever exposures exceed preset limits
- Charge contacts for plugging directly to its charging station
- Gas entry and exit ports
- USB communication port for PC interface
- Protective rubber cover

Specifications

Size:	9.25" L x 3.6" W x 2.9" H
Weight:	28 oz with battery pack
Detector:	Photoionization sensor with 9.8, 10.6, or 11.7 eV UV lamp
Battery:	A 3.7V rechargeable Lithium-Ion battery pack (snap in, field replaceable, at non-hazardous location only)
	Alkaline battery holder (for 4 AA batteries)
Battery Charging:	Less than 8 hours to full charge
Operating Hours:	Up to 16 hours continuous operation
Display:	Large dot matrix screen with backlight

Measurement range & resolution

Lamp	Range	Resolution
10.6 eV	1 ppb to 10,000 ppm	1 ppb
9.8 eV	0.01 ppm to 5,000 ppm	10 ppb
11.7 eV	0.01 ppm to 2,000 ppm	10 ppb

Response time (T_{90}): 2 seconds

Accuracy (Isobutylene): 10 to 2000 ppm: ±3% at calibration point.

PID Detector: Easy access to lamp and sensor for cleaning and replacement

Correction Factors: Over 200 VOC gases built in (based on RAE Systems Technical Note TN-106)

Calibration: Two-point field calibration of zero and standard reference gases

Calibration Reference: Store up to 8 sets of calibration data, alarm limits and span values

Inlet Probe: Flexible 5" tubing

Radio module: Bluetooth (2.4GHz), RF module (433MHz, 868MHz , 915MHz, or 2.4GHz)

Keypad: 1 operation key and 2 programming keys; 1 flashlight switch

Direct Readout: Instantaneous, average, STEL, TWA and peak value, and battery voltage

Intrinsic Safety: US and Canada: Class I, Division 1, Groups A, B, C, D
Europe: ATEX (0575 Ex II 2G Ex ia IIC/IIB T4 Gb)
KEMA 07 ATEX 0127
Complies with EN60079-0:2009, EN60079-11:2007

	IECEx CSA 10.0005 Ex ia IIC/IIB T4 Gb Complies with IEC 60079-0:2007, IEC 60079-11:2006 (IIC: 059-3051-000 Li-ion bat pack or 059-3054-000 NiMH bat pack; IIB: 059-3052-000 alkaline bat pack)
EM Interference:	Highly resistant to EMI/RFI. Compliant with EMC R&TTE (RF Modules)
Alarm Setting:	Separate alarm limit settings for Low, High, STEL and TWA alarm
Operating Mode:	Hygiene or Search mode
Alarm:	Buzzer (95dB at 30cm) and flashing red LEDs to indicate exceeded preset limits, low battery voltage, or sensor failure
Alarm Type:	Latching or automatic reset
Real-time Clock:	Automatic date and time stamps on datalogged information
Datalogging:	260,000 points with time stamp, serial number, user ID, site ID, etc.
Communication:	Upload data to PC and download instrument setup from PC via USB on charging station.
Sampling Pump:	Internally integrated. Flow rate: 450 to 550 cc/min.
Temperature:	-20º C to 50º C (-4º to 122º F)
Humidity:	0% to 95% relative humidity (non-condensing)
Housing (including rubber boot):	Polycarbonate, splashproof and dustproof Battery can be changed without removing rubber boot.

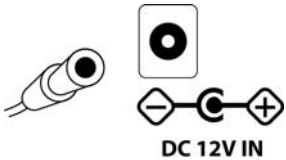
Charging The Battery

Always fully charge the battery before using the instrument. The instrument's Li-ion battery is charged by placing the instrument in its cradle. Contacts on the bottom of the instrument meet the cradle's contacts, transferring power without other connections.

Note: Before setting the instrument into its charging cradle, visually inspect the contacts to make sure they are clean. If they are not, wipe them with a soft cloth. Do not use solvents or cleaners.

Follow this procedure to charge the instrument:

1. Plug the AC/DC adapter's barrel connector into the instrument's cradle.



2. Plug the AC/DC adapter into the wall outlet.
3. Place the instrument into the cradle, press down, and lean it back. It locks in place and the LED in the cradle glow

The instrument begins charging automatically. The "Primary" LED in the cradle blinks green to indicate charging. During charging, the diagonal lines in the battery icon on the instrument's display are animated and you see the message "Charging..."

When the instrument's battery is fully charged, the battery icon is no longer animated and shows a full battery. The message "Fully charged!" is shown. The cradle's LED glows continuously green.

Note: If you see the "Battery Charging Error" icon (a battery outline with an exclamation mark inside), check that the instrument or rechargeable battery has been set into the cradle

properly. If you still receive the message, check the Troubleshooting section of this guide.

Note: If the instrument or battery has been in the cradle for more than 10 hours and you see the "Battery Charging Error" icon and a message that says, "Charging Too Long," this indicates that the battery is not reaching a full charge. Try changing the battery and make sure the contacts between the instrument (or battery) are meeting the cradle. If the message is still shown, consult your distributor or RAE Systems Technical Services.

Charging A Spare Rechargeable Battery

A rechargeable Li-ion battery can be charged when it is not inside the monitor. The charging cradle is designed to accommodate both types of charging. Contacts on the bottom of the battery meet the contacts on the cradle, transferring power without other connections, and a spring-loaded capture holds the battery in place during charging.

1. Plug the AC/DC adapter into the monitor's cradle.
2. Place the battery into the cradle, with the gold-plated contacts on top of the six matching charging pins.
3. Plug the AC/DC adapter into the wall outlet.

The battery begins charging automatically. During charging, the Secondary LED in the cradle blinks green. When charging is complete, it glows steady green.

Release the battery from the cradle by pulling it back toward the rear of the cradle and tilting it out of its slot.

Note: If you need to replace the Li-ion battery pack, replacements are available from RAE Systems. The part number is 059-3051-000.

Note: An Alkaline Battery Adapter (part number 059-3052-000), which uses four AA alkaline batteries (Duracell MN1500), may be substituted for the Li-Ion battery.

WARNING!

To reduce the risk of ignition of hazardous atmospheres, recharge and replace batteries only in areas known to be non-hazardous. **Remove and replace batteries only in areas known to be non-hazardous.**

Low Voltage Warning

When the battery's charge falls below a preset voltage, the instrument warns you by beeping once and flashing once every minute, and the "empty battery" icon blinks on and off once per second. You should turn off the instrument within 10 minutes and either recharge the battery by placing the instrument in its cradle, or replace the battery with a fresh one with a full charge.

Clock Battery

An internal clock battery is mounted on one of the instrument's printed circuit boards. This long-life battery keeps settings in memory from being lost whenever the Li-ion battery or alkaline batteries are removed. This backup battery should last approximately five years, and must be replaced by an authorized RAE Systems service technician. It is not user-replaceable.

Data Protection While Power Is Off

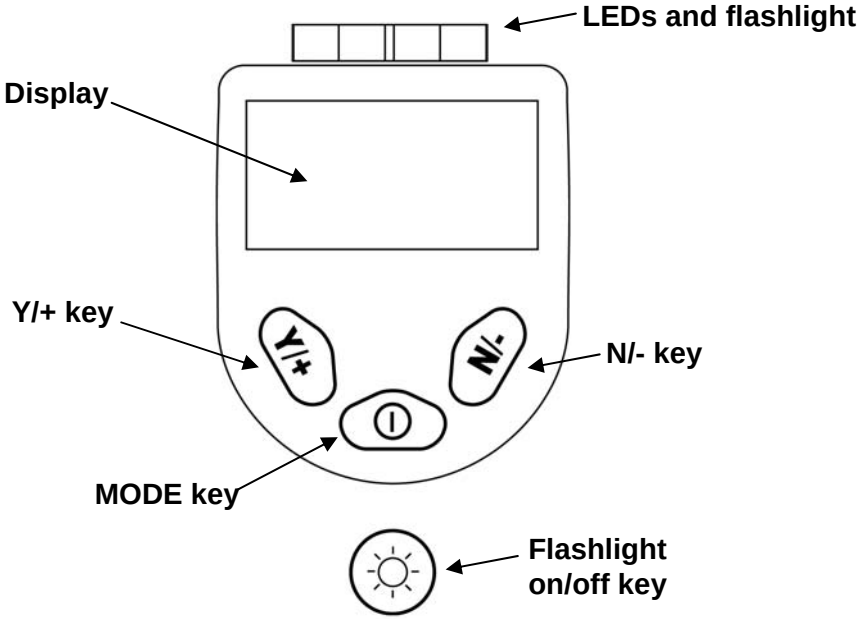
When the instrument is turned off, all the current real-time data including last measured values are erased. However, the datalog data is preserved in non-volatile memory. Even if the battery is disconnected, the datalog data will not be lost.

User Interface

The instrument's user interface consists of the display, LEDs, an alarm transducer, and four keys. The keys are:

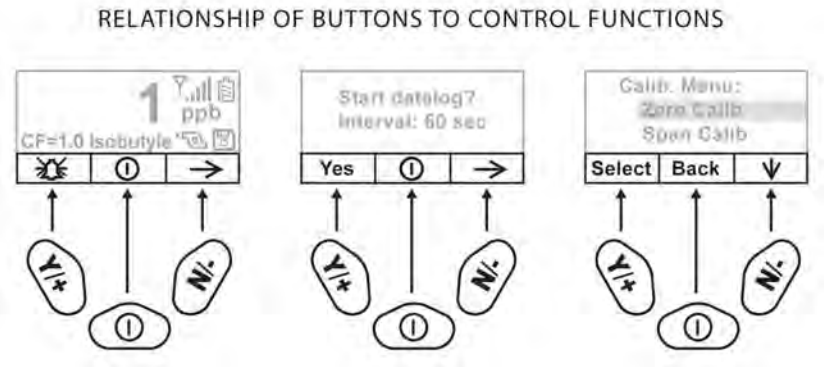
Y/+
MODE
N/-
Flashlight on/off

The LCD display provides visual feedback that includes the reading, time, battery condition, and other functions.



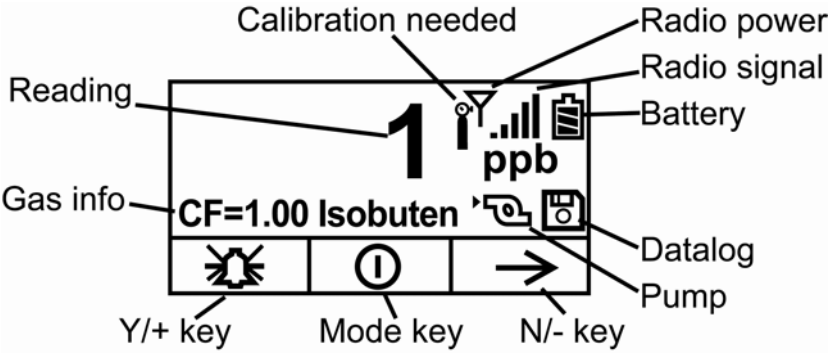
In addition to their labeled functions, the keys labeled Y/+, MODE, and N/- act as "soft keys" that control different parameters and make different selections within the instrument's menus. From menu to menu, each key controls a different parameter or makes a different selection.

Three panes along the bottom of the display are "mapped" to the keys. These change as menus change, but at all times the left pane corresponds to the [Y/+] key, the center pane corresponds to the [MODE] key, and the right pane corresponds to the [N/-] key. Here are three examples of different menus with the relationships of the keys clearly shown:



Display

The display shows the following information:



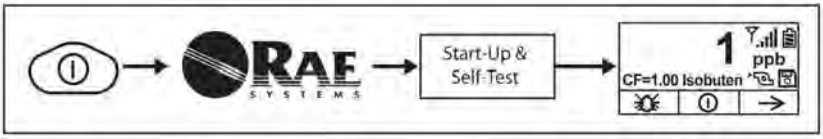
Graph	Graphic representation of concentration plotted over time
Gas info	Tells the Correction Factor and type of calibration gas
Reading	Concentration of gas as measured by the instrument
Calibration needed	Indicates that calibration should be performed
Radio power	Indicates whether radio connection is on or off
Radio signal	Indicates signal strength in 5-bar bargraph
Battery	Indicates battery level in 3 bars
Pump	Indicates that pump is working
Datalog	Indicates whether datalog is on or off
Y/+	Y/+ key's function for this screen
MODE	MODE key's function for this screen
N/-	N/- key's function for this screen

Operating The Instrument

The instrument is designed as a broadband VOC gas monitor and datalogger for work in hazardous environments. It gives real-time measurements and activates alarm signals whenever the exposure exceeds preset limits. Prior to factory shipment, the instrument is preset with default alarm limits and the sensor is pre-calibrated with standard calibration gas. However, you should test the instrument and verify the calibration before the first use. After the instrument is fully charged and calibrated, it is ready for immediate operation.

Turning The Instrument On

1. With the instrument turned off, press and hold [MODE].
2. When the display turns on, release the [MODE] key.



The RAE Systems logo should appear first. (If the logo does not appear, there is likely a problem and you should contact your distributor or RAE Systems Technical Support.) The instrument is now operating and performs self tests. If any tests (including sensor and memory tests fail), refer to the Troubleshooting section of this guide.

Once the startup procedure is complete, the instrument shows a numerical reading screen with icons. This indicates that the instrument is fully functional and ready to use.

Turning The Instrument Off

1. Press and hold the Mode key for 3 seconds. A 5-second countdown to shutoff begins.
2. Once the countdown stops, the instrument is off. Release the Mode key.
3. When you see "Unit off..." release your finger from the [MODE] key. The instrument is now off.

Note: You must hold your finger on the key for the entire shutoff process. If you remove your finger from the key during the countdown, the shutoff operation is canceled and the instrument continues normal operation.

Operating The Built-In Flashlight

The instrument has a built-in flashlight that helps you point the probe in dark places. Press the flashlight key to turn it on. Press it again to turn it off.

Note: Using the flashlight for extended periods shortens the battery's operating time before it needs recharging.

Pump Status

IMPORTANT!

During operation, make sure the probe inlet and the gas outlet are free of obstructions. Obstructions can cause premature wear on the pump, false readings, or pump stalling. During normal operation, the pump icon alternately shows inflow and outflow as shown here:

During duty cycling (PID lamp cleaning), the display shows these icons in alternation:

If there is a pump failure or obstruction that disrupts the pump, you will see this icon blinking on and off:

If you see this blinking icon, consult the Troubleshooting section of this guide.

Calibration Status

The instrument displays this icon if it requires calibration:

Calibration is required (and indicated by this icon) if:

- The lamp type has been changed (for example, from 10.6 eV to 9.8 eV).
- The sensor has been replaced.
- It has been 30 days or more since the instrument was last calibrated.
- If you have changed the calibration gas type without recalibrating the instrument.

Operating Modes

Your instrument operates in different modes, depending on the model and its factory default settings. In some cases, you can change modes using a password and using the instrument's navigation. In other cases, you must use ProRAE Studio software.

The default setting for your instrument is:

User Level: Basic
Operation Mode: Hygiene

This is outlined in detail on page 76.

The other options, covered later in this guide, are:

User Level: Advanced (page 80)
Operation Mode: Hygiene

User Level: Advanced (page 84)
Operation Mode: Search

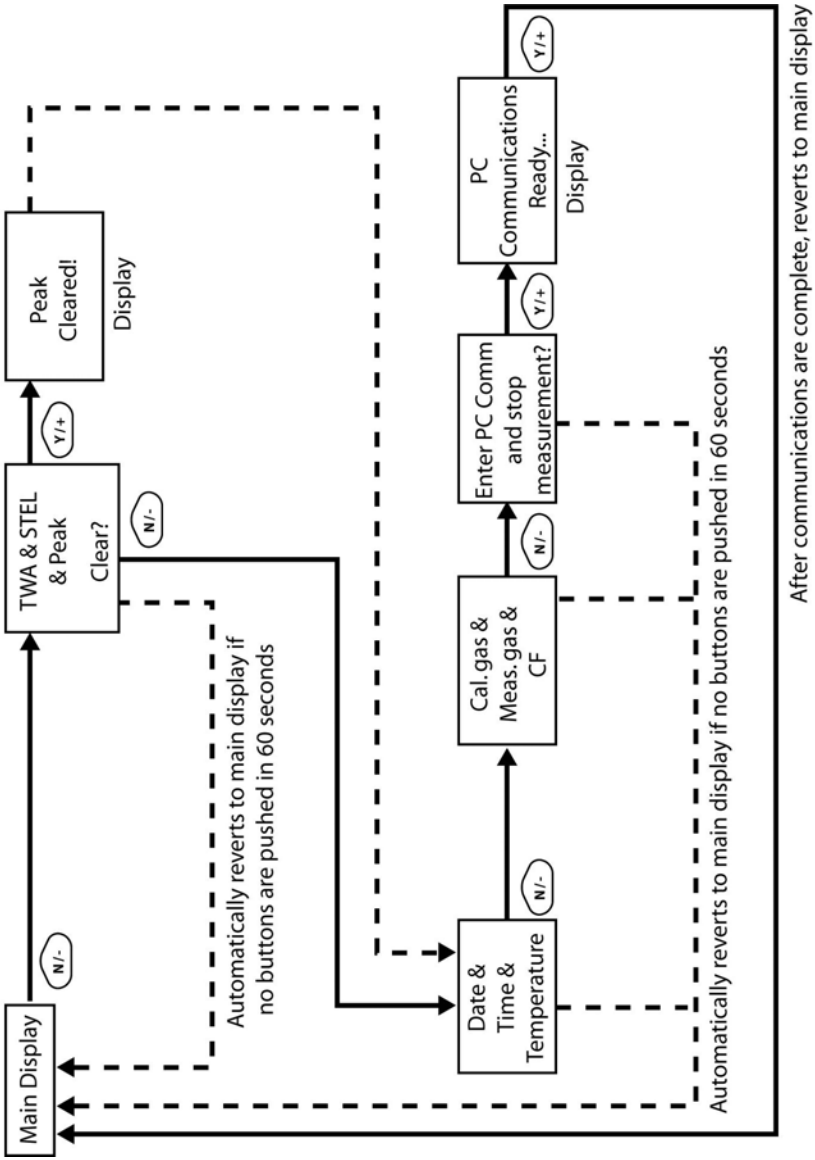
Using ProRAE Studio allows access to other options. In addition, Diagnostic Mode (page 85) is available for service technicians.

Basic User Level/Hygiene Mode (Default Settings)

The instrument is programmed to operate in Basic User Level/Hygiene Mode as its default. This gives you the most commonly needed features while requiring the fewest parameter adjustments.

Pressing [N/-] steps you from one screen to the next, and eventually return to the main display. If you do not press a key within 60 seconds after entering a display, the instrument reverts to its main display.

Note: While viewing any of these screens, you can shut off your instrument by pressing [MODE].



Note: Dashed line indicates automatic progression.

After the instrument is turned on, it runs through the start-up menu. Then the message "**Please apply zero gas…**" is displayed.

At this point, you can perform a zero air (fresh air) calibration. If the ambient air is clean, you can use that. Otherwise, use a cylinder of zero air. Refer to Zero Calibration on page 37 for a more detailed description of zero calibration.

Start zero calibration by pressing Start. You see the message "Zeroing…" followed by a 30-second countdown.

Note: You can press [MODE] to quit, bypassing the zero air calibration.

When zero calibration is complete, you see the message:

Zeroing is done!

Reading = 0 ppb

The instrument is now sampling and collecting data.

Note: At the Average & Peak, Date & Time & Temperature, Calibration Gas & Measurement Gas & Correction Factor, and PC Communications screens, the instrument automatically goes to the main display after 60 seconds if you do not push a key to make a selection.

Alarm Signals

During each measurement period, the gas concentration is compared with the programmed alarm limits (gas concentration alarm limit settings). If the concentration exceeds any of the preset limits, the loud buzzer and red flashing LED are activated immediately to warn you of the alarm condition.

In addition, the instrument alarms if one of the following conditions occurs: battery voltage falls below a preset voltage level, failure of the UV lamp, or pump stall.

Alarm Signal Summary

Message	Condition	Alarm Signal
HIGH	Gas exceeds "High Alarm" limit	3 beeps/flashes per second*
OVR	Gas exceeds measurement range	3 beeps/flashes per second*
MAX	Gas exceeds electronics' maximum range	3 beeps/flashes per second*
LOW	Gas exceeds "Low Alarm" limit	2 beeps/flashes per second*
TWA	Gas exceeds "TWA" limit	1 Beep/flash per second*
STEL	Gas exceeds "STEL" limit	1 Beep/flash per second*
Pump icon flashes	Pump failure	3 beeps/flashes per second
Lamp	PID lamp failure	3 beeps/flashes per second plus "Lamp" message on display
Battery icon flashes	Low battery	1 flash, 1 beep per minute plus battery icon flashes on display
CAL	Calibration failed, or needs calibration	1 beep/flash per second
NEG	Gas reading measures less than number stored in calibration	1 beep/flash per second

* Hygiene mode only. In Search mode, the number of beeps per second (1 to 7) depends upon the concentration of the sampled gas. Faster rates indicate higher concentrations.

Preset Alarm Limits & Calibration

The instrument is factory calibrated with standard calibration gas, and is programmed with default alarm limits.

Cal Gas (Isobutylene)	Cal Span	unit	Low	High	TWA	STEL
ppbRAE 3000	10	ppm	10	25	10	25

Testing The Alarm

You can test the alarm whenever the main (Reading) display is shown. Press [Y/+], and the audible and visible alarms are tested.

Integrated Sampling Pump

The instrument includes an integrated sampling pump. This diaphragm-type pump that provides a 450 to 550 cc per minute flow rate. Connecting a Teflon or metal tubing with 1/8" inside diameter to the gas inlet port of the instrument, this pump can pull in air samples from 100' (30 m) horizontally or vertically.

Note: In Search Mode, the pump turns on when a sample measurement is started, and turns off when the sample is manually stopped.

If liquid or other objects are pulled into the inlet port filter, the instrument detects the obstruction and immediately shuts down the pump. The alarm is activated and a flashing pump icon is displayed.

You should acknowledge the pump shutoff condition by clearing the obstruction and pressing the [Y/+] key while in the main reading display to restart the pump.

Backlight

The LCD display is equipped with an LED backlight to assist in reading the display under poor lighting conditions.

Datalogging

During datalogging, the instrument displays a disk icon to indicate that datalogging is enabled. The instrument stores the measured gas concentration at the end of every sample period (when data logging is enabled). In addition, the following information is stored: user ID, site ID, serial number, last calibration date, and alarm limits. All data are retained (even after the unit is turned off) in non-volatile memory so that it can be down- loaded at a later time to a PC.

Datalogging event

When Datalogging is enabled, measurement readings are being saved. These data are stored in "groups" or "events." A new event is created and stored each time the instrument is turned on and is set to automatic datalogging, or a configuration parameter is changed, or datalogging is interrupted. The maximum time for one event is 24 hours or 28,800 points. If an event exceeds 24 hours, a new event is automatically created. Information, such as start time, user ID, site ID, gas name, serial number, last calibration date, and alarm limits are recorded.

Datalogging sample

After an event is recorded, the unit records a shorter form of the data. When transferred to a PC running ProRAE Studio, this data is arranged with a sample number, time, date, gas concentration, and other related information.

Auto/Manual/Snapshot Datalogging

The instrument has three datalog types:

Auto	Default mode. Collects datalog information when the instrument is sampling.
Manual	Datalogging occurs only when the instrument's datalogging is manually started (see page 63 for details).
Snapshot	Datalogs only during snapshot (single-event capture, initiated by pressing [MODE]) sampling. See page 63 for details.

Note: You can only choose one datalog type to be active at a time.

Accessories

The following accessories are included with the instrument:

- An AC Adapter (Battery Charger)
- Alkaline battery adapter
- External Filter
- Organic Vapor Zeroing kit

Hard-case kits also include these accessories:

- Calibration adapter
- Calibration regulator and Flow controller

Standard Kit & Accessories

AC Adapter (Battery Charger)

WARNING

To reduce the risk of ignition of hazardous atmospheres, recharge battery only in area known to be non-hazardous. Remove and replace battery only in area known to be non-hazardous.

Ne charger les batteries que dans emplacements designés non-dangereuses.

A battery charging circuit is built into the instrument cradle. It only needs a regular AC to 12 VDC adapter (wall-mount transformer, part number 500-0114-000) to charge the instrument.

To charge the battery inside the instrument:

1. Power off the instrument.
2. Connect the AC adapter to the DC jack on the instrument's cradle. If the instrument is off, it automatically turns on.
3. While charging, the display message shows "Charging." The Primary LED on the cradle flashes green when charging.
4. When the battery is fully charged, the LED changes to glowing green continuously, and the message "Fully charged" appears on

the display. If there is a charging error, the LED glows red continuously.

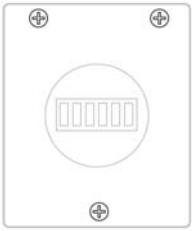
A completely discharged instrument can be charged to full capacity within 8 hours. Batteries drain slowly even if an instrument is off. Therefore, if the instrument has been in storage or has not been charged for several days or longer, check the charge before using it.

The factory-supplied battery is designed to last for 16 hours of normal operation (no alarm), for a new battery under the optimum circumstances. As the battery becomes older or is subject to adverse conditions (such as cold ambient temperature), its capacity will be significantly reduced.

Alkaline Battery Adapter

An alkaline battery adapter is supplied with each instrument. The adapter (part number 059-3052-000) accepts four AA alkaline batteries (use only Duracell MN1500) and provides approximately 12 hours of operation. The adapter is intended to be used in emergency situations when there is no time to charge the Li-ion battery pack.

To insert batteries into the adapter:



1. Remove the three Philips-head screws to open the compartment in the adapter.
2. Insert four fresh AA batteries as indicated by the polarity (+/-) markings.
3. Replace the cover. Replace the three screws.

To install the adapter in the instrument:

1. Remove the Li-ion battery pack from the instrument by sliding the tab and tilting out the battery.
2. Replace it with the alkaline battery adapter
3. Slide the tab back into place to secure the battery adapter.

IMPORTANT!

Alkaline batteries cannot be recharged. The instrument's internal circuit detects alkaline batteries and will not allow recharging. If you place the instrument in its cradle, the alkaline battery will not be

recharged. The internal charging circuit is designed to prevent damage to alkaline batteries and the charging circuit when alkaline batteries are installed inside the instrument. If you try to charge an alkaline batteries installed in the instrument, the instrument's display will say, "Alkaline Battery," indicating that it will not charge the alkaline batteries.

Note: When replacing alkaline batteries, dispose of old ones properly.

WARNING!

To reduce the risk of ignition of hazardous atmospheres, recharge the battery only in areas known to be non-hazardous. Remove and replace the battery only in areas known to be non-hazardous.

External Filter

The external filter is made of PTFE (Teflon®) membrane with a 0.45 micron pore size to prevent dust or other particles from being sucked into the sensor manifold, which would cause extensive damage to the instrument. It prolongs the operating life of the sensor. To install the external filter, simply connect it to the instrument's inlet tube.

Optional Accessories

Calibration Adapter

The calibration adapter for the instrument is a simple 6-inch Tygon tubing with a metal adapter on one end. During calibration, simply insert the metal adapter into the regular gas inlet probe of the instrument and the tubing to the gas regulator on the gas bottle.

Calibration Regulator

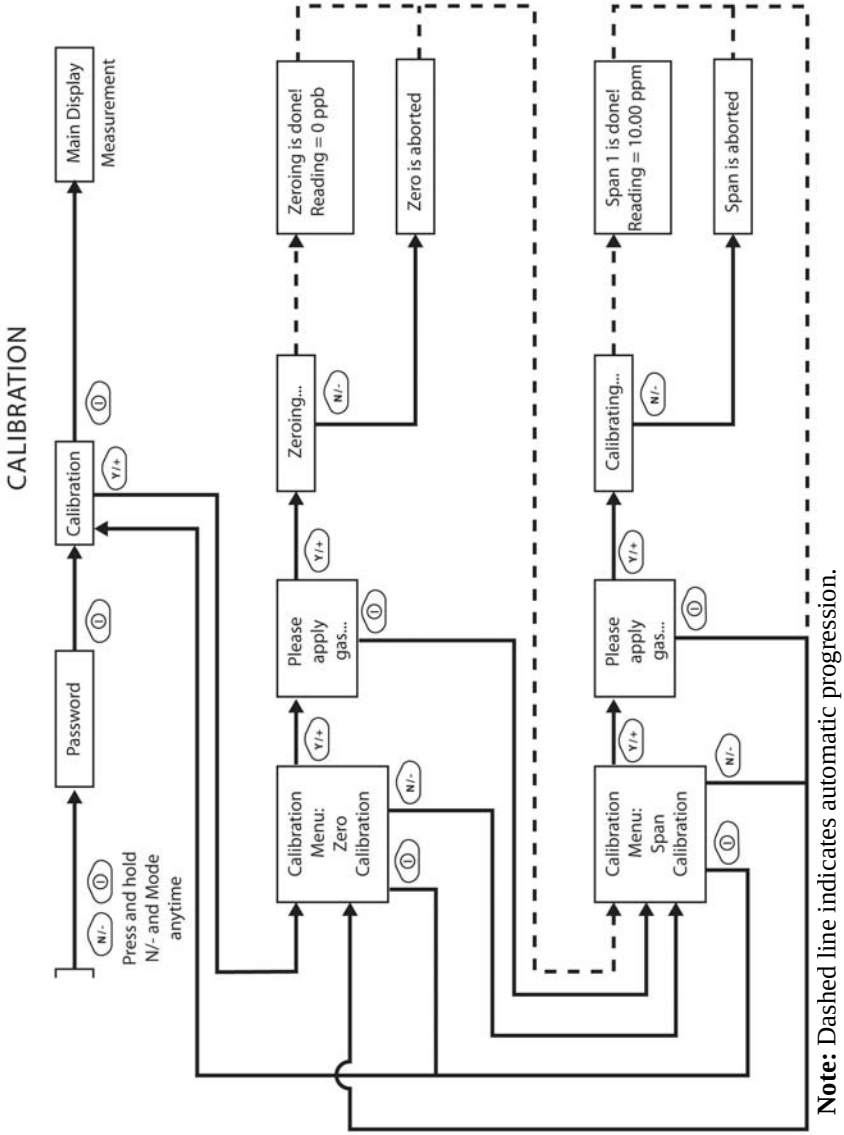
The Calibration Regulator is used in the calibration process. It regulates the gas flow rate from the Span gas cylinder into the gas inlet of the instrument during calibration process. The maximum flow rate allowed by the flow controller is about 0.5L/min (500 cc per min.). Alternatively, a demand-flow regulator or a Tedlar gas bag may be used to match the pump flow precisely.

Organic Vapor Zeroing Kit

The Organic Vapor Zeroing Kit is used for filtering organic air contaminants that may affect the zero calibration reading. To use the Organic Vapor Zeroing Kit, simply connect the filter to the inlet port of the instrument.

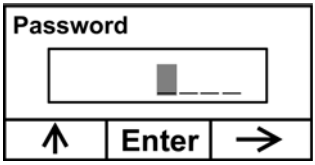
Standard Two-Point Calibration (Zero & Span)

The following diagram shows the instrument's calibrations in Basic/Hygiene mode.



Entering Calibration

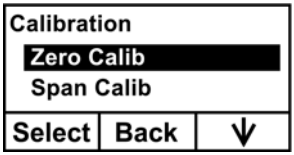
1. Press and hold [MODE] and [N/-] until you see the Password screen.



2. In Basic User Level, you do not need a password to perform calibrations. Instead of inputting a password, enter calibration by pressing [MODE].

   Note: If you inadvertently press [Y/+] and change any of the numbers, simply press [MODE] and you will be directed to the calibration menu.

The Calibration screen is now visible with Zero Calibration highlighted.



These are your options:

- Press [Y/+] to select the highlighted calibration (Zero Calib or Span Calib).
- Press [MODE] to exit calibration and return to the main display and resume measurement.
- Press [N/-] to toggle the highlighted calibration type.

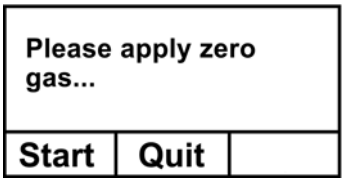
Zero (Fresh Air) Calibration

This procedure determines the zero point of the sensor calibration curve. To perform a fresh air calibration, use the calibration adapter to connect the instrument to a "fresh" air source such as from a cylinder or Tedlar bag (optional accessory). The "fresh" air is clean, dry air without organic impurities and an oxygen value of 20.9%. If such an air cylinder is not available, any clean ambient air without detectable contaminants or a charcoal filter can be used.

At the Zero Calibration menu, you can proceed to perform a Zero calibration or bypass Zero calibration and perform a Span calibration. You may also go back to the initial Calibration menu if you want to exit calibration.

- Press [Y/+] to start calibration.
- Press [MODE] to quit and return to the main calibration display.

If you have pressed [Y/+] to enter Zero calibration, then you will see this message:



1. Turn on your Zero calibration gas.
2. Press [Y/+] to start calibration.

   Note: At this point, you may press [MODE] if you decide that you do not want to initiate calibration. This will take you directly to the Calibration menu, highlighted for Span calibration.

3. Zero calibration starts a 30-second countdown and displays this message:

   Zeroing...

During the zeroing process, the instrument performs the Zero calibration automatically and does not require any action on your part.

Note: To abort the zeroing process at any time and proceed to Span calibration, press [N/-] at any time while zeroing is being performed. You will see a confirmation message that says "Zero aborted!" and then the Span calibration menu appears.

When Zero calibration is complete, you see this message:

Zeroing is done!
Reading = 0 ppb

The instrument will then show the Calibration menu on its display, with Span Calib highlighted.

Span Calibration

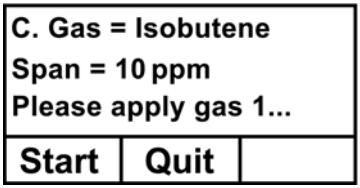
This procedure determines the second point of the sensor calibration curve for the sensor. A cylinder of standard reference gas (span gas) fitted with a 500 cc/min. flow-limiting regulator or a flow-matching regulator is the simplest way to perform this procedure. Choose the 500 cc/min. regulator only if the flow rate matches or slightly exceeds the flow rate of the instrument pump. Alternatively, the span gas can first be filled into a Tedlar bag or delivered through a demand-flow regulator. Connect the calibration adapter to the inlet port of the instrument, and connect the tubing to the regulator or Tedlar bag.

Another alternative is to use a regulator with >500 cc/min flow but allow the excess flow to escape through a T or an open tube. In the latter method, the span gas flows out through an open tube slightly wider than the probe, and the probe is inserted into the calibration tube.

At the Span Calibration menu, you perform a Span calibration. You may also go back to the Zero calibration menu or to the initial Calibration menu if you want to exit calibration.

- Press [Y/+] to enter Span calibration.
- Press [N/-] to skip Span calibration and return to Zero calibration.
- Press [MODE] to exit Span calibration and return to the top calibration menu.

If you have pressed [Y/+] to enter Span calibration, then you will see the name of your Span gas (the default is isobutylene) and the span value in parts per million (ppm). You will also see this message that prompts you:



1. Turn on your span calibration gas.

2. Press [Y/+] to initiate calibration.

   Note: You may press [MODE] if you decide that you do not want to initiate calibration. This will abort the span calibration and take you directly to the Calibration menu for Zero calibration.

3. Span calibration starts and displays this message:

   Calibrating...

During the Span calibration process, there is a 30-second countdown and the instrument performs the Span calibration automatically. It requires no actions on your part.

Note: If you want to abort the Span calibration process, press [N/-] at any time during the process. You will see a confirmation message that says "Span is aborted!" and then the Zero calibration menu appears. You can then proceed to perform a Zero calibration, perform a Span calibration, or exit to the topmost Calibration menu.

When Span calibration is complete, you see a message similar to this (the value is an example only):

Span 1 is done!
Reading = 10.0 ppm

The instrument then exits Span calibration and shows the Zero calibration menu on its display.

Note: The reading should be very close to the span gas value.

Exiting Two-Point Calibration In Basic User Level

When you are done performing calibrations, press [MODE], which corresponds with "Back" on the display. You will see the following message:

Updating settings…

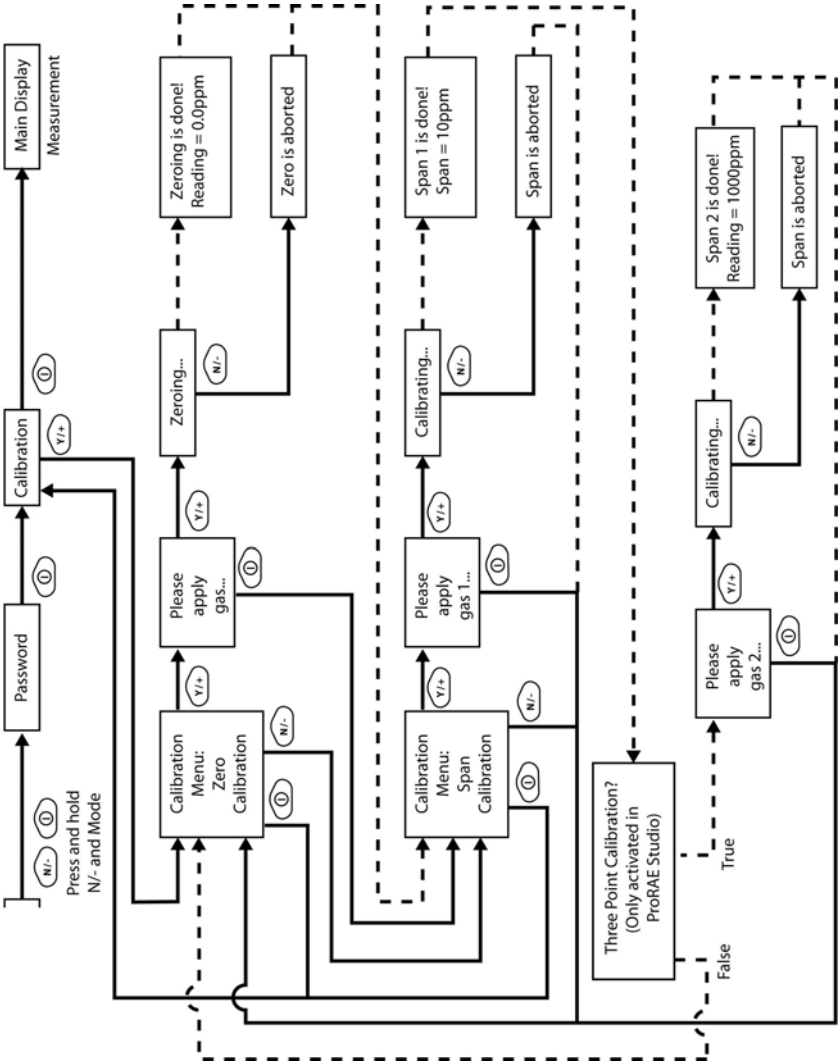
The instrument updates its settings and then returns to the main display. It begins or resumes monitoring.

Three-Point Calibration

For enhanced accuracy, it is possible to perform a second Span calibration in addition to the Zero and Span calibrations outlined in the previous section. Your instrument first must be set to allow this third calibration. This requires using ProRAE Studio software and a PC, as well as a higher concentration of calibration gas.

Note: Once the third calibration is set, you do not need to use ProRAE Studio to allow future 3-point calibrations. Also, you can only disable 3-point calibration capability by using ProRAE Studio again.

Perform the Zero and Span calibrations. After the first Span calibration (Span 1) is completed, the display a second Span calibration (Span 2) can be performed. The process is identical to the first calibration. As in the Span 1 calibration, you may exit and return to the Zero calibration screen if you choose not to perform this calibration or to abort it.



Note: Dashed line indicates automatic progression.

Span 2 Calibration

A cylinder of standard reference gas (span gas) fitted with a 500 cc/min. flow-limiting regulator or a flow-matching regulator is the simplest way to perform this procedure.

Note: This gas should be of a higher concentration than the gas used for Span 1 calibration.

Choose the 500 cc/min. regulator only if the flow rate matches or slightly exceeds the flow rate of the instrument pump. Alternatively, the span gas can first be filled into a Tedlar bag or delivered through a demand-flow regulator. Connect the calibration adapter to the inlet port of the instrument, and connect the tubing to the regulator or Tedlar bag.

Another alternative is to use a regulator with >500 cc/min flow but allow the excess flow to escape through a T or an open tube. In the latter method, the span gas flows out through an open tube slightly wider than the probe, and the probe is inserted into the calibration tube.

At the Span Calibration menu, you perform a Span calibration. You may also go back to the Zero calibration menu or to the initial Calibration menu if you want to exit calibration.

- Press [Y/+] to enter Span 2 calibration.
- Press [N/-] to skip Span calibration and return to Zero calibration.
- Press [MODE] to exit Span calibration and return to the top calibration menu.

If you have pressed [Y/+] to enter Span calibration, then you will see the name of your Span gas (the default is isobutylene) and the span value in parts per million (ppm). You will also see this message that prompts you:

Please apply gas...

4. Turn on your span calibration gas.

5. Press [Y/+] to initiate calibration.

   Note: You may press [MODE] if you decide that you do not want to initiate calibration. This will take you directly to the Calibration menu for Zero calibration.

6. Span calibration starts a 30-second countdown and displays this message:

   Calibrating...

During the Span calibration process, the instrument performs the Span calibration automatically and does not require any action on your part.

Note: If you want to abort the Span calibration process, press [N/-] at any time during the process. You will see a confirmation message that says "Span is aborted!" and then the Zero calibration menu will appear. You can then proceed to perform a Zero calibration, perform a Span calibration, or exit to the topmost Calibration menu.

When Span calibration is complete, you will see a message similar to this (the value shown here is for example only):

Span 2 is done!
Reading = 1000 ppm

The instrument then exits Span calibration and shows the Zero calibration menu on its display.

Note: The reading should be very close to the span gas value.

Exiting Three-Point Calibration

When you are done performing calibrations, press [MODE], which corresponds with "Back" on the display. You will see the following message:

Updating settings…

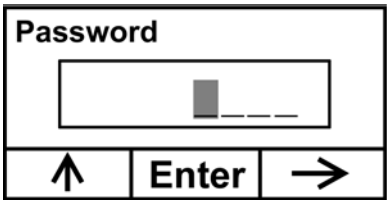
The instrument updates its settings and then returns to the main display. It begins or resumes monitoring.

Programming Mode

Programming Mode can be entered from either Hygiene Mode or Search Mode. If the current user mode is Basic, you must provide a 4-digit password to enter.

Entering Programming Mode

1. Press and hold [MODE] and [N/-] until you see the Password screen.



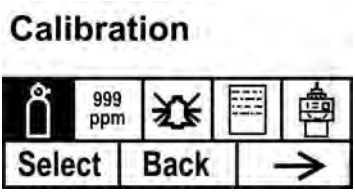
2. Input the 4-digit password:

- Increase the number from 0 through 9 by pressing [Y/+].
- Step from digit to digit using [N/-].
- Press [MODE] when you are done.

If you make a mistake, you can cycle through the digits by pressing [N/-] and then using [Y/+] to change the number in each position.

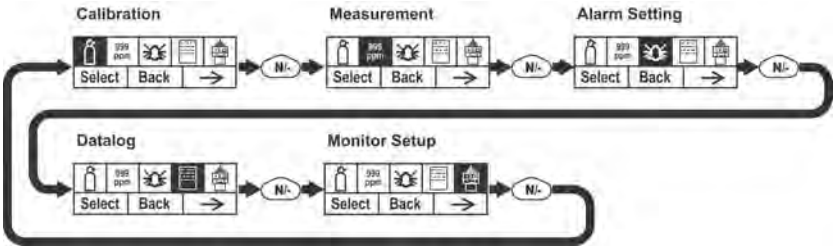
Note: The default password is 0000.

When you have successfully entered Programming Mode, you see this screen:



Note: The password can only be changed by connecting the instrument to a PC running ProRAE Studio software. Follow the instructions in ProRAE Studio to change it.

The Calibration label is shown and its icon is highlighted, but you can press [N/-] to step from one programming menu to the next, with the name of the menu shown at the top of the display and the corresponding icon highlighted. As you repeatedly press [N/-], the selection moves from left to right, and you see these screens:



Note: When you reach Monitor Setup and press [N/-], the menu cycles back to Calibration.

Programming Mode Menus

The Programming Mode allows anyone with the password to change the instrument's settings, calibrate the instrument, modify the sensor configuration, enter user information, etc. Programming Mode has five menus. Each menu includes several sub-menus to perform additional programming functions.

This table shows the menus and sub-menus:

	999 ppm			
Calibration	**Measurement**	**Alarm Setting**	**Datalog**	**Monitor Setup**
Zero Calibration	Meas. Gas	High Alarm	Clear Datalog	Op Mode
Span Calibration	Meas. Unit	Low Alarm	Interval	Site ID
		STEL Alarm	Data Selection	User ID
		TWA Alarm	Datalog Type	User Mode
		Alarm Type		Date
		Buzzer & Light		Time
				Pump Duty Cycle
				Pump Speed
				Temperature Unit
				Language
				Radio Power
				Real Time Protocol
				Power On Zero
				Unit ID
				LCD Contrast

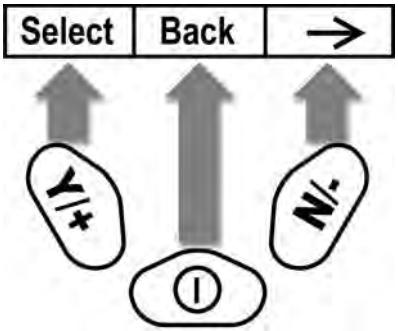
Once you enter Programming Mode, the LCD displays the first menu, Calibration. Each subsequent menu is accessed by pressing [N/-] repeatedly until the desired menu is displayed. To enter a sub-menu of a menu, press [Y/+].

Exiting Programming Mode

To exit Programming Mode and return to normal operation, press [MODE] once at any of the programming menu displays. You will see "Updating Settings…" as changes are registered and the mode changes.

Navigating Programming Mode Menus

Navigating through the Programming Mode menus is easy and consistent, using a single interface format of "Select," "Back" and "Next" at the top level. The three control buttons correspond to these choices as shown:



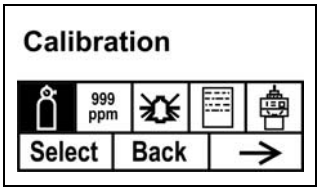
Note: Pressing [MODE] in the Programming Mode's top level causes the instrument to exit Programming Mode and return to monitoring.

The three keys perform the following functions in Programming Mode:

Key	Function in Programming Mode
[MODE]:	Exit menu when pressed momentarily or exit data entry mode
[Y/+]:	Increase alphanumerical value for data entry or confirm (yes) for a question
[N/-]:	Provides a "no" response to a question

Calibration

Two types of calibration are available: Zero (fresh air) and Span.



Select Zero or Span Calibration by pressing [N/+]. Once your choice is highlighted, press [Y/+].

Zero Calibration

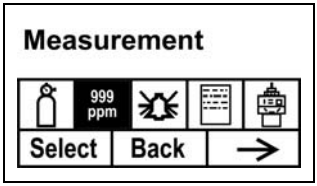
The procedure for performing a zero calibration is covered on page 35.

Span Calibration

The procedure for performing a basic span calibration is covered on page 35.

Measurement

The sub-menus for Measurement are Measurement Gas and Measurement Unit.



Meas. Gas

Measurement gases are organized in four lists:

- My List is a customized list of gases that you create. It contains a maximum of 10 gases and can only be built in ProRAE Studio on a PC and transferred to the instrument. **Note:** The first gas in the list is always isobutylene (it cannot be removed from the list).
- Last Ten is a list of the last ten gases used by your instrument. The list is built automatically and is only updated if the gas selected from Custom Gases or Library is not already in the Last Ten. This ensures that there is no repetition.
- Gas Library is a library that consists of all the gases found in RAE Systems' Technical Note TN-106 (available online at www.raesystems.com).
- Custom Gases are gases with user-modified parameters. Using ProRAE Studio, all parameters defining a gas can be modified, including the name, span value(s), correction factor, and default alarm limits.

1. Scroll through each list by pressing [N/-].
2. Press [Y/+] to select one (My List, Last Ten, Gas Library, or Custom Gases).

3. Once you are in one of the categories, press [N/-] to scroll through its list of options and [Y/+] to select one. (If you press [MODE], you exit to the next submenu.)
4. Press [Y/+] to save your choice or [N/-] to undo your selection.

Leave the sub-menu and return to the Programming Mode menus by pressing [MODE].

Meas. Unit

Standard available measurement units include:

Abbreviation	Unit
ppm	parts per million
ppb	parts per billion
mg/m3	milligrams per cubic meter
ug/m3	micrograms per cubic meter

- Scroll through the list by pressing [N/-].
- Select by pressing [Y/+].
- Save your selection by pressing [Y/+] or undo your selection by pressing [N/-].

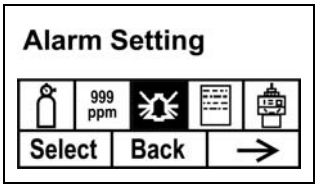
Leave the sub-menu and return to the Programming Mode menus by pressing [MODE].

Alarm Setting

During each measurement period, the gas concentration is compared with the programmed alarm limits (gas concentration alarm limit settings: Low, High, TWA and STEL). If the concentration exceeds any of the preset limits, the loud buzzer and red flashing LED are activated immediately to warn of the alarm condition.

An alarm signal summary is shown on page 27.

In this menu, you can change the High and Low alarm limits, the STEL limit, and the TWA. Press [Y/+] to to enter the Alarm Setting menu. **Note:** All settings are shown in ppm (parts per million), or mg/m^3 (milligrams per cubic meter), depending on your setting.



1. Scroll through the Alarm Limit sub-menu using the [N/-] key until the display shows the desired limit to be changed (High Alarm, Low Alarm, STEL Alarm, and TWA Alarm)
2. Press [Y/+] to select one of the alarm types. The display shows a flashing cursor on the left-most digit of the previously stored alarm limit.
3. Press [Y/+] to increase each digit's value.
4. Press [N/-] to advance to the next digit.
5. Again, use [Y/+] to increase the number.

Repeat this process until all numbers are entered.

Press [MODE] when you are done.

- Press [Y/+] to save the changes.
- Press [N/-] to undo the changes and revert to the previous settings.

When all alarm types have been changed or bypassed, press [MODE] to exit to the Programming Menu.

High Alarm

You can change the High Alarm limit value. The value is typically set by the instrument to match the value for the current calibration gas. It is expressed in parts per billion (ppb). **Note:** The default value depends on the measurement gas.

To change the High Alarm value:

1. Press [Y/+] to increase each digit's value.
2. Press [N/-] to advance to the next digit.
3. Again, use [Y/+] to increase the number.

Repeat this process until all numbers are entered.
When you have completed your selections, press [MODE]. You will see two choices: Save and Undo. You have the opportunity to register the new settings or to change your mind and revert to your previous settings.

Press [Y/+] to save the changes.
Press [N/-] to undo the changes and revert to the previous settings.

Low Alarm

You can change the Low Alarm limit value. The value is typically set by the instrument to match the value for the current calibration gas. It is expressed in parts per billion (ppb). **Note:** The default value depends on the measurement gas.

To change the Low Alarm value:

1. Press [Y/+] to increase each digit's value.
2. Press [N/-] to advance to the next digit.
3. Again, use [Y/+] to increase the number.

Repeat this process until all numbers are entered.

When you have completed your selections, press [MODE]. You will see two choices: Save and Undo. You have the opportunity to register the new settings or to change your mind and revert to your previous settings.

- Press [Y/+] to save the changes.
- Press [N/-] to undo the changes and revert to the previous settings.

STEL Alarm

You can change the STEL Alarm limit value. The value is typically set by the instrument to match the value for the calibration gas. It is expressed in parts per billion (ppb). **Note:** The default value depends on the measurement gas.

To change the STEL Alarm value:

1. Press [Y/+] to increase each digit's value.
2. Press [N/-] to advance to the next digit.
3. Again, use [Y/+] to increase the number.

Repeat this process until all numbers are entered.

When you have completed your selections, press [MODE]. You will see two choices: Save and Undo. You have the opportunity to register the new settings or to change your mind and revert to your previous settings.

- Press [Y/+] to save the changes.
- Press [N/-] to undo the changes and revert to the previous settings.

TWA Alarm

You can change the TWA (time-weighted average) Alarm limit value. The value is typically set by the instrument to match the value for the calibration gas. It is expressed in parts per billion (ppb). **Note:** The default value depends on the measurement gas.

To change the TWA Alarm value:

1. Press [Y/+] to increase each digit's value.
2. Press [N/-] to advance to the next digit.
3. Again, use [Y/+] to increase the number.

Repeat this process until all numbers are entered.

When you have completed your selections, press [MODE]. You will see two choices:

- Save
- Undo

You have the opportunity to register the new settings or to change your mind and revert to your previous settings.

- Press [Y/+] to save the changes.
- Press [N/-] to undo the changes and revert to the previous settings.

Alarm Type

There are two selectable alarm types:

Latched	When the alarm is triggered, you can manually stop the alarm. The latched setting only controls alarms for High Alarm, Low Alarm, STEL Alarm, and TWA alarm. **Note:** To clear an alarm when the instrument is set to "Latched," press [Y/+] when the main (Reading) display is shown.
Automatic Reset	When the alarm condition is no longer present, the alarm stops and resets itself.

1. Press **[N/-]** to step from one alarm type to the other.
2. Press **[Y/+]** to select an alarm type.

When you have completed your selections, press [MODE].

You will see two choices: Save and Undo. You have the opportunity to register the new settings or to change your mind and revert to your previous settings.

- Press [Y/+] to save the changes.
- Press [N/-] to undo the changes and revert to the previous settings.

Buzzer & Light

The buzzer and light alarms can be programmed to be on or off individually or in combination. Your choices are:

- Both on
- Light only
- Buzzer only
- Both off

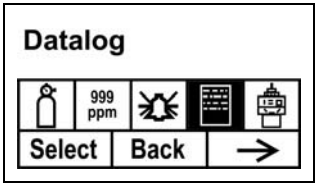
1. Press [N/-] to step from one option to the next.
2. Press [Y/+] to make your selection (the dark circle in the "radio button" indicates your selection).
3. When you have completed your selections, press [MODE].

   You will see two choices: Save and Undo. You have the opportunity to register the new settings or to change your mind and revert to your previous settings.

   - Press [Y/+] to save the changes.
   - Press [N/-] to undo the changes and revert to the previous settings.

Datalog

The instrument calculates and stores the concentration and ID of each sample taken. In the datalog sub-menu, a user can perform the tasks and functions shown below.



1. Scroll through the Datalog sub-menu using the [N/-] key until the display shows the desired parameter to be changed:

   Clear Datalog
   Interval
   Data Selection
   Datalog Type

2. Press [Y/+] to make your selection. Exit by pressing [MODE] for Back.

Clear Datalog

This erases all the data stored in the datalog.

Note: Once the datalog is cleared, the data cannot be recovered.

Press [Y/+] to clear the datalog. The display asks, "Are you sure?"

- Press [Y/+] if you want to clear the datalog. When it has been cleared, the display shows "Datalog Cleared!"
- Press [N/-] if you do not want to clear the datalog.

The display changes, and you are taken to the next sub-menu, Interval.

Interval

Intervals are shown in seconds. The default value is 60 seconds. The maximum interval is 3600 seconds.

1. Press [Y/+] to increase each digit's value.
2. Press [N/-] to advance to the next digit.
3. Again, use [Y/+] to increase the number.

Repeat this process until all numbers are entered.

When you have completed your selections, press [MODE].

You will see two choices: Save and Undo. You have the opportunity to register the new settings or to change your mind and revert to your previous settings.

- Press [Y/+] to save the changes.
- Press [N/-] to undo the changes and revert to the previous settings.

Data Selection

Data Selection allows you to select which types of data are stored and made available when you offload your datalog to a computer via ProRAE Studio software.

You can choose any or all of three types of data (you must choose at least one):

- Average
- Maximum
- Minimum

1. Press [N/-] to step from one option to the next. The highlighter indicates your choice.
2. Press [Y/+] to toggle your selection on or off (the check box indicates "on" with an "X").
3. When you have completed your selections, press [MODE].

You will see two choices: Save and Undo. You have the opportunity to register the new settings or to change your mind and revert to your previous settings.

- Press [Y/+] to save the changes.
- Press [N/-] to undo the changes and revert to the previous settings.

Datalog Type

The instrument has three datalog types:

Auto	Default mode. Collects datalog information when the instrument is sampling.
Manual	Datalogging occurs only when the instrument's datalogging is manually started (see below for details).
Snapshot	Datalogs only during single-event capture sampling.

Note: You can only choose one datalog type to be active at a time.

1. Press [N/-] to step from one option to the next.
2. Press [Y/+] to make your selection (the dark circle in the "radio button" indicates "on").
3. When you have completed your selection, press [MODE].

You will see two choices: Save and Undo. You have the opportunity to register the new settings or to change your mind and revert to your previous settings.

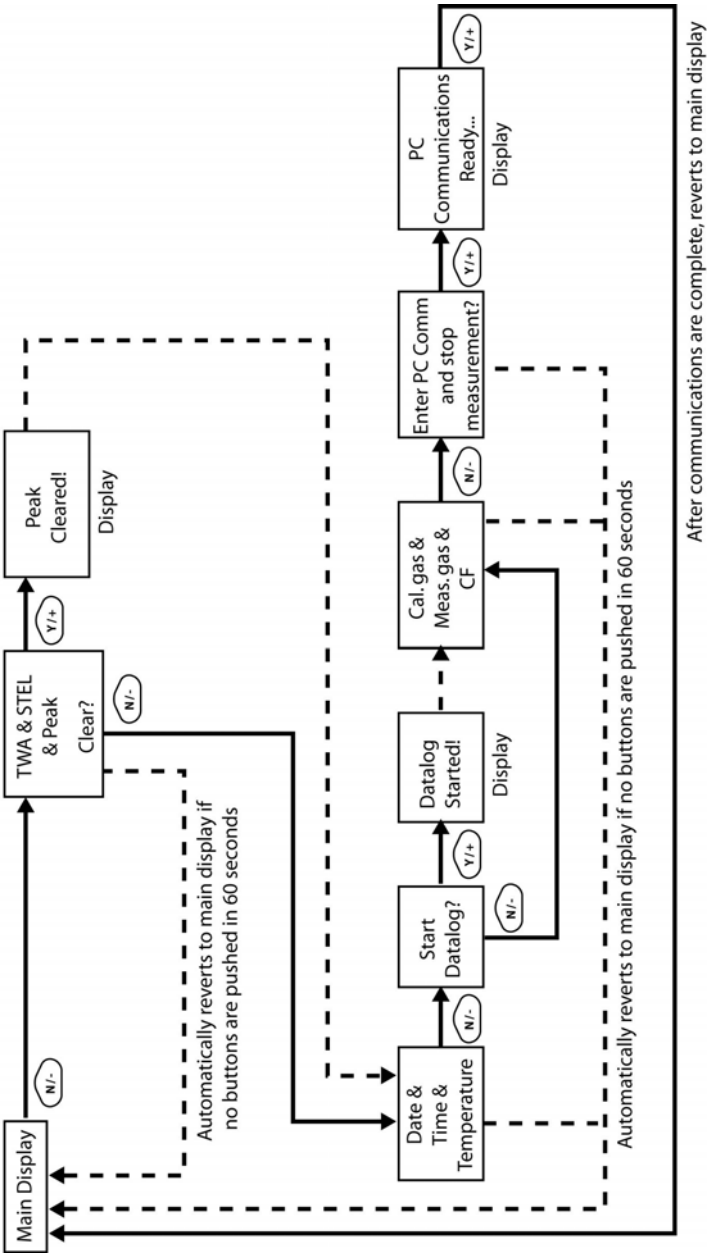
- Press [Y/+] to save the changes.

Press [N/-] to undo the changes and revert to the previous settings.

Manual Datalog

When the instrument is set to Manual Datalog, you turn datalogging on and off by stepping through the displays from the Main Display, and then pressing the keys to select datalog on/off functions.

- When you reach the screen that says "Start Datalog?" press [Y/+] to start it. You see "Datalog Started," confirming that datalogging is now on.
- When you reach the screen that says "Stop Datalog?" press [Y/+] to stop it. You see "Datalog Stopped," confirming that datalogging is now off.



Note: Dashed line indicates automatic progression.

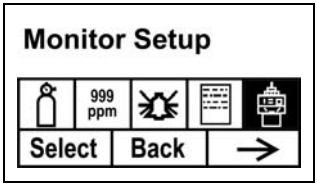
Snapshot Datalog

When the instrument is in Snapshot datalogging mode, it captures a single "snapshot" of the data at the moment of your choosing. Whenever the instrument is on and it is set to Snapshot, all you have to do is press [MODE] each time you want to capture a snapshot of the data at that instant.

When you send the data to a computer using ProRAE Studio, the data snapshots are uniquely identified by time and other parameters.

Monitor Setup

Many settings can be accessed in this menu, including setting the date and time and adjusting the pump's on/off duty cycle.



Op Mode

Under Monitor Setup is "Op Mode."

Press [Y/+] to select.

You see two options (one is highlighted):

Hygiene
Search

The current mode is indicated by a dark circle within the circle in front of either Hygiene or Search.

1. Select Hygiene or Search by pressing [N/-]. The highlighting changes from one to the other each time you press [N/-].
2. Press [Y/+] to select that mode for the instrument.
3. Press [MODE] when you want to register your selection to place the instrument in the selected mode.
4. Press [Y/+] to commit the change and exit to the Monitor Setup screen, or press [N/-] to Undo (exit to the Monitor Setup screen without changing the Mode).

Site ID

Enter an 8-digit alphanumeric/character Site ID in the programming mode. This Site ID is included in the datalog report.

1. Press [Y/+] and the display shows the current site ID. Example: "RAE00001." Note that the left-most digit flashes to indicate it is the selected one.
2. Press [Y/+] to step through all 26 letters (A to Z) and 10 numerals (0 to 9).
   Note: The last four digits must be numerals.
3. Press [N/-] to advance to the next digit. The next digit to the right flashes.

   Repeat this process until all eight digits of the new site ID are entered.

Press [MODE] to exit.

If there is any change to the existing site ID, the display shows "Save?" Press [Y/+] to accept the new site ID. Press [N/-] to discard the change and move to the next sub-menu.

User ID

Enter an 8-digit alphanumeric User ID in the programming mode. This User ID is included in the datalog report.

1. Press [Y/+] and the display shows the current User ID. Example: "RAE00001." Note that the left-most digit flashes to indicate it is the selected one.
2. Press [Y/+] to step through all 26 letters (A to Z) and 10 numerals (0 to 9).
3. Press [N/-] to advance to the next digit. The next digit to the right flashes.

   Repeat this process until all eight digits of the new User ID are entered.

Press [MODE] to exit.

If there is any change to the existing User ID, the display shows "Save" Press [Y/+] to accept the new site ID. Press [N/-] to discard (undo) the change and move to the next sub-menu.

User Mode

The instrument has two user modes:

Basic Basic users can only see and use a basic set of functions.

Advanced Advanced users can see all screens and perform all available functions.

Note: The default value for User Mode is Basic.

To change the User Mode:

1. Press [N/-] to step from one option to the next. The highlighting changes each time you press [N/-].
2. Press [Y/+] to make your selection (the dark circle in the "radio button" indicates "on").
3. When you have completed your selection, press [MODE].
4. Press [Y/+] to accept the new User Mode. Press [N/-] to discard the change and move to the next sub-menu.

Date

The Date is expressed as Month/Day/Year, with two digits for each.

1. Press [Y/+] and the display shows the current date. Note that the left-most digit flashes to indicate it is selected.
2. Press [Y/+] to step through all 10 numerals (0 to 9).
3. Press [N/-] to advance to the next digit. The next digit to the right flashes.

   Repeat this process until all six digits of the new date are entered.

Press [MODE] to exit.

- Press [Y/+] to save the new date.
- Press [N/-] to undo the change and move to the next sub-menu.

Time

The Time is expressed as Hours/Minutes/Seconds, with two digits for each. The time is in 24-hour (military) format.

1. Press [Y/+] and the display shows the current time. Note that the left-most digit flashes to indicate it is selected.
2. Press [Y/+] to step through all 10 numerals (0 to 9).
3. Press [N/-] to advance to the next digit. The next digit to the right flashes.

   Repeat this process until all six digits of the new time are entered.

Press [MODE] to exit.

- Press [Y/+] to save the new date.

- Press [N/-] to undo the change and move to the next sub-menu.

Duty Cycle

The pump's duty cycle is the ratio of its on time to off time. The duty cycle ranges from 50% to 100% (always on), and the period is 10 seconds. Therefore, a duty cycle of 60% means that the pump is on for 6 seconds and off for four seconds. Duty cycling is employed by the instrument to clean the PID. A lower duty cycle has a greater effect on keeping the PID clean than a higher duty cycle.

Important! Pump duty cycling is interrupted when the instrument senses a gas. The pump's duty cycle is disabled when the measurement is greater than the 2ppm threshold and is re-enabled when the reading falls below 90% of the threshold (1.8 ppm).

1. Press [Y/+] to increase the value.
2. When you have completed your selection, press [MODE].
   - Press [Y/+] to save the new duty cycle value.
   - Press [N/-] to undo the change and move to the next sub-menu.

Temperature Unit

The temperature display can be switched between Fahrenheit and Celsius units.

1. Press [N/-] to step from one option to the next.
2. Press [Y/+] to make your selection (the dark circle in the "radio button" indicates "on").
3. When you have completed your selection, press [MODE].
   - Press [Y/+] to save the new temperature unit.
   - Press [N/-] to undo the change and move to the next sub-menu.

Pump Speed

The pump can operate at two speeds, high and low. Running at low speed is quieter and conserves a small amount of power. There is almost no difference in sampling accuracy.

1. Press [N/-] to step from one option to the next.
2. Press [Y/+] to make your selection (the dark circle in the "radio button" indicates "on").
3. When you have completed your selection, press [MODE].
   - Press [Y/+] to save the new temperature unit.
   - Press [N/-] to undo the change and move to the next sub-menu.

Language

English is the default language, but other languages can be selected for the instrument.

1. Press [N/-] to step from one option to the next.
2. Press [Y/+] to make your selection (the dark circle in the "radio button" indicates "on").
3. When you have completed your selection, press [MODE].
   - Press [Y/+] to save your new language choice.
   - Press [N/-] to undo it and return to the previous language selection.

Radio Power

The radio connection can be turned on or off.

1. Press [N/-] to step from one option to the next (on or off).
2. Press [Y/+] to make your selection (the dark circle in the "radio button" indicates that the option is selected).
3. When you have completed your selection, press [MODE].

   - Press [Y/+] to accept the new radio setting (on or off).
   - Press [N/-] to discard the change and move to the next sub-menu.

Real Time Protocol

Real Time Protocol is the setting for data transmission.

The choices are:

P2M (cable)	Point to multipoint. Data is transferred from the instrument to multiple locations using a wired connection. Default data rate: 19200 bps.
P2P (cable)	Point to point. Data is transferred only between the instrument and one other location, such as a computer. Default data rate: 9600 bps.
P2M (wireless)	Point to multipoint, wireless. Data is transferred wirelessly and can be received by multiple receivers.

1. Press [N/-] to step from one option to the next.
2. Press [Y/+] to make your selection (the dark circle in the "radio button" indicates "on").
3. When you have completed your selection, press [MODE].
   - Press [Y/+] to save the new real-time communications protocol.
   - Press [N/-] to undo the change and move to the next sub-menu.

Power On Zero

When Power On Zero is on, the instrument performs a zero calibration when it is turned on.

1. Press [N/-] to step from one option to the next.
2. Press [Y/+] to make your selection (the dark circle in the "radio button" indicates your selection).
3. When you have completed your selection, press [MODE].
   - Press [Y/+] to save the change.
   - Press [N/-] to discard the change and move to the next sub-menu.

Unit ID

This three-digit number keeps data separated by instrument when more than one instrument is used in a network. If multiple sensing units are attempting to communicate with the same Host, then the units must all have a different Unit ID.

1. Press [Y/+] to step through all 10 numerals (0 to 9). If you pass the numeral you want, keep pressing [Y/+]. After it counts up to 9, it starts counting up from 0 again.
2. Press [N/-] to advance to the next digit. The next digit to the right flashes.

Repeat this process until all three digits of the Unit ID are entered.

3. Press [MODE] when you are done.
   - Press [Y/+] to save the change.
   - Press [N/-] to discard the change and move to the next sub-menu.

LCD Contrast

The display's contrast can be increased or decreased from its default setting. You may not need to ever change the default setting, but sometimes you can optimize the display to suit extreme temperature and ambient brightness/darkness conditions.

- The minimum value is 20.
- The maximum value is 60.

1. Press [Y/+] to increase the value or [N/-] to decrease the value.
2. Press [MODE] to save your selection.
   - Press [Y/+] to save your new contrast value.
   - Press [N/-] to undo it and return to the previous value.

Hygiene Mode

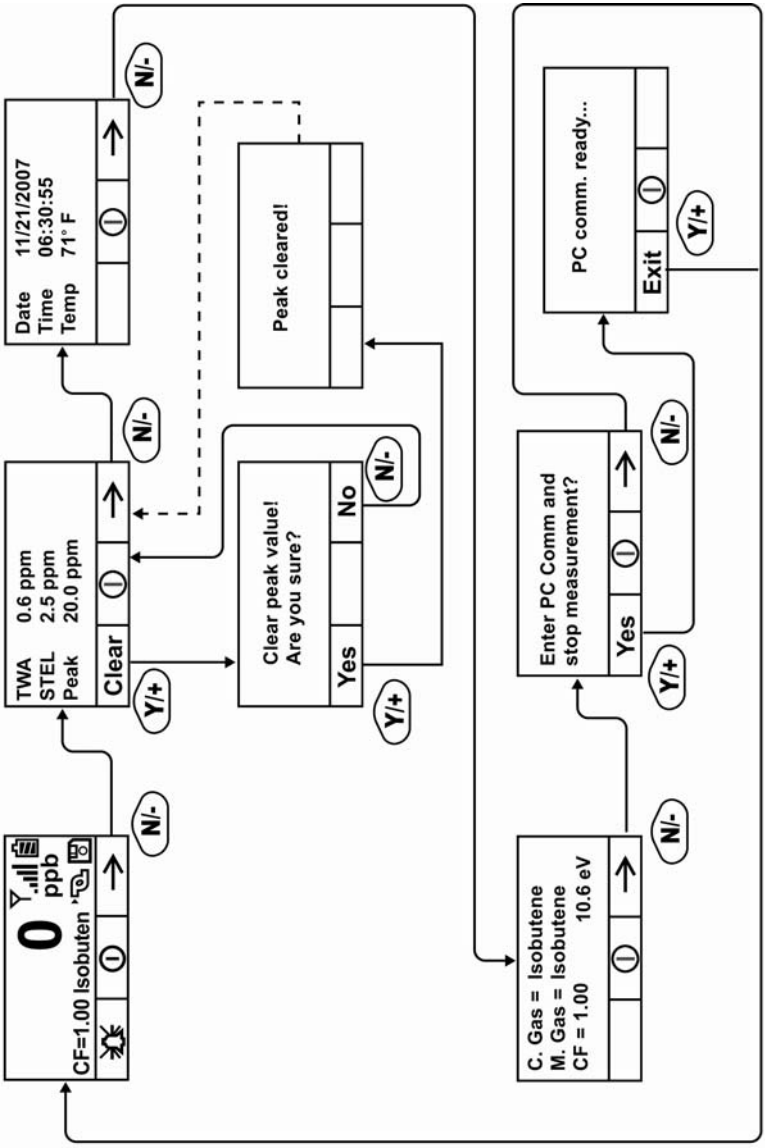
The instrument usually operates in Hygiene Mode, which provides basic functionality. However, it is possible to operate it in a second mode called Search Mode. Here are the primary differences:

Hygiene Mode: Automatic measurements, continuously running and datalogging, and calculates additional exposure values.

Search Mode: Manual start/stop of measurements and display of certain exposure values.

Basic User Level & Hygiene Mode

The default setting is navigated in the following way:



Note: Dashed line indicates automatic progression.

Pressing [N/-] steps you from screen to screen. Options include clearing the Peak value and turning on the instrument's PC Communications for data transfer to a PC.

Entering Search Mode From Hygiene Mode

In order to change the instrument's operational mode from Hygiene Mode to Search Mode, you must enter the password-protected Programming Mode:

1. Hold [MODE] and [N/-] until you see the password screen.
2. Use [Y/+] to increment to the number you want for the first digit. (If you pass by the desired number, press [Y/+] until it cycles through to 0 again. Then press [Y/+] until you reach the desired number.)
3. Press [N/-] to advance to the next digit.
4. Again press [Y/+] to increment the number.
5. Press [N/-] to advance to the next digit.

Continue the process until all four numbers of the password have been input. Then press [MODE] to proceed.

The screen changes to icons with the label "Calibration."

1. Press [N/-] to advance to "Monitor Setup."
2. Press [Y/+] to select Monitor Setup.

Under Monitor Setup, you will see "Op Mode."

Press [Y/+] to select.

You will see:

Hygiene
Search

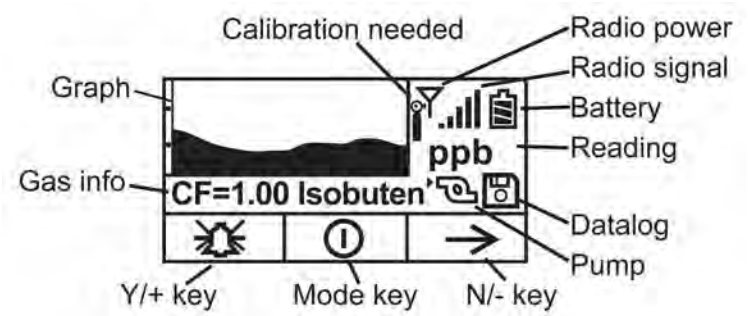
The current mode is indicated by a dark circle within the circle in front of either Hygiene or Search.

1. Select Hygiene or Search by pressing [N/-].
2. Press [Y/+] to place the instrument into the selected mode.

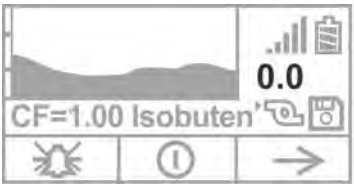
3. Press [MODE] when you want to register your selection to place the instrument in the selected mode.
4. Press [Y/+] to commit the change and exit to the Monitor Setup screen, or press [N/-] to Undo (exit to the Monitor Setup screen without changing the Mode).

Optional Graphic Screen In Search Mode

Using ProRAE Studio, you can set your instrument to show a graphic display instead of a numeric display of ongoing data. Consult your ProRAE Studio disc for information.



During sampling, the display's readings are shown numerically, plus the graph tracks the highest readings over time. The numeric reading alternates between the value and the measurement units, as well:



Advanced User Level (Hygiene Mode Or Search Mode)

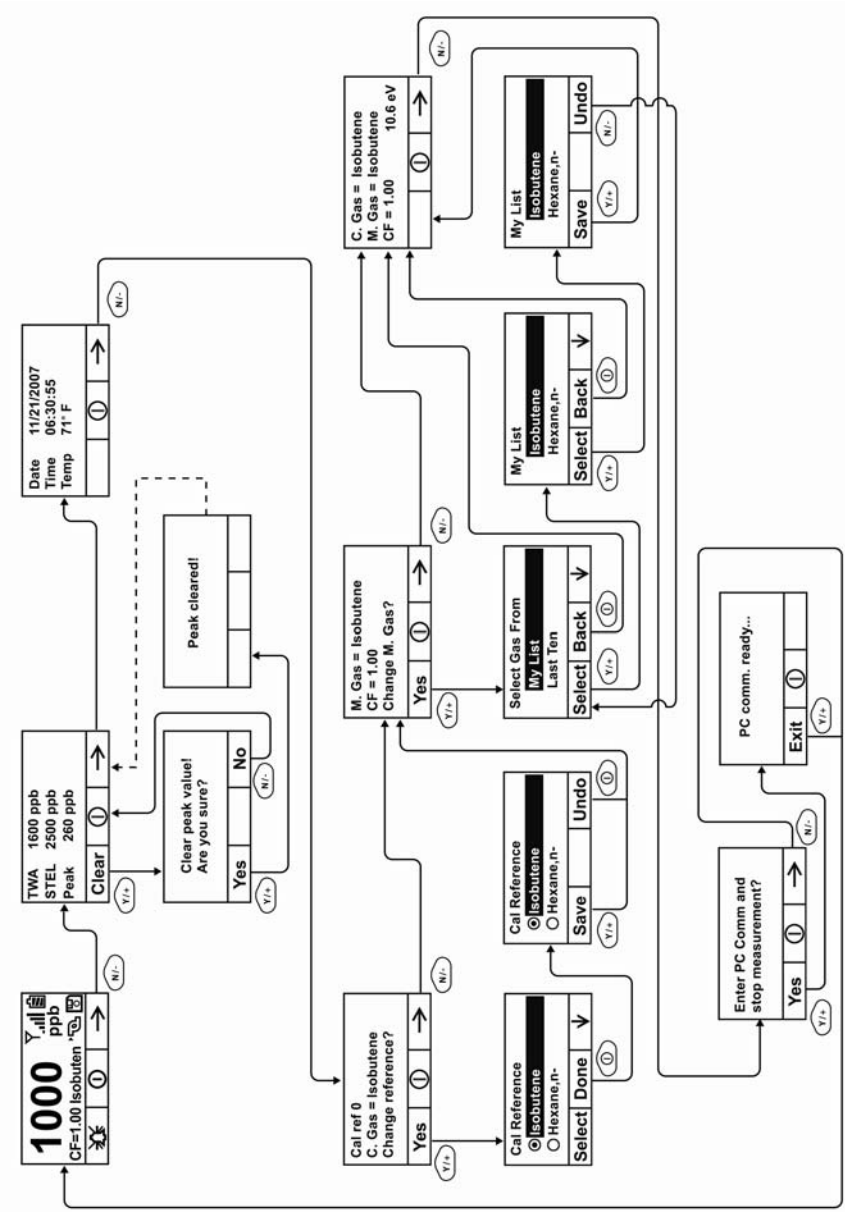
The User Mode called Advanced User Level allows a greater number of parameters to be changed than Basic User Level. It can be used with either of the Operation Modes, Hygiene Mode or Search Mode.

Advanced User Level & Hygiene Mode

With the instrument in Operation Mode: Hygiene Mode, enter User Mode: Advanced User Level (refer to the section called Monitor Mode for instructions).

Once you are in Advanced User Level and Hygiene Mode together, you can change the calibration reference and measurement gas, in addition to performing normal monitoring functions.

Pressing [N/-] progresses through the screens, while pressing [Y/+] selects options. Pressing [MODE] makes menu choices when it is shown for "Done" or "Back." Pressing and holding [Mode] whenever the circle with a vertical line in the middle is shown activates the countdown to shutoff.

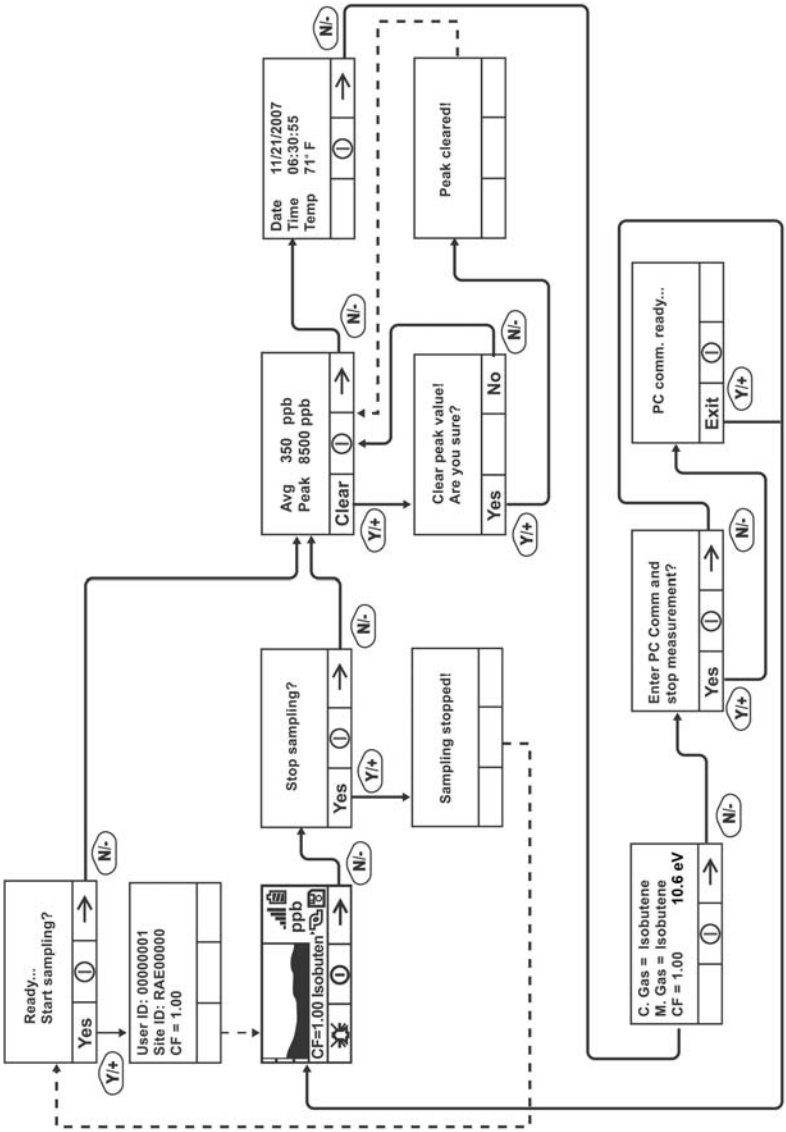


Note: Dashed line indicates automatic progression.

Basic User Level & Search Mode

With the instrument in Operation Mode: Search Mode, enter User Mode and select Basic User Level (refer to the section called User Mode for instructions).

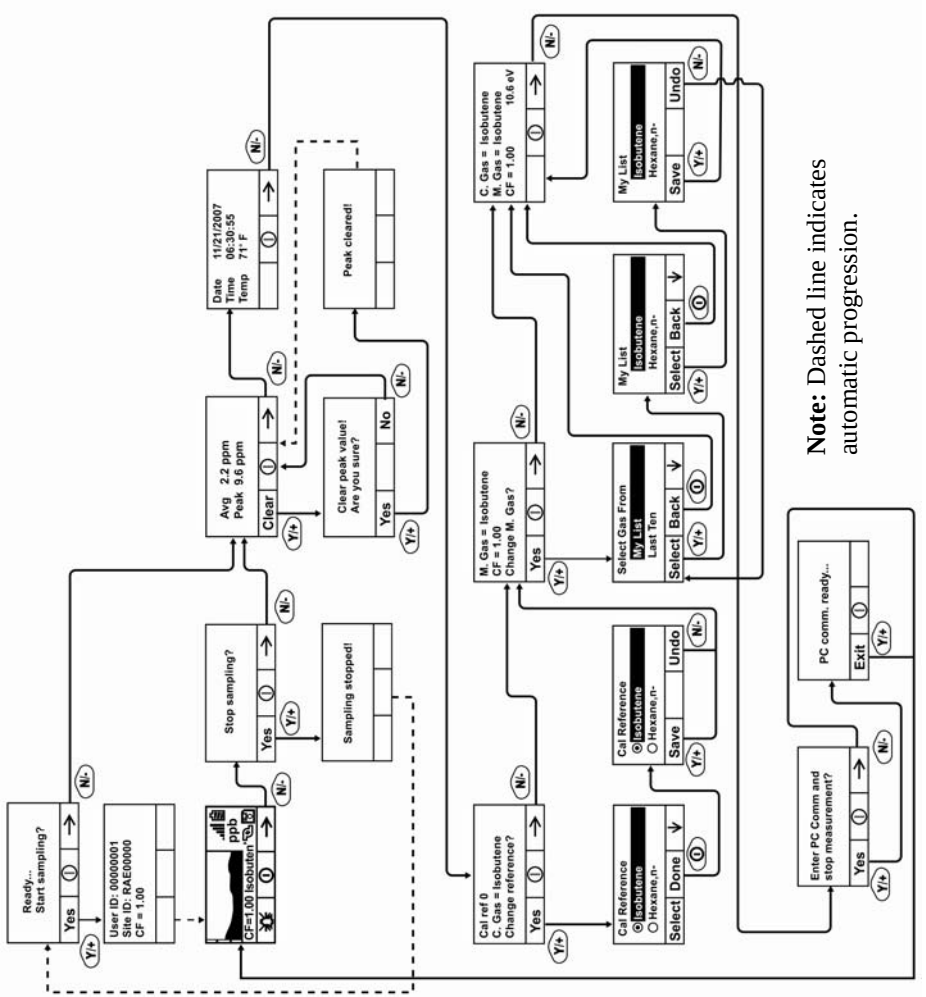
When the instrument is in Search Mode, it only samples when you activate sampling. When you see the display that says, "Ready…Start sampling?" press [Y/+] to start. The pump turns on and the instrument begins collecting data. To stop sampling, press [N/-] while the main display is showing. You will see a new screen that says, "Stop sampling?" Press [Y/+] to stop sampling. Press [N/-] if you want sampling to continue.



Note: Dashed line indicates automatic progression.

Advanced User Level & Search Mode

With the instrument in Operation Mode: Search Mode, enter User Mode and select Advanced User Level (refer to the section called Monitor Mode for instructions). Operation is similar to Basic User Level & Sampling Mode, but now allows you to change calibration and measurement reference gases. Refer to the section on measurement gases on page 53 for more details.



Note: Dashed line indicates automatic progression.

Diagnostic Mode

IMPORTANT! Diagnostic Mode is designed for servicing and manufacturing, and therefore is not intended for everyday use, even by advanced users. It provides raw data from sensors and about settings, but only allows adjustment of pump stall parameters, which should only be changed by qualified personnel.

Note: If the instrument is turned on in Diagnostic Mode and you switch to User Mode, datalog data remains in raw count form. To change to standard readings, you must restart the instrument.

Entering Diagnostic Mode

Note: To enter Diagnostic Mode, you must begin with the instrument turned off.

Press and hold [Y/+] and [MODE] until the instrument starts.

The instrument goes through a brief startup, and then displays raw data for the PID sensor. These numbers are raw sensor readings without calibration. The instrument is now in Diagnostic Mode.

Note: In Diagnostic Mode, the pump and lamp are normally on.

You can enter Programming Mode and calibrate the instrument as usual by pressing both [MODE] and [N/-] for three seconds.

You can enter Monitoring Mode by pressing [MODE] and [Y/+] together for three seconds.

Once the instrument is started up in Diagnostic Mode, you can switch between Diagnostic Mode and Monitoring Mode by pressing and holding [MODE] and [Y/+] simultaneously for two seconds.

In Diagnostic mode, you can step through parameter screens by pressing [MODE].

Adjusting The Pump Stall Threshold

If the gas inlet is blocked but the pump does not shut down, or the pump shuts down too easily with a slight blockage, the pump stall threshold value may be set too high or too low.

Use the following steps to adjust the pump stall threshold:

Pump High

In Diagnostic Mode, press the [MODE] key until "Pump High" is displayed. The display shows the maximum, minimum, and stall values for the pump at its high speed. Write down the "Max" reading.

Block the gas inlet and watch the pump current reading (labeled "I") increase. Write down its blocked reading. **Note:** If the pump current reading does not increase significantly (less than 10 counts), then there may be a leak in the gas inlet or the pump is weak or defective.

Add the two readings you wrote down. This is the average of the maximum block count and the maximum idle count. Divide that number by 2. Use the [Y/+] or [N/-] key to increase or decrease the stall value to equal that number.

Press the [MODE] key to exit this display.

Pump Low

In Diagnostic Mode, press the [MODE] key until "Pump Low" is displayed. The display shows the maximum, minimum, and stall values for the pump at its low speed. Write down the "Max" reading.

Block the gas inlet and watch the pump current reading (labeled "I") increase. Write down its blocked reading. **Note:** If the pump current reading does not increase significantly (less than 10 counts), then there may be a leak in the gas inlet or the pump is weak or defective.

Add the two readings you wrote down. This is the average of the maximum block count and the maximum idle count. Divide that

number by 2. Use the [Y/+] or [N/-] key to increase or decrease the stall value to equal that number.

Press the [MODE] key to exit this display.

Exiting Diagnostic Mode

You can exit Diagnostic Mode and go directly to Programming Mode or Monitor Mode as outlined above, or you can exit Diagnostic Mode completely.

To exit Diagnostic Mode so that it cannot be re-entered without a restart:

Shut down the instrument. When it is off, restart it by holding the [MODE] key. Diagnostic Mode cannot be entered until the instrument is restarted as outlined in "Entering Diagnostic Mode."

Transferring Data To & From A Computer

Once you have connected your instrument cradle to the PC, you can can transfer data, including a download of the datalog to the computer and updates of firmware to the instrument (should this ever be necessary).

Downloading The Datalog To A PC

1. Connect the data cable to the PC and the cradle.
2. Place the instrument into its cradle. The charging LED should be illuminated.
3. Start ProRAE Studio on your PC.
4. From ProRAE Studio, select "Operation" and select Setup Connection.
5. Select the COM port to establish a communication link between the PC and the instrument.
6. To receive the datalog in the PC, select "Downlog Datalog."
7. When you see "Unit Information," click OK.

During the data transfer, the display shows a progress bar.

When the transfer is done, you will see a screen with the datalog information. You can now export this datalog for other use or printing.

Uploading Firmware To The instrument From A PC

Uploading new firmware to your instrument requires connecting the instrument and PC. Follow these steps to make the connection:

1. Connect the data cable to the PC and the cradle.
2. Place the instrument into its cradle. The charging LED should be illuminated.
3. Start RAEProgrammer 7000 on your PC.
4. From RAEProgrammer 7000, select "Operation" and select Setup Connection.
5. Select the COM port to establish a communication link between the PC and the instrument.
6. Select Operation → Download Firmware.

Once communication is established, follow the instructions that accompany RAEProgrammer 7000 and the firmware to upload the new firmware to your instrument.

Note: Check for the latest updates to ProRAEProgrammer 7000 at www.raesystems.com.

Maintenance

The major maintenance items of the instrument are:

- Battery pack
- Sensor module
- PID lamp
- Sampling pump
- Inlet connectors and filters

Note: Maintenance should be performed by qualified personnel only.

NOTE: The printed circuit board of the instrument is connected to the battery pack even if the power is turned off. **Therefore, it is very important to disconnect the battery pack before servicing or replacing any components inside the instrument**. **Severe damage to the printed circuit board or battery may occur if the battery pack is not disconnected before servicing the unit.**

Battery Charging & Replacement

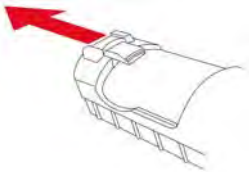
When the display shows a flashing empty battery icon, the battery requires recharging. It is recommended to recharge the instrument upon returning from fieldwork. A fully charged battery runs a instrument for 16 hours continuously. The charging time is less than 8 hours for a fully discharged battery. The battery may be replaced in the field (in areas known to be non-hazardous), if required.

WARNING!

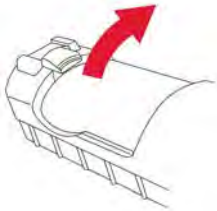
To reduce the risk of ignition of hazardous atmospheres, recharge battery only in area known to be non-hazardous. **Remove and replace battery only in areas known to be non-hazardous.**

Replacing The Li-ion Battery

1. Turn off the instrument.
2. Located on the rear of the instrument is a battery tab. Slide it down to unlock the battery.



3. Remove the battery pack from the battery compartment by tilting it out.



4. Replace a fully charged spare battery pack inside the battery compartment. Make sure the battery pack is oriented properly inside the compartment.
5. Slide the capture tab back up to its locked position.

Replacing The Alkaline Battery Adapter

An alkaline battery adapter is supplied with each instrument. The adapter (part number 059-3052-000) accepts four AA alkaline batteries (use only Duracell MN1500) and provides approximately 12 hours of operation. The adapter is intended to be used in emergency situations when there is no time to charge the Li-ion battery pack.

To insert batteries into the adapter:

1. Remove the three Philips-head screws to open the compartment.
2. Insert four fresh AA batteries as indicated by the polarity (+/-) markings.
3. Replace the cover. Replace the three screws.

To install the adapter in the instrument:

1. Remove the Li-ion battery pack from the battery compartment by sliding the tab and tilting out the battery.
2. Replace it with the alkaline battery adapter
3. Slide the tab back into place to secure the battery adapter.

IMPORTANT!

Alkaline batteries cannot be recharged. The instrument's internal circuit detects alkaline batteries and will not allow recharging. If you place the instrument in its cradle, the alkaline battery will not be recharged. The internal charging circuit is designed to prevent damage to alkaline batteries and the charging circuit when alkaline batteries are installed inside the instrument.

Note: When replacing alkaline batteries, dispose of old ones properly.

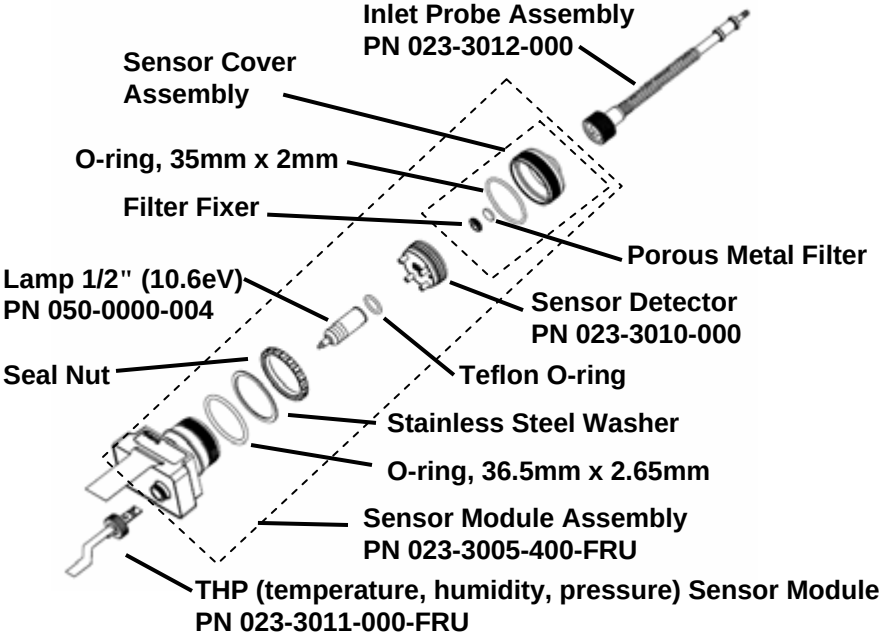
WARNING!

To reduce the risk of ignition of hazardous atmospheres, recharge the battery only in areas known to be non-hazardous. Remove and replace the battery only in areas known to be non-hazardous.

Note: The internal charging circuit is designed to prevent charging to alkaline batteries.

PID Sensor & Lamp Cleaning/Replacement

The sensor module is made of several components and is attached to the lamp-housing unit as shown below.



Sensor Components

Note: The cleaning procedure is not normally needed. Clean the PID sensor module, the lamp and the lamp housing only when one of the following has happened:

1. The reading is inaccurate even after calibration.
2. The reading is very sensitive to air moisture.
3. A chemical liquid has been sucked into the unit and damaged the unit.

Use of the external filter helps to prevent contamination of the sensor.

To access the sensor components and lamp, gently unscrew the lamp-housing cap, remove the sensor adapter with the gas inlet probe and the metal filter all together. Then hold the PID sensor and pull it straight out. A slight, gentle rocking motion helps release the sensor.

Cleaning The PID Sensor

Place the entire PID sensor module into GC grade methanol. It is highly recommended that an ultrasound bath to be used to clean the sensor for at least 15 minutes. Then dry the sensor thoroughly. Never touch the electrodes of the sensor by hand.
Also use a methanol-soaked cotton swab to wipe off the lamp housing where it contacts the sensor when the sensor is installed.

Turn over the sensor so that the pins point up and the sensor cavity is visible. Examine the sensor electrodes for any corrosion, damage, or bending out of alignment. The metal sensor electrode "fingers" should be flat and straight. If necessary, carefully bend the sensor fingers to ensure that they do not touch the Teflon portions and that they are parallel to each other. Make sure that the nuts on the sensor pins are snug but not overtight. If the sensor is corroded or otherwise damaged, it should be replaced.

Cleaning The Lamp Housing Or Changing The Lamp

If the lamp does not turn on, the instrument will display an error message to indicate replacement of the lamp may be required.

1. If the lamp is operational, clean the lamp window surface and the lamp housing by wiping it with GC grade methanol using a cotton swab using moderate pressure. After cleaning, hold the lamp up to the light at an angle to detect any remaining film. Repeat the process until the lamp window is clean. Never use water solutions to clean the lamp. Dry the lamp and the lamp housing thoroughly after cleaning.

   CAUTION: Never touch the window surface with the fingers or anything else that may leave a film. Never use acetone or aqueous solutions.

2. If the lamp does not turn on, remove the lamp from the lamp housing. Place the lamp O-ring onto the new lamp. Insert the new lamp, avoiding contact with the flat window surface.
3. Reinstall the PID sensor module.
4. Tighten the Lamp Housing Cap.

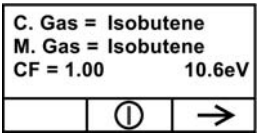
Determining The Lamp Type

The monitor can accommodate three lamp values: 10.6eV (standard), 9.8eV, and 11.7eV. The monitor automatically reads a marking on the side of the lamp to set the proper Correction Factor. There are two ways to determine the lamp type:

Remove the lamp and look for markings (bars) on the side:

- No bars: 10.6eV
- 1 bar: 11.7eV
- 2 bars: 9.8eV

Also, when the monitor is running, the lamp type is shown along with the calibration and measurement gas and Correction Factor:



Note: This screen can be accessed from the reading screen by pressing [N/-] four times.

Sampling Pump

When approaching the end of the specified lifetime of the pump, it will consume higher amount of energy and reduce its sample draw capability significantly. When this occurs, it is necessary to replace or rebuild the pump. When checking the pump flow, make sure that the inlet connector is tight and the inlet tubing is in good condition. Connect a flow meter to the gas inlet probe. The flow rate should be above 450 cc/min when there is no air leakage.

If the pump is not working properly, refer the instrument to qualified service personnel for further testing and, if necessary, pump repair or replacement.

Cleaning The Instrument

Occasional cleaning with a soft cloth is recommended. Do not use detergents or chemicals.

Visually inspect the contacts at the base of the instrument, on the battery, and on the charging cradle to make sure they are clean. If they are not, wipe them with a soft, dry cloth. Never use solvents or cleaners.

Ordering Replacement Parts

If you need replacement parts, contact your local RAE Systems distributor. A list is available online:

http://www.raesystems.com

In the U.S., you can order sensors, replacement batteries, and other accessories online at:

http://istore.raesystems.com/

Special Servicing Note

If the instrument needs to be serviced, contact either:

1. The RAE Systems distributor from whom the instrument was purchased; they will return the instrument on your behalf.

   or

2. The RAE Systems Technical Service Department. Before returning the instrument for service or repair, obtain a Returned Material Authorization (RMA) number for proper tracking of your equipment. This number needs to be on all documentation and posted on the outside of the box in which the instrument is returned for service or upgrade. Packages without RMA Numbers will be refused at the factory.

Troubleshooting

Problem	Possible Reasons & Solutions
Cannot turn on power after charging the battery	**Reasons:** Discharged battery. Defective battery. **Solutions:** Charge or replace battery.
Lost password	**Solutions:** Call Technical Support at +1 408-752-0723 or toll-free at +1 888-723-4800
Reading abnormally High	**Reasons:** Dirty filter. Dirty sensor module. Excessive moisture and water condensation. Incorrect calibration. **Solutions:** Replace filter. Blow-dry the sensor module. Calibrate the unit.
Reading abnormally Low	**Reasons:** Dirty filter. Dirty sensor module. Weak or dirty lamp. Incorrect calibration. **Solutions:** Replace filter. Remove Calibration Adapter. Calibrate the unit. Check for air leakage.
Buzzer Inoperative	**Reasons:** Bad buzzer. **Solutions:** Check that buzzer is not turned off. Call authorized service center.

Inlet flow too low	**Reasons:**	Pump diaphragm damaged or has debris. Flow path leaks.
	Solutions:	Check flow path for leaks; sensor module O-ring, tube connectors, Teflon tube compression fitting. Call Technical Support at +1 408-752-0723 or toll-free at +1 888-723-4800
"Lamp" message during operation	**Reasons:**	Lamp drive circuit. Weak or defective PID lamp, defective.
	Solutions:	Turn the unit off and back on. Replace UV lamp

Technical Support

To contact RAE Systems Technical Support Team:

Monday through Friday, 7:00AM to 5:00PM Pacific (US) Time
Phone (toll-free): +1 888-723-4800
Phone: +1 408-952-8461
Email: tech@raesystems.com

Life-critical after-hours support is available:

+1 408-952-8200 select option 8

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Controlled Part Of Manual

Intrinsic Safety:
US and Canada: Class I, Division 1, Groups A,B,C,D T4

Europe: ATEX (0575 Ex II 2G Ex ia IIC/IIB T4 Gb)
KEMA 07 ATEX 0127
Complies with EN60079-0:2009, EN60079-11:2007
IECEx CSA 10.0005 Ex ia IIC/IIB T4 Gb
Complies with IEC 60079-0:2007, IEC 60079-11:2006

Temperature:	-20º C to 50º C (-4º to 122º F)
Humidity:	0% to 95% relative humidity (non-condensing)

Basic Operation

Turning The Instrument On

1. With the instrument turned off, press and hold [MODE].
2. When the display turns on, release the [MODE] key.

The instrument is now operating and performs self tests. Once the self tests are complete, the display shows a graph or numerical gas reading. This indicates that the instrument is fully functional and ready to use.

Turning The Instrument Off

1. Press and hold the Mode key for 3 seconds. A 5-second countdown to shutoff begins.
2. When you see "Unit off..." release your finger from the [MODE] key. The instrument is now off.

Note: You must hold your finger on the key for the entire shutoff process. If you remove your finger from the key during the countdown, the shutoff operation is canceled and the instrument continues normal operation.

Alarm Signals

During each measurement period, the gas concentration is compared with the programmed alarm limits (gas concentration alarm limit settings). If the concentration exceeds any of the preset limits, the loud buzzer and red flashing LED are activated immediately to warn you of the alarm condition.

In addition, the instrument alarms if one of the following conditions occurs: battery voltage falls below a preset voltage level, failure of the UV lamp, pump stall, or when the datalog memory is full.

Alarm Signal Summary

Message	Condition	Alarm Signal
HIGH	Gas exceeds "High Alarm" limit	3 beeps/flashes per second*
OVR	Gas exceeds measurement range	3 beeps/flashes per second*
MAX	Gas exceeds electronics' maximum range	3 beeps/flashes per second*
LOW	Gas exceeds "Low Alarm" limit	2 beeps/flashes per second*
TWA	Gas exceeds "TWA" limit	1 Beep/flash per second*
STEL	Gas exceeds "STEL" limit	1 Beep/flash per second*
Pump icon flashes	Pump failure	3 beeps/flashes per second
Lamp	PID lamp failure	3 beeps/flashes per second plus "Lamp" message on display

Battery icon flashes	Low battery	1 flash, 1 beep per minute plus battery icon flashes on display
CAL	Calibration failed, or needs calibration	1 beep/flash per second
NEG	Gas reading measures less than number stored in calibration	1 beep/flash per second

Preset Alarm Limits & Calibration

The instrument is factory calibrated with standard calibration gas, and is programmed with default alarm limits.

Cal Gas (Isobutylene)	Cal Span	unit	Low	High	TWA	STEL
ppbRAE 3000	10	ppm	10	25	10	25
MiniRAE 3000	100	ppm	50	100	10	25
MiniRAE Lite	100	ppm	50	100	10	25
UltraRAE 3000	100	ppm	50	100	10	25

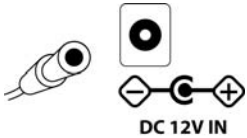
Charging The Battery

Always fully charge the battery before using the instrument. The instrument's Li-ion/NiMH battery is charged by placing the instrument in its cradle. Contacts on the bottom of the instrument meet the cradle's contacts, transferring power without other connections.

Note: Before setting the instrument into its charging cradle, visually inspect the contacts to make sure they are clean. If they are not, wipe them with a soft cloth. Do not use solvents or cleaners.

Follow this procedure to charge the instrument:

1. Plug the AC/DC adapter's barrel connector into the instrument's cradle.



2. Plug the AC/DC adapter into the wall outlet.
3. Place the instrument into the cradle, press down, and lean it back. It locks in place and the LED in the cradle glows.

Note: To release the instrument, press down and tilt the top out of the cradle and lift up.

The instrument begins charging automatically. The LED on the front of the cradle marked "Primary" blinks during charging. During charging, the diagonal lines in the battery icon on the instrument's display are animated and you see the message "Charging..."

When the instrument's battery is fully charged, the battery icon is no longer animated and shows a full battery. The message "Fully charged!" is shown and the Primary LED on the cradle glows continuously green.

Note: A spare Li-ion battery (059-3051-000) or NiMH(059-3054-000) can be charged by placing it directly in the charging port on the back of the cradle. It can be charged at the same time as the instrument. Press the battery in place, sliding it slightly toward the front of the cradle. This locks it in the cradle. To release the battery, slide it forward again and tilt it up.

Note: An Alkaline Battery Adapter (part number 059-3052-000), which uses four AA alkaline batteries (Duracell MN1500), may be substituted for the Li-Ion battery.

WARNING!

To reduce the risk of ignition of hazardous atmospheres, recharge and replace batteries only in areas known to be non-hazardous. **Remove and replace batteries only in areas known to be non-hazardous.**

Low Voltage Warning

When the battery's charge falls below a preset voltage, the instrument warns you by beeping once and flashing once every minute, and the battery icon blinks once per second. You should turn off the instrument within 10 minutes and either recharge the battery by placing the instrument in its cradle, or replace the battery with a fresh one with a full charge.

Clock Battery

An internal clock battery is mounted on one of the instrument's printed circuit boards. This long-life battery keeps settings in memory from being lost whenever the Li-ion, NiMH, or alkaline batteries are removed. This backup battery should last approximately five years, and must be replaced by an authorized RAE Systems service technician. It is not user-replaceable.

WARNING

To reduce the risk of ignition of hazardous atmospheres, recharge battery only in area known to be non-hazardous. Remove and replace battery only in an area known to be non-hazardous.

Replacing Rechargeable Li-Ion or NiMH Battery

Caution: Turn off the instrument before removing or replacing the battery.

Alkaline Battery Adapter

An alkaline battery adapter is supplied with each instrument. The adapter (part number 059-3052-000) accepts four AA alkaline batteries (use only Duracell MN1500).

Do not mix old and new batteries or different type batteries.

Troubleshooting

Problem	Possible Reasons & Solutions	
Cannot turn on power after charging the battery	**Reasons:**	Discharged battery. Defective battery.
	Solutions:	Charge or replace battery.
Lost password	**Solutions:**	Call Technical Support at +1 408-752-0723 or toll-free at +1 888-723-4800
Reading abnormally High	**Reasons:**	Dirty filter. Dirty sensor module. Excessive moisture and water condensation. Incorrect calibration.
	Solutions:	Replace filter. Blow-dry the sensor module. Calibrate the unit.
Reading abnormally Low	**Reasons:**	Dirty filter. Dirty sensor module. Weak or dirty lamp. Incorrect calibration.
	Solutions:	Replace filter. Remove Calibration Adapter. Calibrate the unit. Check for air leakage.
Buzzer Inoperative	**Reasons:**	Bad buzzer.
	Solutions:	Check that buzzer is not turned off. Call authorized service center.

Inlet flow too low	**Reasons:**	Pump diaphragm damaged or has debris. Flow path leaks.
	Solutions:	Check flow path for leaks; sensor module O-ring, tube connectors, Teflon tube compression fitting. Call Technical Support at +1 408-752-0723 or toll-free at +1 888-723-4800
"Lamp" message during operation	**Reasons:**	Lamp drive circuit. Weak or defective PID lamp, defective.
	Solutions:	Turn the unit off and back on. Replace UV lamp

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Rev. C
August 2010
P/N 059-4021-000

MultiRAE
User's Guide

Rev B
August 2011
P/N: M01-4003-000

Product Registration

Register your product online by visiting:

http://www.raesystems.com/support/product-registration

By registering your product, you can:

- Receive notification of product upgrades or enhancements
- Be alerted to Training classes in your area
- Take advantage of RAE Systems special offers and promotions

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⚠ WARNINGS ⚠

Read Before Operating

This manual must be carefully read by all individuals who have or will have the responsibility of using, maintaining, or servicing this product. The product will perform as designed only if it is used, maintained, and serviced in accordance with the manufacturer's instructions.

CAUTION!

Never operate the monitor when the cover is removed. Remove the monitor rear cover or battery only in an area known to be non-hazardous.

ANY RAPID UP-SCALE READING FOLLOWED BY A DECLINING OR ERRATIC READING MAY INDICATE A GAS CONCENTRATION BEYOND UPPER SCALE LIMIT, WHICH MAY BE HAZARDOUS.

TOUTE LECTURE RAPIDE ET POSITIVE, SUIVIE D'UNE BAISSE SUBITE AU ERRATIQUE DE LA VALEUR, PEUT INDIQUER UNE CONCENTRATION DE GAZ HORS GAMME DE DÉTECTION QUI PEUT ÊTRE DANGEREUSE

ONLY THE COMBUSTIBLE GAS DETECTION PORTION OF THIS INSTRUMENT HAS BEEN ASSESSED FOR PERFORMANCE.

UNIQUMENT, LA PORTION POUR DÉTECTOR LES GAZ COMBUSTIBLES DE CET INSTRUMENT A ÉTÉ ÉVALUÉE.

CAUTION: BEFORE EACH DAY'S USAGE, SENSITIVITY OF THE LEL SENSOR MUST BE TESTED ON A KNOWN CONCENTRATION OF METHANE GAS EQUIVALENT TO 20 TO 50% OF FULL-SCALE CONCENTRATION. ACCURACY MUST BE WITHIN 0 AND +20% OF ACTUAL. ACCURACY MAY BE CORRECTED BY CALIBRATION PROCEDURE.

ATTENTION: AVANT CHAQUE UTILISATION JOURNALIERE, VERIFIER LA SENSIBILITE DU CAPTEUR DE LIE AVEC UNE CONCENTRATION CONNUE DE METHANE EQUIVALENTE DE 20 A 50% DE LA PLEINE ECHELLE. LA PRECISION DOIT ETRE COMPRISE ENTRE 0 ET 20% DE LA VALEUR VRAIE ET PEUT ETRE CORRIGEE PAR UNE PROCEDURE D'ETALONNAGE.

CAUTION: HIGH OFF-SCALE READINGS MAY INDICATE AN EXPLOSIVE CONCENTRATION.

ATTENTION: DES LECTURES HAUTES ET HORS D'ECHELLE PEUVENT INDIQUER DES CONCENTRATIONS DE GAZ INFLAMMABLES

CAUTION: SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY.

Note: Users are recommended to refer to ISA-RP12.13, Part II-1987 for general information on installation, operation, and maintenance of combustible gas detection instruments.

The MultiRAE multi-gas detector must be calibrated if it does not pass a bump test, or at least once every 180 days, depending on use and sensor exposure to poisons and contaminants.

SPECIAL CONDITIONS FOR SAFE USE

1. The PGM-62xx shall only be fitted with RAE Systems Battery Pack type M01-3051-000 or M01-3053-000 or Battery Adapter M01-3052-000 or M01-3054-000 fitted with Duracell MN1500 batteries.
2. The PGM62xx shall only be charged outside hazardous areas.
3. No precautions against electrostatic discharge are necessary for portable equipment that has an enclosure made of plastic, metal, or a combination of the two, except where a significant static-generating mechanism has been identified. Activities such as placing the item in a pocket or on a belt, operating a keypad or cleaning with a damp cloth, do not present a significant electrostatic risk. However, where a static-generating mechanism is identified, such as repeated brushing against clothing, then suitable precautions shall be taken, e.g., the use of anti-static footwear.

1 Standard Contents

The MultiRAE is available in four configurations, each with different kits, outlined below.

MultiRAE Pro	MultiRAE
MultiRAE Pro monitor with pump, sensors, battery, and wireless options as specified and protective rubber boot, filter, and belt clip installed	MultiRAE monitor with pump, sensors, battery, and wireless options as specified and protective rubber boot, filter, and belt clip installed
Travel charger / PC communications adapter	Travel charger / PC communications adapter
Desktop charging / PC communications cradle	Desktop charging / PC communications cradle
PC communication cable	PC communication cable
AC adapter	AC adapter
Calibration adapter	Calibration adapter
6" flexible probe	6" flexible probe
Alkaline battery adapter (included with rechargeable configurations only)	Alkaline battery adapter (included with rechargeable configurations only)
3 spare filters	3 spare filters
PID sensor cap removal tool	PID sensor cap removal tool
PID zeroing adapter	Hex tool
Hex tool	QuickStart Guide
QuickStart Guide	CD with documentation
CD with ProRAE Studio II instrument configuration and data management software	CD with ProRAE Studio II instrument configuration and data management software
CD with documentation	Calibration and test certificate
Calibration and test certificate	Warranty / registration card
Technical Note TN-106 with ionization energies and correction factors for 300+ VOCs	Technical Note TN-106 with ionization energies and correction factors for 300+ VOCs
Warranty / registration card	Ships in a hard transport case
IP-67/decontamination valve	
Ships in a Pelican case	

MultiRAE Lite Diffusion	MultiRAE Lite Pumped
MultiRAE Lite monitor with sensors, battery, and wireless options as specified and protective rubber boot installed	MultiRAE Lite monitor with pump, sensors, battery, and wireless options as specified and protective rubber boot, filter, and belt clip installed
Travel charger / PC communications adapter	Travel charger / PC communications adapter
PC communication cable	PC communication cable
AC adapter	AC adapter
Calibration adapter	Calibration adapter
Alkaline battery adapter (included with rechargeable configurations only)	Alkaline battery adapter (included with rechargeable configurations only)
Hex tool	3 spare filters
QuickStart Guide	PID sensor cap removal tool
CD with documentation	Hex tool
CD with ProRAE Studio II instrument configuration and data management software	QuickStart Guide
Calibration and test certificate	CD with documentation
Warranty / registration card	CD with ProRAE Studio II instrument configuration and data management software
	Calibration and test certificate
	Warranty / registration card

Note: A decontamination plug is standard with the MultiRAE Pro and optional with other models. It enhances the IP rating of the instrument from IP-65 to IP-67 (to dust- and water-proof for temporary immersion).

2 General Information

The MultiRAE is a family of multi-threat gas detectors that combine continuous monitoring capabilities for volatile organic compounds (VOCs), toxic and combustible gases, and radiation, with Man Down Alarm functionality in one highly portable instrument. MultiRAE monitors offer an industry-leading selection of interchangeable field-replaceable electrochemical, combustible, infrared, PID (photoionization detector), and gamma radiation sensors to fit a wide variety of applications. The MultiRAE family's wireless capability elevates worker protection to the next level by providing safety officers real-time access to instrument readings and alarm status from any location for better visibility and faster response.

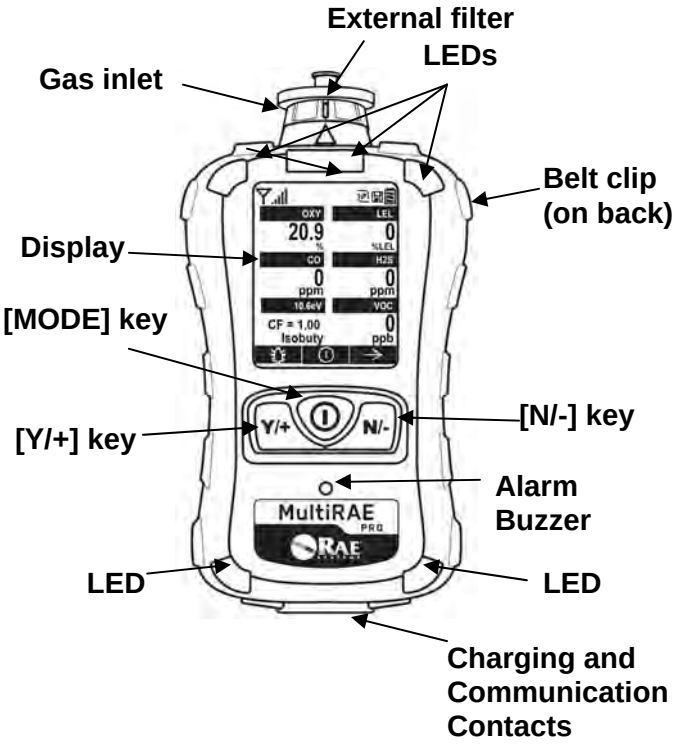
Notes:

- ClO_2 and H_2S sensors cannot be installed in the same instrument.
- NO and NH_3 sensors cannot be installed in the same instrument.
- NDIR combustible sensors are not supported on the diffusion version with CSA certification.
- The PID sensor requires a pumped configuration.
- If a %Vol. NDIR sensor is installed in an instrument, a catalytic bead %LEL sensor must also be installed in the instrument for CSA certification.

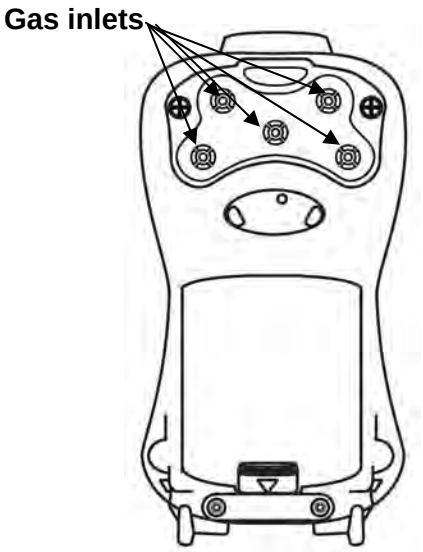
2.1 Key Features

- All-in-one continuous monitoring capabilities for radiation, VOCs, oxygen, toxic and combustible gases, for a total of up to six threats at a time
- Highly customizable with over 30 field-interchangeable intelligent sensor options
- Wireless access to real-time instrument readings and alarm status from any location
- Unmistakable five-way local and remote wireless notification of alarm conditions, including Man Down Alarm
- Large graphical display with easy-to-use, icon-driven user interface
- Simple maintenance with easily accessible sensors, pump, and plug-and-play Li-ion battery
- Fully-automated bump testing and calibration with AutoRAE 2

MultiRAE With Pump, front view



MultiRAE Diffusion Model, rear view



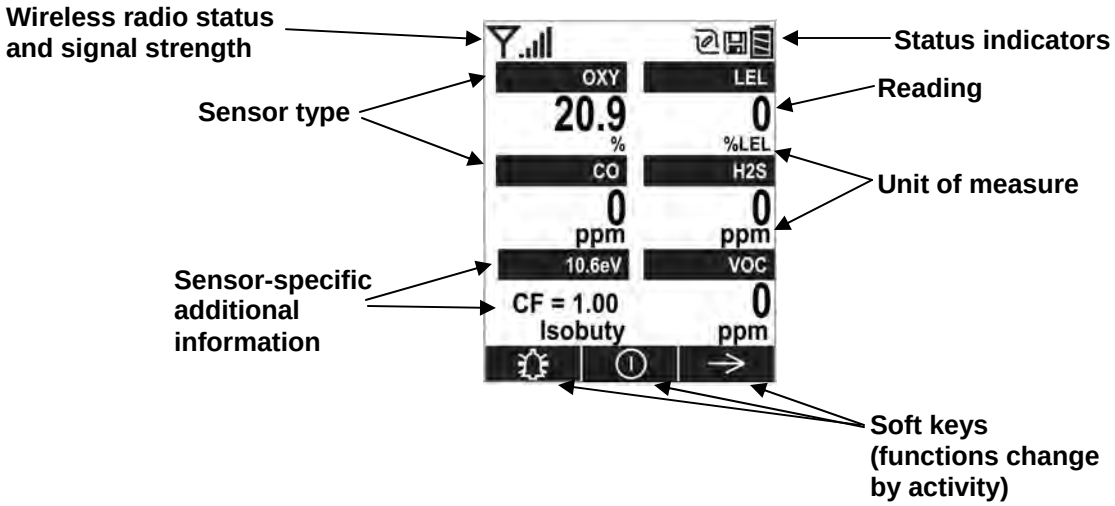
Note: The front of the diffusion model of the MultiRAE is the same as the pumped model, but instead of a single inlet, there are five inlets on the back.

3 User Interface

The MultiRAE's user interface consists of the display, LEDs, an alarm buzzer, and three keys.

3.1 Display Overview

The LCD display provides visual feedback that includes the sensor types, readings, time, battery condition, and other functions.



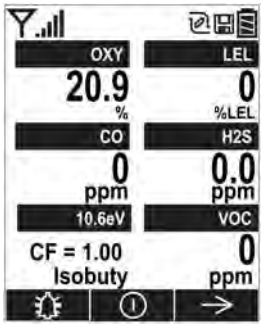
3.1.1 Status Indicator Icons

Along the top of most screens are status indicators that tell you whether a function is operating and/or its strength or level.

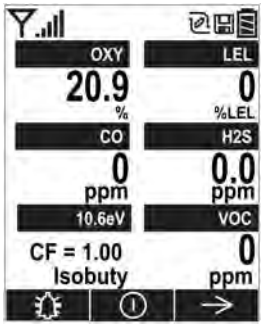
Icon	Function
	Wireless status (shown when wireless is on, blank when off)
	Wireless strength (0 to 5 bars)
	Pump status (only on pump-equipped models)
	Datalogging status (shown when datalogging is on, blank when off)
	Battery status (three segments show battery charge level)

3.1.2 LCD Flip

The MultiRAE senses its vertical/horizontal orientation, and can automatically flip the display180 degrees, making it easy to read if the MultiRAE is upside down. (You can turn this feature on or off in Programming Mode, under "Monitor.")



As the MultiRAE is tilted, the sensor detects its orientation and inverts the screen when it past its horizontal position.



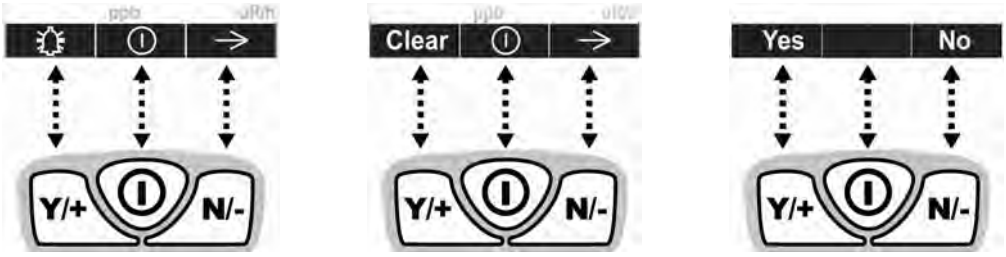
3.1.3 Keys & Interface

The MultiRAE has three buttons:

Y/+ MODE N/-

In addition to their labeled functions, the keys labeled [Y/+], [MODE], and [N/-] act as "soft keys" that control different parameters and make different selections within the instrument's menus. From menu to menu, each key controls a different parameter or makes a different selection.

Three panes along the bottom of the display are "mapped" to the keys. These change as menus change, but at all times the left pane corresponds to the [Y/+] key, the center pane corresponds to the [MODE] key, and the right pane corresponds to the [N/-] key. Here are examples that show the relationships of the keys and functions:



In addition to the functions described above, any of the buttons can be used to manually activate display backlighting. Press any button when the backlighting is off to turn it on.

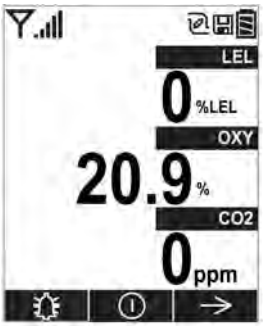
3.2 Screen Display For Various Numbers Of Active Sensors

The MultiRAE family of instruments can accommodate from one to five sensors (some are dual sensors), depending on the configuration. In order to maximize readability and the amount of information shown, the display is automatically reconfigured, according to the number and types of sensors in the MultiRAE.

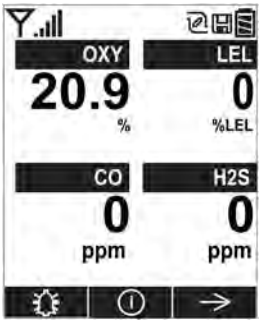
If the configuration includes five sensors, and one of them is a PID, then the lamp value (9.8eV or 10.6eV) is shown, along with the currently applied correction factor (CF).

One sensor.

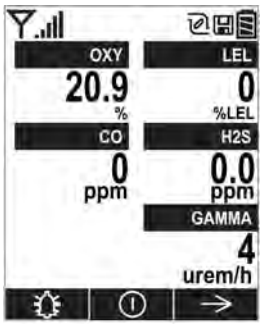
Two sensors.



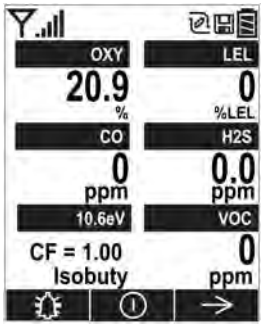
Three sensors.



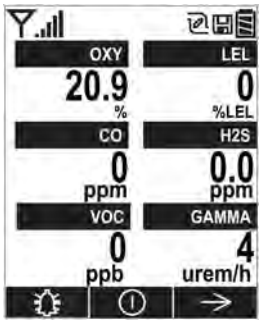
Four sensors.



Five sensors, including Gamma radiation sensor



Five sensors, including PID, showing lamp type and correction factor.



Six-threat configuration with CO+H2S combo sensor

3.3 Menus

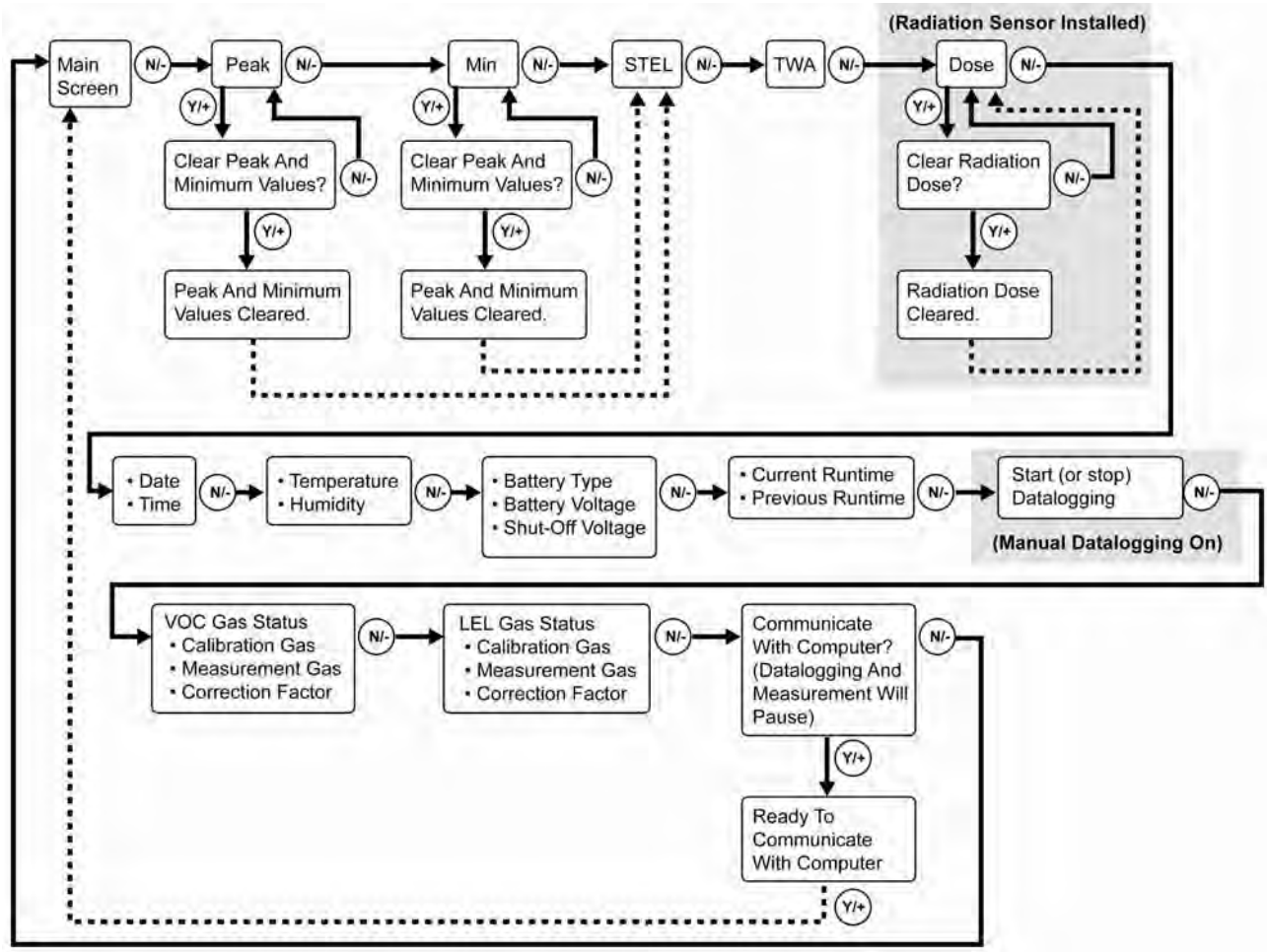
The reading menus are easy to step through by pressing the [N/-] button.

Hygiene Mode, in which sampling is continuous, allows you to clear peak and minimum values at any time.

Search Mode allows you to clear peak and minimum values, but samples only when you tell it to sample. This allows you to save sample readings as individual events in the datalog.

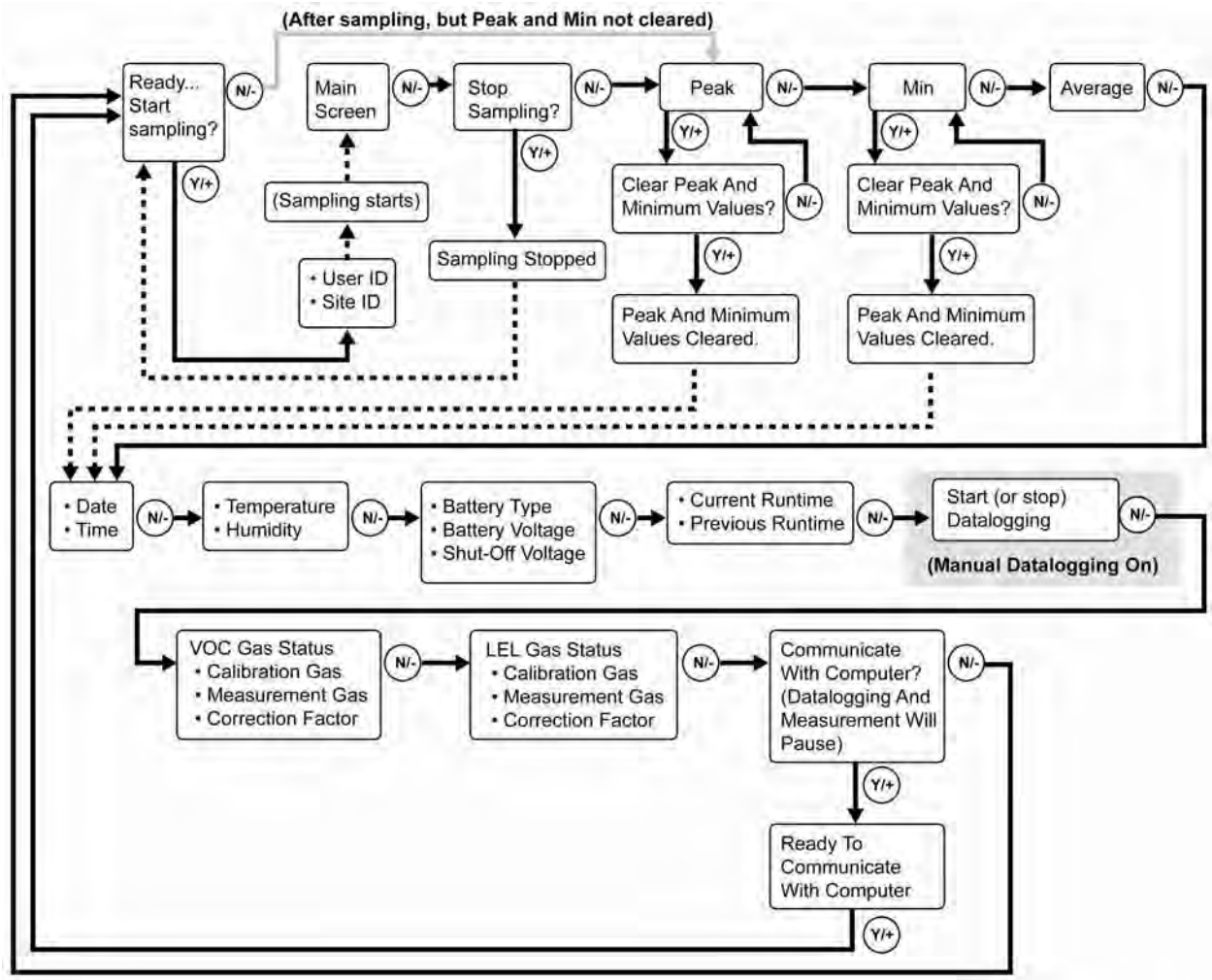
Note: You can switch between Hygiene and Search modes via the Programming Menu (Select Monitor and then Operation Mode).

Hygiene Mode



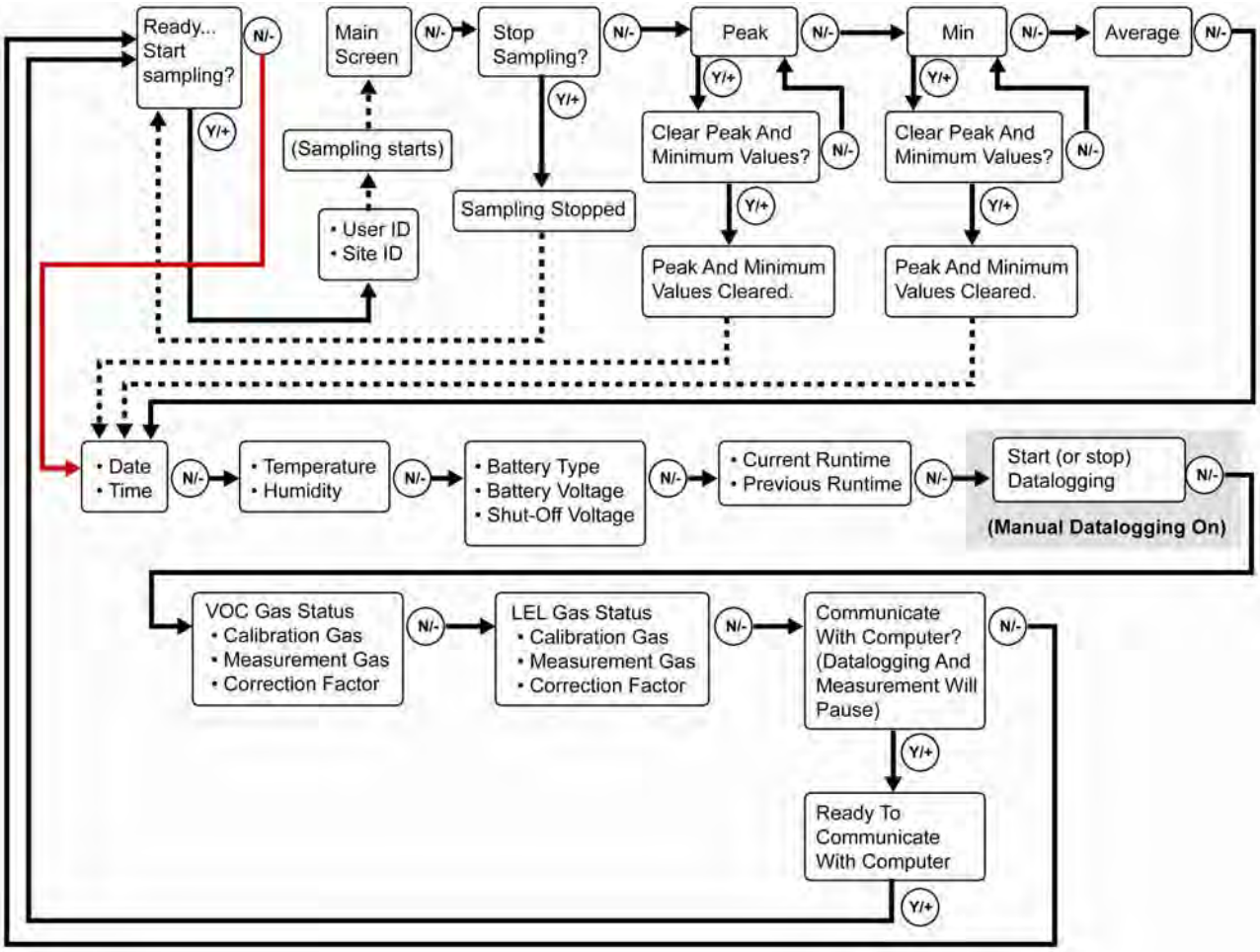
Note: Dashed line indicates automatic progression.

Search Mode



Note: Dashed line indicates automatic progression.

Note: If the Peak or Min is cleared, the Average is also cleared. In addition, each cycle through the main screen after they are cleared will route from "Ready… Start sampling?" directly to Date and Time if you press [N/-] (see red line in diagram below), until you perform a new sample. Also, if you start sampling again and stop sampling, clear the Peak, or clear the Min, it advances to Date and Time, as well.



Note: Dashed line indicates automatic progression.

4 Battery

Always fully charge the battery before using the MultiRAE. Its Li-ion battery is charged by placing the MultiRAE in its cradle or using the travel charger. Contacts on the bottom of the instrument meet the cradle's contact pins, transferring power.

There are two types of output power for battery packs or adapters. Battery pack (PN: M01-3051-000) and adapter (PN: M01-3052-000) are used for MultiRAE's model number PGM-62x0. Battery pack (PN: M01-3053-000) and adapter (PN: M01-3054-000) are used for model number PGM-62x6/PGM-62x8.

Note: Before setting the MultiRAE into its charging cradle or attaching its travel charger, visually inspect the contacts to make sure they are clean. If they are not, wipe them with a soft, dry cloth. Do not use solvents or cleaners.

WARNING

To reduce the risk of ignition of hazardous atmospheres, recharge, remove or replace the battery only in an area known to be non-hazardous!

4.1 Using The Charging Cradle

Follow this procedure to charge the MultiRAE:

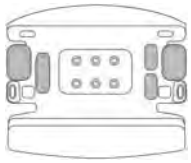
1. Plug the AC/DC adapter into the MultiRAE's cradle.
2. Plug the AC/DC adapter into the wall outlet.
3. Place the MultiRAE into the cradle and press down until it is locked in place.

The MultiRAE begins charging automatically. The LED in the cradle should glow red to indicate charging. When charging is complete, the LED in the cradle glows green.

4.2 Using The Travel Charger

Follow these steps to use the travel charger.

Before attaching the travel charger, check that it is aligned correctly with the base of the MultiRAE. There are two alignment points on one side and one alignment point on the other side, designed to mate with matching points on the bottom of the MultiRAE:



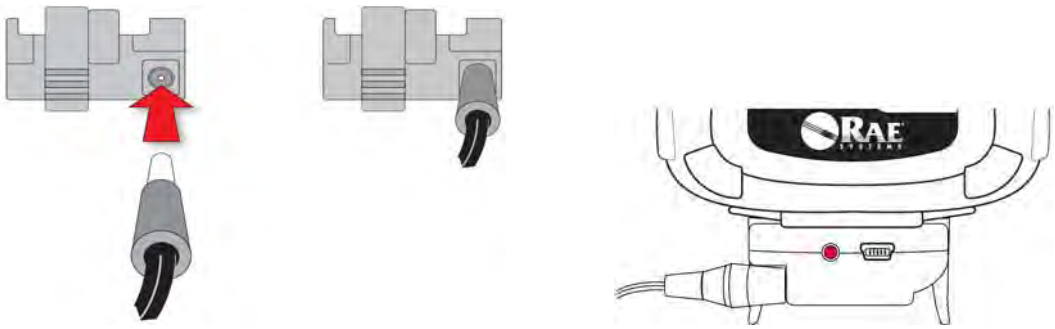
1. Check bottom of MultiRAE Travel Charger's alignment pins for correct orientation with the MultiRAE.

2. Align travel charger with bottom of MultiRAE.

3. Press travel charger onto bottom of MultiRAE.

5. Make sure the travel charger is firmly attached.

Next, put the plug from the power supply into the jack on the side of the travel charger:

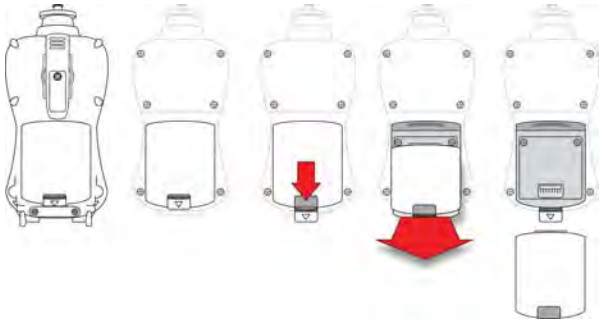


Plug the other end of the charger into a power source (AC outlet or 12VDC mobile power port, depending on the model). When power is applied and the MultiRAE's battery is charging, the LED glows red. The LED glows green when the battery is fully charged.

4.3 Replacing A Battery

The MultiRAE battery packs are plug-and-play, and can be replaced on the go without tools. To replace the MultiRAE battery:

1. Remove the battery adapter from the instrument by sliding the tab and tilting out the adapter. **Note:** The belt clip and rubber boot are removed in the illustration for clarity. They can be left on while replacing a battery.



2. Tilt a fully charged battery (or alkaline battery adapter) into the battery compartment and place it in the instrument.
3. Slide the tab back into place to secure the battery.

4.4 Battery States

The battery icon on the display shows how much charge is in the battery and alerts you to any charging problems.

Full charge	**2/3 charge**	**1/3 charge**	**Low charge**	**Battery alert**

When the battery's charge falls below a preset voltage, the instrument warns you by beeping once and flashing once every minute, and the "empty battery" icon blinks on and off once per second. The instrument automatically powers down within 10 minutes, after which you will need to either recharge the battery, or replace it with a fresh one with a full charge.

4.5 Alkaline Battery Pack

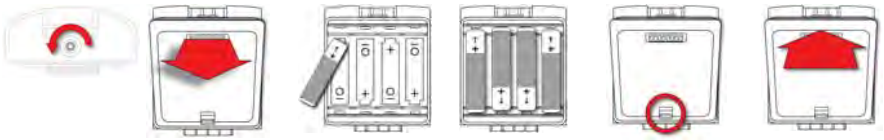
An alkaline battery adapter is supplied with each instrument. The adapter (part number M01-3054-000) is installed and removed just like the rechargeable battery. It accepts four AA alkaline batteries (use only Duracell

MN1500) and provides approximately 8 hours of normal operation. (An optional rechargeable lithium-ion battery pack, part number M01-3053-000, is also available.)

Note: The vibration alarm is disabled whenever the alkaline adapter is used.

To replace the alkaline adapter's batteries:

1. Remove the hex-socket screw at the end of the adapter.
2. Lift the cover off the battery compartment.
3. Insert four fresh AA batteries as indicated by the polarity (+/-) markings.
4. Replace the cover and replace the hex screw.



IMPORTANT!

Alkaline batteries cannot be recharged. The instrument's internal circuit detects alkaline battery pack and will not allow recharging. If you place the instrument in its Travel Charger or Charging Cradle, the alkaline battery will not be recharged. The internal charging circuit is designed to prevent damage to alkaline batteries and the charging circuit when alkaline batteries are installed inside the instrument. If you try to charge alkaline batteries installed in the instrument, the Charging Cradle or Travel Charger's charging LED does not glow, indicating that it will not charge them.

The alkaline battery adapter accepts four AA alkaline batteries (use only Duracell MN1500). Do not mix old and new batteries or batteries from different manufacturers.

Note: When replacing alkaline batteries, dispose of old ones properly.

4.6 Proper Battery Disposal

This product may contain one or more sealed lead-acid, nickel-cadmium (NiCd), nickel-metal hydride (NiMH), lithium (Li), or lithium-ion batteries. Specific battery information is given in this user guide. Batteries must be recycled or disposed of properly.

This symbol (crossed-out wheeled bin) indicates separate collection of waste electrical and electronic equipment in the EU countries. Please do not throw the equipment into the domestic refuse. Please use the return and collection systems available in your country for the disposal of this product.

5 Turning The MultiRAE On And Off

5.1 Turning The MultiRAE On

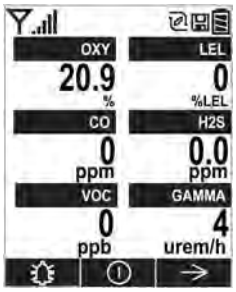
With the instrument turned off, press and hold the [MODE] key until the audible alarm stops, and then release.

When starting up, the MultiRAE turns the backlight on and off, beeps once, blinks once, and vibrates once. A RAE Systems logo (or a company name) should appear first.

This is followed by a progression of screens that tell you the MultiRAE's current settings:

- Product model number, serial number and firmware version.
- List of installed sensors.
- Current date, time and temperature.
- User mode,
- Battery type, voltage, shutoff voltage.
- Alarm mode.
- Datalog period (if it is activated).
- Sensor information such as production/expiration/calibration date and alarm limit settings.

Then the MultiRAE displays instantaneous readings similar to the following screen (depending on the sensors installed) and is ready for use.



Note: If the battery is completely empty, then the display briefly shows the message "Battery Fully Discharged," and the MultiRAE shuts off. You should charge the battery or replace it with a fully charged battery before turning it on again.

5.2 Turning The MultiRAE Off

Press and hold [MODE]. A 5-second countdown to shutoff begins. You must hold your finger on the key for the entire shutoff process until the MultiRAE is powered off.

Caution: The alarm is very loud. During startup, you can mute most of the sound by holding a finger over the alarm port. Do not put tape over the alarm port to permanently mute it.

5.3 Testing Alarm Indicators

Under normal-operation mode and non-alarm conditions, the buzzer, vibration alarm, LED, and backlight can be tested at any time by pressing [Y/+] once.

IMPORTANT!

If any of the alarms does not respond to this test, check the Alarm Settings in Programming Mode. It is possible that any or all of the alarms have been turned off. If all of the alarms are turned on, but one or more of them (buzzer, LED lights, or vibration alarm) does not respond to this test, do not use the instrument. Contact your RAE Systems distributor for technical support.

5.4 Pump Status

IMPORTANT!

During operation, make sure the probe inlet and the gas outlet are free of obstructions. Obstructions can cause premature wear on the pump, false readings, or pump stalling. During normal operation, the pump icon alternately shows inflow and outflow as shown here:

If there is a pump failure or obstruction that disrupts the pump, the alarm sounds and you see this icon blinking on and off:

Once the obstruction is removed, you can try to restart the pump by pressing the Y/+ button. If the pump does not restart, and the pump stall alarm continues, consult the Troubleshooting section of this guide or contact RAE Systems Technical Support.

Note: Pump Status is not indicated on diffusion MultiRAEs.

5.5 Calibration Status

The instrument displays this icon next to the sensor that requires calibration:

Calibration is required (and indicated by this icon) if:

- The lamp type has been changed (for example, from 10.6 eV to 9.8 eV).
- The sensor module has been replaced with one whose calibration is overdue.
- The defined period of time between calibrations has been exceeded.
- If you have changed the calibration gas type without recalibrating the instrument.
- The sensor has failed a previous calibration.

6 Modes Of Operation

The MultiRAE has two operation modes and two user modes.

6.1 Hygiene Operation Mode

Hygiene Mode provides continuous monitoring.

6.2 Search Operation Mode

Search Mode provides monitoring only when monitoring is turned on. This allows specific samples to be taken at different times, rather than continuously.

6.3 Basic User Mode

In Basic User Mode, some restrictions are applied, including password protection that guards against entering Programming Mode by unauthorized personnel.

6.4 Advanced User Mode

In Advanced User Mode, there are no access restrictions (you do not need a password), and MultiRAE provides the indications and data you need most for typical monitoring applications.

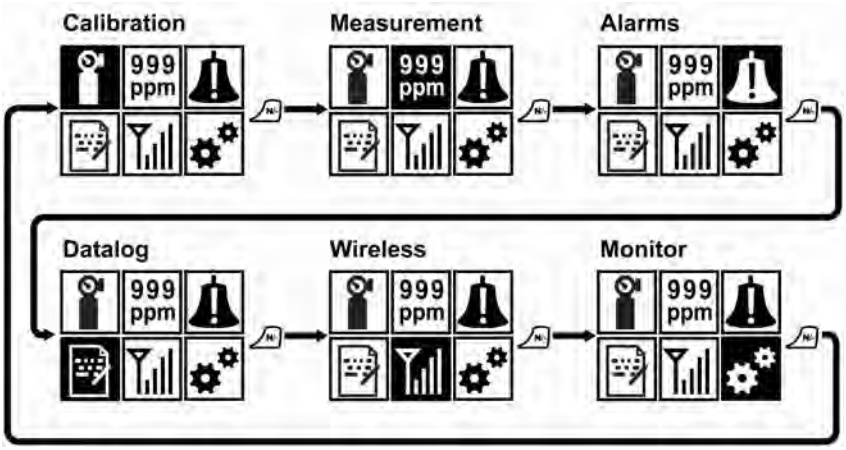
7 Programming

The menu in Programming Mode is to adjust settings, calibrate sensors, and initiate communication with a computer. It has the following submenus:

- Calibration
- Measurement
- Alarms
- Datalog
- Wireless
- Monitor

7.1 Enter Programming In Advanced Mode

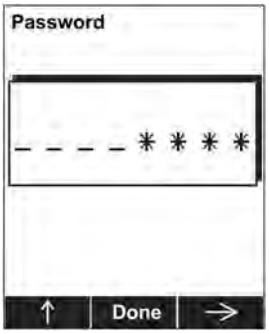
1. To enter Programming Mode, press and hold [MODE] and [N/-] until you see the Calibration screen. No password is necessary in Advanced Mode.
2. Press [N/-] to step through the programming screens.



To enter a menu and view or edit parameters in its submenus, press [Y/+].

7.2 Enter Programming In Basic Mode

1. To enter Programming Mode, press and hold [MODE] and [N/-] until you see the Password screen.



2. Input the 4-digit password:

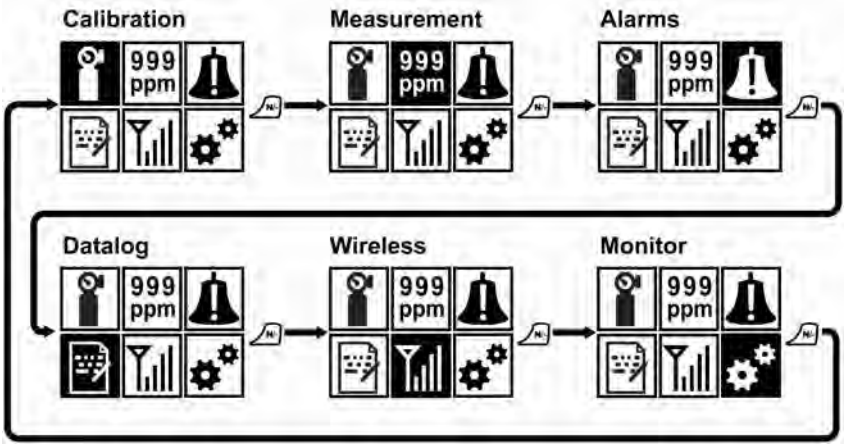
- Increase the number from 0 through 9 by pressing [Y/+].
- Step from digit to digit using [N/-].
- Press [MODE] when you are done.

If you make a mistake, you can cycle through the digits by pressing [N/-] and then using [Y/+] to change the number in each position.

Note: The default password is 0000.

Note: The password screen only appears when you enter the Programming Mode the first time after turning the instrument on in Basic Mode. If you have input the correct password, you do not have to input it again to enter Programming Mode until you turn the instrument off and on again.

Once you enter Programming Mode, the Calibration screen is shown. Press [N/-] to step through the programming screens.



To enter a menu and view or edit parameters in its submenus, press [Y/+].

7.3 Menus And Submenus

In Programming Mode, menus and submenus are organized as shown here:

	999 ppm				
Calibration	Measurement	Alarms	Datalog	Wireless*	Monitor
Fresh Air	Sensor On/Off	Alarm Limits	Clear Datalog		LCD Contrast
Multi Sensor Span	Change Meas. Gas	Alarm Mode	Datalog Interval		Operation Mode
Single Sensor Zero	Measurement Units	Alarm Settings	Sensor Selection		Pump Speed**
Single Sensor Span		Comfort Beep	Data Selection		Zero At Start
Cal. Reference		Man Down Alarm	Datalog Type		Fast Startup
Change Cal. Gas			Memory Full Action		Temperature Units
Multi Cal Select					Language
Change Span Value					Site ID
Change Span2 Value***					User ID
					Date Format
					Date
					Time Format
					Time
					User Mode
					Backlight
					LCD Flip

* Wireless is still in development.
** Pump-equipped version only.
***By default, only a ppb PID sensor (used only in MultiRAE Pro) has 3-point calibration enabled. Third-point calibration can be enabled for the MultiRAE PID (high-range) sensor via ProRAE Studio 2. The MultiRAE Lite PID sensor only supports 2-point calibration.

7.3.1 Editing And Selecting Parameters And Sensors

There are a few basic ways to edit parameters, select sensors, and perform other activities in the MultiRAE. The actions performed by pressing keys always match 1-to-1 with the boxes along the bottom of the display and the three keys. Some parameters are edited by scrolling and selecting individual items (black bars behind white text act as highlighters). Some include a choice via "radio buttons," where only one item in a list can be selected, while other menus use boxes for you to "check" with an "X," and these allow for multiple items in a list to be selected. In all cases of editing, you can save or undo your choice.

7.3.2 Calibration

Use this menu to perform zero or span calibration for one or more sensors, and change the gas concentration value assumed to be used in span calibration, as well as zero calibration and calibration reference gas.

7.3.2.1 Fresh Air

This procedure determines the zero point of the sensor calibration curve for all the sensors that require a zero calibration.

7.3.2.2 Multi Sensor Span

Depending on the configuration of your MultiRAE and span gas you have, you can perform a span calibration simultaneously on multiple sensors.

7.3.2.3 Single Sensor Zero

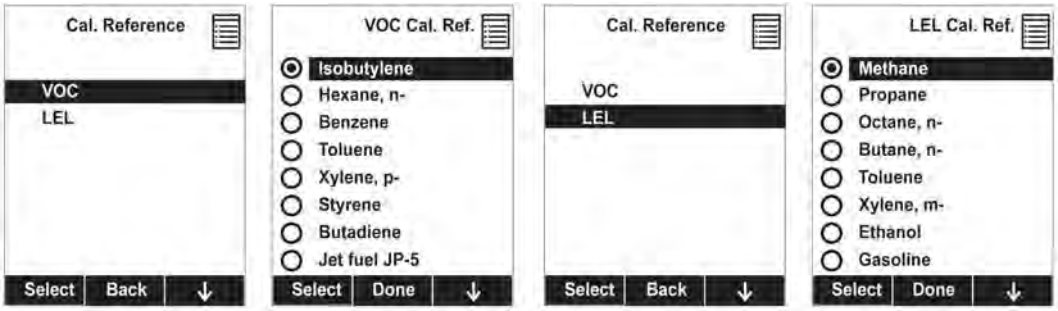
This allows you to perform zero (fresh air) calibration on individual sensors.

7.3.2.4 Single Sensor Span

Instead of performing a span calibration on more than one sensor simultaneously, you can select a single sensor and perform a span calibration.

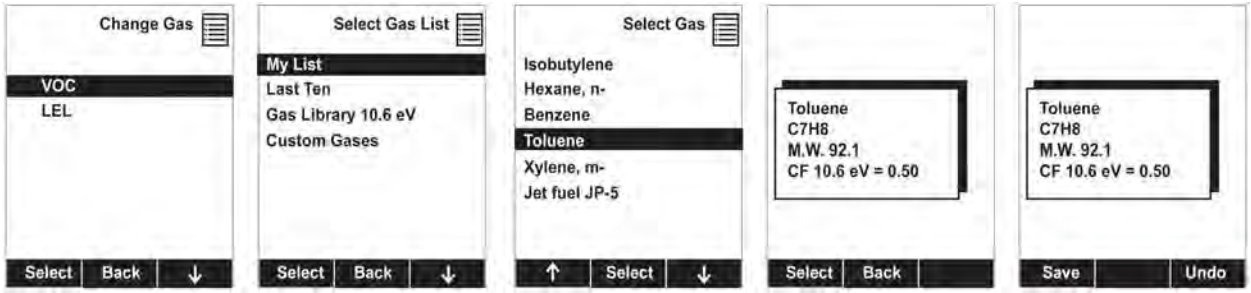
7.3.2.5 Cal. Reference

It is sometimes desirable to calibrate a sensor (PID for VOC, and LEL) with a specific gas for best response to a gas you are surveying. Changing the gas requires selecting the right calibration reference gas in the MultiRAE. Choose the sensor, and then select from the list of reference gases.



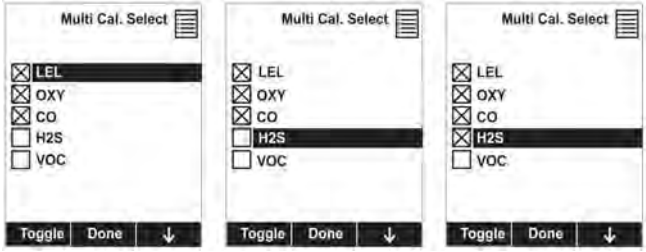
7.3.2.6 Change Cal. Gas

You can change the calibration gas for the MultiRAE's PID and LEL sensors. Select from a custom list that you create (My List), the last ten gases used, the built-in gas library for your PID lamp (taken from RAE Systems' Technical Note TN-106), and custom gases. Each gas is shown in the list for selection and the screen automatically changes to show its full name, chemical formula, molecular weight (M.W.) and correction factor (CF).



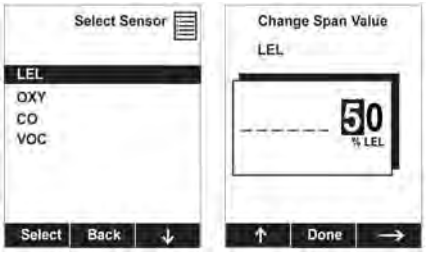
7.3.2.7 Multi Cal Select

You can select one or more sensors to be calibrated at a time. An "X" in a box to the left of a sensor's name indicates it is selected.



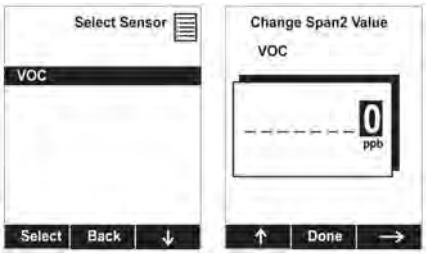
7.3.2.8 Change Span Value

You can individually set the span gas value for each sensor. The units of measure (ppm, %LEL, etc.) are shown on the display.



7.3.2.9 Change Span2 Value

If your MultiRAE is equipped with a PID sensor, you can set the span gas value for a third calibration point (Span2). The unit of measure is shown on the display.



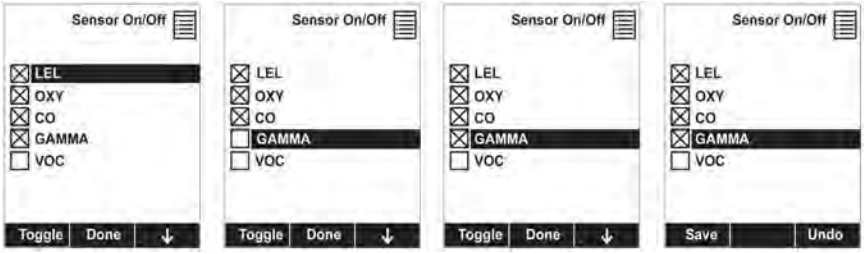
Note: By default, only a ppb PID sensor (used only in MultiRAE Pro) has 3-point calibration enabled. Third-point calibration can be enabled for the MultiRAE PID (high-range) sensor via ProRAE Studio 2. The MultiRAE Lite PID sensor only supports 2-point calibration.

7.3.3 Measurement

The submenus for Measurement include Sensor On/Off, Change Measurement Gas, and VOC and Gamma (if equipped) Measurement Units.

7.3.3.1 Sensor On/Off

You can turn sensors on or off via this set of submenus. An "X" in a box to the left of a sensor's name indicates it is turned on.

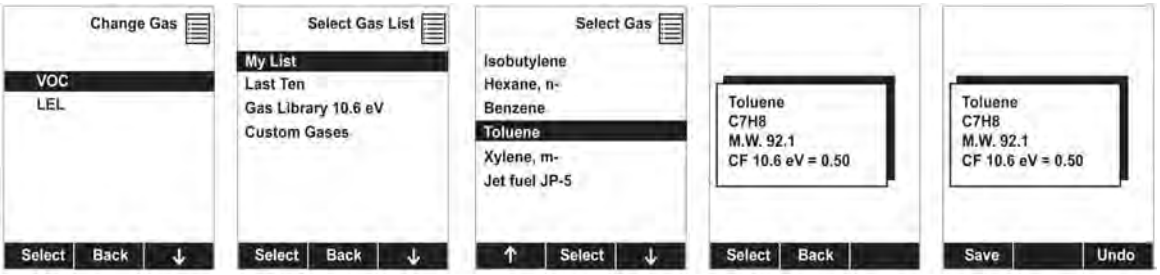


7.3.3.2 Change Meas. Gas

The MultiRAE has extensive onboard gas libraries for combustible gases and VOCs that you can use to configure your MultiRAE to automatically apply the appropriate correction factors and produce readings in the units of the desired combustible gas or VOC.

Measurement gases are organized in four lists:

- **My List** is a customized list of gases that you create. It contains a maximum of 10 gases and can only be built in ProRAE Studio II on a PC and transferred to the instrument. **Note:** The first gas in the list is always isobutylene (it cannot be removed from the list).
- **Last Ten** is a list of the last ten gases used by your instrument. The list is built automatically and is only updated if the gas selected from Custom Gases or Library is not already in the Last Ten. This ensures that there is no repetition.
- **Gas Library** is a library that consists of many of the gases found in RAE Systems' Technical Note TN-106 (available online at www.raesystems.com).
- **Custom Gases** are gases with user-modified parameters. Using ProRAE Studio II, all parameters defining a gas can be modified, including the name, span value(s), correction factor, and default alarm limits.



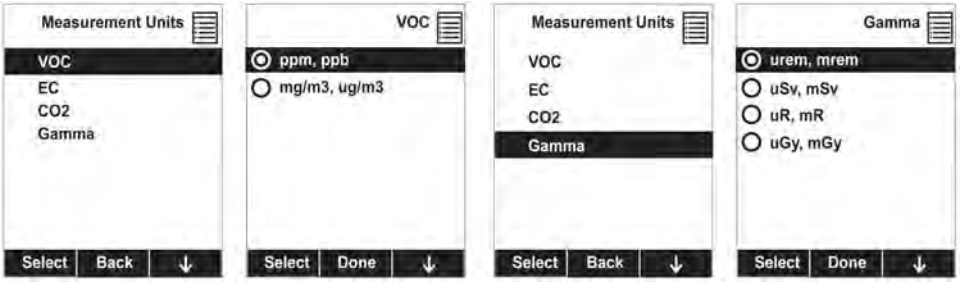
7.3.3.3 Measurement Units

In some cases, the measurement unit for displaying data from sensors can be changed. Standard available measurement units include:

Abbreviation	Unit	Sensor Type
ppm, ppb	parts per million, parts per billion	PID for VOC
mg/m3, ug/m3	milligrams per cubic meter, micrograms per cubic meter	PID for VOC
ppm, mg/m3	parts per million, milligrams per cubic meter	EC (electrochemical)
ppm Only, %VOL only, Auto Range	parts per million, percent by volume, automatically switch from ppm to %VOL at 10000 ppm and higher*	CO_2
urem, mrem	microrems and millirems	Gamma
uSv, mSv	microSieverts and milliSieverts	Gamma
uR, mR	microRoentgens and milliRoentgens	Gamma
uGy, mGy	microGrays and milliGrays	Gamma

* The CO_2 switch point from ppm to %VOL can be changed via ProRAE Studio 2.

Here are two examples of menu hierarchies (select the sensor type and then the measurement unit):



7.3.4 Alarms

Use this menu to change high, low, STEL, and TWA alarm limits - the points at which alarms are triggered. It can also change alarm mode (latched or automatic reset) and alarm output methods (combinations of light, buzzer, and vibration alarm indications).

7.3.4.1 Alarm Limits

There are four groups of alarm settings that you can adjust for each individual sensor for which a particular alarm type is available.

Settings:

- High Alarm
- Low Alarm
- STEL Alarm
- TWA Alarm

Note: Some alarm settings are not applicable to all sensors. If a setting is irrelevant to a sensor (for example, STEL for a gamma radiation sensor), then that sensor does not appear in the list.

7.3.4.2 Alarm Mode

You can program the MultiRAE so that there are two ways to shut off an alarm:

Auto Reset	When the alarm condition is no longer present, the alarm stops and resets itself.
Latch	You can manually stop the alarm when one is triggered. The latched setting only controls alarms for High Alarm, Low Alarm, STEL Alarm, and TWA alarm.

7.3.4.3 Alarm Settings

You can enable/disable any combination of light (LEDs), buzzer, and vibration alarms.

Settings:

- All Enabled
- Light
- Vibration
- Buzzer
- Buzzer & Light
- Buzzer & Vibration
- Vibration & Light
- All Disabled

7.3.4.4 Comfort Beep

A Comfort Beep is a single beep of the audible alarm at 60-second intervals that reminds the person using the MultiRAE that it is functioning. It can be turned on or off.

7.3.4.5 Man Down Alarm

The Man Down Alarm is a critical and potentially lifesaving safety feature of every MultiRAE. The Man Down Alarm is based on the premise that if the instrument is motionless when it is not supposed to be, something wrong may be happening to its user. If that is the case, the MultiRAE blasts the alarm not only locally on the instrument, but also remotely, over the RAE Systems Dedicated Wireless Network to notify people in the vicinity, as well as remote safety officers at the command center, that a person is down, so that help can get on the way quickly.

When the Man Down feature is on and there is no gas or radiation alarm, the MultiRAE senses that it is motionless for the amount of time set in the "Motionless Time" parameter. If the instrument is not moved during that time, then a pre-alarm is activated to alert the user, and shows the "Are You OK?" screen. Pressing [Y/+] clears the alarm and returns the MultiRAE to its normal operation. Pressing [N/-] sets it into Man Down Alarm (and if wireless connectivity is enabled, a Man Down message is sent in real time to remote observers). If neither key is pressed, then after the countdown, it goes into Man Down Alarm (again sending a message to remote observers if wirelessly enabled).

Settings are available for:

- Off/On
- Motionless Time (time the instrument is motionless before initiating a pre-alarm)
- Motion Sensitivity (set to low, medium, or high to compensate for ambient vibration or motion)
- Warning Time (countdown, in seconds, from pre-alarm to Man Down alarm)

When the Man Down alarm is activated, the buzzer sounds and LEDs flash continuously, and a countdown begins.

- If the MultiRAE's user presses [Y/+] for "Yes" in response to the "Are You OK?" question on the screen before the countdown reaches zero, the Man Down alarm stops and the main reading screen is displayed.
- If the person does not press [Y/+] for "Yes" in response to the "Are You OK?" question on the screen before the countdown reaches zero, the Man Down alarm is sounded and LEDs flash continuously.
- If the person presses [N/-] during the countdown, answering the "Are You OK?" question with "No," the Man Down alarm starts.

If wireless connectivity is enabled, a Man Down message is also sent to remote observers.

7.3.5 Datalog

The instrument displays a floppy disk icon to indicate that a datalog is being recorded. The instrument stores the measured gas concentration for each sensor, date and time for each measurement, Site ID, User ID, and other parameters. The MultiRAE memory is sufficient to record six months' worth of data for five sensors at one-minute intervals. All data are retained (even after the unit is turned off) in non-volatile memory so that they can be downloaded at a later time to a PC.

7.3.5.1 Clear Datalog

This operation erases all data stored in the datalog.

Note: Once the datalog is cleared, the data cannot be recovered.

7.3.5.2 Datalog Interval

Intervals are shown in seconds. The default value is 60 seconds. The maximum interval is 3600 seconds, and the minimum is 1 second.

7.3.5.3 Sensor Selection

You can choose which sensors' data are included in the datalog. The entire list of installed sensors is shown, and you can individually select whether their data is included.

Note: Turning a sensor off in the list does not change or erase its settings.

7.3.5.4 Data Selection

Data Selection allows you to select which types of data are stored and made available when you download your datalog to a computer via ProRAE Studio II (version 1.04 or higher) software.

You can choose any or all of four types of data (you must choose at least one):

- Minimum
- Average
- Maximum
- Real Time

7.3.5.5 Datalog Type

The instrument offers three options for starting the datalogging process:

Auto	Automatically collects datalog information every time the instrument is sampling until the datalog memory is full.
Manual	Datalogging occurs only when you manually initiate it (see below for details).
Snapshot	Datalogs only during snapshot (single-event capture, initiated by pressing [MODE]) sampling.

Note: You can only choose one datalog type to be active at a time.

About Manual Datalog

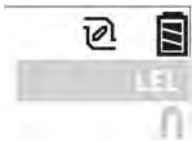
When the instrument is set to Manual Datalog, you can turn datalogging on and off by repeatedly pressing [N/-] and stepping through the screens from the main display until you reach the screen that says "Start Datalog?"

- When you reach the screen that says "Start Datalog?" press [Y/+] to start it. You see "Datalog Started," confirming that datalogging is now on. You can turn it off by pressing [Y/+] again.
- If datalogging is running, you can leave it running. However, if you want to turn it off, follow this procedure:

  Press [N/-] repeatedly to step through the screens until you reach the screen that says, "Stop Datalog?" press [Y/+] to stop datalogging. The screen displays "Datalog Stopped" for a few seconds, before displaying "Start Datalog?" and the datalog interval. You can restart it anytime by pressing [Y/+].

About Snapshot Datalog

When the instrument is in Snapshot datalogging mode, it captures a single "snapshot" of the data at the moment of your choosing. All you have to do is press [MODE] each time you want to capture a snapshot of the data at that instant.



No snapshot.

Press [MODE] for snapshot.

Datalog icon is shown during snapshot

7.3.5.6 Memory Full Action

When the internal datalog memory is full, the MultiRAE can either stop collecting data (Stop when full) or go back to the beginning and overwrite the data from the first entry, second entry, etc. (Wraparound).

7.3.6 Wireless

This feature is currently in development.

7.3.7 Monitor

The submenus under "Monitor" control the LCD's contrast, operation mode, pump speed, and other parameters.

7.3.7.1 LCD Contrast

The display's contrast can be increased or decreased from its default setting. You may not need to ever change the default setting, but sometimes you can optimize the display to suit extreme temperature and ambient brightness/darkness conditions.

Use the [Y/+] and [N/-] keys to decrease or increase LCD contrast, respectively. When you are done, select "Done" and save your change or "Undo" to abort changes and revert to the original setting. If no change is made, you can simply exit LCD Contrast.

7.3.7.2 Operation Mode

There are two operation modes, outlined below.

Hygiene Mode

When the MultiRAE is in Hygiene Mode, it continuously monitors, and if datalogging is on, it saves data continuously.

Search Mode

When the instrument is in Search Mode, it only samples when you activate sampling. When you see the display that says, "Ready…Start sampling?" press [Y/+] to start. The pump turns on and the instrument begins collecting data. To stop sampling, press [N/-] while the main display is showing. You will see a new screen that says, "Stop sampling?" Press [Y/+] to stop sampling. Press [N/-] if you want sampling to continue.

7.3.7.3 Pump Speed

If the MultiRAE is equipped with a pump, the pump can operate at two speeds, high and low. Running at low speed is quieter, extends pump lifespan, and conserves a small amount of power. There is almost no difference in sampling accuracy.

7.3.7.4 Zero At Start

If your MultiRAE has been configured to perform a zero (fresh air) calibration upon startup, called Zero At Start, then the startup routine is interrupted so that you can perform a fresh air calibration.

If you do not want to perform a zero calibration, press [MODE] to bypass it. If you start a zero calibration and want to abort it, press [N/-], and the calibration stops and the main display is shown.

7.3.7.5 Fast Startup

Fast Startup skips showing you many settings and is best suited to environments where the MultiRAE is turned on and off very often during a given day. If Fast Startup is not selected, then when the instrument starts, it shows you details of each sensor, including calibration information, high and low alarm settings, etc.

7.3.7.6 Temperature Units

The display unit of the internal temperature sensor can be switched between Fahrenheit and Celsius.

7.3.7.7 Language
English is the default language, but other languages can also be selected for the instrument.

7.3.7.8 Site ID
Choose and enter an 8-digit Site ID to uniquely identify the particular site where the instrument is to be used. The first four digits can be an alphabet letter or number, while the last four digits can only be numbers. This Site ID is included in the datalog report.

Note: Advance through the alphabet and numbers (0 through 9) by one with each press of the [Y/+] key. To scroll quickly, hold down the [Y/+] key for as long as you want it to scroll rapidly.

7.3.7.9 User ID
Enter an 8-digit alphanumeric User ID to uniquely identify a user. This User ID is included in the datalog report.

Note: Advance through the alphabet and numbers (0 through 9) by one with each press of the [Y/+] key. To scroll quickly, hold down the [Y/+] key for as long as you want it to scroll rapidly.

7.3.7.10 Date Format
Month (MM) and Day (DD) have two digits each, while the year (YYYY) uses four digits. The Date can be expressed in three different formats:

- MM/DD/YYYY
- DD/MM/YYYY
- YYYY/MM/DD

7.3.7.11 Date
Set the date according to the format selected in Date Format.

7.3.7.12 Time Format
The time format can be either of these two options:

- 12 Hour (AM/PM)
- 24 Hour

7.3.7.13 Time
Regardless of the Time Format you select, the MultiRAE's time must be set using the 24-hour format, following hours, minutes, and seconds (HH:MM:SS).

7.3.7.14 User Mode
Two User Modes are available: Advanced and Basic. The Advanced User Mode allows a greater number of parameters to be changed than Basic User Mode. It can be used with either of the Operation Modes, Hygiene or Search. No password is required to enter the Programming Menu when in Advanced User Mode.

7.3.7.15 Backlight
The display's backlight can be set to illuminate either automatically, based on ambient light conditions, or manually, or it can be shut off.

7.3.7.16 LCD Flip
The display can be configured to flip 180° automatically when the MultiRAE is turned upside-down. The LCD Flip feature can be set to On or Off.

8 Calibration And Testing

8.1 Bump Testing And Calibration

RAE Systems recommends a bump test be performed periodically on the MultiRAE. A bump test is defined as a brief exposure of the monitor to the calibration gas to show response and trigger the lowest alarm set point for each sensor.

- The MultiRAE multi-gas detector must be calibrated if it does not pass a bump test, or at least once every 180 days, depending on use and sensor exposure to poisons and contaminants.
- Calibration intervals and bump test procedures may vary due to national legislation.

8.1.1 Bump (Functional) Testing

RAE Systems recommends periodic bump testing to confirm that the sensors and alarms are functional. Test each sensor with an appropriate test gas in a concentration not less than the sensor's low alarm setting. To pass, each sensor should go at least to a low alarm. With the MultiRAE in Normal Mode:

1. Connect the calibration gas cylinder, flow regulator, and calibration adapter to the MultiRAE and start the gas flow.
2. Make sure the unit goes into at least a low alarm for each of the tested sensors and that the buzzer produces at least two beeps per second, the LED lights flash on and off, and the vibration alarm functions. The display backlight should illuminate and an alarm message should be shown in the display.
3. Turn off the gas flow.
4. Remove the calibration adapter.

8.2 Zero/Fresh Air Calibration

This operation sets the zero point of the sensor calibration curve for clean air. It should be performed before other calibrations.

Note: If you use a zero air cylinder, you must use the MultiRAE Calibration Adapter. Using a calibration adapter is not necessary for calibration in fresh air.

8.2.1 Zero Calibration For A CO_2 Sensor

Important! If your MultiRAE is equipped with a CO_2 sensor, it must be zero calibrated using 100% Nitrogen (N_2), which is inert, instead of fresh air or zero air. You can also use CO_2-free isobutylene, which is convenient to use for zeroing the CO_2 sensor and span calibrating a VOC sensor.

8.2.2 Fresh Air Calibration

This procedure determines zero points of most sensors. The MultiRAE should be zero-calibrated in clean air with 20.9% oxygen or with a cylinder of clean zero air.

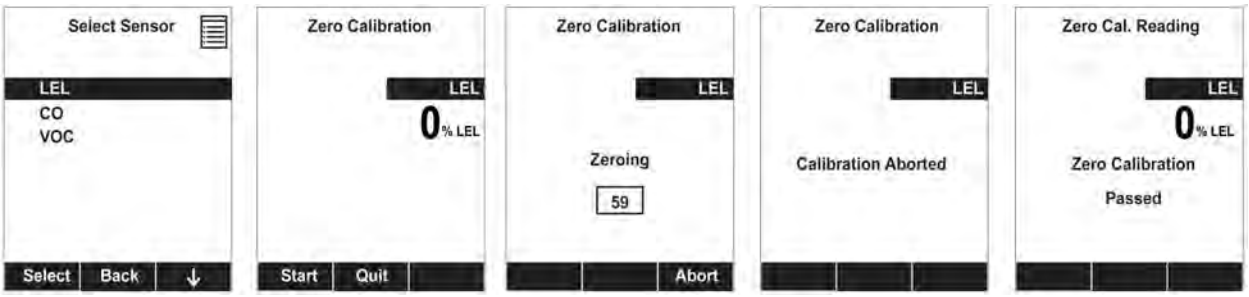
At the Calibration menu, select "Fresh Air" by pressing [Y/+] once to enter fresh air calibration.

After a timer countdown, the zero calibration is done. The LCD displays the sensor names and tells you whether each calibration passed or failed, followed by the sensor readings.

Note: You can abort the calibration at any time during the countdown by pressing [N/-].

8.2.3 Single-Sensor Zero Calibration

Select the sensor and then start the calibration by pressing [Y/+]. You can abort the procedure anytime by pressing [N/-].



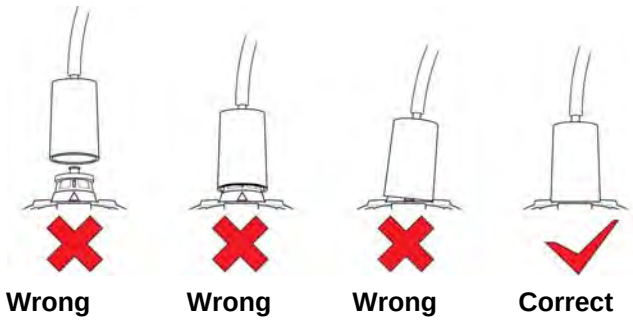
8.3 Span Calibration

This procedure determines the second point of the sensor calibration curve for the sensor.

MultiRAE Equipped With A Pump

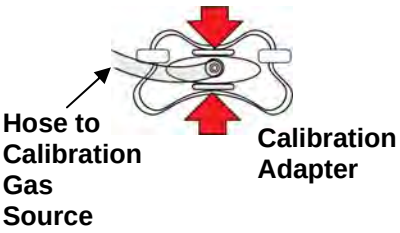
With its pump speed setting of low or high, a MultiRAE normally draws in air at a flow rate of between 200 cc/min and 300 cc/min. RAE Systems recommends that a calibration cap to be used with calibration gas flow rates from 500 cc/min to 1000 cc/min.

WARNING: Make sure the calibration cap clips on and stays in the correct position during calibration, as illustrated below. Otherwise, the calibration cap must be manually held in the correct position.

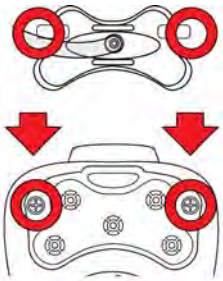


MultiRAE Lite Diffusion Model (No Pump)

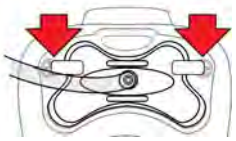
Because there is no single inlet on the diffusion (non-pumped) version of the MultiRAE, a Calibration Adapter is used for supplying calibration gas to all sensors at one time. Follow these steps for attaching the Calibration Adapter.



Grasp the small handles on the Calibration Adapter.



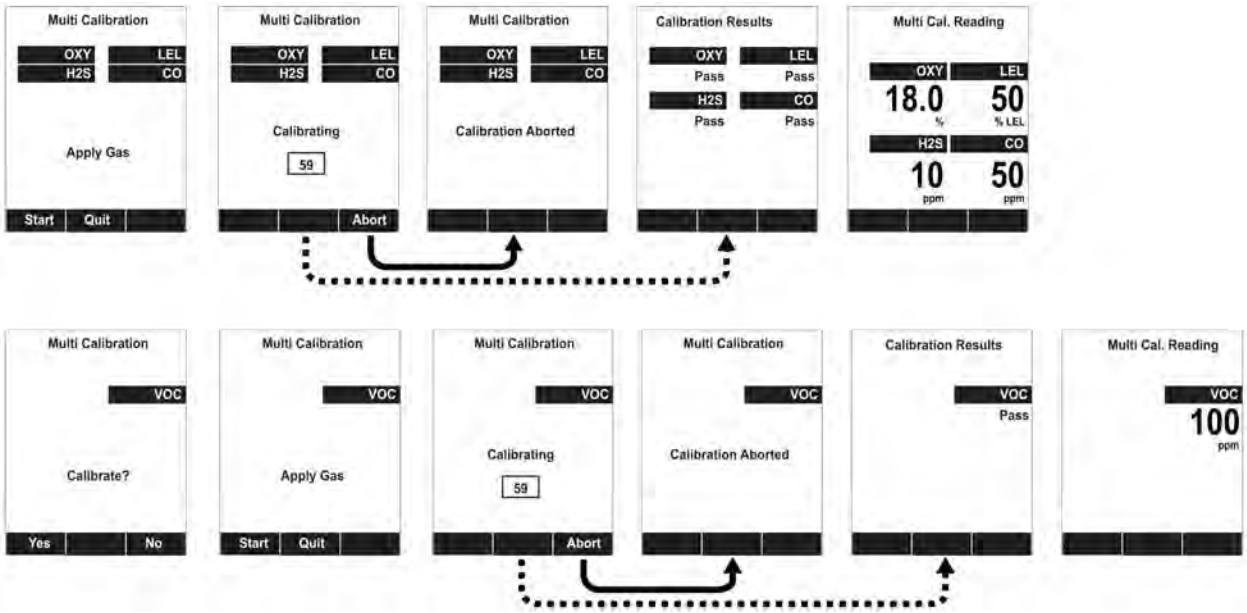
Align the Calibration Adapter's two connectors with the screws on both sides of the MultiRAE's gas inlets.



Make sure the connectors are securely in place before starting the flow of calibration gas. (The Calibration Adapter has small grooves on its underside to allow gas to escape after passing over the sensors.

8.3.1 Multi-Sensor Span Calibration

This lets you perform a span calibration on multiple sensors simultaneously. It requires using the appropriate span gas and that the concentration labeled on the gas cylinder matches the concentration programmed in the MultiRAE.



1. Attach the calibration adapter and gas to the MultiRAE.
2. Start the flow of gas and then press [Y/+] to begin calibration. A countdown screen is shown. You can abort the calibration at any time during the countdown by pressing [N/-].

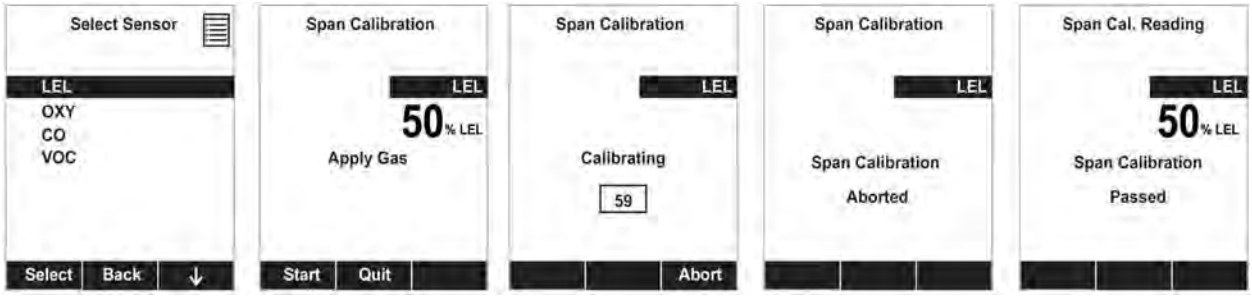
If the calibration reaches its conclusion, it shows the sensor names and tells you whether the calibration passed or failed, followed by the sensor readings.

8.3.2 Single-Sensor Span Calibration

To perform span calibration of an individual sensor, follow these steps:

1. At the Calibration Menu, select "Single Sensor Span."
2. Select a sensor from the list.
3. Connect the calibration adapter and connect it to a source of calibration gas.
4. Start the flow of calibration gas.
5. Verify that the displayed calibration value meets the concentration label on the gas cylinder.

6. Press [Y/+] to start calibrating. You can abort the calibration at any time during the countdown by pressing [N/-].



After a timer countdown, the span calibration is done. The LCD will display whether the calibration was successful and the reading for that calibration gas.

Note: If the sensor calibration fails, try again. If calibration fails again, replace the sensor.

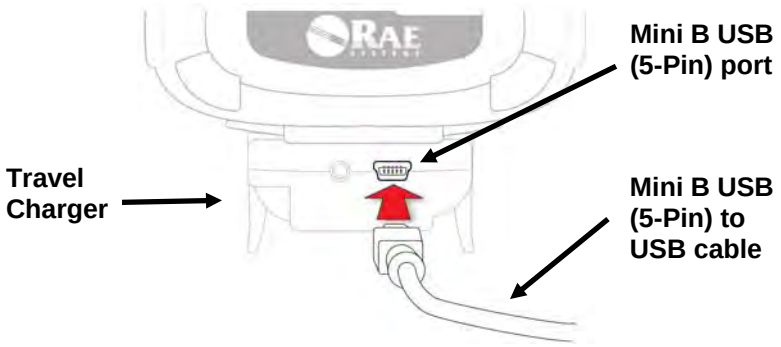
Warning: Do not replace sensors in hazardous locations.

8.4 Testing The Gamma Sensor

The gamma radiation sensor does not require user calibration. You can check it by placing a check-source on the rear of the MultiRAE equipped with a gamma sensor to check the readings. There is a raised dot on the rubber boot that marks where the sensor is located inside the instrument.

9 Datalog Transfer, Monitor Configuration, and Firmware Upgrades Via Computer

Datalogs can be downloaded from the MultiRAE to a computer, and firmware updates can be uploaded to the MultiRAE via the USB port on the Travel Charger or Charging Cradle. Use the included Mini B USB (5-pin)-to-USB cable to connect the Travel Charger or Charging Cradle to a computer running ProRAE Studio II (version 1.04 or higher).



9.1 Downloading Datalogs And Performing PC-Based Instrument Configuration and Firmware Upgrades

The MultiRAE communicates with a PC running ProRAE Studio II Instrument Configuration and Data Management software (version 1.04 or higher) to download datalogs, configure the instrument, or upload new firmware.

The MultiRAE must be connected to a PC through the supplied Charging / PC Communications Cradle and must be in the PC communications mode.

1. Use the supplied PC Communications Cable (USB to mini-USB cable) to connect the Cradle or Travel Charger to a PC.
2. Turn on the MultiRAE. Make sure it is running in Normal mode (with the main measurement screen showing).
3. Insert the MultiRAE in the cradle.
4. Activate the PC communications mode on the MultiRAE by pressing [N/-] repeatedly, starting from the main measurement screen until you reach the "Communicate With Computer?" screen.
5. Press [Y/+]. Measurement and datalogging stop, and the instrument is now ready to communicate with the PC. The display now says "Ready To Communicate With Computer."
6. Start up the ProRAE Studio II software, enter a password, and detect the instrument following the directions provided in the ProRAE Studio II User's Manual.
7. Follow the instructions in the ProRAE Studio II User's Manual to download the datalog, configure the instrument settings, or update the MultiRAE's firmware.
8. When you are done, press [Y/+] to exit the PC communications mode on the MultiRAE. The instrument returns to operating in Normal mode.

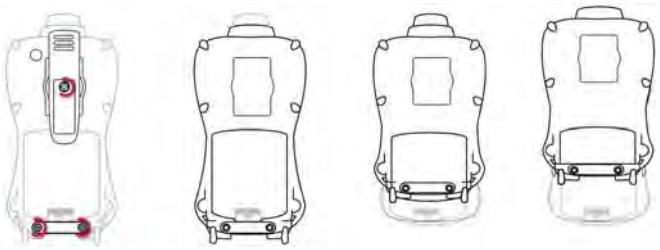
10 Maintenance

The MultiRAE requires little maintenance, aside from replacing sensors, the filter, and the battery. If the instrument is equipped with a pump, it may need replacement, as well. If the instrument has a PID, then the PID sensor lamp and sensor electrode panel may require periodic cleaning.

10.1 Removing/Installing The Rubber Boot

In order to open the MultiRAE, it is necessary to remove the belt clip and the rubber boot. Note that there are two hex screws on the bottom rear side that secure the boot.

1. Remove the belt clip by unscrewing the Philips screw (pumped version only).
2. Remove the two hex screws located below the battery area.
3. Pull the bottom of the boot back over the rear side of the instrument.
4. Carefully slide the boot upward, and slide it over the D-ring and clamp.



10.2 Replacing The Filter

Pumped Version

If a filter is dirty or clogged, remove it by unscrewing it from the inlet. Discard it and replace it with a new filter.

Diffusion Version

If the filters appear dirty, remove the rear cover to access them (this requires removing the rubber boot first).

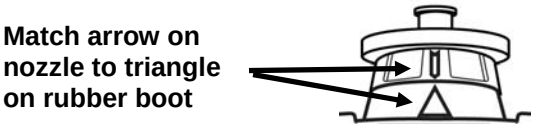
Remove the four screws holding the sensor compartment cover in place.

Remove the O-rings and then remove the filters. Replace them with new filters and return the O-rings to their proper locations.

Replace the rear cover and tighten the four screws.

10.3 Replacing The Inlet

When you remove the nozzle, unscrew it in the same manner as the filter. When replacing it, make sure that the arrow on the front points to the triangle on the rubber boot.



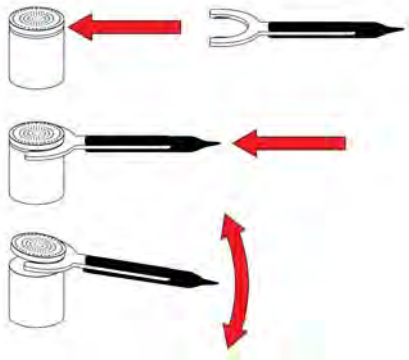
10.4 Removing/Cleaning/Replacing A PID (Pump Version Only)

Note: If you need to access a PID for cleaning or replacement, you must remove the rubber boot and belt clip first.

1. Turn off the instrument.
2. Remove the four screws in holding the MultiRAE sensor compartment cover in place.
3. Remove the cover to expose the sensors.

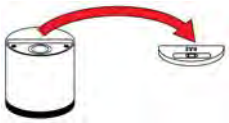
4. Gently lift out the PID module with your fingers.
5. If the module requires replacement (for example, because the lamp does not illuminate, or the module has been used past its expiration date), place a new module into the slot, being careful to match the indexing keys. The sensor can only go into its slot one way.
6. If you want to open the sensor module to inspect and clean the lamp and sensor electrode panel, you must use the special tool (part number G02-0306-003, package of three). Its "C"-shaped end has small "teeth" inside. Slide the tool so that the teeth slip into the notch between the module's cap and body:

7. Gently pry up the cap using a rocking motion:



8. Once the cap is removed, set it aside.

9. Now lift the sensor electrode panel from the module:



10. Clean the sensor electrode panel in a solution of methanol lamp cleaner (included, along with cleaning swabs, in a PID Lamp Cleaning Kit, part number 081-0002-000), and allow it to dry.

11. Clean the lamp's window with a cleaning swab dipped in methanol lamp cleaner, and allow it to dry. Do not touch the lamp window with your fingers, as the residual oils will shorten its life.

12. Inspect the electrical contacts. Clean them with a swab dipped in lamp cleaner if they appear to need cleaning:

13. Reassemble the sensor module by placing the sensor electrode panel back in place and firmly pressing the cap back onto the top.

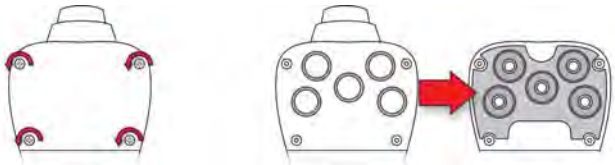
14. Place the sensor module back into the MultiRAE. Make sure the index points are aligned (it can only go in one way).
15. Reinstall the rear cover.
16. Tighten all four screws.

Note: Always calibrate the MultiRAE after replacing the sensor module.

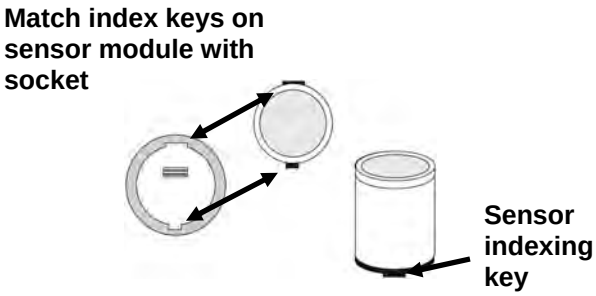
10.5 Removing/Cleaning/Replacing Sensor Modules

WARNING! Do not replace a sensor in hazardous locations.

All sensors are located inside the sensor compartment in the upper half of the MultiRAE. They are accessed by removing the cover that is held on by four screws.



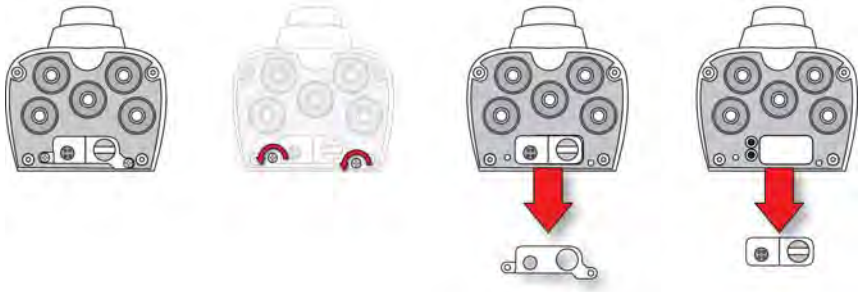
1. Turn off the instrument.
2. Remove the four screws holding the sensor compartment.
3. Remove the cover. The sensors are plugged into the slots.
4. Gently lift out the desired sensor module with your fingers.
5. Install the replacement sensor. It can only go into its slot one way. The connector inside the MultiRAE and the indexing guides are good visual indicators of how to set the sensor into position. Make sure the indexing keys are aligned and that the sensor is seated firmly.



10.6 Replacing The Pump

If your MultiRAE has a pump and it requires replacement, follow these steps. Make sure the battery is removed before proceeding.

1. Remove the rear cover.
2. The pump is held in place by a metal bracket and two Philips screws. Remove the two screws.
3. Lift off the metal bracket.
4. Pressing down on the gas plate with one hand, pull the pump straight out. It has an inlet and outlet that are held in the two holes with rubber gaskets to the left of the pump cavity.



5. Press a new pump into place (a small amount of wiggling helps), making sure that both the inlet and outlet from the pump go into the two holes.
6. Place the metal bracket over the pump.
7. Insert and tighten the two screws that attach the bracket to the housing.
8. Replace the cover.
9. Turn on the instrument and check for proper pump operation.

11 Alarms Overview

The MultiRAE provides an unmistakable five-way alarm notification system that combines local alarms on the device with real-time remote wireless alarm notification to take worker safety to the next level. Local alarms include audible buzzer alarm, visible alarm via bright LED lights, vibration alarm, and an alarm notification on the display. These can be programmed or selectively turned on or off.

Note: The vibration alarm is automatically disabled whenever the alkaline adapter is used.

11.1 Alarm Signals

During each measurement period, the gas concentration is compared with the programmed alarm limits for Low, High, TWA and STEL alarm. If the concentration exceeds any of the preset limits, the alarms are activated immediately to warn both the MultiRAE user and a remote safety officer (if wireless is enabled) of the alarm condition.

In addition, the MultiRAE alarms if one of the following conditions occurs: battery voltage low, pump blocked, PID lamp failed, etc.

When the low battery alarm occurs, there may be approximately 10 minutes of operating time remaining. In this case, it is recommended that you promptly change or charge the battery in a non-hazardous location.

11.2 Changing The Alarm Mode

Your choices are Auto Reset and Latched. A latched alarm stays on until you acknowledge the alarm by pressing a button. An auto-reset alarm turns off when the condition that set off the alarm is no longer present (for instance, a high H2S reading that exceeds the preset threshold and triggers an alarm, but then lowers below that threshold, turning the alarm off).

1. Enter the Alarm Mode sub-menu of the Alarms section under the Programming Menu.
2. Select Auto Reset or Latched by pressing [N/-] to select, and [Y/+] to confirm the choice.
3. Press [Y/+] to save your selection.

11.3 Alarm Signal Summary

Hygiene Mode

Alarm Type	Buzzer & LED	Display	Vibration	Reading	Backlight	Priority
Super Alarm	4 beeps/sec	"Super Alarm" screen	400ms	-	On	Highest
Man Down Alarm	3 beeps/sec	"Man Down Alarm" screen	400ms	-	On	
Man Down Warning	2 beeps/sec	"Are you OK" screen	400ms	-	On	
Fail	3 beeps/sec	"Lamp" at PID location "Off" at LEL location	400ms	Blinking reading	On	
Pump	3 beeps/sec	Blinking pump symbol	400ms	Reading	On	
Max	3 beeps/sec	"Max" at sensor location	400ms	Blinking reading	On	
Over Range	3 beeps/sec	"Over" at sensor location	400ms	Blinking 9999	On	
High	3 beeps/sec	"High" at sensor location	400ms	Reading	On	
Low	2 beeps/sec	"Low" at sensor location	400ms	Reading	On	
Negative	1 beep/sec	"Neg" at sensor location	400ms	0	On	
STEL	1 beep/sec	"STEL" at sensor location	400ms	Reading	On	
TWA	1 beep/sec	"TWA" at sensor location	400ms	Reading	On	
Calibration	1 beep/sec	"Cal" at sensor location	400ms	Reading	On	
Datalog Full	1 beep/sec	Blinking datalog symbol	400ms	Reading	On	
Calib Due	-	Bottle symbol	-	Reading	-	
Battery	1 beep/min	Blinking battery symbol	400ms	Reading	Stays as is	
Nwk Lost	1 beep/min	Blinking RF offline symbol	400ms	Reading	On	
Nwk Joined	1 beep	RF symbol with RSSI	400ms	Reading	On	
Comfort Beep	1 beep/min no LED flash	-	-	Reading	-	Lowest

Notes
"Negative" means that the reading is below zero.
"Nwk Lost" means "Network Lost." This indicates that the MuliRAE has lost wireless connectivity with its network.
"Nwk Joined" means that the MultiRAE has joined a wireless network.

Search Mode

Alarm Type		Buzzer & LED	Display	Vibration	Reading	Backlight	Priority
Super Alarm		4 beeps/sec	"Super Alarm" screen	400ms	-	On	Highest
Man Down Alarm		3 beeps/sec	"Man Down Alarm" screen	400ms	-	On	
Man Down Warning		2 beeps/sec	"Are You OK?" screen	400ms	-	On	
Fail		3 beeps/sec	"Lamp" at PID location "Off" at LEL location	400ms	Blinking reading	On	
Pump		3 beeps/sec	Blinking pump symbol	400ms	Reading	On	
Max		3 beeps/sec	"Max" at sensor location	400ms	Blinking reading	On	
Over Range		3 beeps/sec	"Over" at sensor location	400ms	Blinking 9999	On	
Geiger Counter style Alarm	G7 (>High)	7 beeps(30ms)/sec	No change	400ms	Reading	On	
	G6	6 beeps(40ms)/sec					
	G5	5 beeps(50ms)/sec					
	G4	4 beeps(60ms)/sec					
	G3	3 beeps(70ms)/sec					
	G2	2 beeps(80ms)/sec					
	G1 (>Low)	1 beep(90ms)/sec					
Negative		1 beep/sec	"Neg" at sensor location	400ms	0	On	
STEL		1 beep/sec	"STEL" at sensor location	400ms	Reading	On	
TWA		1 beep/sec	"TWA" at sensor location	400ms	Reading	On	
Calibration		1 beep/sec	"Cal" at sensor location	400ms	Reading	On	
Datalog Full		1 beep/sec	Blinking datalog symbol	400ms	Reading	On	
Calib Due		-	Bottle symbol	-	Reading	-	
Battery		1 beep/min	Blinking battery symbol	400ms	Reading	Stays as is	
Nwk Lost		1 beep/min	Blinking RF offline symbol	400ms	Reading	On	
Nwk Joined		1 beep	RF symbol with RSSI	400ms	Reading	On	

General Alarms

Message	Condition	Alarm Indications
HIGH	Gas exceeds "High Alarm" limit	3 beeps/flashes per second
OVR	Gas exceeds sensor's measurement range	3 beeps/flashes per second
MAX	Gas exceeds electronic circuit's maximum range	3 beeps/flashes per second
LOW	Gas exceeds "Low Alarm" limit*	2 beeps/flashes per second
TWA	Gas exceeds "TWA" limit	1 Beep/flash per second
STEL	Gas exceeds "STEL" limit	1 Beep/flash per second
Crossed pump icon flashes	Inlet blocked or pump failure	3 beeps/flashes per second
"Lamp" flashes	PID lamp failure	3 beeps/flashes per second
Empty battery icon flashes	Low battery	1 flash, 1 beep per minute
CAL	Calibration failed, or needs calibration	1 beep/flash per second
NEG	Zero gas reading measures less than number stored in calibration	1 beep/flash per second

* For oxygen, "low alarm limit" means a concentration is lower than the low alarm limit.

12 Troubleshooting

Problem	Possible Reasons & Solutions
Cannot turn on power after charging the battery	**Reasons:** Defective charging circuit. Defective battery. **Solutions:** Replace battery or charger. Try another charge of battery.
Lost password	**Solutions:** Call Technical Support at +1 408-952-8461 or toll-free at +1 888-723-4800
Buzzer, LED lights, and vibration motor inoperative	**Reasons:** Buzzer and/or other alarms disabled. Bad buzzer. **Solutions:** Check under "Alarm Settings" in Programming Mode that buzzer and/or other alarms are not turned off. Call authorized service center.
"Lamp" message when power on. Lamp alarm.	**Reasons:** Low ion concentration inside PID lamp especially in cold environment when first powered on. Defective PID lamp or defective circuit. **Solutions:** Turn the unit off and back on. Replace UV lamp.
Pump failed message. Pump alarm.	**Reasons:** Inlet probe blocked. Direct connection to a gas outlet while the gas value is turned off. Water trap filter sucks in water. Water trap filter too dirty. Water condensed along the inlet probe. Bad pump or pump circuit. **Solutions:** Remove the blocking objects and then press [Y/+] key to reset the pump alarm. Replace contaminated water trap filter. Be careful not to allow water condensation inside the unit. Replace the pump.

If you need replacement parts, a list is available online:

www.raesystems.com

13 Diagnostic Mode

In Diagnostic Mode, the MultiRAE provides raw counts for sensor, battery, and other readings, as well as a list of installed sensors and information about them (expiration date, serial number, etc.). Most of these screens are useful only to service technicians. A few allow access for changing settings.

The MultiRAE's Diagnostic Mode can only be accessed at startup time. In Diagnostic Mode, MultiRAE displays readings in raw counts instead of units such as parts per million (ppm).

13.1 Entering Diagnostic Mode

1. With the MultiRAE turned off, press and hold both [MODE] and [Y/+].
2. When the display turns on and the password screen appears, release the keys.
3. Enter the 4-digit password (the password is the same as the one for the Programming Mode; the default password is 0000):

   - Step from one position in the four-character string to the other by pressing [N/-].
   - Press [Y/+] repeatedly to select a desired number. Numbers increase from 0 to 9.
   - Once 9 is reached, pressing [Y/+] again "wraps" around back to 0.

4. When you are done, press [MODE]. If you input the correct password, you see the "Product Model" screen.

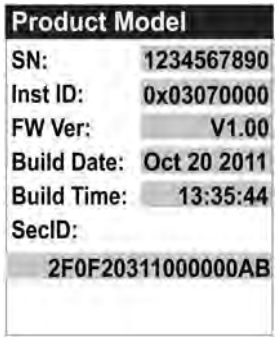
13.2 Exiting Diagnostic Mode

1. Turn off the MultiRAE by pressing and holding [MODE]. There will be a standard shutoff countdown.
2. When the instrument shuts off, you will be alerted. Release your finger.

Note: The next time you start MultiRAE, hold only [MODE], and it will automatically start in Normal Mode.

13.3 Navigating Diagnostic Mode

Step through Diagnostic Mode by pressing [MODE]. The first screen you see is information about the product, including the serial number, firmware version, etc.:



Press [MODE] to advance through the screens:

- Sensor Firmware
- ExtFlash
- Sensor Installed
- Location 1
- Location 2
- Location 3
- Location 4
- Location 5

- Socket Raw Count
- Calibration Data
- Buzzer
- Pump
- Battery
- RTC (real-time clock)
- Lights/Vibrator
- T.H. (temperature and humidity)
- LCD Contrast
- Position Sensor
- Communicate With Computer? (Datalogging And Measurement Will Pause)

14 Specifications

Instrument Specifications

Size	7.6" H x 3.8" W x 2.6" D (193 x 96.5 x 66 mm)
Weight	Pumped models: 31 oz. (880 g) Diffusion models: 26.8 oz. (760 g)
Sensor	Over 30 intelligent interchangeable field-replaceable sensors, including Gamma radiation, ppb and ppm PIDs, electrochemicals for toxics and oxygen, combustible LEL and NDIR, and CO_2 NDIR
Battery Options	• Rechargeable Li-ion (~12 hours runtime, pumped/18 hours, diffusion; < 6 hours recharge time) • Alkaline adapter for 4 x AA batteries (~ 6 hours runtime, pumped/8 hours, diffusion)
Display	• Monochrome graphical LCD display (128 x 160) with backlighting (activated automatically in dim ambient lighting conditions, when monitor is in alarm, or with a button press) • Automatic screen flipping.
Display Readout	• Real-time reading of gas concentrations; PID measurement gas and correction factor; battery status; datalogging on/off; wireless on/off and reception quality. • STEL, TWA, peak, and minimum values
Keypad	1 operation and 2 programming keys (MODE, Y/+, and N/-)
Sampling	Built-in pump or diffusion. Average flow rate, pumped: 250 cc/min. Auto shutoff in low-flow conditions
Calibration	Automatic with AutoRAE 2 Test and Calibration Station or manual
Alarms	• Wireless remote alarm notification; multi-tone audible (95 dB @ 30 cm), vibration, visible (flashing bright red LEDs), and on-screen indication of alarm conditions • Man Down Alarm with pre-alarm and real-time remote wireless notification
Datalogging	• Continuous datalogging (six months for 5 sensors at 1-minute intervals, 24/7) • User-configurable datalogging interval (from 1 to 3,600 seconds)
Communication and Data Download	• Data download and instrument set-up and upgrades on PC via charging and PC communication cradle, travel charger, or AutoRAE 2 Automated Test and Calibration Station[1] • Wireless data and status transmission via built-in RF modem (optional)
Wireless Network	RAE Systems Dedicated Wireless Network
Wireless Frequency	ISM license-free bands
Wireless Range (Typical)	656 feet (200 meters)
EM Immunity	No effect when exposed to 0.43mW/cm^2 RF interference (5-watt transmitter at 12")
Operating Temperature	-4° to 122° F (-20° to 50° C)

Instrument Specifications *continued*	
Humidity	0% to 95% relative humidity (non-condensing)
Dust and Water Resistance	IP-65 (pumped), IP-67 (diffusion)
Hazardous Location Approvals	Exia Class I, Division 1, Groups A, B, C, D, T4 SIRA 11ATEX2152X, CE 0575 II 1G Ex ia IIC T4 Ga (for PGM62x0/PGM62x6) SIRA 11ATEX2152X, CE 0575 II 2G Ex ia d IIC T4 Gb (for PGM62x8) UM=20V IECEx SIR 11.0069X, Ex ia IIC T4 Ga (for PGM62x0/PGM62x6) IECEx SIR 11.0069X, Ex ia d IIC T4 Gb (for PGM62x8)
CE Compliance (European Conformity)	EMC directive: 2004/108/EC R&TTE directive: 1999/5/EC ATEX directive: 94/9/EC
Performance Tests	LEL CSA C22.2 No. 152; ISA-12.13.01
Languages	Arabic, Chinese, Czech, Danish, Dutch, English, French, German, Indonesian, Italian, Japanese, Korean, Norwegian, Polish, Portuguese, Russian, Spanish, and Swedish
Warranty	• Two years on non-consumable components and catalytic LEL, CO, H_2S, and O_2 sensors • One year on all other sensors, battery, and other consumable parts
Specifications are subject to change.	

Sensor Specifications

Radiation Sensor	Range	Resolution
Gamma	0 to 20,000 microREM/h	1 microREM/h
PID Sensors	**Range**	**Resolution**
VOC 10.6 eV (HR) VOC 10.6 eV (ppb) VOC 9.8 eV[1]	0.1 to 5,000 ppm 10 ppb to 2,000 ppm 0.1 to 1,000 ppm	0.1 ppm 10 ppb 0.1 ppm
Combustible Sensors	**Range**	**Resolution**
Catalytic bead LEL NDIR (0-100% LEL Methane) NDIR (0-100% Vol. Methane)	0 to 100% LEL 0 to 100% LEL 0 to 100% Vol.	1% LEL 1% LEL 0.1% Vol.
Carbon Dioxide Sensor	**Range**	**Resolution**
Carbon Dioxide (CO_2) NDIR	0 to 50,000 ppm	100 ppm
Electrochemical Sensors	**Range**	**Resolution**
Ammonia (NH_3)	0 to 100 ppm	1 ppm
Carbon Monoxide (CO) Carbon Monoxide (CO), Ext. Range Carbon Monoxide (CO), H_2-comp. Carbon Monoxide (CO) + Hydrogen Sulfide (H_2S) Combo	0 to 500 ppm 0 to 2,000 ppm 0 to 2,000 ppm 0 to 500 ppm 0 to 200 ppm	1 ppm 10 ppm 10 ppm 1 ppm 0.1 ppm
Chlorine (Cl_2)	0 to 50 ppm	0.1 ppm
Chlorine Dioxide (ClO_2)	0 to 1 ppm	0.03 ppm
Ethylene Oxide (EtO-A) Ethylene Oxide (EtO-B) Ethylene Oxide (EtO-C), Ext. Range	0 to 100 ppm 0 to 10 ppm 0 to 500 ppm	0.5 ppm 0.1 ppm 10 ppm
Formaldehyde (HCHO)	0 to 10 ppm	0.01 ppm
Hydrogen (H_2)	0 to 1,000 ppm	2 ppm
Hydrogen Chloride (HCl)	0 to 15 ppm	1 ppm
Hydrogen Cyanide (HCN)	0 to 50 ppm	0.5 ppm
Hydrogen Fluoride (HF)	0 to 10 ppm	0.1 ppm
Methyl Mercaptan (CH_3-SH)	0 to 10 ppm	0.1 ppm
Nitric Oxide (NO)	0 to 250 ppm	0.5 ppm
Nitrogen Dioxide (NO_2)	0 to 20 ppm	0.1 ppm
Oxygen (O_2)	0 to 30% Vol.	0.1% Vol.
Phosgene ($COCl_2$)	0 to 1 ppm	0.02 ppm
Phosphine (PH_3) Phosphine (PH_3), Ext. Range	0 to 20 ppm 0 to 1,000 ppm	0.1 ppm 1 ppm
Sulfur Dioxide (SO_2)	0 to 20 ppm	0.1 ppm

All specifications are subject to change without notice.

LEL Range, Resolution & Response Time

LEL 0-100% 1 % 15 sec

LEL Cross-Sensitivity

Compound	LEL Relative Sensitivity*	LEL CF
Methane	100	1.0
Propane	62	1.6
Propene	67	1.5
n-Butane	50	2.0
Isobutylene	67	1.5
n-Pentane	45	2.2
n-Hexane	43	2.3
Cyclohexane	40	2.5
Benzene	45	2.2
Toluene	38	2.6
n-Heptane	42	2.4
n-Octane	34	2.9
Turpentine	34	2.9
Leaded Gasoline	48	2.1
Methanol	67	1.5
Ethanol	59	1.7
Isopropanol	38	2.6
Acetone	45	2.2
Methyl Ethyl Ketone	38	2.6
Ethyl Acetate	45	2.2
Carbon Monoxide	75	1.2
Hydrogen	91	1.1
Ammonia	125	0.80

* Response of the RAE Systems LEL sensor to a range of gases at the same LEL, expressed as percent of methane response (=100). These figures are for guidance only and are rounded to the nearest 5%. For the most accurate measurements, the instrument should be calibrated with the gas under investigation. See RAE Systems Technical Note TN-156 for more details and other compounds.

Caution:
Refer to RAE Systems Technical Note TN-144 for LEL sensor poisoning.

Year Of Manufacture

To identify the year of manufacture, refer to the serial number of the instrument.

The second to last digit in the serial number indicates the year of manufacture. For example, "M" indicates the manufacturing year is 2010.

First digit	Year
J	2008
K	2009
M	2010
N	2011
P	2012
Q	2013
R	2014
S	2015
T	2016
U	2017
V	2018
W	2019

15 Technical Support

To contact RAE Systems Technical Support Team:

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GEM5000 Gas Analyzer

Operating Manual

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Manual guidelines

0.5 *Document history*

Issued By	Issue Date	Change Control ID	Issue No.	Reason for Change
	JAN 2012	5K-MNL-GEM5000	1.09	New Instructions.

0.6 *Hazard warnings and safety symbols*

Warning	Information in this manual that may affect the safety of users and others is preceded by the warning symbol. Caution - Failure to follow the correct information may result in physical injury which in some cases could be fatal. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

0.7 *General product label symbols are listed as follows:*

CE	CE conformity-The CE-marking is the manufacturer's statement to the EU authorities that the product complies with all relevant CE-marking Directives.	C US 236822	If the CSA mark appears with the indicator "US" or "NRTL" it means that the product is certified for the U.S. market, to the applicable U.S. standards.
V D E	VDE mark is a symbol for electrical, mechanical, thermal, toxic, radiological and other hazards.		Separate collection, handling and disposal for waste electrical and electronic equipment and its components.
	Electric shock warning.		Refer to operators manual.
	Double insulated construction - does not require an Earth.	Ex	Specific marking of explosion protection (ATEX only).
II 2G	Equipment group and category. G = gases; the type of explosive atmosphere.	IEC Ex	IECEx licensed mark (IECEx only).
T	Fuse.		Equipment for indoor use only.

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0.8 *Notes*

Important/useful information and instructions are shown clearly throughout the manual in a note format. For example:

✍ Note: For further information please contact Technical Support at LANDTEC at +1 (909) 783-3636 or email technical@landtecna.com

1 Introduction

This manual explains how to use the GEM5000 landfill gas analyzer. The GEM5000 measures flow and calculates the calorific values of the gas as well as being a useful tool for balancing the gas field. The GEM5000 gas analyzer may be used to monitor, calculate, adjust and record the flow at each monitoring point.

This instrument may also be used in GA (gas analyzer) mode of operation if required. The operator may change the analyzer between a gas extraction monitor (GEM mode) or a landfill gas analyzer (GA Mode). The mode of operation can be changed from the 'Special Action' menu. Please refer to the section 'Taking Readings' for further instruction.

The 5000 series of gas analyzers complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1) This device may not cause harmful interference.

2) This device must accept any interference received, including interference that may cause undesired operation.

1.1 *Safety instructions—English*

⚠ **Warning**	The 5000 series of gas analyzers can be used for measuring gases from landfill sites and other sources as described in this manual. The operator may be exposed to harmful gases during the use of the instrument. Inhaling these gases may be harmful to health and in some cases may be fatal. It is the responsibility of the user to ensure that he/she is adequately trained in the safety aspects of the gases being used and appropriate procedures are followed. In particular, where hazardous gases are being used the gas exhausted from the analyzer must be piped to an area where it is safe to discharge the gas. Hazardous gas can also be expelled from the instrument when purging with clean air.

✍ Note: Gas analyzers are a sensitive piece of scientific equipment, and should be treated as such. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the instrument may be impaired.

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1.2 *Instructions for safe use*

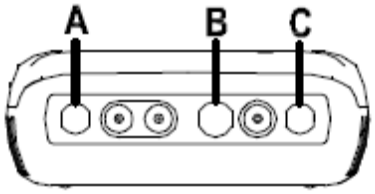
For ATEX and IECEx the 5000 series of gas analyzers are certified to Hazardous Area Classification

II 2G Ex ib IIA T1 Gb (Ta = +14ºF to +122°F)

It is vital that instructions be followed closely. It is the responsibility of the operator to determine the protection concept and classification required for a particular application.

(Reference European ATEX Directive 94/9/EC, Annex II, 1.0.6.)
The following instructions apply to equipment covered by certificate numbers SIRA 11ATEX2197X and IECEx Directive SIR 11.0089X:

- The equipment may be used with flammable gases and vapors with apparatus group IIA and temperature class T1.
- The equipment is only certified for use in ambient temperatures in the range (-10ºC to +50ºC) and should not be used outside this range.
- The equipment must not be used in an atmosphere of greater than 21% oxygen.
- Repair of this equipment shall be carried out in accordance with the applicable code of practice.
- When used in a hazardous area only use (TP-5000 temperature probe (SIRA 11ATEX2197X and IECEx SIR11.0089X).. The analyzer should not be connected to any other devices in the hazardous area including the 5000-USB cable (connector A) or GEM5000 BC battery charger (connector B) supplied with the analyzer.



Do not charge, recharge or open in a potentially explosive atmosphere.
In hazardous area only use "TP-5000 Temperature Probe" in Connector B.
Connector C (Uo=10V,Io=5mA,Po=50mW,Ci=0,Li=0,Co=100uF,Lo=1000mH),
Connector B (Uo=5V,Io=6mA,Po=7mW,Ci=0,Li=0,Co=100uF,Lo=1000mH)

MAXIMUM NON-HAZARDOUS SUPPLIES:
Connector A - Um=6V Connector B - Um=10.1V

- If the equipment is likely to come into contact with harmful substances, e.g. acidic liquids or gases that may attack metals, or solvents that may affect polymeric materials, then it is the responsibility of the user to take suitable precautions, e.g. regular checks as part of routine inspections or establishing from the material's data sheet that it is resistant to specific chemicals that prevent it from being adversely affected, thus ensuring that the type of protection is not compromised.

- The relative pressure range is +/-200 in H_20 (+/-500 mbar). Note, however, that the input pressure should not exceed +/-200 in H_20 (+/- 500 mbar) relative to

atmospheric pressure and the output pressure should not exceed 40 in H_20 (+/- 100 mbar) relative to atmospheric pressure.

For CSA (Canada) the 5000 series of gas analyzers are certified to Hazardous Area Classification

CLASS 2258 03 - PROCESS CONTROL EQUIPMENT - Intrinsically Safe and Non-Incendive Systems - For Hazardous Locations

C US
M,C,#243446

Ex ib IIA:

Model GA 5000, GEM 5000 and BIOGAS 5000 Methane Detectors; portable, battery powered with non-field-replaceable Battery Pack P/N 20087; intrinsically safe and providing intrinsically safe circuits ("[ib]" for Zone 1) to Model TP-5000 Temperature Probe (Connector B) and with entity output parameters as tabulated below; Temperature Code T1; 14 ºF ≤ Tamb. ≤ +122ºF (-10 ºC ≤ Tamb. ≤ +50ºC).

Connector	Entity Parameters						
	Uo (V)	Io (mA)	Po (mW)	Co (uF)	Lo (mH)	Ci (uF)	Li (mH)
B	5.0	6	7	100	1000	0	0
C	10.0	5	50	100	1000	0	0

✍ Note: This device has been investigated for electrical safety features only.

For CSA (USA) the 5000 series of gas analyzers are certified to Hazardous Area Classification

CLASS 2258 83 - PROCESS CONTROL EQUIPMENT - Intrinsically Safe and Non-Incendive Systems – For Hazardous Locations - CERTIFIED TO U.S. STANDARDS

C US
M,C,#243446

AEx ib IIA:

Model GA 5000, GEM 5000 and BIOGAS 5000 Methane Detectors; portable, battery powered with non-field-replaceable Battery Pack P/N 20087; intrinsically safe and providing intrinsically safe circuits ("[ib]" for Zone 1) to Model TP-5000 Temperature Probe (Connector B) and with entity output parameters as tabulated below; Temperature Code T1; 14 ºF ≤ Tamb. ≤ +122ºF (-10 ºC ≤ Tamb. ≤ +50ºC)

Connector	Entity Parameters						
	Uo (V)	Io (mA)	Po (mW)	Co (uF)	Lo (mH)	Ci (uF)	Li (mH)
B	5.0	6	7	100	1000	0	0
C	10.0	5	50	100	1000	0	0

✍ Note: This device has been investigated for electrical safety features only.

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1.3 *MCERTS (applied for)*

MCERTS is the UK Environment Agency's Monitoring Certification Plan. The Plan provides a framework within which environmental measurements can be made in accordance with the Agency's quality requirements. The scheme covers a range of monitoring, sampling and inspection activities.

The GEM5000 instrument is MCERTS certified only if:

- The MCERTS logo appears on the screen after initial power on.

✍ Note: MCERTS - Cross sensitivity tests using hydrogen sulfide were not carried out on this instrument. Therefore, users should be aware if H_2S is present on sites, as there may be an interferential effect.

MCERTS promotes public confidence in monitoring data and provides industry with a proven framework for choosing monitoring systems and services that meet the Environment Agency's performance requirements.

The Environment Agency has established its Monitoring Certification Scheme (MCERTS) to deliver quality environmental measurements. The MCERTS product certification scheme provides for the certification of products according to Environment Agency performance standards, based on relevant CEN, ISO and national standards.

MCERTS certified instruments have been tested by an independent body to ensure that they meet certain performance requirements. In addition the manufacturer of an MCERTS product is regularly audited to ensure that the performance requirements of the certification are being continually met.

The 5000 series of gas analyzers have been certified to Version 3.1 of the 'Performance Standards for Portable Emission Monitoring Systems'.

1.4 *Declaration of conformity*

Products	• GEM5000 - Landfill Gas Analyzer and Extraction Monitor • BIOGAS 5000 – Anaerobic Digester Gas Analyzer

Geotechnical Instruments (UK) Limited a LANDTEC Subsidiary declares that the item(s) described above are in compliance with the following standards:

ATEX Directive 94/9/EC

Certification body	SIRA Certification Service
Notified body number	0518
Address	Rake Lane, Eccleston, Chester, CH4 9JN

SIRA certificate number	SIRA 11ATEX2197X
Standards applied	EN60079-0 :2006 EN60079-0 :2009 EN60079-11 :2007

IECEx

Certification body	SIRA Certification Service
Notified body number	0518
Address	Rake Lane, Eccleston, Chester, CH4 9JN
IECEx certificate number	SIR 11.0089X
Standards applied	IEC60079-0 :2004 Ed4 IEC60079-0 :2007 Ed5 IEC60079-11 :2006 Ed5

CSA (Canada and USA)

Certification body	CSA International
Address	178 Rexdale Boulevard, Toronto, ON, Canada M9W 1R3
CSA Certificate number	CSA 11 2445306
Standards applied	C22.2 No. 0-10 - General Requirements – Canadian Electrical Code, Part II CAN/CSA-C22.2 No. 60079-0:07 - Electrical apparatus for explosive gas atmospheres - Part 0: General Requirements CAN/CSA-C22.2 No. 60079-1:07 - Electrical apparatus for explosive gas atmospheres - Part 1: Flameproof enclosures "d" CAN/CSA-E60079-11:02 - Electrical apparatus for explosive gas atmospheres - Part 11: Intrinsic Safety "i" ANSI/UL 60079-0:09 - Electrical Apparatus for Explosive Gas Atmospheres - Part 0: General Requirements ANSI/UL 60079-1:09 - Electrical Apparatus for Explosive Gas Atmospheres - Part 1: Flameproof Enclosures "d" ANSI/UL 60079-11:09 - Electrical apparatus for Explosive Gas Atmospheres - Part 11: Intrinsic Safety "i"

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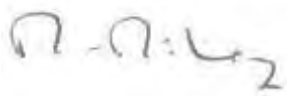
EMC Directive 2004/108/EC

EN 301 489 Pt 1 (V1.9.1 – 2011-04)	Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements
EN 301 489 Pt 17 (V2.1.1 – 2009-05)	Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment; Part 17: Specific conditions for Broadband Data Transmission Systems EMC for broadband data transmission systems
EN 301 489 Pt 19 (V1.2.1 – 2002-11)	Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 19: Specific conditions for Receive Only Mobile Earth Stations (ROMES) operating in the 1,5 GHz band providing data communications EMC for Receive Only Mobile Earth Stations (ROMES)
BS EN 61000-3-2: 2006 + A2:2009	Electromagnetic compatibility (EMC). Limits. Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)
BS EN 61000-3-3: 2008	Electromagnetic compatibility (EMC). Limits. Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection

Signed:



Dr. Roger Riley
NPI Director and Authorized Person

2 The GEM5000 gas analyzer

2.1 *The GEM5000*

Figure 1—GEM5000 gas analyzer

The GEM5000 gas analyzer is designed to monitor landfill gas extraction systems.

Key Benefits:

- Designed specifically for use on landfills to monitor landfill gas (LFG) extraction systems, flares, and migration control systems.
- No need to take more than one instrument to site
- Can be used for routine sub-surface migration monitoring of landfill site perimeter probe for measuring gas composition, pressure and flow in gas extraction systems
- The user is able to setup comments and questions to record information at site and each sample point.
- Ensures consistent collection of data for better analysis
- Streamlined user experience reduces operational times

Features:

- Measures CH_4, CO_2 and O_2 percent by volume, static pressure and differential pressure
- Calculates balance gas, flow (SCFM) and energy
- CO and H_2S (on Plus models)
- High Accuracy and Fast Response Time
- Lighter and More Compact
- Certified intrinsically safe for landfill use
- Annual recommended factory service
- Calibrated ISO/IEC 17025
- 3 year warranty with optional service plan

Applications:

- Landfills
- Gas Extraction Wells
- Flare Monitoring

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- Subsurface Migration Probes.

2.2 GEM5000 standard product package (shown with optional temperature probe)

Figure 2—GEM5000 instrument package

Reference:

A	High Visibility Hard carry case
B	Gas Analyzer Instrument
C	USB download cable
D	Calibration Certificate
E	LSGAM & Instrument Manual on USB or CD-Rom
F	Hosekit with watertrap
G	Battery Charger
H	Temperature Probe (optional)

3 GEM5000 products and accessories

3.1 *LANDTEC System Gas Analyzer Manager – LSGAM*

LANDTEC System Gas Analyzer Manager (LSGAM) enables the operator to maximize the operation of the gas analyzer. It enables direct communication with the unit, features a simple upload and download facility and is compatible with Microsoft™ operating systems (XP, Vista, Windows 7).

Features:

- Organization and transfer of Device IDs and readings to and from the gas analyzer.
- Configuration of the gas analyzer.
- Structured organization of transferred data.
- Automatic detection of instrument type and available options.
- Secure data mode to prevent tampering.
- Enables flow measurements for GEM5000 gas analyzers.

3.2 *Optional products*

The GEM5000 gas analyzer has a number of optional products for purchase which enhance the usability and enable further analysis of data and reading information.

✍ Note: For more information on the features listed in this section please contact Sales at LANDTEC at +1 (909) 783-3636 or email at sales@landtecna.com

3.2.1 Pitot tube (optional)

The GEM5000 gas analyzer enables the use of a pitot tube to aid with flow measurement where an in situ flow device is not present. The pitot tube is used for gas extraction systems and the pressure readings are taken in inches of water (mbar if in metric). Gas flow is calculated in the analyzer in SCFM (m^3/hr if in metric).

3.2.2 Temperature probe (optional)

The GEM5000 gas analyzer has the facility to automatically display and record the sample temperature via an optional temperature probe.

When a temperature probe is fitted the temperature reading will be displayed on the 'Main Gas Read Screen' and recorded with all other data.

✍ Note: Temperature probes with an Ex label are part of the GEM5000 Ex certification SIRA 11ATEX2197X and IECEx SIR11.0089X, and therefore certified for use under the same conditions as the analyzer.

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3.2.3 H_2S filter (optional)

The GEM5000 gas analyzer has the capability to use an H_2S filter and is required as standard if the compensated CO cell is fitted and configured at the time the instrument is manufactured. H_2S gas can have a cross-gas effect on the CO reading. By using a filter, the H_2S is removed from the gas sample, therefore providing a more accurate CO reading.

The filter only needs to be used when you are trying to get rid of any possible cross gas effects H_2S might have on other gases. Do not use the filter on other monitoring points. For additional information related to H_2S filters please refer to http://www.landtecna.com.

3.2.4 GPS (optional)

An optional GPS feature is available for the GEM5000 gas analyzer. It enables the gas technician to automatically locate sample locations using GPS satellite signal from predefined sample location IDs uploaded from LANDTEC System Gas Analyzer Manager or set on the analyzer when out in the field prior to taking a reading. The GPS reading data is stored with each reading providing an audit trail, as it confirms where the reading was taken.

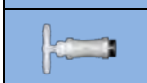
3.2.5 Bluetooth dongle (optional)

An optional Bluetooth feature enables the operator to set and utilize Bluetooth technology. This may be useful when downloading gas readings from the analyzer to the PC instead of connecting the analyzer to a PC via a USB cable. Bluetooth comes standard on many portable computers. For desktop / stationary computers, Bluetooth is activated by plugging the dongle into a pc USB port. The analyzer's Bluetooth discovery is activated by switching on the Bluetooth discovery option feature in the settings menu on the analyzer.

3.3 *Instrument accessory products*

Optional accessory and replacement parts must ONLY be purchased for the GEM5000 gas analyzer directly from LANDTEC or an authorized distributor. Please contact Sales@landtecna.com for further details on pricing and how to order.

Ref	Description	Part Number
	High Visibility Hard carry case	5K-HCase
	Soft carry case	5K-SCase
	Battery charger	5K-BC

Ref	Description	Part Number
	Temperature probe (ATEX certified)	5K-TP
	Hose Kit—In-line water trap filter, tubing, chrome quick connects	5K-HK
	Water trap with barbed filters (pack of 1) Water trap with barbed filters (pack of 5)	3-00000-5083 (QTY 1) 1-00000-5083 (QTY 5)
	Chrome Quick Connects / Gas ports connectors (pack of 5)	1-22502-0000
	Flexible Clear sampling tube length PVC tubing (1/4″id)	3-00000-0006
	Flexible Blue Tint sampling tube (1/4″id)	3-00000-0005
	Flexible Yellow Tint Exhaust tubing (1/4″id)	3-00000-7013
	3PSI pressure Relief Valve	2-00000-1226
	LANDTEC System Gas Analyzer Manager (LSGAM)	LSGAM
	USB Cable	5K-USB
	Bluetooth Dongle	BTDongle
	H_2S filter—Used to remove hydrogen sulfide from your sample gas stream.	1-00000-5155 (QTY 5) 3-00000-5155 (QTY 1)
	Filter Adsorber / Charcoal Filter used to remove non-methane hydrocarbons from the gas sample	1-00000-5084 (Qty 4) 3-00000-5084 (QTY 1)
	Printed Manual	5K-MNL-GEM5000
	Check gas regulator and tubing for calibration gas. Calibration gas cylinder. Please contact sales@landtecna.com for gas cylinder concentrations	CGKit
	Calibration gas* "Mix-N-Match" from any combination of the following gas(es):	CG-Case (Qty 12 Cyl.) CG-4PKG (Qty 4 Cyl.)

Part#	CH_4	CO_2	O_2	N_2
CG-50-35-00	50	35	0	15
CG-15-15-00	15	15	0	70
CG-00-00-04	0	0	4	96
CG-N2	0	0	0	100

*Calibration gas and certain accessories only sold regionally. Consult with your nearest

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LANDTEC office or distributor for availability.

4 GEM5000 instrument features

4.1 *Physical characteristics of the instrument panel*

Front view:

Reference:	
A	Main Gas Read Screen
B	Soft-keys
C	Backlight Key
D	Menu Key
E	Key 2 – Page Up
F	Key 4 – Scroll Left
G	Pump Key
H	LED Light
I	On/Off Key
J	Assistance Key
K	Key 6 – Scroll Right
L	Key 8 – Page Down
M	Enter Key
N	General Keys

Back view:

Reference:	
O	Serial Number
P	Part Number
Q	Certification Number
R	Recalibration Due

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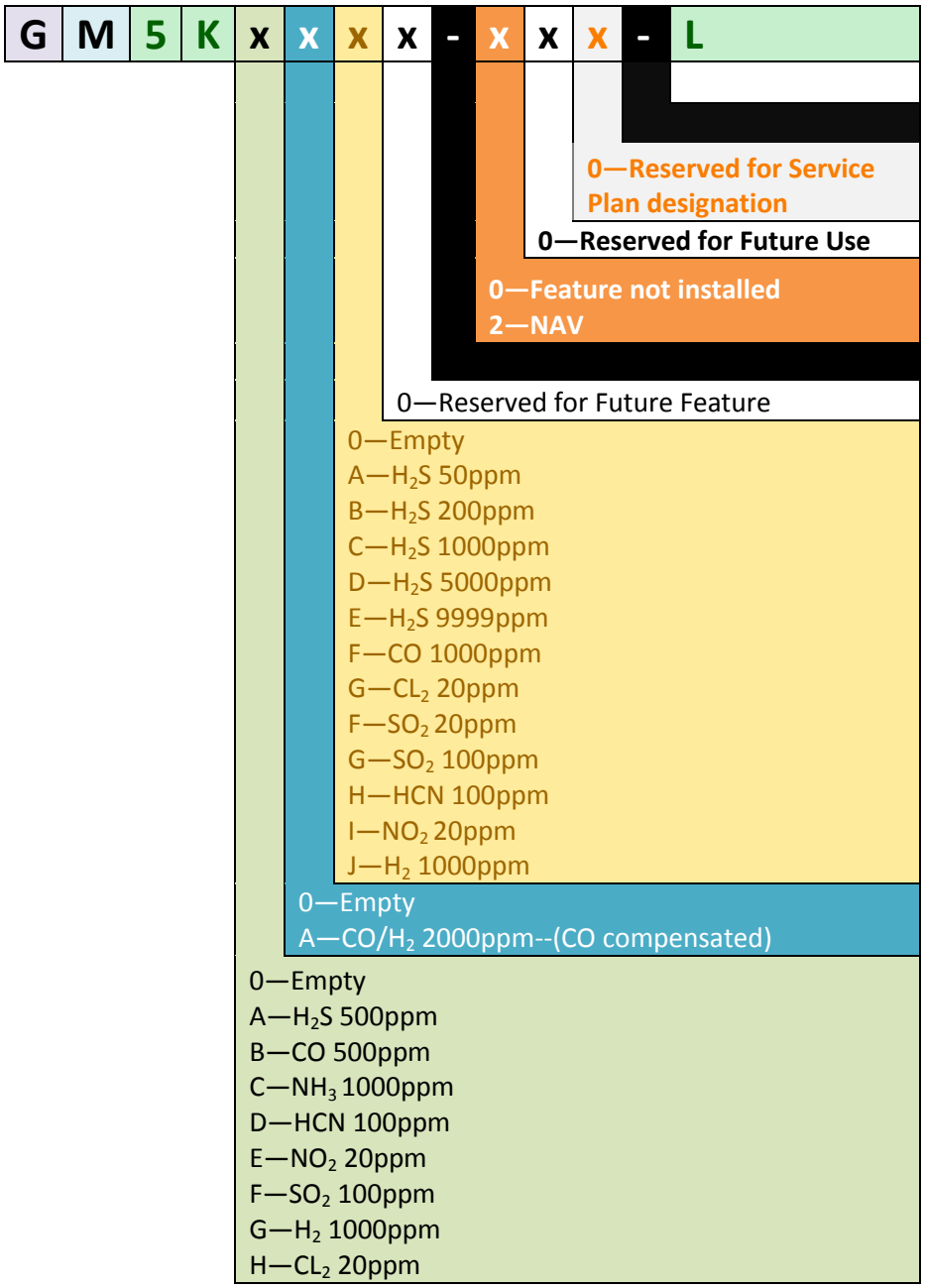
4.2 *GEM5000 Part Number Legend*

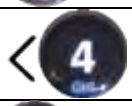
The GEM5000 part number consists of a variety of options that can be fitted to meet specific customer needs. All GEM5000 series instruments begin with GM5K followed by a series of options. An "x" represents an option. A "0" represents option not selected or reserved for future use.



Typical Configurations:

GM5K0000-000-L	GEM-5000 Base Model
GM5K0000-200-L	GEM-5000 with GPS option
GM5KAA00-000-L	GEM5000 with CO & H_2S (500PPM)

4.3 *Analyzer features and keys*

A	Main Reading Screen		Start and end screen when using the instrument.
B	Soft-keys		The function of the three 'soft-keys' on the front of the instrument panel is determined by menu options taken. Functions vary from screen to screen.
C	Backlight Key		Enables the operator to backlight the analyzer display panel.
D	Menu Key		Press the 'Menu' key to view and maintain User, Device and Operation settings.
E	Page Up Key		Also 'Key 2'. Press scroll up to view further information on the instrument screen.
F	Scroll Left Key		Also 'Key 4'. Enables the operator to scroll left to display more information.
G	Pump Key		Press the 'Pump' key to start or stop the pump.
H	LED Light		LED power light is visible on the front of the analyzer when the instrument is powered on.
I	On/Off Key		Press the 'On/Off' key briefly to switch the instrument on and off.
J	Assistance Key		Press the 'Assistance' key to view help text relevant to the analyzer screen you are currently displaying.
K	Scroll Right Key		Also 'Key 6'. Press scroll right to view further information on the instrument screen.
L	Page Down Key		Also 'Key 8'. Enables the operator to scroll down to display more information.
M	Enter Key		The 'Enter' key accepts/confirms choices made by the operator. Also required to confirm numeric data entry.
N	General Keys		Keys 0, 1, 2, 3, 4, 5, 6, 7, 8, 9
O	Model Number		Instrument model type identification.
P	Serial Number		Unique identification for the instrument. Verification of the serial number will be required if Technical Support assistance is needed.
Q	Part Number		Manufacturer part number.

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R	Certification Number		Displays instrument certification information.
S	Recalibration Due		The date displayed is the date the instrument is due to be calibrated.

4.4 *Instrument connection points*

Top view:

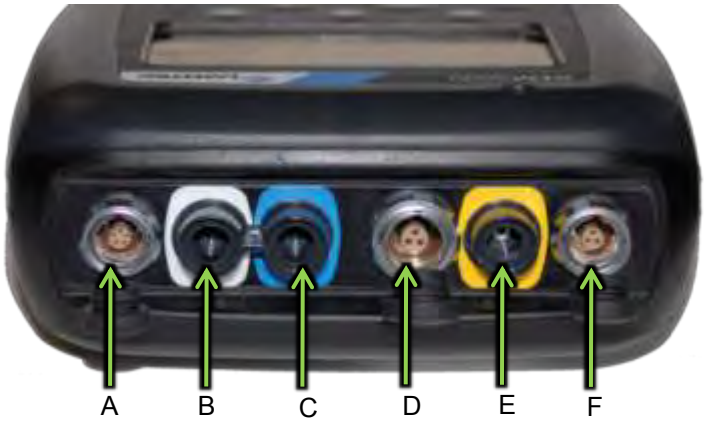

Figure 3—Connection Points

Ref:	Connection Point:	Function:
A	Connector A & Dust Cap	Attach the USB cable for PC-to-analyzer connectivity.
B	Inlet Port & Static Pressure Port (White port)	Attach the sample tube to take a gas sample. Also used to measure the static pressure.
C	Differential Pressure Port (Blue port)	Attach the sample tube to measure differential pressure.
D	Connector B & Dust Cap	Attach the temperature probe and also used to attach the mains charger to the analyzer for charging.
E	Gas Outlet Port (Yellow port)	The gas outlet port is the point at which the sample gas is expelled. Tubing may also be attached to the port.
F	Connector C & Dust Cap	Reserved for future accessories that will be developed.
	Dust Caps	Dust caps are used to protect the connector points of the instrument.

5 The LANDTEC System Gas Analyzer Manager (LSGAM) Software

LSGAM software is used to communicate with the GEM5000 and GEM2xxx family of instruments. This allows a simple upgrade of information from older GEM2xxx instruments to the GEM5000 instruments.

Configuration Options
The GEM5000 instruments and LANDTEC System Gas Analyzer Manager (LSGAM) software can be utilized in a number of ways:

- Configured for operation with the LANDTEC System online service
- Used offline as a local application storing information on the desktop/laptop computer
- Use of the GEM5000 out of the box without software; (this does not allow the user to generate flow rate values, select comments or select IDs with the instrument. This also prevents downloading of readings to the computer.)

5.1 *LANDTEC System Online Users*

The procedures included in this section are intended for those who connect to the LANDTEC System online service. The LANDTEC System is an online collaboration tool to Collect, Validate, Analyze, and Communicate information based on field data obtained using LANDTEC instrumentation. LANDTEC offers a variety of On-Line service subscription levels for LANDTEC System software.

If you are a currently registered user on the LANDTEC System, please log in at http://www.landtecsystem.com/. If you are not currently using the LANDTEC System, you may register by contacting LANDTEC in the US: (800) 821-0496 or International: +1 (909) 783-3636.

Online reference for using LANDTEC System Gas Analyzer Manager (LSGAM) with the LANDTEC System can be found under the About → Help & Support menu within the LANDTEC System.

If you do not have login information please contact LANDTEC System Technical Support at +1 (909) 783-3636 extension 6131. Alternatively, you may contact your local LANDTEC office for information on connecting to the LANDTEC System online service.

5.2 *Offline Users*

The procedures included in the section describe use of the LANDTEC System Gas Analyzer Manager (LSGAM) Software while **NOT** connected to the LANDTEC System online service.

5.3 *Installation with the CD or memory stick*

System Requirements

- Windows XP, Vista, 7
- Pentium 750MHz or faster
- 128MB RAM
- 200MB Hard Drive Space Available
- CD-ROM Drive
- Available USB port or bluetooth connection

NOTE: The computer may need administrative privileges to install the program. Program may run on other versions of Windows but LANDTEC has not tested the program on older versions of windows or with lesser processor and memory requirements.

As part of LANDTEC's continual improvement process, LANDTEC has consolidated its product

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information and instrument communications software into one menu structure. On your memory stick or CD you will find technical information, instrument communication software, USB cable drivers, videos and instrument manuals.

To install the USB Cable Drivers and LSGAM (instrument communication software) from this media format, you will need to place your CD or memory stick into your computer. If you have a CD it should automatically start. If you have a memory stick, you may have to browse to it in your computer and then click on the ***ClickHereToStart.htm*** icon. If you don't have a CD or memory stick simply call LANDTEC's technical support for internet links required to install the software.

Once the media opens, you should see the GEM5000 and GEM2000 instruments on the homepage.

Click on the GEM5000 instrument to open the LSGAM Software Setup.

From the setup screen you will see four buttons directly related to the GEM5000:

- Step1 Legacy Comms Driver
- Step2 Install LSGAM Software
- 5000 instrument Manual
- 5000 Instructional Videos

✍ *Note: The communications drivers differ between the GEM2000 and GEM5000 instruments. Drivers must be installed separately for each instrument series. The LSGAM software for the GEM5000 is backwards compatible for the GEM2000 instruments.*

The software will automatically update if an internet connection is available when the software starts. This software has been tested with Windows XP and Windows 7.

Should you have any difficulties, please don't hesitate to contact us. Our Software support group can be reached at (909) 783-3636 x6131 or support@landtecna.com

The instrument communicates to the computer by means of a USB cable or by bluetooth. The USB cable requires drivers to be installed prior to use on the computer. From the CD (or USB memory stick) choose the first option "Step 1— Legacy Comms Driver" A Bluetooth connection requires the instrument to be

paired to the computer. Refer to the section "Configuring Communications" for more details.

The Java programming is an import part of this software and will be loaded with the installation. If you have internet access, it is recommended to update your java to the latest version by going to http://www.java.com/en then clicking the button for the Free Java download. Once at the Java downloads you'll see links to download the latest version of Java for your computer.

The java icon, shown below, will be in the task tray at the bottom of your computer screen where your time is shown. There will also be a GAM log icon, shown below, that will be created on your desk top during installation.

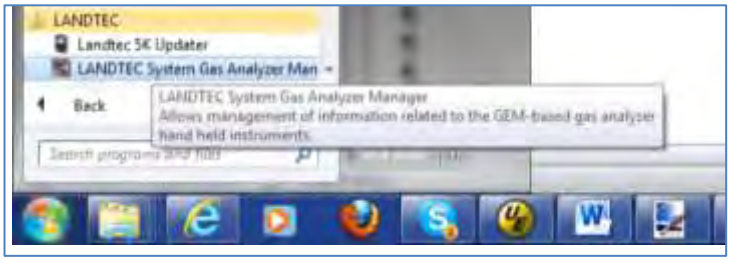
5.4 *Startup*

Once the USB cable drivers are installed and you've checked for the latest Java Runtime from the www.java.com/en website, click on "Step 2 — Install LSGAM". LSGAM will install placing an Icon on your desktop and a new Start Menu Group named LANDTEC.

Starting LSGAM can be easily done by doing one of the following:

Double-Click on the Desktop icon. OR - go to;

Start → All Programs → LANDTEC → LANDTEC System Gas Analyzer Manager



The software will start.

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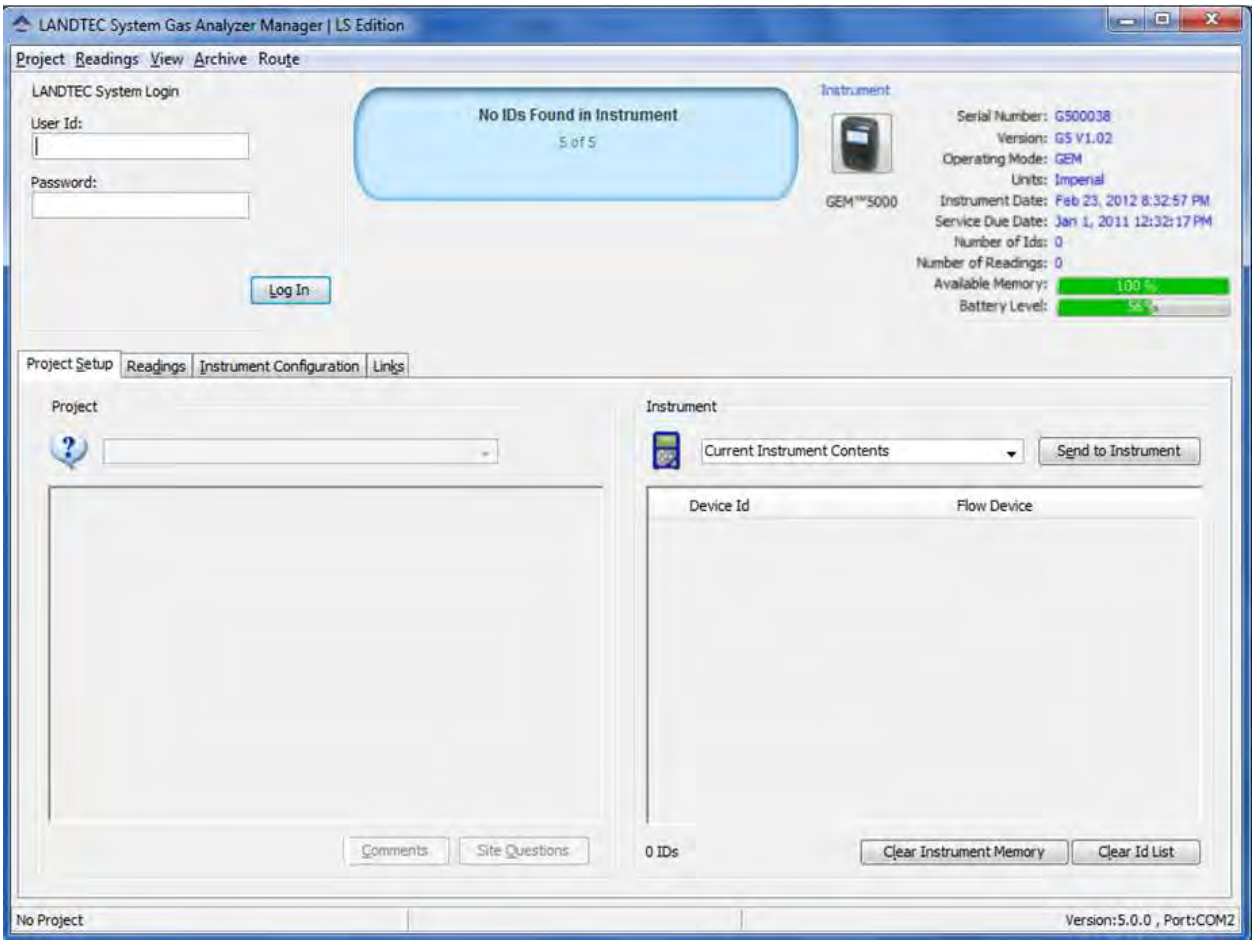
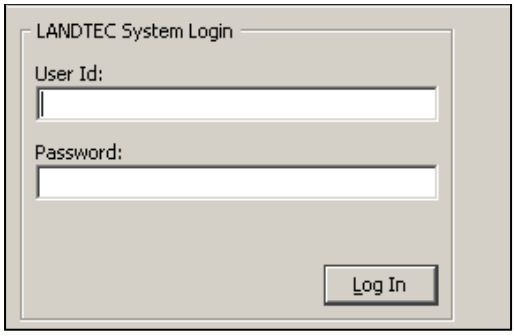


5.5 *Navigation*

The LANDTEC System Gas Analyzer Manager User Interface allows for easy access and navigation to various utilities to use the LANDTEC portable instrument on a day to day basis. The following is a general description of the user interface.

LANDTEC System Login

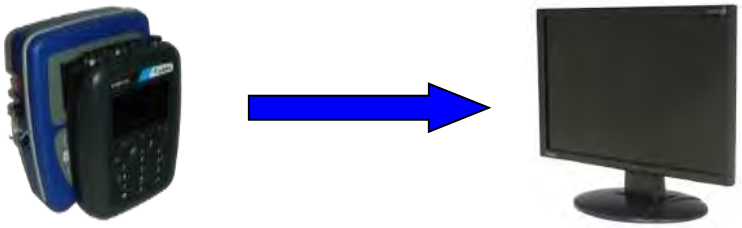
When LSGAM is used with the LANDTEC System online service, the username and password will be entered in the screen below, if you are using LSGAM as a desktop application the User Id and Password fields do not need to be filled in.



The Progress section indicates the status of the current process. For example, when starting up LSGAM, this will show you the activity of the software.

The Instrument section displays whether or not an instrument is connected. This also downloads the IDs, readings, and comments. If an instrument is found the following details are shown about the instrument:

5.6 *Connecting to the Instrument*



- Connect the GEM5000 to your computer with either the USB cable or a Bluetooth connection. Refer to Appendix—Configuring Communication Connections for more information setting up and testing USB Serial communications and Bluetooth Serial communications.
- The Instrument must be powered ON and in the Gas Reading screen
- Launch the LSGAM software by clicking on the icon on your desktop

This is the first screen you will see when starting the program.

Once the software is installed on your computer with an internet connection this instrument communications program has Auto application updates. This enables you to always have the most current version of the instrument communications LSGAM.

If an update to LSGAM is available, you will see this notice when connected to the internet.

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Click on OK this will return you to the desktop and you will then need to click on the LSGAM shortcut again.

The GEM5000 must be connected to computer and turned ON. It must also be in the Gas Reading screen. The LSGAM software will automatically download any information in the instrument including readings, comments and IDs.

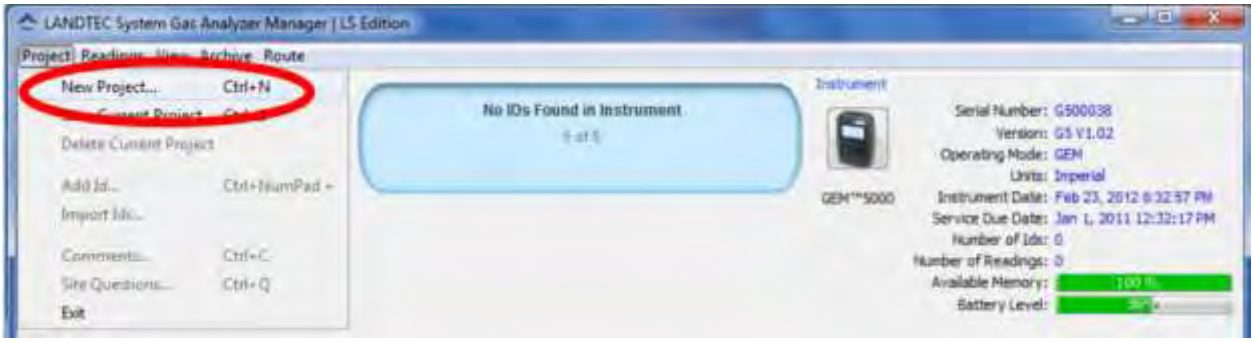
Note: Connection of instrument to computer should not be performed in a hazardous area.

A new instrument containing no information will display only the instrument information: Serial Number, Version, Operating Mode, Instrument Date, Service Due Date, Number of IDs, Number of Readings, Available Memory, and Battery Level.

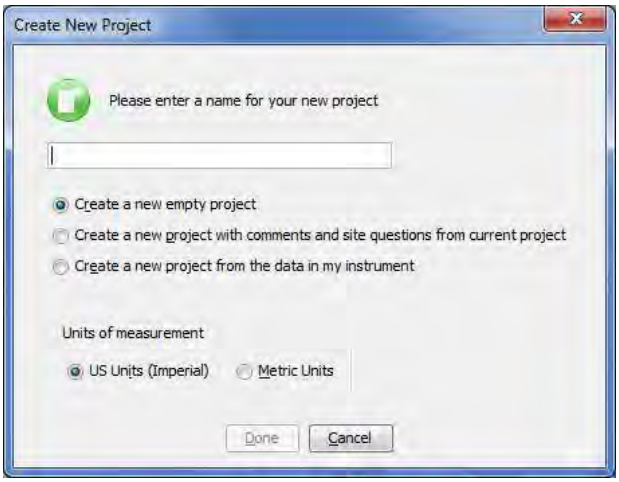
5.7 *Create a Project / Select a Project*

Projects are a collection of Device IDs and their associated reading history. A project can be created using LSGAM to contain a group of sequenced IDs and chronological history of instrument readings.

To create a Project, click on the Project menu and select New Project.



Upon selecting **New Project…** you will be prompted to enter a Project Name and select from one of three options.



Create a New Empty Project
This option creates a blank project where you configure all IDs and Comments.

Create a New Project with comments and site questions from a Current Project
Selecting this option allows the user to create a new project that will have the same Comments and Site Questions as an existing project.

Create a New Project from the data in a GEM instrument
This option will create a New Project and automatically associate the IDs, Comments, and Site Questions that exist in the connected portable instrument.

5.7.1 ID Setup

An ID represents a physical sampling point in the field. An ID can be allocated to field components such as extraction wellheads, gas transmission lines, or passive monitoring probes. LSGAM allows users to configure an ID for each sampling point in order to obtain accurate readings with LANDTEC portable instrumentation

IDs are created, modified, and removed from the Project Setup tab in the software.

5.7.2 Creating Comments

Comments should be setup prior to creating new IDs. The user can define Comments that can be associated with a reading in the portable instrument.

If you selected Create a New Project, when creating your project, you will need to click on the Create Comments button. Comments can be entered in this setup screen or loaded from a file and will be displayed in the user interface.

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Typical Comments Might Include
Valve Fully Open
Valve Partially Open
Valve Closed
Air Leak in Wellhead
Water Blockage in Header
Surging at well
Sample Port Needs Replacement
More Vacuum Needed
5 Day Recheck

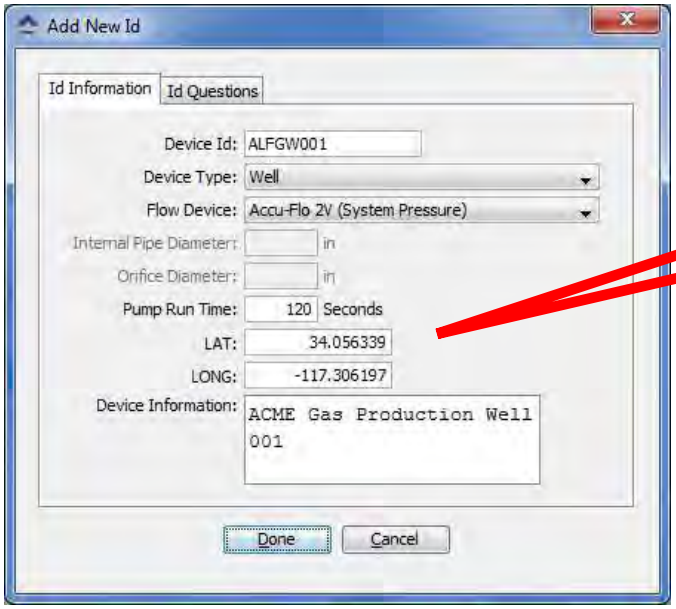
5.7.3 Creating IDs

There are several ways to input IDs to the Project. The following describes each process:

Creating new IDs with LSGAM

To create a new ID using the LANDTEC System Gas Analyzer Manager, Right Click on the left ID pane beneath your active project and select the Add New ID option.

The Add New ID form will be displayed. From the ID Information tab of this form, entry of the following is available:



*Note: LAT & LONG will only be available on **GEMs with the NAV option***

ID INFORMATION

Device ID: Must be eight (8) alphanumeric character spaces. (For example, ALFGW001)

Device Type:

- Well: An active gas extraction well connected to a piping network which may require a flow rate reading.
- Sample Port: A sample point along a gas transmission line that may require a flow rate.
- Probe: A passive gas migration monitoring probe that does not require a flow rate.

The GEM5000 calculates flow rate values specific to each device type (listed above). The available flow devices programmed in GEM mode are listed below.

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Flow Devices:

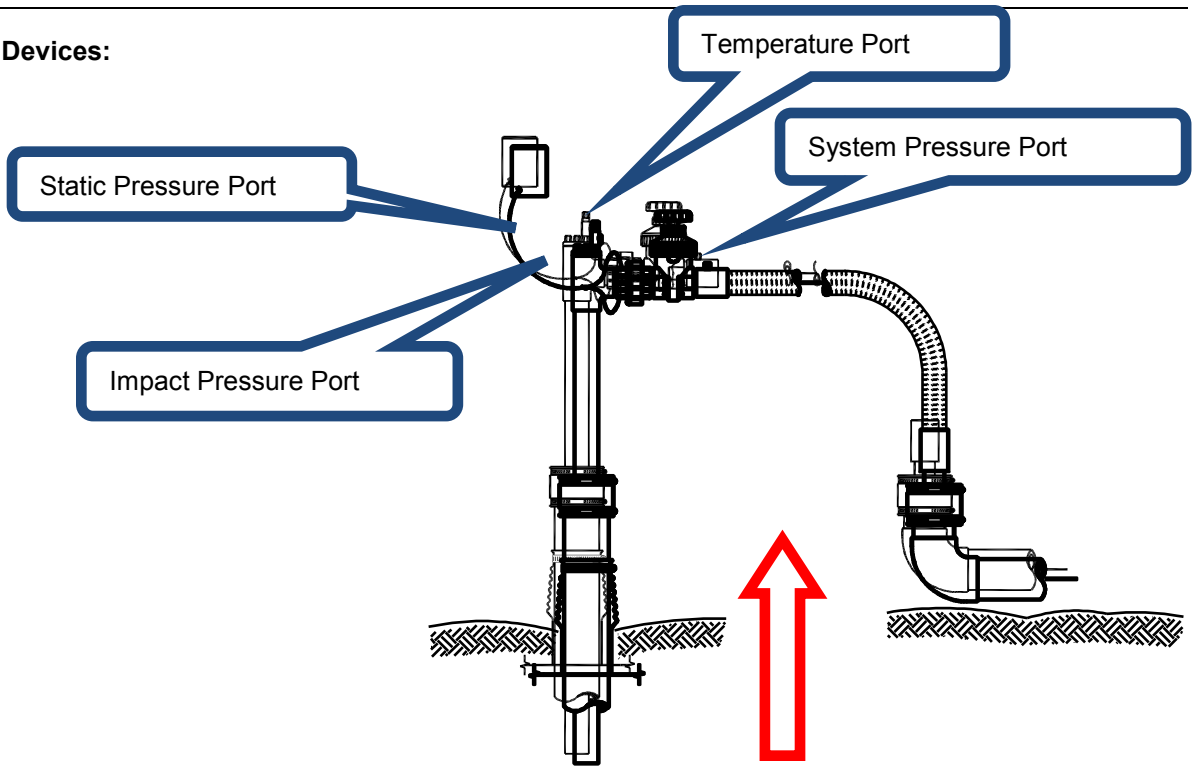

Figure 4 - ACCU-FLO Vertical Wellhead

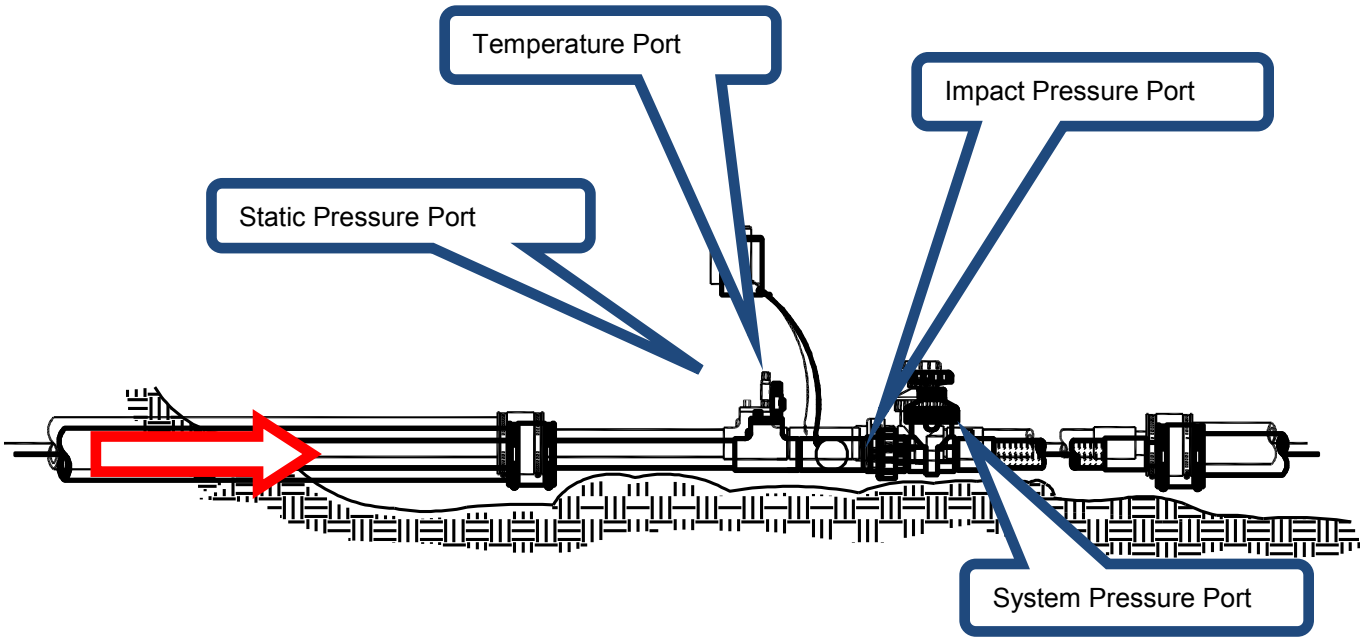

Figure 5 - ACCU-FLO Horizontal Wellhead

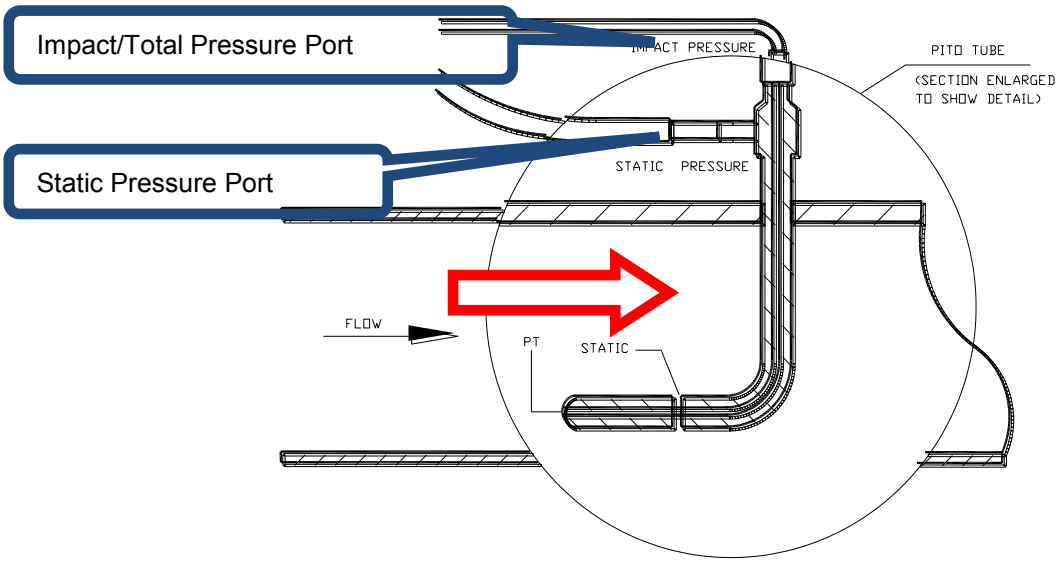

Figure 6 - Pitot Tube

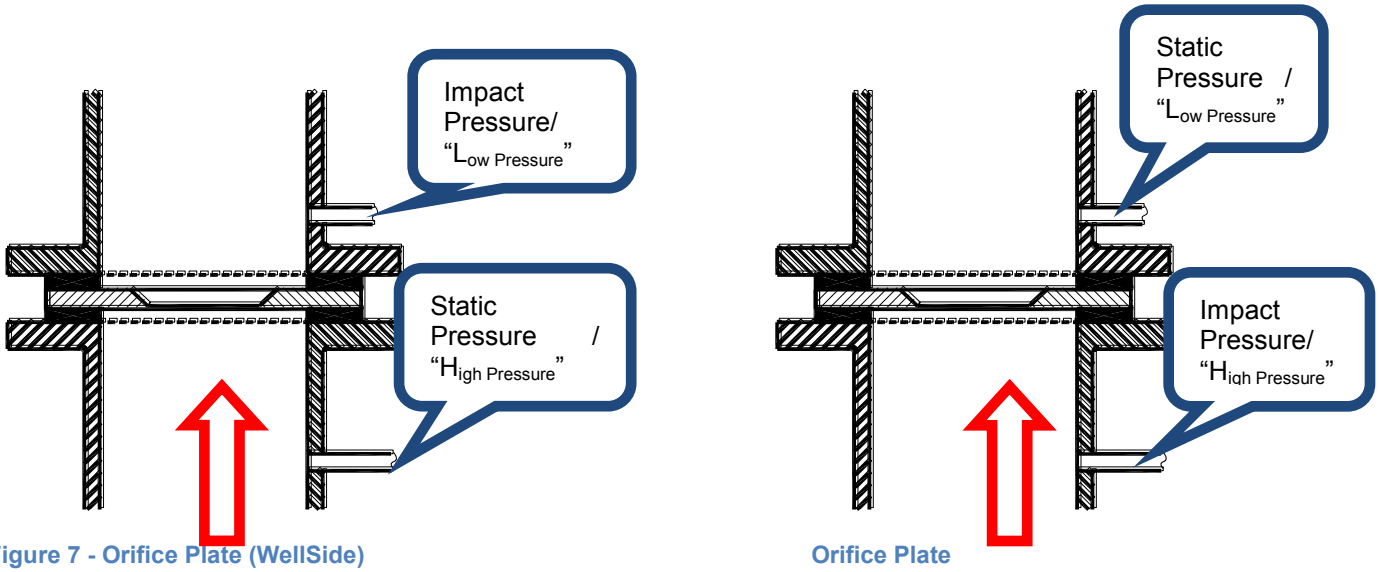

Figure 7 - Orifice Plate (WellSide) **Orifice Plate**

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Flow Device Name Programmed in GEM	Orientation	Size (Inches)	Flow Range (SCFM)	System Pressure
No Flow (GA Mode) *				
ACCU-FLO 1.5V	Vertical	1.5	1-50+	
ACCU-FLO 1.5H	Horizontal	1.5	1-50+	
ACCU-FLO 2V	Vertical	2.0	5-125+	
ACCU-FLO 2H	Horizontal	2.0	5-125+	
ACCU-FLO 3V	Vertical	3.0	35-300+	
ACCU-FLO 3H	Horizontal	3.0	35-300+	
Orifice Plate				
Pitot Tube				
User Input				
Orifice Plate WellSide				
ACCU-FLO-1.5V (System Pressure)	Vertical	1.5	1-50+	✓
ACCU-FLO-1.5H (System Pressure)	Horizontal	1.5	1-50+	✓
ACCU-FLO-2V (System Pressure)	Vertical	2.0	5-125+	✓
ACCU-FLO-2H (System Pressure)	Horizontal	2.0	5-125+	✓
ACCU-FLO-3V (System Pressure)	Vertical	3.0	35-300+	✓
ACCU-FLO-3H (System Pressure)	Horizontal	3.0	35-300+	✓
Orifice Plate-System Side (System Pressure)				✓
Pitot Tube (System Pressure)				✓
User Input (System Pressure)				✓
Orifice Plate WellSide (System Pressure)				✓

- **Note: Use of the No Flow type of device on a Probe will allow the instrument to automatically switch to the GA workflow when the ID is selected. The user can always use special actions from the menu to switch workflows between GEM and GA.*

Pipe Diameter: The pipe inside diameter (ID) is required for Orifice Plate and Pitot Tube type flow devices.

Orifice Diameter: The field for orifice bore diameter is available for all Orifice Plate flow devices.
Note: For the instrument to calculate a flow the ratio of orifice size to pipe diameter must be between 0.25 and 0.75.

Pump Run Time: Indicates the duration the instrument's pump will run while sampling for the selected ID.

Device Information: Allows the user to enter general information for the device. This will display on the screen of the instrument if the user chooses the ③ View ID Details option from the ID selection screen on the instrument.

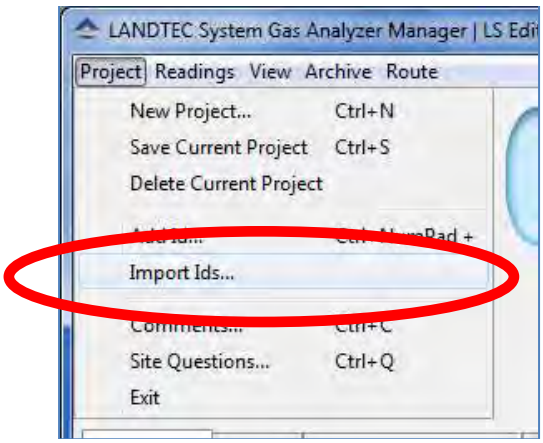
ID QUESTIONS

There are 5 Question Types that can be selected:

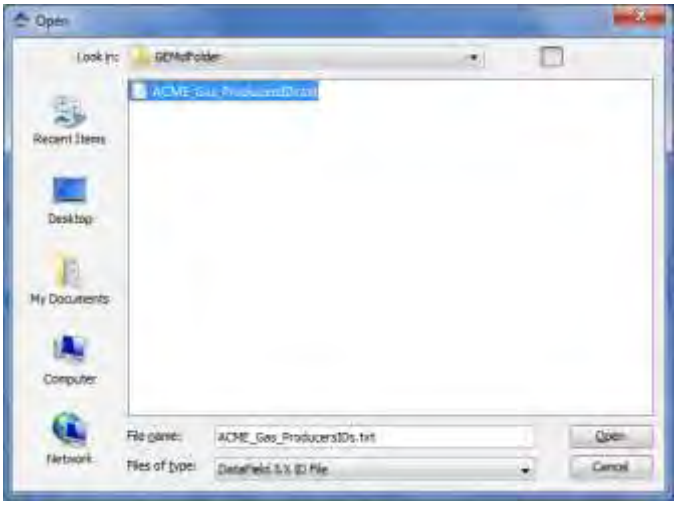
- **None -** No question will be prompted to the user
- **Alphanumeric -** An alphanumeric answer can be entered when taking a reading
- **Numeric** - A numeric only answer can be entered when taking a reading
- **Multiple Comment selection -** Up to 8 comments that may be appropriate for this device ID can be selected in the ID setup. Then one or all of the comments can be selected when taking a reading.
- **Single comment selection -** Up to 8 comments that may be appropriate for this device ID can be selected in the ID Setup but only one comment can be selected when taking a reading. Comments related to valve position are often used with a Single Comment Selection because the valve can only be in one position.

5.7.4 Importing DataField CS IDs

If you have existing ID files from DataField CS v3.4.x, these files can be imported by LSGAM. To begin this operation select the ***Import IDs…*** option from the ***Project*** menu.



Select an ID file generated by DataField CS v3.4.x.



5.7.5 Create a new project based upon IDs ALREADY IN THE INSTRUMENT:

To create a Project based on the information in the instrument, select ***Create a new project from the data in my instrument***.

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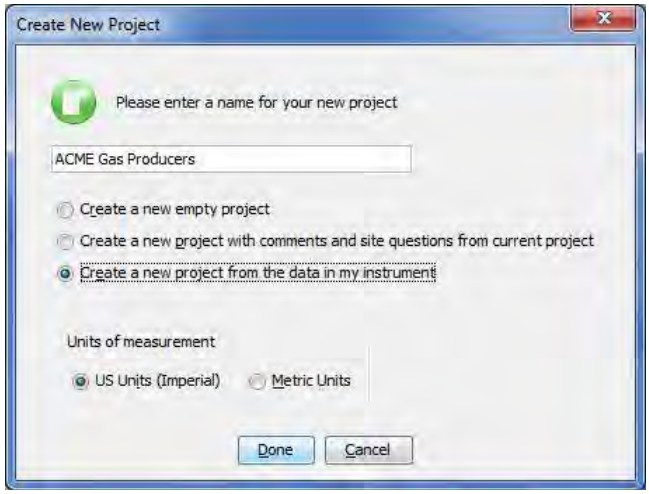
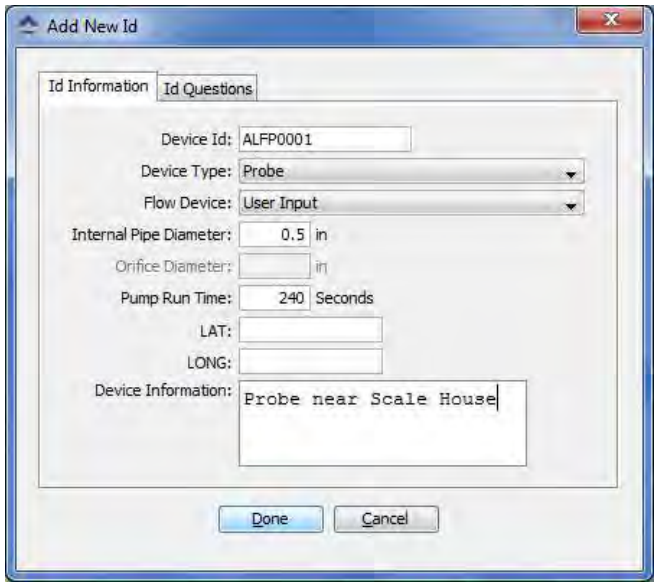


Note: When using the Creating a new project from the data in the instrument option, only IDs NOT associated with other projects will be created into the new project.

Creating a Device ID that does not measure flow Example- Probe or Sample Port

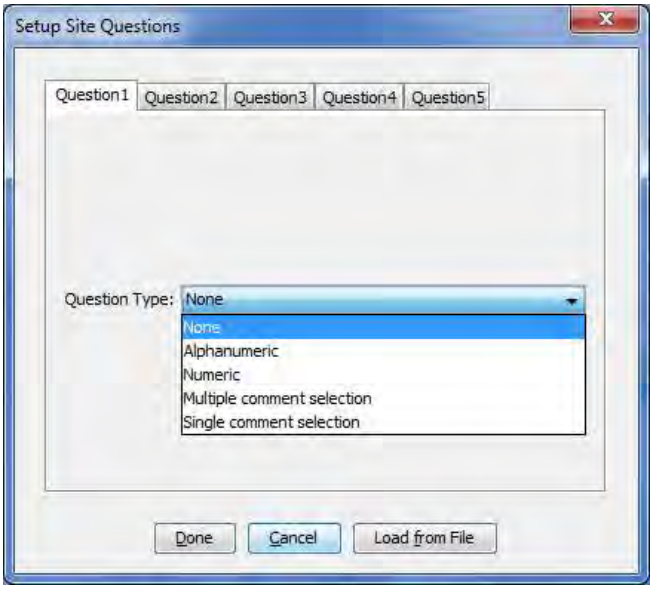
If there is no flow device you can choose the "No Flow (GA Mode)" option. Alternately you can also choose User Input. When choosing the User Input option you will need to enter the appropriate pipe inside diameter. A pump run-time must be specified in with either type of flow device.



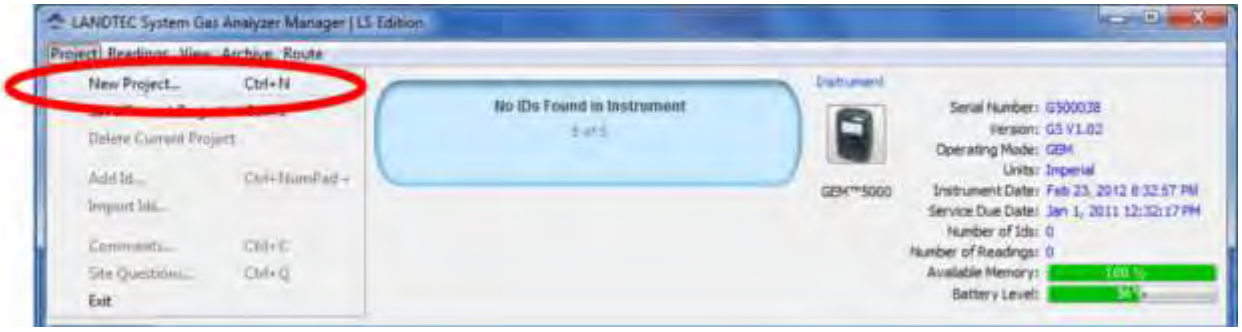
5.7.6 Creating your Site Questions

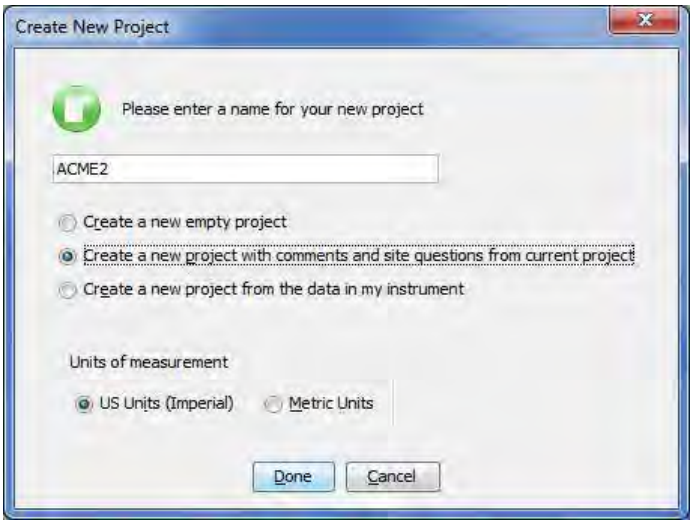
Site questions are setup in the same manner as ID questions however unlike ID questions, the answers for Site questions will apply to all subsequent readings until the site question is updated. A total of 5 site questions can be sent to your instrument. These must be updated each time you use the GEM. This is done by going to the ① Menu selection on the instrument and choosing [Update Site Data]

The options for questions are Alphanumeric – Numeric – Multiple or Single comment selection.



These Site Questions may be used again with another project by selecting the Create New Project and create new project with comments and **site questions** from current project.





The project will be created and the IDs, Comments, and Site Questions that exist in the instrument will be applied to the new project.

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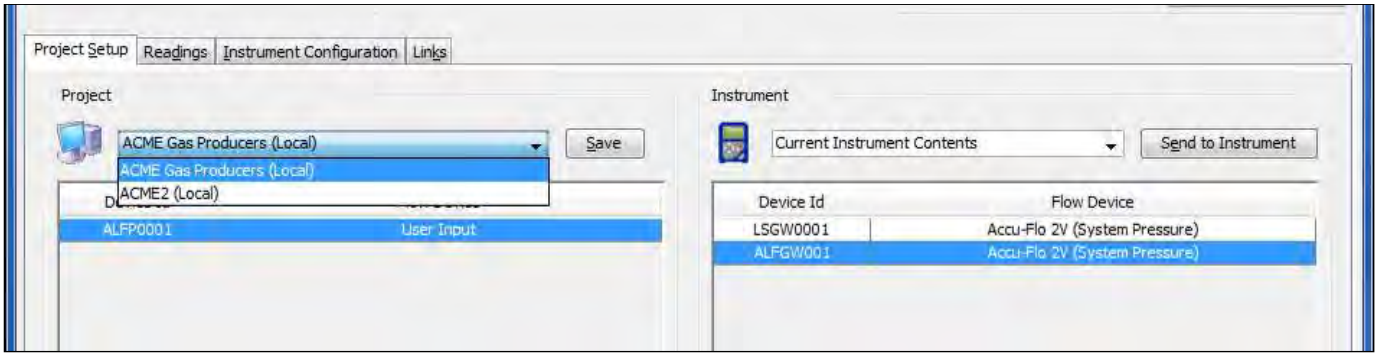
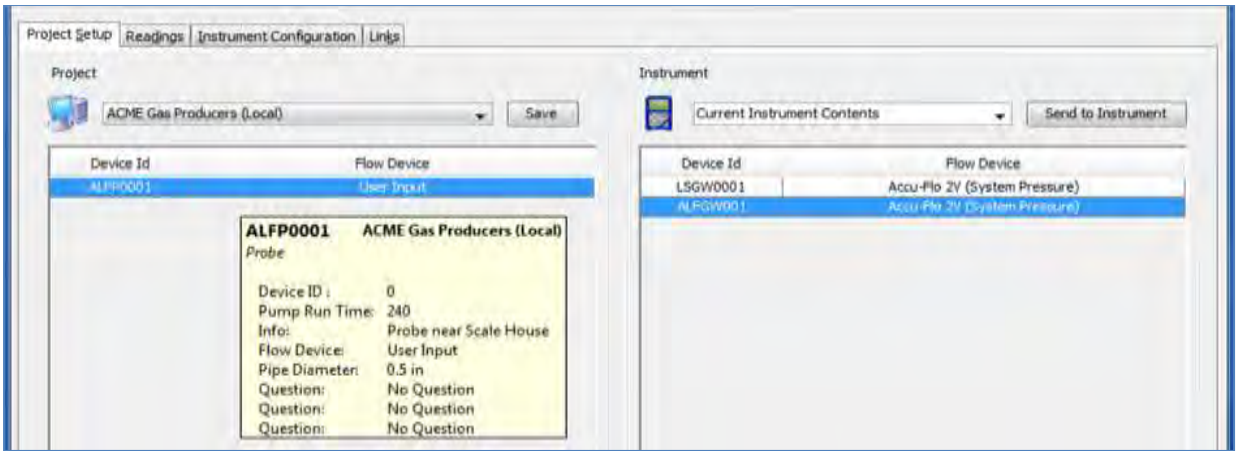
5.7.7 Working with Device IDs

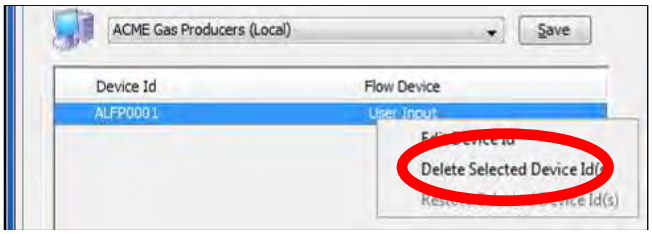
Once some IDs are added to your project you may need to occasionally edit them or reference them. First select the project which you want to work with from the project drop down list.



Placing the mouse cursor over a specific device ID will show detailed information about that ID.



To edit a Device ID, right click on the desired device and select ***Edit Device ID***.



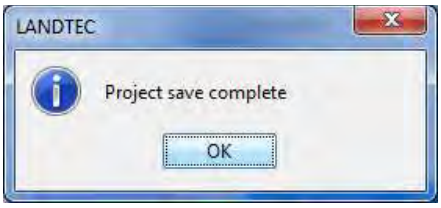
To delete an existing ID, right click on the desired device and select ***Delete Selected Device ID(s)***.

Upon clicking on Delete Selected Device Id(s) you will see the line ~~strikeout~~.

The computer Icon will now display a red * over the image . This indicates that the IDs are NOT saved. Deleted IDs are displayed with a line through the information on the screen. To restore a deleted ID, right click on the ID and click ***Restore Selected Device ID(s).***

Note: Deleted ID's can only be restored while the project state is unsaved. Once saved, the ID changes are saved and restoration cannot be completed.

Once all work with the device ID's is complete, click on the Save button.



After clicking on OK, the device is removed and the computer icon returns to the unaltered state .

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5.7.8 Sending IDs to the instrument

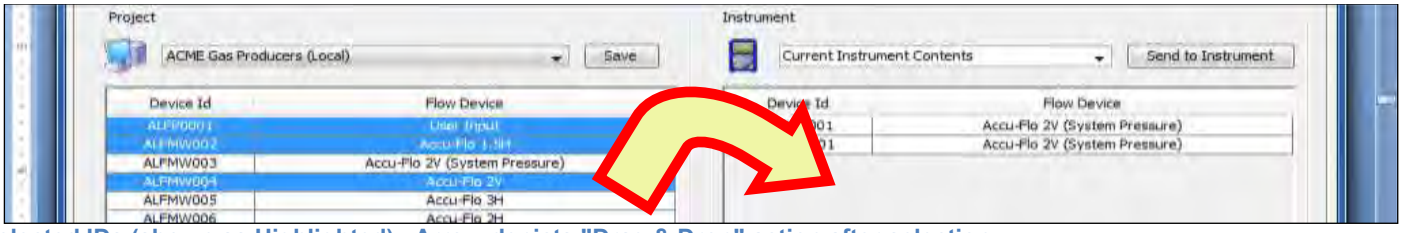
Once IDs have been created in the project, they must be uploaded to the instrument. To perform this operation, select the desired IDs from the left hand table under the Project name (computer side), left click and hold while dragging the IDs to the right hand table and release the mouse button. This is action is know as a "Drag & Drop".

Three basic methods of selecting IDs exist.

- Select Specific ID(s)
- Select a Range of IDs
- Select All IDs

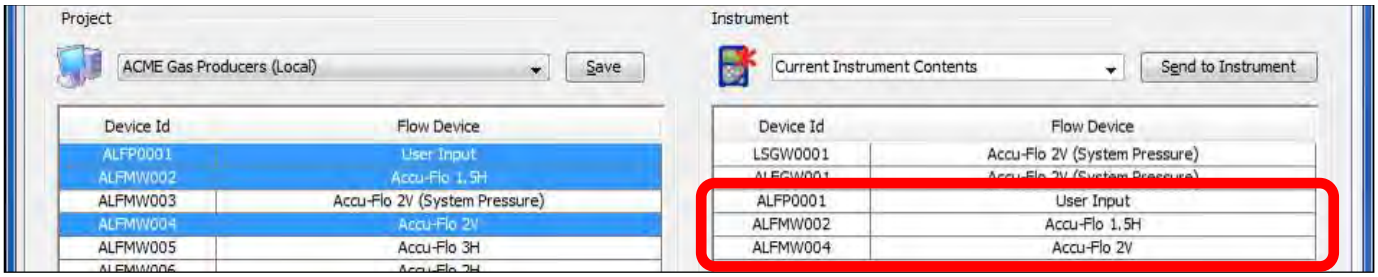
Specific IDs

To Select Specific List of IDs, place the mouse arrow at the edge of the first cell and hold down the left Ctrl key. Now click the next ID cell that you wish to select. Repeat this as many times as necessary.

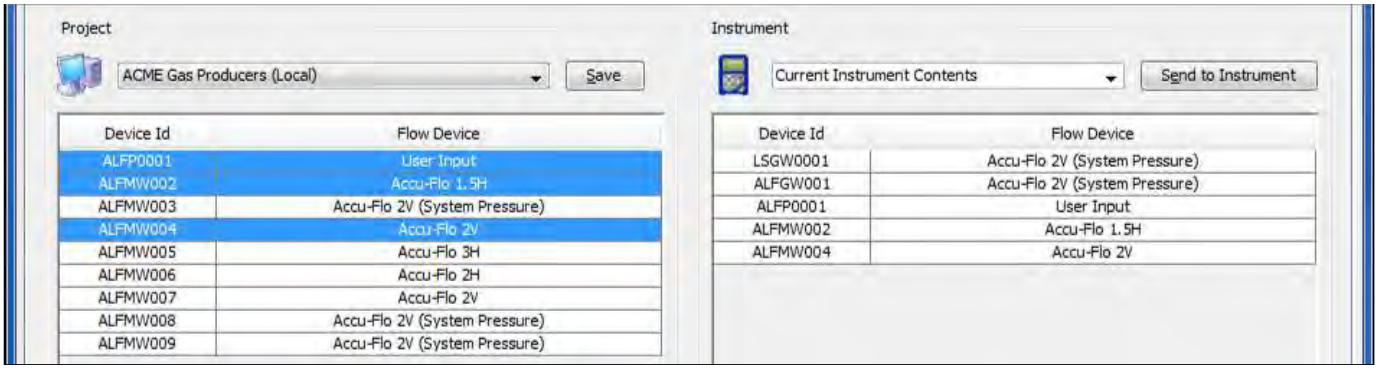


Selected IDs (shown as Highlighted). Arrow depicts "Drag & Drop" action after selection.

Now "Drag & Drop" the IDs from the left (computer window) to the right (instrument window). During the "Drag &Drop" process, the arrow will change to .



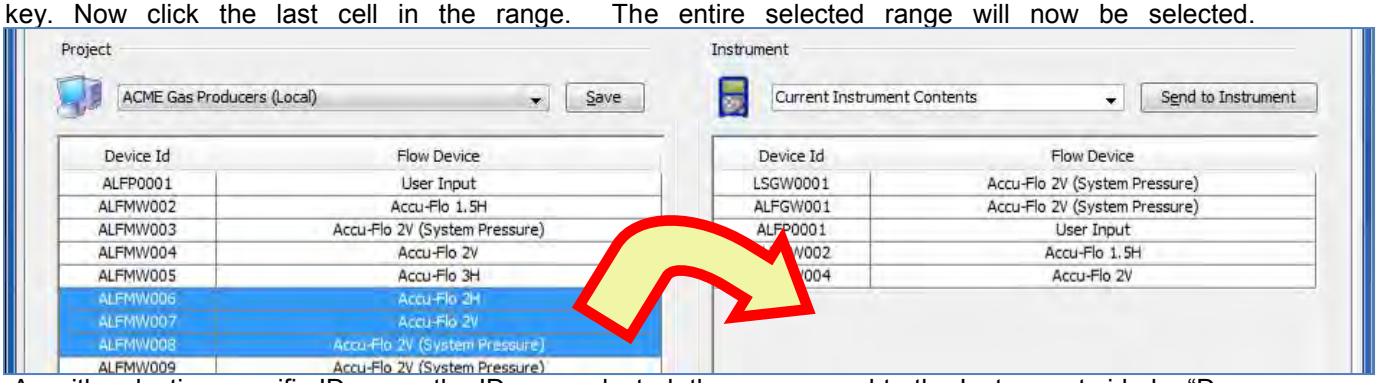
The selected IDs ALFP001, ALFMW002, and ALFMW004 now appear on the Right (Instrument) side. At this point the IDs are on the Instrument side but have NOT been sent to the instrument. The instrument with the red * indicates this unsent ID state. Click on the Send to Instrument button to send these IDs to the instrument.



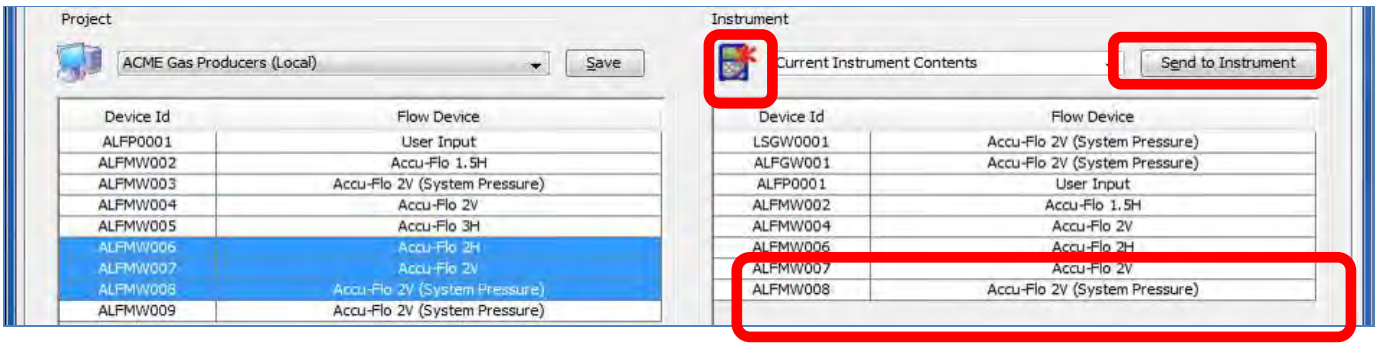
After the IDs are sent to the instrument, the instrument will appear without the red *

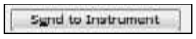
Range of IDs

To Select A Range of IDs, place the mouse arrow at the edge of the first cell and hold down the left shift key. Now click the last cell in the range. The entire selected range will now be selected.



As with selecting specific IDs once the IDs are selected, they are moved to the Instrument side by "Drag & Drop". The Instrument icon will appear with a red * and the ID's will need to be sent to the instrument.



Click on the Send to Instrument button  to send these IDs to the instrument.

Selecting All IDs

All IDs can be selected by selecting one ID in the Project window and then pressing Ctrl-A.

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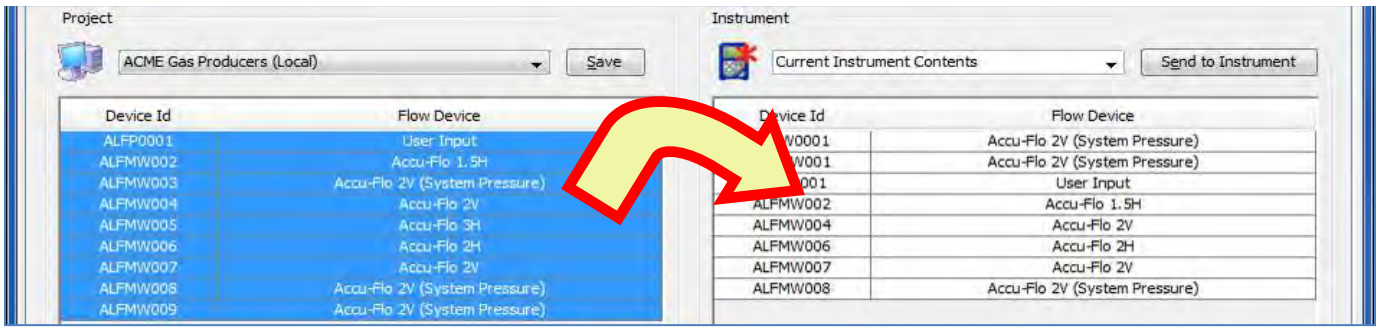
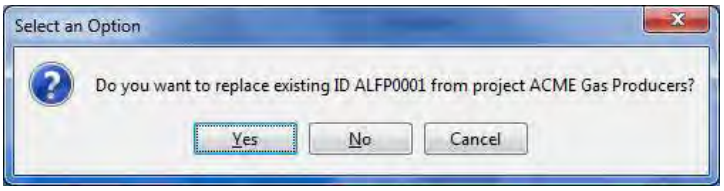
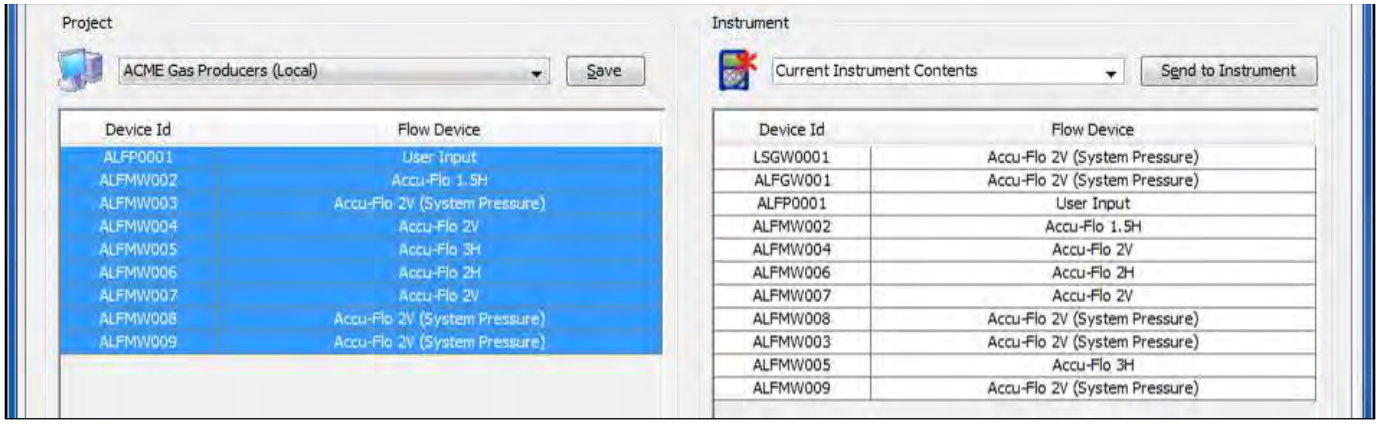
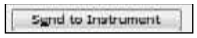


Now move IDs from the Project Side to the Instrument Side by dragging and dropping them.

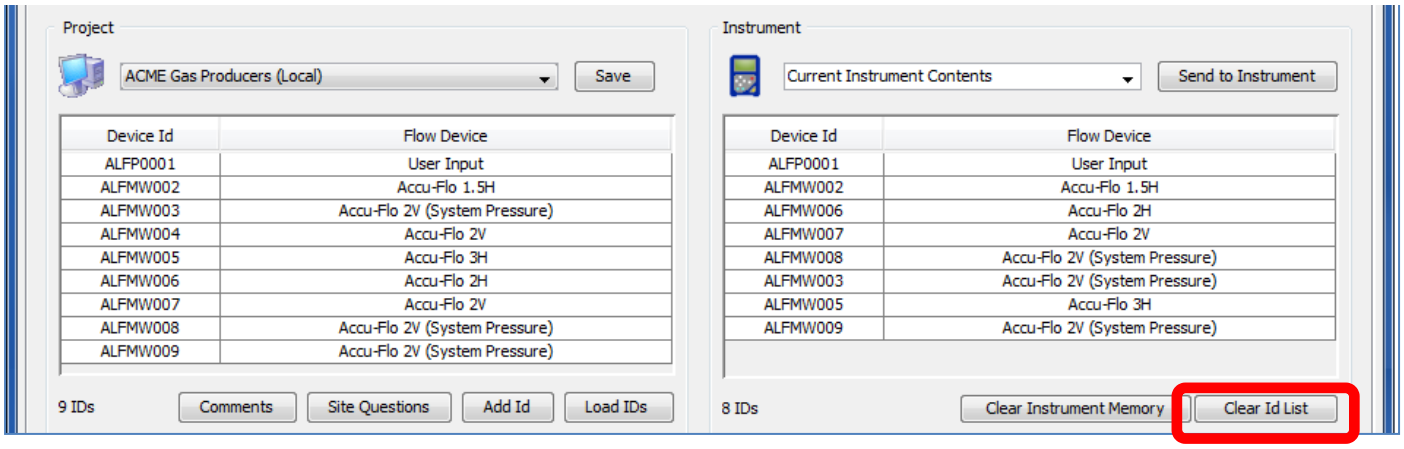


If you are dragging and dropping an ID that is already on the instrument side, you will be prompted with the above message. Answer Yes to update the IDs on the instrument side from those on the computer side. Answer No to ignore IDs that are already in the instrument. Answer Cancel to cancel the action without sending ID's to the instrument side.

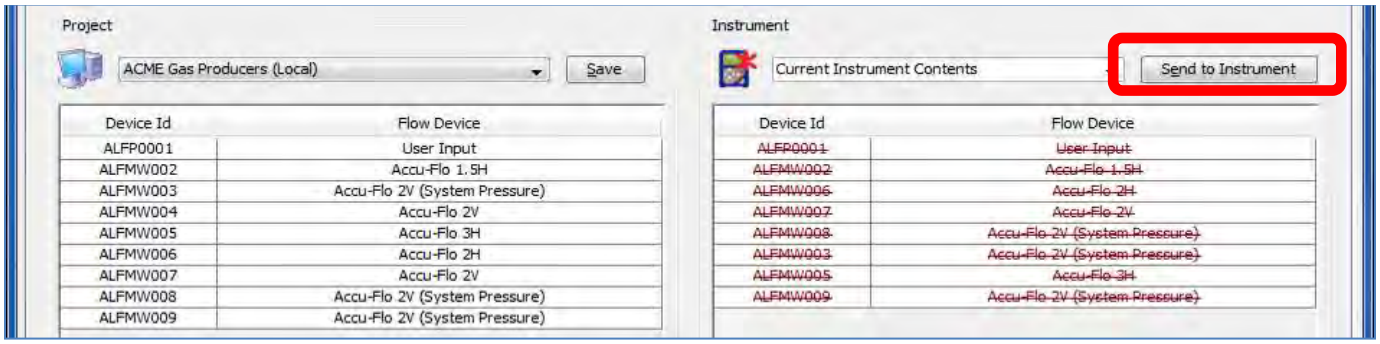


Click on the Send to Instrument button  to send these IDs to the instrument.

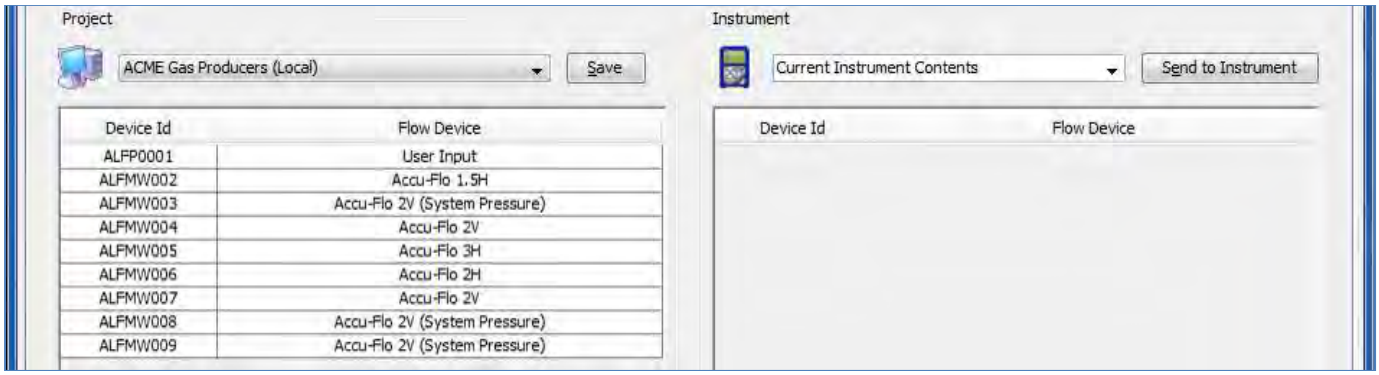
5.7.9 Clearing ID s from your instrument or Deleting a Project



In current instrument contents when selecting the Clear ID List option it will draw lines through the IDS.



You then need to select ***Send to Instrument***. This will clear all IDs from the instrument in both the GEM and GA mode.



You may also delete one ID from a list by highlighting the ID RIGHT CLICK with your mouse and select the Delete Selected Device option. If you have selected the wrong ID and deleted then you may select the Restore option to return the ID to the list.

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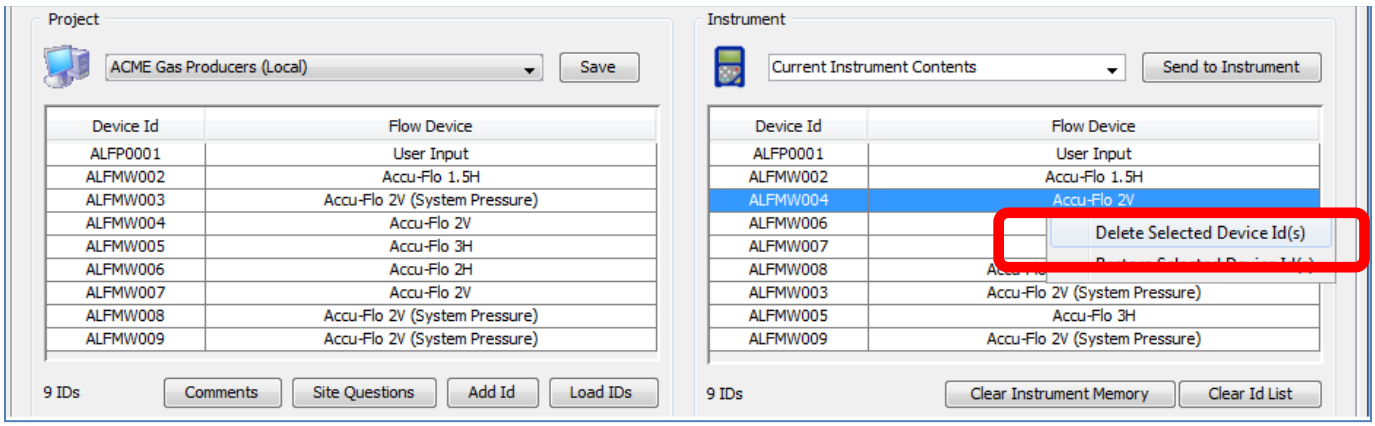
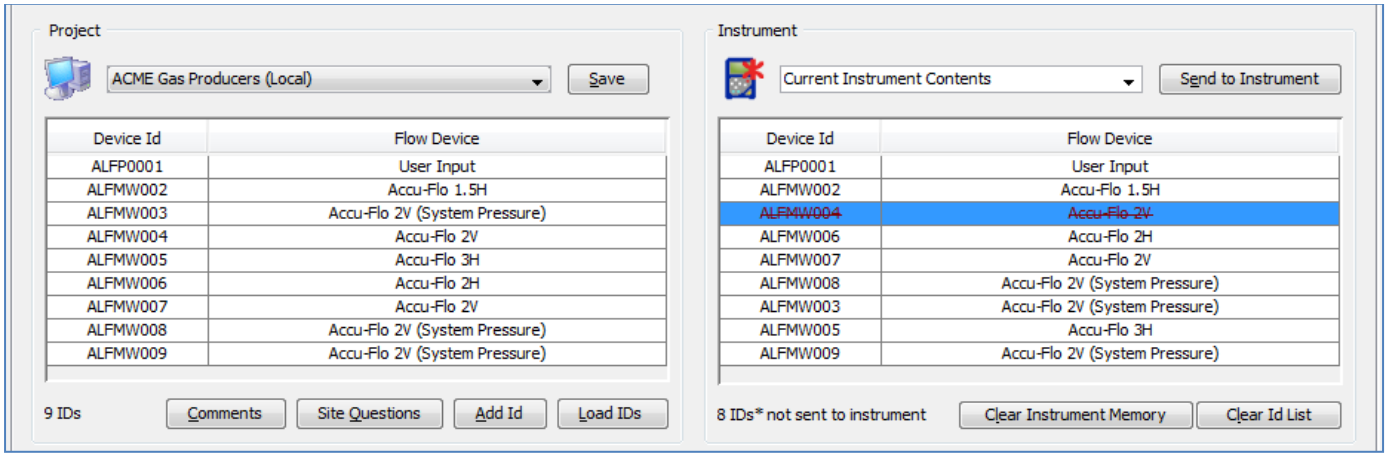
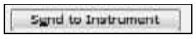
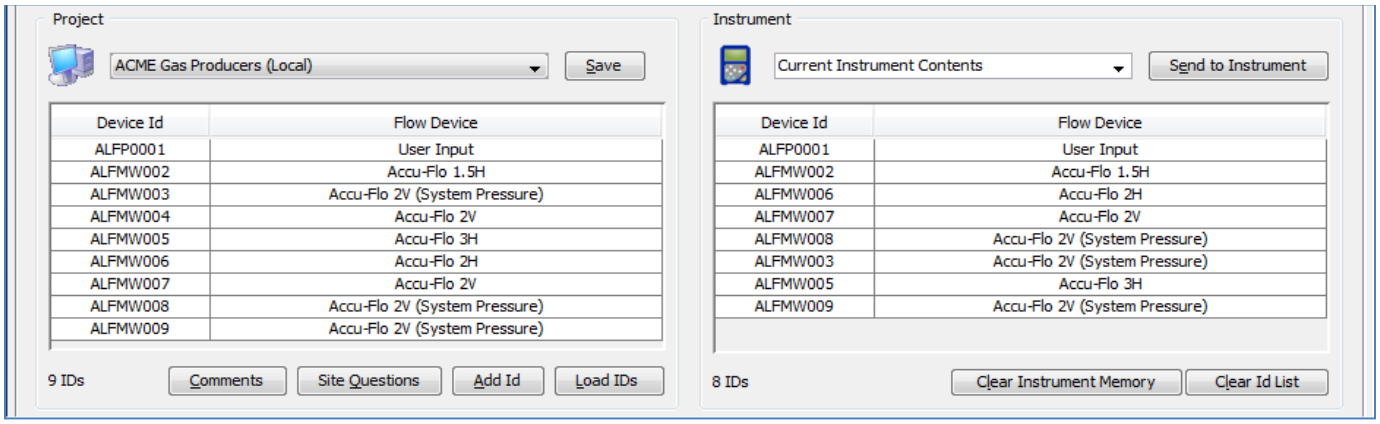


Upon selecting Delete Selected Device Id(s) you will see a ~~strikeout~~ line appear through the ID



Click on the Send to Instrument button  to send the ID corrections to the instrument.



The instrument contents will now be updated and the ALFMW004 ID no longer shows in the instrument side of the list.

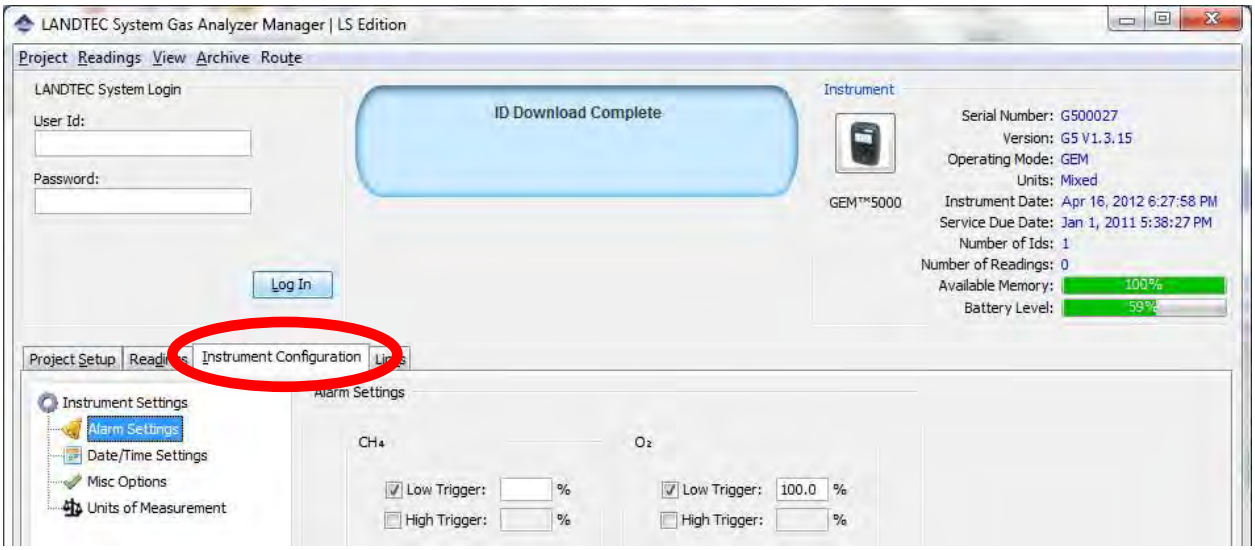
5.7.10 **Clearing the Instrument Memory**

The Clear Instrument Memory function allows various parts of the instrument's memory to be cleared. Upon clicking on the Clear Instrument Memory button the following options are available.

Answer Yes to perform the action.
Answer No or Cancel to return to the clear memory dialog.

5.7.11 **Instrument Settings**

The LANDTEC System Gas Analyzer Manager software allows users to change many of the operational settings of the instrument. To view and change the available settings click on the ***Instrument Configuration*** tab.



In the Instrument Configuration user interface, there is an Instrument Settings option tree. The Instrument Settings tree allows for easy navigation to the following categories:

- **Alarm Settings**
- **Date/Time Settings**
- **Misc Options**
- **Units of Measurement**

The following sections describe each option category.

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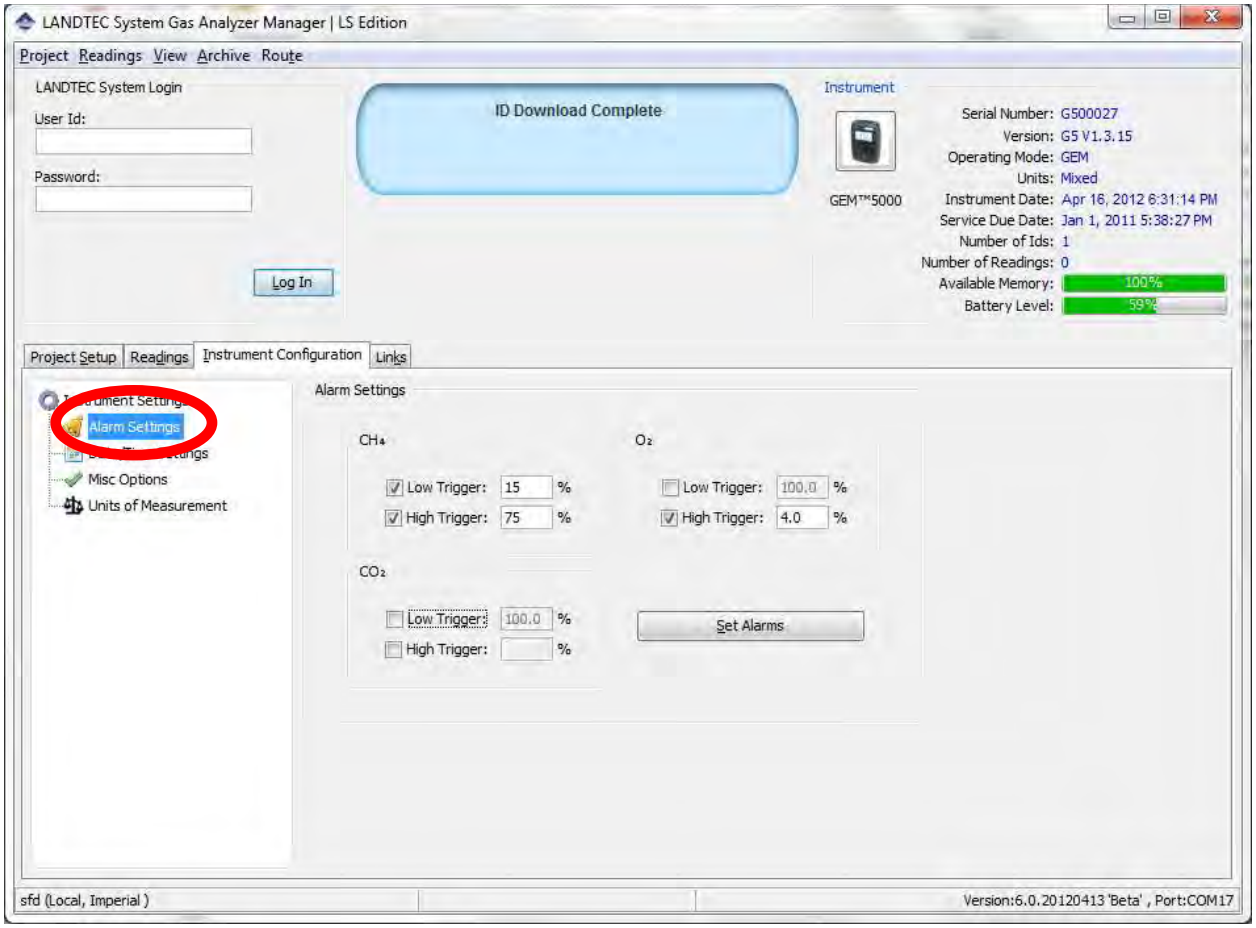
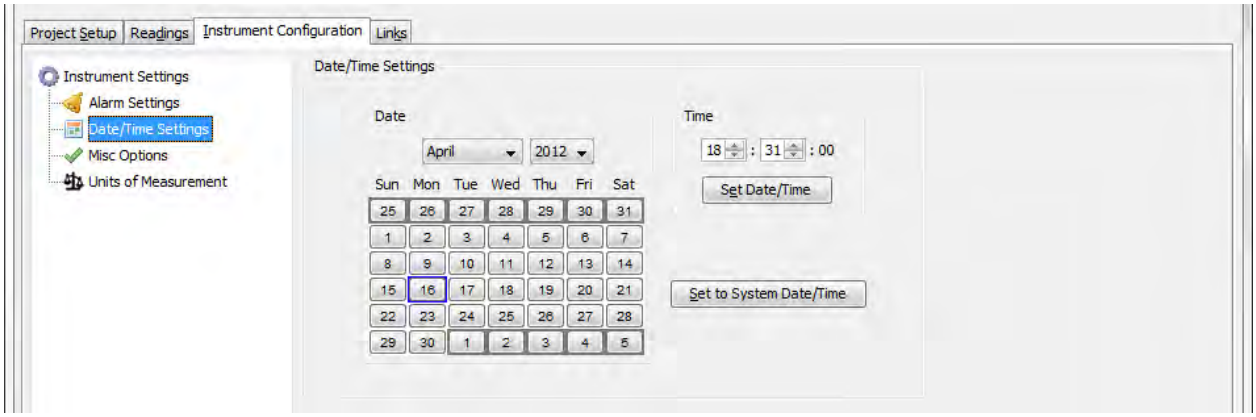
5.7.12 **Alarm Settings**



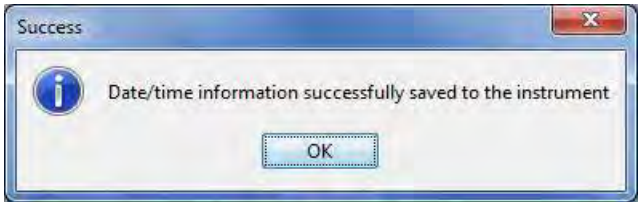
The Alarm Settings options control the activation and deactivation of the audible alarms in the instrument. Audible alarms can be configured for CH_4, CO_2, and O_2 parameters. Each parameter can be configured with a Low Trigger and/or High Trigger for the alarm. To activate any specific alarm, click and place a checkmark in the desired box. This will activate the entry field to place the value. The values must be 0 – 100 percent. When alarms are set, the instrument will beep and flash the parameter on the screen if an alarm threshold is surpassed when taking a gas reading.

Date/Time Settings



The **Date/Time Settings** screen allows the user to set the date and time of the instrument.

Setting the Computer's Date and Time
To set the instrument's date and time to that of the computer, click on the Set to System Date/Time button.



Answer OK and the instrument's date/time will be set to that of the computer.

Date
Use the calendar options to select the desired date.

Time
Use the up and down controls to select the desired hour and minutes.

Set Date/Time in the instrument
Click the Set Date/Time button to apply the settings to the instrument

5.7.13 **Misc Options**

Under the miscellaneous options interface the user can change the following instrument settings:

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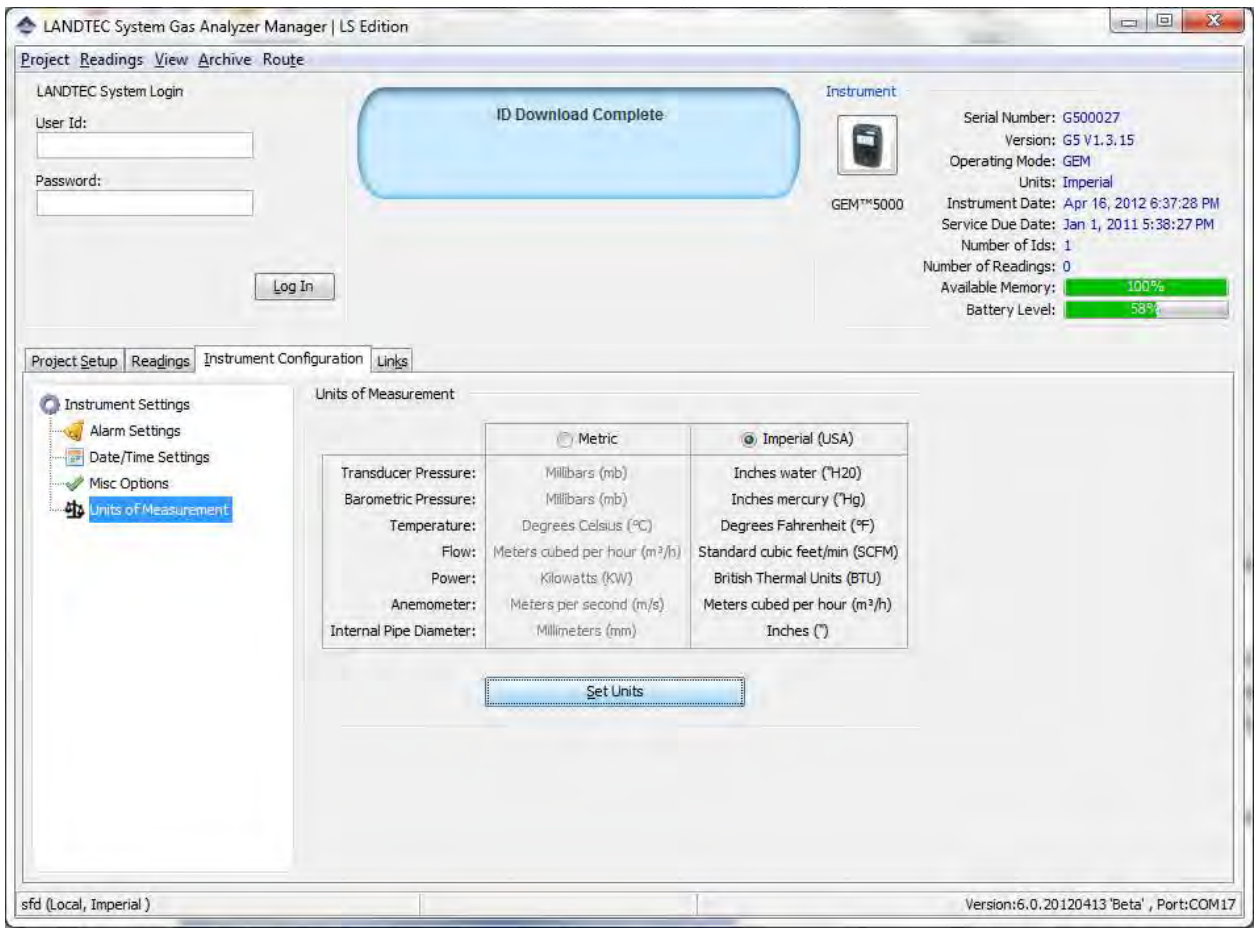
Automatically purge instrument
Activates and deactivates the automatic purge feature in the instrument

Automatically zero instrument
Activates and deactivates the automatic zero feature in the instrument

Low Flow Warning
Specifies the point at which the instrument will "Flow Fail". If the instrument detects that it is not able to extract the appropriate gas flow for analysis the word "Flow" will flash in the upper left part of the screen where the pump timer is normally shown. If flow does not increase the pump will automatically be stopped. Adjusting the setting to "Low" will allow the pump to run with less flow going through the instrument. This may help avoid flow fail conditions when sampling from high vacuum systems.

Purge Time
Specifies the duration the pump will run when activated by the purge feature of the instrument.

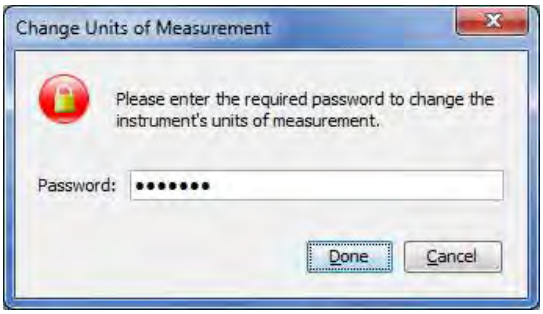
5.7.14 Units of Measurement



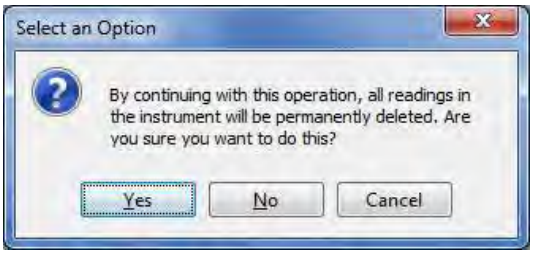
The Units of Measurement interface allows users to select whether to operate the instrument in metric or imperial units. The units for each parameter are displayed on the screen.

WARNING: *Units of Measure are as critical as the values of the readings stored. Be certain to verify the appropriate Units of Measure for your project prior to making a change to this option. Changing the Units of Measure will* ***NOT*** *convert any existing values stored in the instrument. To avoid confusion, download any stored readings prior the changing the Units of Measurement.*

Clicking on the Set Units button will bring up the Change Units Password box. If you must change the units of measure please call LANDTEC's Software Support for a password.



Upon entering the password you'll be prompted one last time to download your data from the instrument. If you have not downloaded your instrument press the No or Cancel buttons. Click Yes only if you have all data from your instrument as changing the units of measure must erase data that is in the instrument to ensure data integrity.



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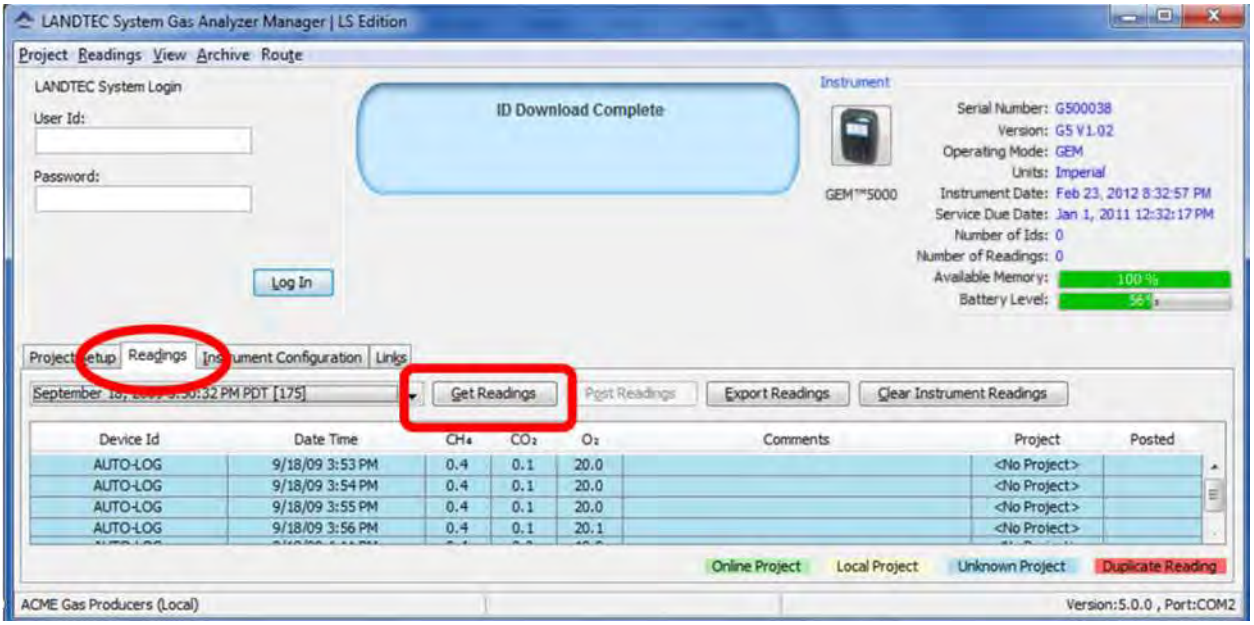
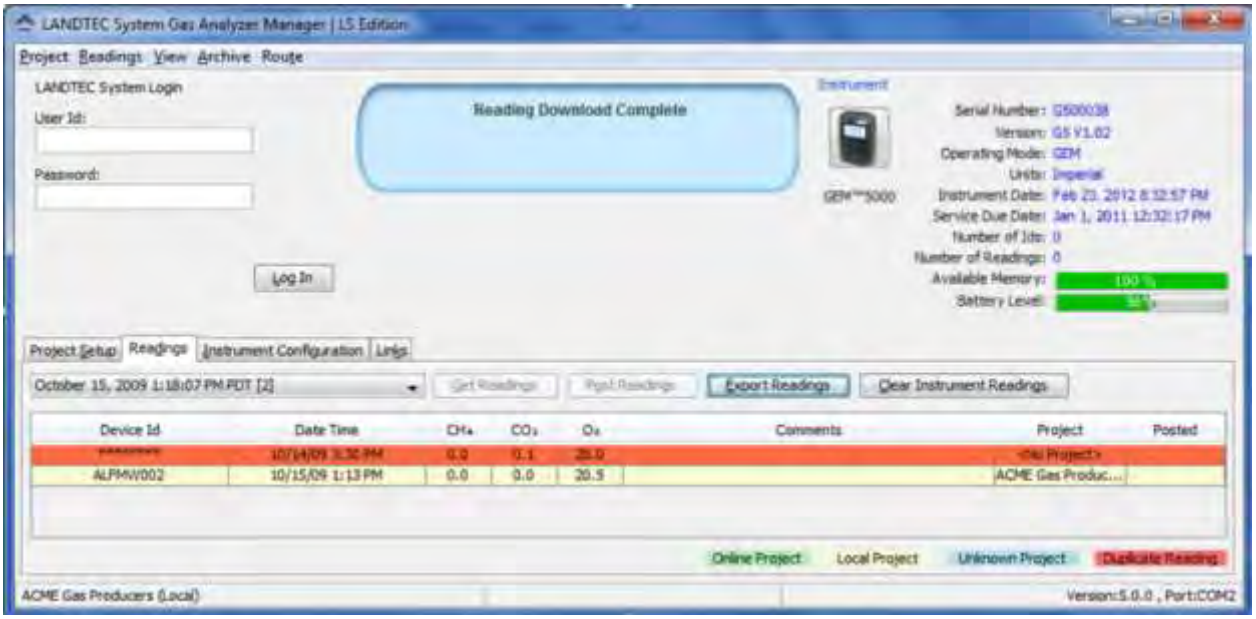
5.7.15 **Downloading Readings**

After successfully creating projects, IDs, and setting appropriate instrument settings, the instrument is ready for field use. When used in the field, ***readings*** are collected and stored within the instrument's memory. The readings consist of the measured, input, and calculated parameters such as CH_4, CO_2, O_2, Gas Temperature, Flow Rate, etc. These readings must be downloaded from the instrument to be reviewed on the computer and stored for review at a later time. This section of the Operation Manual reviews the process of downloading and storing readings from the instrument.

To view your readings from the instrument, select the Readings tab of the LANDTEC System Gas Analyzer Manager software. Then click on the Get Readings button



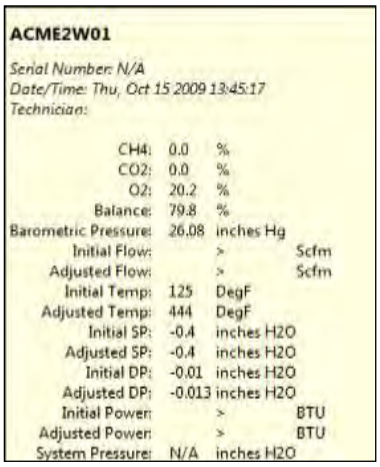


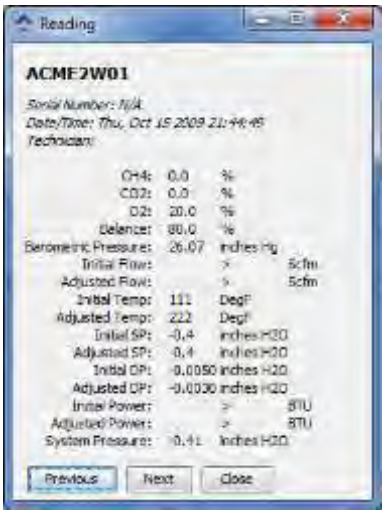
When the instrument is initially detected by the LSGAM software, the Get Readings button will activate if there are readings in the instrument to be downloaded.

Readings will be highlighted based upon the following:

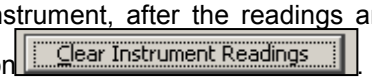
- **Online Project**: If the readings were taken against an ID belonging to an On-Line Enterprise System which the download computer is configured for as (REMOTE) the readings will highlight in a green color.
- **Local Project**: If the readings were taken against a project that is setup on the computer as a local project then they will highlight in a beige color.
- **Unknown Project**: IDs in the instrument that do not match any of the Local or Remote projects on the download computer. This is the result of uploading an instrument with IDs from one computer but downloading on a different computer without the exact same project configuration(s).
- **Duplicate Reading**: This does not imply that the reading was taken twice. Rather it is an indication that the reading was previously downloaded and exists on the computer in a different readings file.

Placing your mouse over a reading will display additional parameters of the reading. As shown below on the left. Clicking on a reading will open a Reading details window and allow you to click through the readings one-by-one in detail by clicking the Previous and Next buttons.

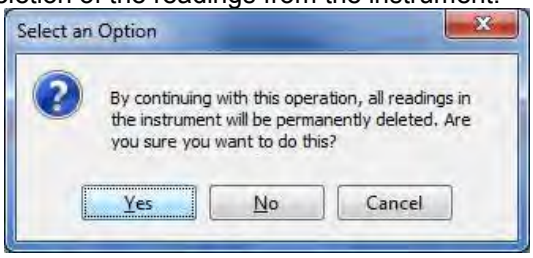




5.7.16 Clear Readings

To clear the readings from your instrument, after the readings are downloaded successfully, click the ***Clear Instrument Readings*** button 

. A prompt will verify the permanent deletion of the readings from the instrument.



This will clear information within the GEM and GA Mode **simultaneously**.

Note: Clicking yes will NOT check to ensure all data is saved from the instrument. If you plug in an instrument and click the Clear Instrument Readings button without first performing a Get Readings operation, data not previously downloaded will be lost!

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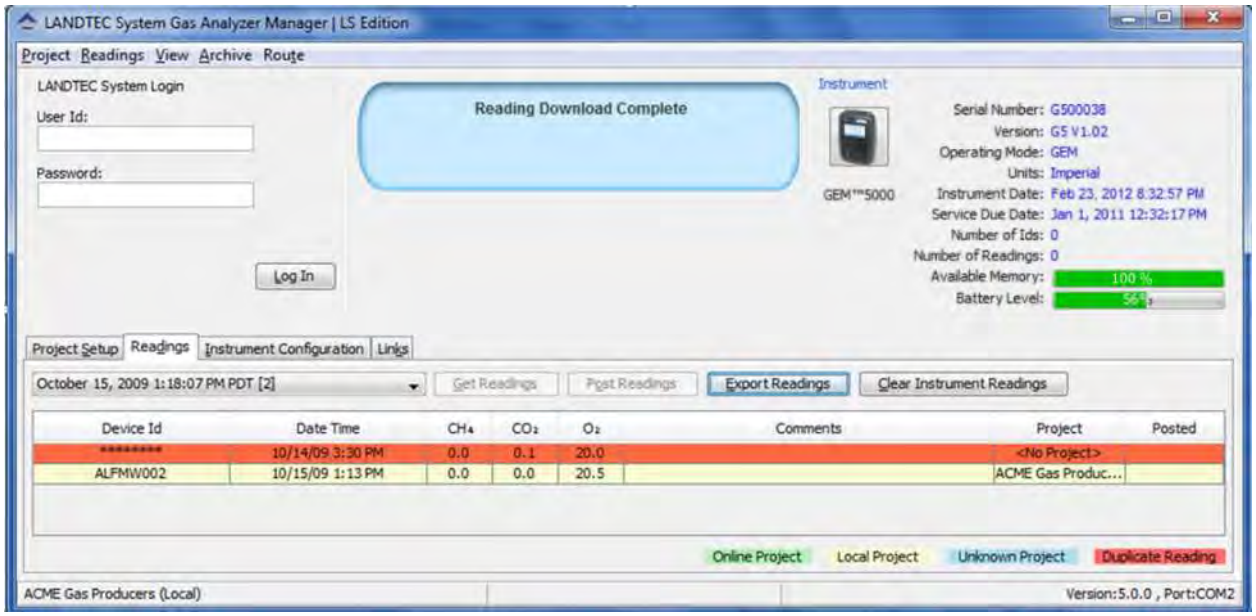
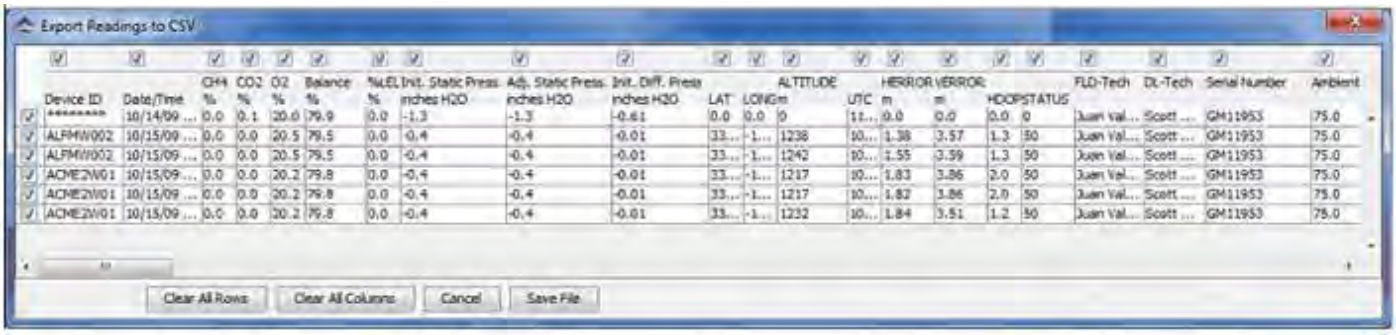
5.7.17 **Exporting Readings**

To export readings to a file, click the ***Export Readings*** button.



This will open the Stamping Information Screen. Stamping information are details that are most often stored with the historical data but not directly stored by the instrument. Detailed historical Stamping Information can assist when reviewing the data as atmospheric conditions do impact a gas system's production performance.

Clicking on Done will open the ***Export Readings to CSV*** screen.

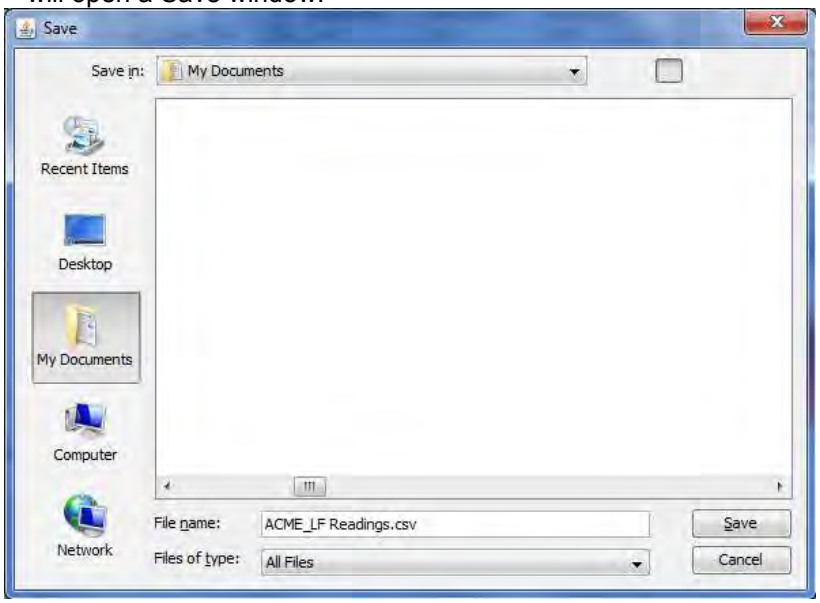


Note: Depending upon your specific Instrument model you will see additional fields specific to the

instrument. For example "NAV" option models have the fields of Latitude, Longitude, Altitude, Herror, Verror, and HDOP Status that the others models do not have.

This interface provides several options described below.

- To add or remove a single reading from export, uncheck the checkbox in the leftmost column.
- To add or remove a specific parameter from export, uncheck the corresponding checkbox across the top.
- To clear all row checkboxes, click the ***Clear All Rows*** button at the bottom of the screen. After Clearing all Rows you can click the button and it will change to ***Set all Rows***
- To clear all column selections, click on the ***Clear All Columns*** button at the bottom of the screen. After Clearing All Columns the button will change and you can then choose ***Set All Columns***
- To exit the operation without saving, click the ***Cancel*** button.
- To specify a filename and save the selection to a file, click the ***Save File*** button. Clicking this button will open a Save window.



The save file dialog will open and default to the My Documents of the user who is currently logged in on the computer. Specify a filename and location then click the Save button. The selected readings will be saved in comma separated value (.CSV) format. The .CSV file may now be opened in another application such as Microsoft Office Excel or Open Office Calc.

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6 General Operational Instructions

6.1 *Switching the instrument on*

1) To switch on the analyzer, press and hold the 'On/Off' key. The LANDTEC logo will display followed by the instrument warm up.

2) Following the instrument warm up, the 'Date and Time' screen is displayed if the battery was completely ran down. Otherwise date and time must be updated from LSGAM Software.

3) When complete select the soft-key to 'Exit' and the 'Power On Self-test' screen is displayed followed by instrument status. Instrument status displays the instruments service due date, serial number, options, service scheme and software version. Text will also display stating 'Self-test complete'.

4) Select the soft-key 'Next' to move onto the next screen and the 'Technician Login' screen is displayed.

5) Use the cursor keys to move through the list of ID's. Select either the required 'Technician ID' from the list followed by the soft-key 'Accept', or select 'Default'' followed by the soft-key 'Accept' to continue to the 'Main Gas Read Screen'.

   ✍ Note: The selected technician ID is displayed at the top left corner of the Main Gas Read Screen.

6.2 *Power on self-test*

When switched on, the read-out will perform a pre-determined self-test sequence. During this time many of the analyzer's functions are tested, including:

- General operation
- Gas flow measurement
- Calibration
- Screen Backlight / Brightness
- Battery charge level

During the self-test the following information is also displayed:

- Manufacturer's service due date
- The last gas check date
- Software version programmed
- Date format
- Serial number
- Operating language
- The currently enabled sales option

✍ Note: The self-test should only be done with the analyzer sampling fresh air.

6.3 *Switching the analyzer off*

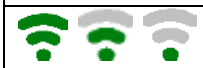
1) To switch off the analyzer, press and hold the 'On/Off' key, at which point a clean air purge will be carried out and the instrument will then switch off.

2) If for any reason the analyzer 'locks up' and will not switch off in this manner, press

and hold the 'On/Off' key for about 15 seconds until the red light above the power key turns on momentarily; this will force the instrument to switch off.

6.4 *Instrument status icons*

The following icons may be displayed on the instrument screen:

Icon	Description	Icon	Description
	Battery charge state Gives the operator an estimation of the battery charge state. For example 100% (green icon) gives about 8 hours use in the field and 50% (orange icon) would mean that there is approximately 4 hours battery life remaining.		**Battery charge state** The red battery icon indicates less than 1 hour of charge remaining.
	Pump status The black pump icon is displayed along with a counter showing the pump run-time. This counts down where the operator has specified the pump run-time; if not it counts up; the icon turns red when stalled.		**Pump stalled** The red pump icon is displayed when the pump stalls. The instrument's gas inlet (or outlet) may be blocked. This warning is most commonly caused by a water-logged or dirty sample filter. Change the sample filter and check for obvious blockages in the sample tubes. Alternatively, a small amount of adjustment can be made to the low flow detection point to compensate for minor changes in the performance of the pump fitted to the instrument.
	**GPS signal strength** This icon shows the signal strength the analyzer's GPS module is able to provide. Full, okay and fair strength respectively.		**GPS failure** The GPS was unable to get a line of sight lock on enough satellites. Or, it may be that it hasn't had time to get a lock.
	This indicates when Bluetooth has been enabled. The color changes from grey to blue when connected.		USB connected to PC (flickers when transferring data)
	Onboard Diagnostics Indicator		**Language** This icon indicates the currently selected operating language. This can be changed via the main menu.

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6.5 *Instrument LED power states*

When the instrument is powered on a LED power light is visible on the front of the analyzer, located above the 'On/Off' key. The following LED power light states are as follows:

Steady yellow	Unit turning on. This will extinguish when software has loaded correctly.
Flashing (rapid)	Unit is powering off.
Flashing (slow)	Power off is being delayed for purge/shutdown handling.
Flashing yellow	Unit is turning off due to power button being pressed.
Flashing red	Unit is turning off due to critically low battery.

✍ Note: Pressing and holding the power button for ~20s. The light will turn red indicating the reset of the analyzer. Press the power button one more time after the red light turns off to turn the analyzer on.

6.6 *Changing between parameters*

By default, the instrument displays the 'Main Gas Read Screen' (for gas measurement). The instrument will return to this screen after power on or when returning from the menus. The 'Scroll' keys can be used to switch to another measurement screen.

6.7 *Entering data*

During normal operation the operator may be prompted to enter data or information via the keypad, i.e. selecting a Device ID code or setting an alarm level.

When entering data into the instrument all fields are fixed format and are populated from the left.

Text:
Entering text uses similar multi-tap functionality as a mobile phone. Key the numeric/alpha key pad the required number of times to select the appropriate letter. To key numeric data continue to press the numeric/alpha key until the required number is displayed.

Numeric data:
To enter a new date 09/11/12 the operator would type in 091112 using the numeric keypad in the following sequence:-

* 0_/__/__
* 09/__/__
* 09/1_/__
* 09/11/__
* 09/11/1_
* 09/11/12

Press the 'Enter' key to confirm/accept data keyed.

Any mistakes can be corrected using the 'Delete' soft-key which will delete the last digit typed. Alternatively, the sequence can be retyped before the 'Enter' key is pressed and the existing numbers will be pushed off the screen.

✍ Note: The instrument will not allow invalid data to be entered; invalid data should be deleted and re-entered.

6.8 *Instrument main gas read screen*

The 'Main Gas Read Screen' is considered to be the normal operating screen and all operations are carried out from this starting point.

The actual data shown on this display will depend on the version of the instrument and the options that have been selected. In general, all of the main readings will be shown.

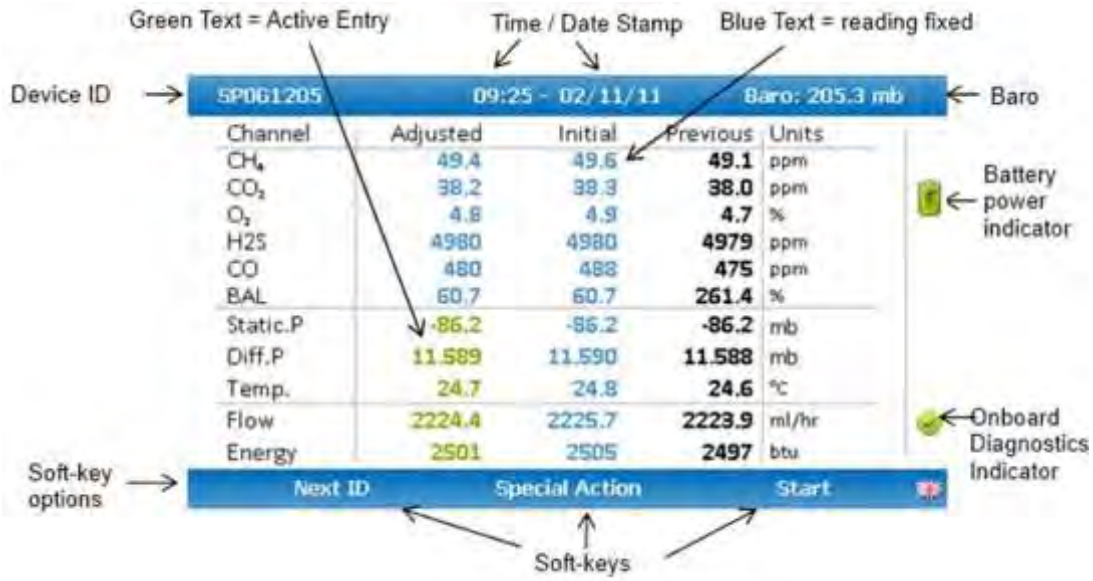

Figure 8—Main Gas Read Screen-change screen

6.9 *Physical Storage*

The analyzer should not be exposed to extreme temperature. For example, do not keep the analyzer in a hot truck. When not in use analyzers should be kept in a clean and dry environment, such as an office and protect the analyzer with either the soft carry case or store in the hard carry case provided with the instrument.

The instrument should be discharged and fully charged at least once every four weeks, regardless of indicated charge state.

6.10 *Battery/charging*

The battery used in the 5000 series of gas analyzers is nickel metal hydride and manufactured as a pack from six individual cells. This type of battery is not so susceptible to the top-up charging 'memory effects' as nickel cadmium batteries. However as a best practice it is suggested to cycle the batteries charge as much as

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possible and then fully charge the batteries. Although small top-up charges can be used to complete a day's readings if necessary they are NOT suggested.

✍ Note: To charge, the analyzer must be switched OFF before attaching the charger. Switching the analyzer on or off during charging will cancel the current charge. The analyzer should be left OFF during the charging cycle.

⚠ **Warning**	The battery charger is NOT covered by the Ex certification. The battery must be charged only in a safe area.

The battery charger is intelligent and will indicate when the unit is charging and charged.

The charger should only be disconnected when fully charged is indicated.

The instrument must be charged ONLY using the battery charger supplied with the instrument. The battery charger supplied is intended for indoor use only. Please ensure adequate ventilation whilst charging.

✍ Note: Connect the charger to A/C power by attaching the appropriate adaptor. Contact LANDTEC for further information

Battery Charger front and back:

Charger:	Input voltage:	100-240V AC +/- 10%
	Input frequency:	50-60Hz +/- 10%
	Input current:	0.4A@100VAC
		0.2A@240VAC
	Output voltage:	10.1VDC max
	Output current:	1.5A max

✍ Note: This charger has been internally restricted to 1.5A

A full charge will take approximately **3-4 hours**. Typically, a fully charged battery will last 7-8 hours. A quick 30 minute charge can be used to give approximately one hour of use in the field but may shorten the battery life. The battery charge status will be indicated on the charger plug. Temperature can dramatically affect the battery life; please take this into account when estimating battery life. The unit should be switched-off while charging to give a complete and consistent charge. Turning off Bluetooth and dimming the contrast will increase battery life.

6.11 *Cleaning instructions*

Do NOT use any cleaning agents to clean the analyzer or battery charger as they may have an adverse effect on the safe use of these devices. The analyzer can be wiped off with a damp cloth.

6.12 *Memory*

The analyzer's memory is stored in sections for readings and configuration information.

✍ Note: The analyzer should never be stored for prolonged periods with valuable data in its memory. It is advisable to download all readings at the end of each day's monitoring. To clear the memory, please refer to the section covering LANDTEC System Gas Analyzer Manager (LSGAM).

6.13 *Warning and error codes*

Upon the initial startup of the analyzer a self-test is performed. If any notable warnings or errors exist they will be displayed. BEFORE using the instrument with warnings or errors it is advised that you should contact Technical Support at +1 (909) 783-3636 or email technical@landtecna.com.

When switched on the instrument will perform a predetermined self-test sequence taking approximately ten seconds. During this time many of the instrument's working parameters and settings are checked. If any operational parameters are out of specification or if the pre-programmed recommended calibration/service date has passed, errors and/or warnings may be displayed.

✍ Note: For further information please refer to section "10 Problem solving".

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7 Operator settings

7.1 *Menu key*

The 'Menu' key enables the operator to select options to set up specific parameters and perform operational tasks prior to sample readings being taken or to view data and information stored in the instrument.

1) Select the 'Menu' key on the front of the analyzer and the following screen is displayed:

Figure 9—Device Settings

2) Press the relevant numeric key on the analyzer keypad to select the required option.

3) To exit this menu, select the soft-key 'Exit' on the front of the analyzer and the operator is returned to Main Gas Read Screen.

7.2 *Device settings*

7.2.1 **Date and time**

This option enables the operator to set the instrument date and time or to receive and update the settings automatically from satellite signal.

1) Select the 'Menu' key on the front of the analyzer to display the 'Device Settings' menu followed by 'Key 1 – Date and Time' and the following screen is displayed:

Figure 10—Date and Time

2) Select 'Key 1 – Set Date' and key in the required date. Type the date using the numeric keypad. Press the soft-key 'Date Format' to toggle and select the required date format i.e. dd/mm/yy. Press the 'Enter' key to confirm and update the date setting.

3) Select 'Key 2 – Set Time' and key in the required time (hh:mm). Type the time using the numeric keypad and press the 'Enter' key to confirm the update.

4) The operator may also change the default time zone. Selecting the 'Key 4 Scroll-left' or 'Key 6 – Scroll right' to move through the different time zones. Press the 'Enter' key to confirm your default setting.

5) Select the soft-key 'Exit' to exit and return to the 'Device Settings' menu.

7.2.2 Bluetooth

This option enables the operator to utilize Bluetooth technology. This may be useful when downloading gas readings from the analyzer to the PC instead of connecting the analyzer to a PC via a USB cable. Bluetooth.

1) Select the 'Menu' key on the front of the analyzer to display the 'Device Settings' menu.

2) Select 'Key 2 – Bluetooth' and the following screen is displayed:

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Figure 11—Bluetooth Menu

3) Enter the 'Pairing PIN' value when prompted by your computer for the device's pairing code.

4) Select soft-key 'Exit' to exit the screen and return to the 'Device Settings' menu.

7.2.3 Device information

This option displays default instrument information and settings such as serial number, service due date, last zero calibration date and last span calibration date.

1) Select the 'Menu' key on the front of the analyzer to display the 'Device Settings' menu.

2) Select 'Key 3 – Device Information' and the following screen is displayed:

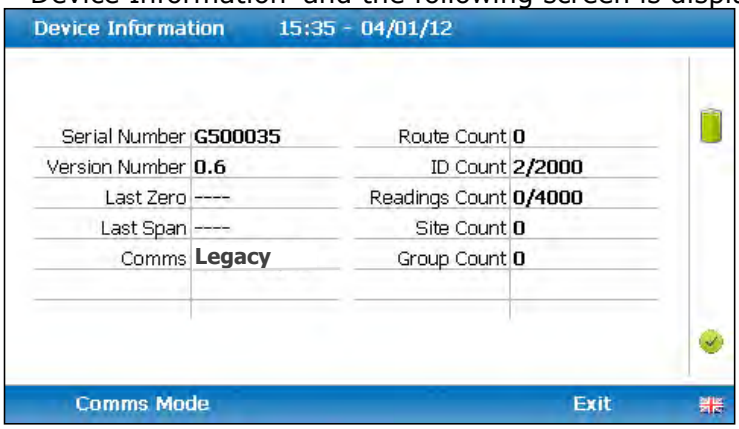

Figure 12—Device Information

3) The information displayed on this screen is informational only and cannot be edited by the operator. The operator may be asked serial number, service due

date and version number information when contacting LANDTEC.

✍ Note: The comms setting 'Legacy' mode is for use with LSGAM. GA5K mode is reserved for future applications.

4) Select soft-key 'Exit' to exit the screen and return to the 'Device Settings' menu.

7.2.4 Space has been left for a future feature

1) Select the 'Menu' key and the 'Device Settings' menu is displayed.

2) The 'Key 4' has been reserved for future functionality.

7.2.5 Navigation (optional)

This option enables the operator to switch the 'GPS Navigation' functionality on or off. (This is optional and dependent upon purchasing the navigation option). The power on self-test screen will display "GPS" in the enabled options screen if the analyzer has been fitted with GPS

1) Select the 'Menu' key and the 'Device Settings' menu is displayed.

2) Select 'Key 5 – Navigation On' to switch on the GPS navigation functionality or 'Key 5 – Navigation Off' to switch the GPS navigation functionality off.

✍ Note: For further information please refer to section '8.0 – Taking Readings'.

7.3 *User settings*

To access the 'User settings' menu, select the 'Menu' key on the front of the analyzer to display the 'Device Settings' menu followed by the soft-key to display 'User Settings' menu. The following menu is displayed:

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Figure 13—User Settings Menu

To exit the user settings menu select the soft-key 'Exit'.

7.3.1 Operating language

This option enables the operator to specify the operating language displayed for the instrument.

1) Select 'Key 1 – Operating Language' and the following screen is displayed:

Figure 14—Set Language

Set language

2) Set the required language for the gas analyzer by selecting the appropriate function key. Choose from:

1 English

2 Spanish

3 French

4 French (This is planned as a future enhancement)

5 Italian

6 Portuguese

3) To exit this option, select the soft-key 'Exit' and the operator is returned to the 'User Settings' menu.

7.3.2 Units of measurement

Units of measure are controlled through the LSGAM Software and can not be directly changed on the Analyzer. This protects from the potential storing of different units of measure for the same project.

7.3.3 Select by route/group (requires LSGAM)

This is a future enhancement option to enable the operator to display IDs by group or by specific route which have been uploaded from LANDTEC System Gas Analyzer Manager (LSGAM) software to the instrument.

7.3.4 Adjust backlight

This option enables the operator to adjust the backlight (brightness). Setting this to a darker setting will help preserve the battery power.

1) Select 'Key 4 – Adjust Backlight' and the following screen is displayed:

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Figure 15—Adjust Backlight

2) Manual adjustment of the instrument backlight is available via this option and can be carried out with use of 'Key 4 - Scroll left' (<) darker and 'Key 6 - Scroll right' (>) lighter.

3) Select the soft-key 'Save' to store the setting or select soft-key 'Exit' to exit the screen without saving the change.

4) The operator will return to the 'User settings' menu.

✍ Note: Setting a lighter screen will utilize more battery power than setting a darker screen. On overcast days, using a Darker screen setting will allow for less battery consumption.

7.3.5 Adjust volume

This option enables the operator to adjust the volume for the internal speaker, for example the alarm tone. A lower setting will help preserve the battery power.

1) Select the 'Menu' button on the front of the analyzer to display the 'Device Settings' menu. Press the soft-key to display 'User Settings'.

2) Select 'Key 5 – Adjust Volume' and the following screen is displayed:

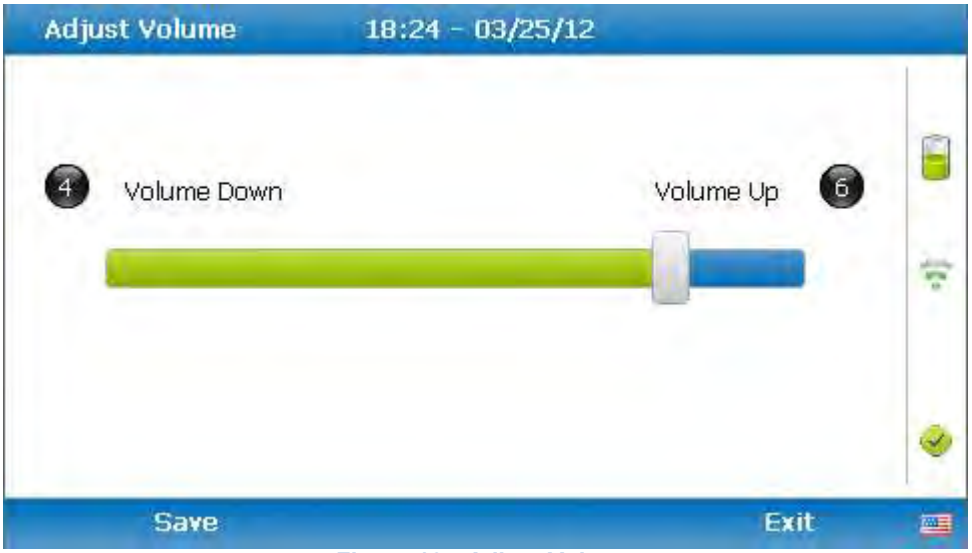

Figure 16—Adjust Volume

3) Manual adjustment of the volume is available via this option and can be carried out with use of 'Key 4 - Scroll left' (<) volume down and 'Key 6 - Scroll right' (>) volume up.

4) Select the soft-key 'Save' to store the setting or select soft-key 'Exit' to exit the screen without saving the change.

5) The operator will return to the 'User settings' menu.

7.3.6 Technician login

This option enables the operator to select from a pre-defined technicians or to add a Technician ID. All subsequent readings will be tagged with this Technician Login ID.

1) Select the 'Menu' button on the front of the analyzer to display the 'Device Settings' menu. Press the soft key to display 'User Settings'.

2) Select 'Key 6 – Technician login' and the following screen is displayed:

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Figure 17—Technician Login

3) Use the cursor keys to move throughout the list of IDs displayed; select the 'Enter' key to select choice of ID, default if no IDs are listed.

4) Alternately you may Add a new technician to the list by clicking the soft-key 'Add'

Press the '1' key to enter in the initials. The initials field will turn green. Tap each key on the keyboard repeatedly similar to a cell phone text entry until the desired letters are entered. When done press the enter key. Press the '2' key to enter the Full Name of the technician.

Once done, press the soft-key 'Add'.

5) The operator will return to the 'User settings' menu.

✍ Note: If no technicians are loaded via LSGAM this section is skipped during start up and the 'Technician ID' icon is removed from the menu.

7.4 *Operation settings*

To access the 'Operation settings' menu, select the 'Menu' key on the front of the analyzer to display the 'Device Settings' menu followed by the soft-key to display the 'Operation Settings' menu. The following menu is displayed:

Figure 18—Operation Settings

7.4.1 Timers

The timers function enables the operator to set standard purge times and set auto-power off if the unit is untouched for the period of time specified.

1) Select 'Key 1 – Timers' and the following screen is displayed:

Figure 19—Timers

1) Select 'Key 1' to edit the purge time. Enter the 'Pump Running Time' in seconds; this

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is the length of time you wish to run the pump to draw the sample, e.g. key in 030 then press the 'Enter' key to accept. Entering a time of 000 minutes will disable the auto-off purge.

1) Select 'Key 2' to edit the auto power off time. Enter the 'Auto power off' in minutes; the instrument will automatically power off to preserve the battery life after the specified time if no activity has occurred on the instrument. Press the 'Enter' key to accept.

Select the soft-key 'Exit' key to exit the screen and return to the 'Operation settings' menu.

✍ Note: Setting the purge time and auto power off functions to 000, disables the option. It is not recommended to reduce the purge time to below 30 seconds.

7.4.2 Gas Check (aka Field Calibration)

This option displays the 'Gas Check' menu and enables the operator to zero and span the gas channels on the instrument. Historical/previous gas checks data can also be viewed and factory settings can be restored.

1) Select the 'Menu' button on the front of the analyzer to display the 'Device Settings' menu. Press the soft key to display 'Operation Settings'.

2) Select 'Key 2 – Gas Check' and the following menu is displayed:

Figure 20—Gas Check

3) For more information about the Gas Check Menu please refer to section 9.0 – Calibration.

4) Select soft-key 'Exit' to exit operation settings and return to the main screen.

7.4.3 View data

This option enables the operator to view the readings collected and stored on the instrument. Readings may be downloaded to the LANDTEC System Gas Analyzer Manager (LSGAM) software if further analysis is required.

1) Select the 'Menu' button on the front of the analyzer to display the 'Device Settings' menu. Press the soft-key to display 'Operation Settings'.

2) Select 'Key 3 – View Data' and the following screen is displayed:

Figure 21—View Data

Note: Depending upon your instruments configuration there may be empty rows or different gases where Figure 21—View Data shows a highlight over CO, H_2 and H_2S.

3) Toggle through the reading by selecting 'Key 4 – Scroll left' and 'Key 6 – Scroll right' on the analyzer. Select 'Key 2 – Page up' and 'Key 8 – Page down' to page through the auxiliary channels listed.

Select the soft-key 'Filter' to filter the data by sample point ID, or specify before or after date. Press the soft-key 'Exit' to exit the filter menu and return to the 'View Data' screen. The screen shown in Figure 22 will filter for the ID named "ANAW0001". All dates in the instruments history will be used because an "After Date" and a "Before Date" is not specified 00/00/00.

Figure 22—Filter Data

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4) Select the soft-key 'Delete' followed by the appropriate soft-key to delete a single reading or all filtered readings. Press soft-key 'Cancel' to cancel the deletion request.

5) Select the soft-key 'Exit' to exit the view data screen.

7.4.4 Set alarms

This option enables the operator to define the conditions for which an alarm will be triggered. These conditions apply to the general operation of the instrument and are not ID specific. A summary of the alarm settings can be found in 'Key 3 – Summary'.

1) Select the 'Menu' button on the front of the analyzer to display the 'Device Settings' menu. Press the soft key to display 'Operation Settings'.

2) Select 'Key 4 – Set Alarms' and the following menu is displayed:

Figure 23—Set Alarms

3) Select 'Key 2' to select the gas for which you wish to set an alarm trigger followed by 'Key 1' to change the trigger condition of an alarm.

4) To manually adjust the alarm set press (<) 'Key 4 – Scroll left' or (>) 'Key 6 – Scroll right' and enter the trigger value.

5) To disable all alarm settings select the soft-key 'Disable All'.

6) Select the 'Enter' key' to store the setting or select soft-key 'Exit' to exit the screen without saving the change.

7) A summary of the alarm settings can be displayed using 'Key 3 – Summary'. Select soft-key 'Exit' to exit alarms summary and the operator returns to the 'Operation Settings' menu.

Once an alarm is set, the main reading screen will show an Orange line when the alarm condition has triggered. For example, Figure 23 shows an alarm of 4%being set. With this alarm set the analyzer will display an orange highlight indicating an alarm once the O_2 > 4% condition is met.

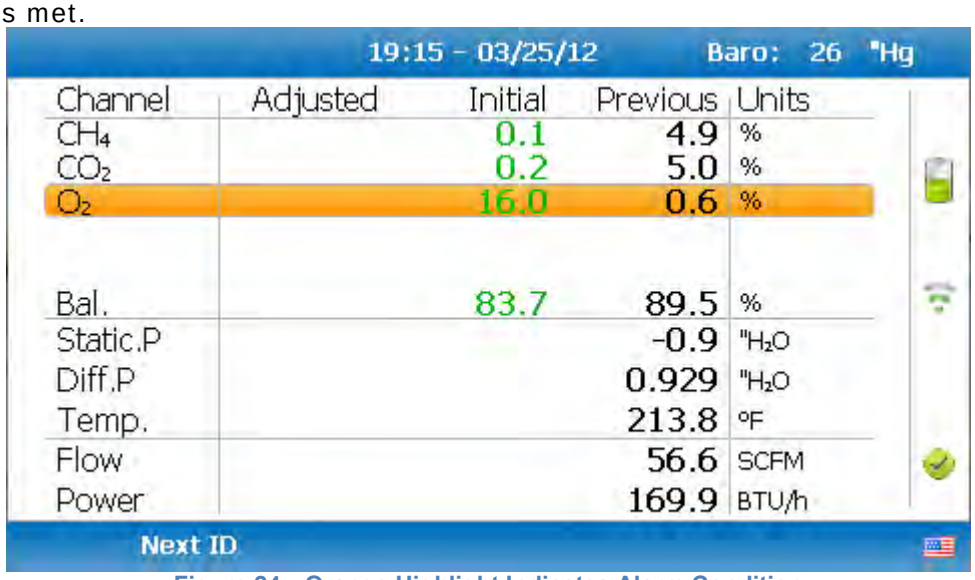

Figure 24—Orange Highlight Indicates Alarm Condition

7.4.5 Adjust flow fail

This option enables the operator to adjust the flow fail tolerance of the instrument, i.e. the operator can adjust the sensitivity for when the pump will stop operating on the presence of a blockage or low flow.

1) Select the 'Menu' button on the front of the analyzer to display the 'Device Settings' menu. Press the soft-key to display 'Operation Settings'.

2) Select 'Key 5 – Adjust Flow Fail' and the following screen is displayed:

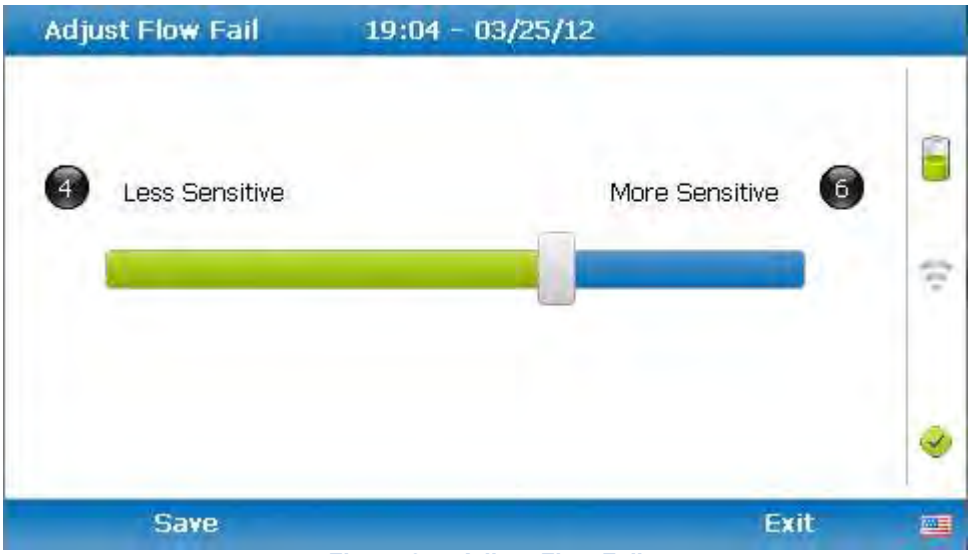

Figure 25—Adjust Flow Fail

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3) Manual adjustment of the flow fail is available via this option and can be carried out with use of 'Key 4 – Scroll left' (<) less sensitive and 'Key 6 – Scroll right' (>) more sensitive.

4) Select the soft-key 'Save' to store the setting or select soft-key 'Exit' to exit the screen without saving the change.

5) The operator will return to the 'Operation settings' menu.

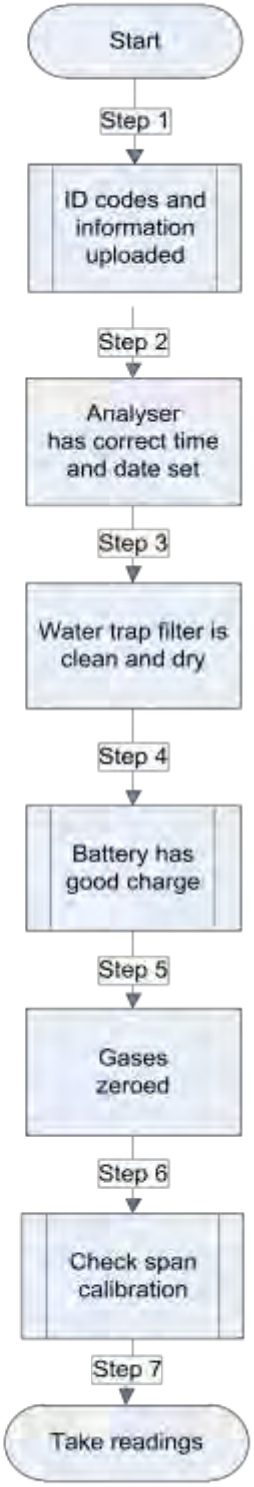
✍ Note: Changing the flow fail to a setting to a less sensitive setting may decrease the life of the pump. The default setting displays the bar in the center. BEFORE altering this setting, please contact Technical Support at +1 (909) 783-3636 or email technical@landtecna.com

7.4.6 Exit menu

1) Press the 'Menu' button on the front of the analyzer to exit settings.

8 Taking readings

8.1 *Preliminary checks before taking readings (best practice)*



Prior to use, it is good practice to ensure that:

Step 1 If using LSGAM - all necessary ID codes and information have been uploaded from LSGAM to the analyser.

Step 2 The instrument has the correct time and date set.

Step 3 The water trap filter is fitted and is clean and dry.

Step 4 The battery has a good charge (minimum 25% charge, even if only a few readings are required).

Step 5 The channels CH_4, H_2S and CO have been zeroed, without gas concentration present.

Step 6 If necessary check the span calibration with a known concentration calibration gas.

Step 7 Take readings.

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⚠ **Warning**	Inhaling hydrogen-sulfide gas (H_2S) or other harmful gases can cause death. It is the responsibility of the user to ensure that he/she is adequately trained in the safety aspects of using H_2S and other harmful gases. In particular, where hazardous gases are being used the gas exhausted from the analyzer must be piped to an area where it is safe to discharge the gas. Hazardous gas can also be expelled from the instrument when purging with clean air.

Good practice

- Travel to site with the gas analyzer in its protective hard case, preferably in the vehicle's interior - not in the back of a truck, where it may be subjected to extremes of temperature and possible shock damage. Do not place the gas analyzer against anything hot (e.g. gas extraction pipe, car body or in an unattended car during the summer) as this will cause a temperature increase in the gas analyzer and may cause erroneous readings.

- As with most instrumentation it is recommended to, protect the gas analyzer from strong direct sunlight and heavy rain.

- Always use the water trap! If the water trap becomes flooded, change the filter and ensure all tubes are clear of moisture before re-use.

  ✍ Note: If the exhaust of a 5000 series gas analyzer is connected to a pressurized system then this results in a flow of gas out of the inlet flow port.

8.2 *Update site questions*

Prior to taking the readings at a particular site, the site questions should be updated. This is accessed via the 'Special Action' menu. The answers to these questions are then stored and appended to each reading stored thereafter, until the site data is updated for another site. If using LANDTEC System Gas Analyzer Manager (LSGAM) software this data will be uploaded to LSGAM along with the reading data.

8.3 *Special action*

This menu enables the operator to perform the additional following functions out of sequence if so desired.

1) From the 'Main Gas Read Screen' select the soft-key 'Special Action' and the following menu is displayed:

Figure 26—Special Actions

✍ Note: The list of special action options displayed on the special action menu is dependent upon device type and sequence.

The following actions may be available:

Action	Function
Restart Process	This action enables the operator to restart the current process again from the beginning. The operator will return the Main Gas Read Screen.
Site Questions	This action enables the operator to update site questions prior to taking a reading.
ID Questions	This action enables the operator to update ID questions specific to sample points prior to taking a reading.
System Pressure	GEM mode - This action enables the operator to measure available system vacuum before the well's valve when taking a reading. Refer to ACCU-FLO well device diagram in Section 5.7.3.
Enter Temperature	This action enables the operator to enter the temperature manually if a temperature probe is not installed.

2) Select the soft-key 'Exit' to exit this menu and return to the 'Main Gas Read Screen'.

8.4 *GEM analyzer in Gas Analyzer (GA) mode*

The operator may toggle between GEM (a gas extraction monitor) and GA (a landfill gas analyzer) mode of operation if required. From the 'Special Action' menu, select the middle soft-key to toggle between GEM and GA Mode.

✍ *Note: The GEM5000 differs from the GEM2000 series of analyzers in that all IDs and Memory within the instrument are contained in a single area. They are not specific to GEM or to GA mode. GEM and GA mode should be considered as "modes of workflow" rather than instrument modes. Readings can be taken in either workflow mode GEM or GA.*

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LSGAM now supports a new flow device called "NO FLOW" for probes. If "NO FLOW" is selected during ID Setup, the instrument will default to the GA workflow after a Device ID containing "NO FLOW" is selected. Subsequent selection of an ID without "NO FLOW" for the flow device will cause the instrument to return to the GEM workflow.

Figure 27—Analyzer in GA Mode—Main Gas Reading Screen

8.5 *The GEM-5000 as a Gas Extraction Monitor (GEM) gas flow measurement screen*

The GEM5000 gas extraction monitor enables gas and flow measurements to be recorded by using:

- A flow device i.e. an Accu-Flo Wellhead, Pitot tube, Orifice plate, or User Input.
- A temperature probe.

The GEM5000 instrument has the extra functionality to measure the calculated calorific (energy) value of the gas. The field technician uses the information recorded by the analyzer to make adjustments to the gas flow for specific wells. The initial and adjusted flow rates are recorded.

8.6 *How to use a pitot tube (optional)*

The GEM5000 gas analyzer enables the field technician to take gas measurements using a pitot tube. The pitot tube is used for gas extraction systems and the pressure readings are taken in mbar. Gas flow is calculated in the analyzer in SCFM (standard cubic feet per minute) or in m^3/hr (meters cubed per hour) depending upon the units of measure setting.

Figure 28—Example of a Pitot Tube

Fitting a pitot tube to the analyzer:

1) It is important to seat the pitot tube into the monitoring point with the tip facing into the gas flow. The pitot tube should also be housed half way down the monitoring pipe.

2) Make sure that the sample tubing attached to the pitot tube fits correctly.

3) Attach the sample tube from the top connection of the pitot tube to the 'blue port' (the differential port) on the analyzer making sure that the gas port connector secure into place.

4) Attach the sample tube from the side of the pitot tube to the 'white port' (inlet port/static pressure port) on the analyzer making sure that the gas port connector secures into place.

5) House the pitot gland correctly onto the monitoring point.

6) When taking a gas reading and flow measurement follow the instruction as displayed on the front of the instrument.

✍ Note: Please refer to the following section for a diagram showing how to fit the tubing to the pitot tube.

8.7 *How to use an H_2S filter (optional)*

8.7.1 Cross gas effects on chemical cells

Measurements of CO are important in landfill management. The GEM5000 analyzer incorporates an improved CO measurement. Measurements of CO can be affected by two other gases that can be found in landfill gas – hydrogen and hydrogen sulfide.

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To reduce the effect of hydrogen, the GEM5000 analyzer uses a technique that is hydrogen compensated. Hydrogen compensation is achievable up to a level of around 2000ppm. Above this level the CO reading will not be compensated for.

In order to assist the operator the GEM5000 instrument also indicates the level of hydrogen present as low, medium or high. If a high hydrogen reading is present then the CO reading may be affected.

The effect of hydrogen sulfide is eliminated by the use of a H_2S filter.

CO measurement

The CO measurement is sensitive to hydrogen sulfide. The presence of hydrogen sulfide can cause the CO reading to elevate (not to be the true value due to the interfering gas). If the presence of hydrogen sulfide is suspected to be causing false CO readings, then it is recommended that the external hydrogen sulfide filter is used whilst obtaining the CO measurement.

The H_2S filter only needs to be used when you are trying to remove of any possible cross gas effects H_2S might have on other gas channels. Do not use the filter on all devices.

When using the H_2S filter you will need to increase the gas sample and clean air purge run-time, as using an H_2S filter decreases the response time of the analyzer.

✍ Note: There is an internal H_2S filter incorporated in the chemical cell that removes the H_2S; however this has a limited life span.

The electrochemical cells used to measure H_2S and CO do suffer from cross-gas effects. Such effects are not accurately specified. However, the following table may be useful as a guide; it represents how many ppm would be read by a cell if 100 ppm of the interfering gas were applied, with no other cross-contaminates being present in the sample.

GEM5000

		Interfering Gas				
		CO	**H_2S**	**SO_2**	**NO_2**	**H_2**
Chemical Cell	**CO (H_2 compensated)**	100	0 / ~300*	0	0	<1
	CO	100	<4 /~300*	0	-20 to +5	<60
	H_2S	<4	100	20	<-25	<0.2

*after internal filter depleted.

✍ Note: Other gases could cause cross-gas effects. If you suspect a cross sensitivity problem please contact the Technical Support Team at +1 (909) 783-3636.

8.7.2 Cross-gas effects on methane, carbon dioxide and oxygen

Methane is measured using dual beam infrared absorption. Analyzers are calibrated

using certified methane mixtures and will give correct readings provided there are no other hydrocarbon gases present within the sample (e.g. ethane, propane, butane, etc…). If there are other hydrocarbons present, the methane reading will typically be higher than the actual methane concentration being monitored.

The extent to which the methane reading is affected depends upon the concentration of the methane in the sample and the concentration of the other hydrocarbons. The effect is totally non-linear and difficult to predict.

✍ Note: The effect can be reduced by using an H_2S filter as it can reduce higher order hydrocarbons. When using the H_2S filter you will need to increase the gas sample and clean air purge run-time, as using an H_2S filter increases the response time of the analyzer.

Carbon dioxide is measured by infrared absorption at a wavelength specific to carbon dioxide. Therefore, the carbon dioxide reading will not be affected by any other gases usually found on landfill sites.

The oxygen sensor is a galvanic cell type and suffers virtually no influence from CO_2, CO, H_2S, NO_2, SO_2 or H_2, unlike many other types of oxygen cell.

The infrared sensors will not be 'poisoned' by other hydrocarbons and will revert to normal operation as soon as the gas sample has been 'purged'.

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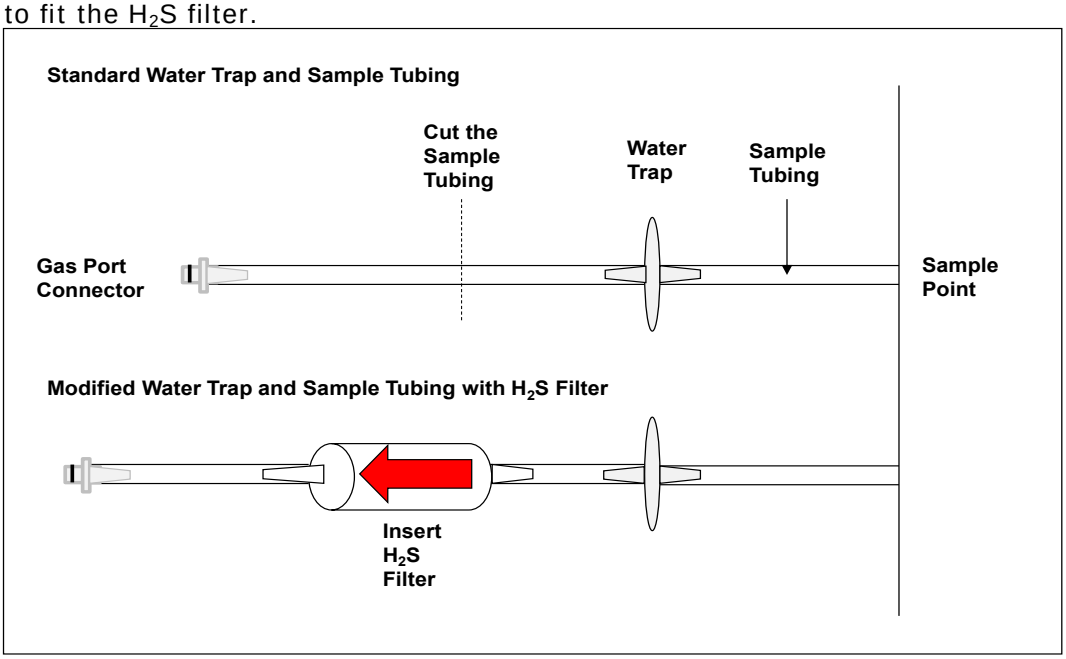
H_2S filter:

Instructions for use:

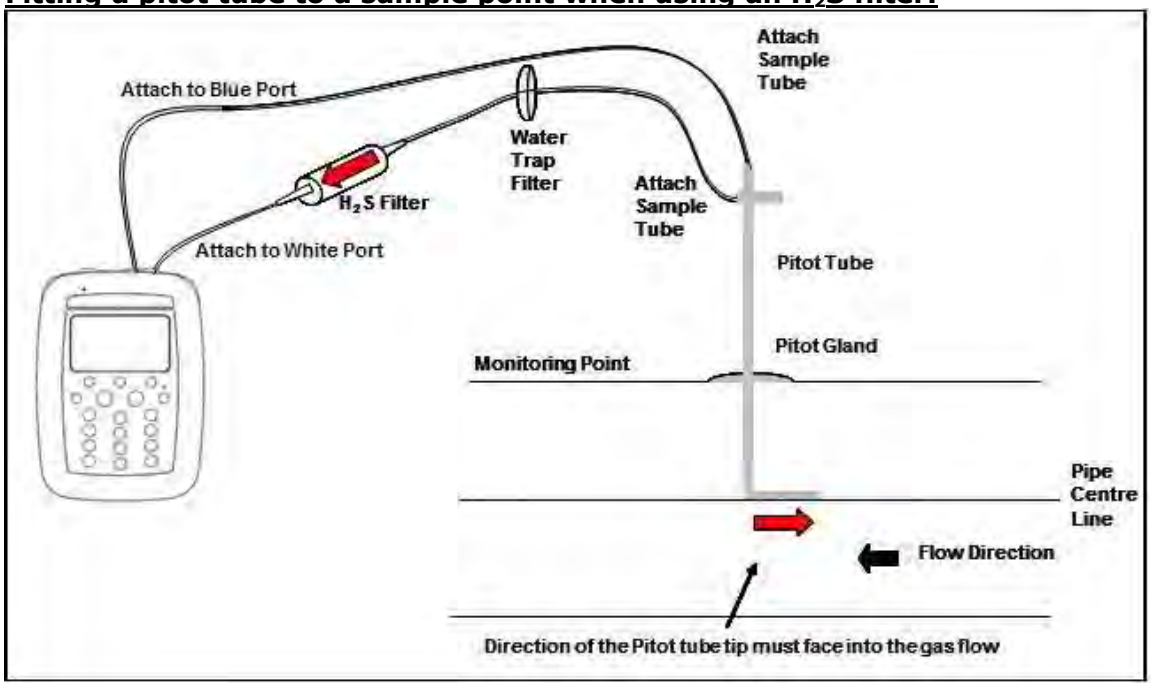
The following diagram shows how to modify the standard water trap and sample tubing to fit the H_2S filter.



✍ Note: When onsite the field technician must have an unmodified water trap assembly in addition to the modified water trap with a H_2S filter in order to take readings with and without a filter.

1) Once the H_2S filter is fitted follow the instructions as detailed on the front of the gas analyzer displayed when taking readings using a H_2S filter.
   ✍ Note: This is only for analyzers fitted with the CO compensated cell.

Fitting a pitot tube to a sample point when using an H_2S filter:



2) Make sure the water trap filter is fitted as close as possible to the pitot tube. This will help protect and trap moisture before it reaches the H_2S filter. Make sure that the water trap filter is clean and dry.

3) Attach the sample tubing into the analyzer.

4) To take flow readings using a pitot tube, please follow the instructions displayed on the front of the instrument. The user will be prompted to complete each step and should follow the instructions on screen or those initially provided with the Pitot Tube.

   ✍ Note: It is important to center the pitot tube within the pipe and ensure it is parallel with the pipe.

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8.7.3 How to use a temperature probe (optional)

The temperature probe enables the field technician to measure the temperature of the gas within a sample point. The GEM5000 gas analyzer uses the temperature of the gas to give more accurate flow measurement readings as part of the instrument calculation.

Figure 29—Temperature Probe Use

Instructions for use:

1) The temperature probe reading is taken along with the flow measurement reading.

2) The analyzer must be at the 'Main Gas Read Screen'.

3) Attach the temperature probe to 'connector B' (refer to 4.4 – Instrument connections points).

4) Insert the temperature probe into the sample point (well device) at the same time as you attach the sample tube to the sample point (two sample points are required for the well).

5) Follow the instructions on the front of the instrument when taking your gas and measurement reading.

6) At the point in which the operator presses 'Enter' to store the gas reading the temperature is recorded.

✍ Note: Temperature probe readings can be analyzed further when downloaded to LANDTEC System Gas Analyzer Manager (LSGAM).

8.7.4 How to locate a device ID using the GPS feature (optional)

An optional GPS feature is available for the GEM5000 gas analyzer. It enables the field

technician to automatically locate Device IDs using GPS satellite signal from predefined Device IDs uploaded from Gas Analyzer Manager. The GPS reading data is stored for each measurement reading.

✍ Note: Device IDs may be uploaded from LSGAM with or without location information. If location details are not uploaded the location longitude and latitude coordinates can be stored when the Device ID is located and downloaded to LSGAM with the reading measurements.

Screen navigation:

1) Switch on the analyzer and wait for the self-test warm-up to complete and the analyzer will display the 'Main Gas Read Screen'.

2) In order to use the navigation function if configured, you must switch 'Navigation - On' on the analyzer. Select the 'Menu' key followed by 'Key 5' to toggle navigation to on. Select the 'Menu' key to exit and return to the 'Main Gas Read Screen'.

3) Select the soft-key 'Next ID', then select a device ID from the list displayed and press the 'Enter 'key to continue.

⚠ **Warning**	Before entering the GPS Navigation Screen for the first time the following health and safety message will be displayed. "Please be aware of the terrain when using this screen. You are responsible for your own safety while walking on-site!"

4) After reading the user warning message, select the soft-key 'Dismiss'. Use the tracking display to locate the device.

✍ Note: There is often a wait time frame of between 30 seconds to two minutes while acquiring a satellite signal. Be aware that heavy rain, trees overhead etc. will give a bad fix.

5) Once the operator selects a Device ID the 'GPS Navigation' screen is displayed.

Figure 30—Navigation using GPS

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6) If required select soft-key 'Options' to go to the 'Navigation Options' menu and the following screen is displayed:

Figure 31—Navigation Options

Key 1 to toggle between 'Meters', 'Feet' or 'Yards' to define the unit of measurement for navigational purposes.

Key 2 to toggle between 'Manual Scaling' and 'Automatic Scaling' to locate a sample point using a satellite signal.

Key 3 to display sample point information:

Bearing: Direction.

UTC time: 'Universal Time Code' received from the satellite and displays GMT.

Latitude: Latitude displays as degrees, minutes, seconds and decimal seconds. The equator is 0.

Longitude: E (East) or W (West) displays the longitude as degrees, minutes, seconds and decimal seconds. The Greenwich meridian defines the zero point.

Altitude: Altitude displays in meters, feet or yards.

Satellite: This is the number of satellites that the system can select. Four satellites will give reasonable position accuracy; eight or more satellites will increase accuracy.

Horizontal: Estimate of horizontal error on the indicated position. The location is accurate to horizontal error 1.6m.

Vertical: Estimate of vertical error on the indicated position.

HDOP: 'Horizontal Dilution of Precision' which measures the accuracy of the indicated position.

Status: Status is the indicator as to the functional state of the GPS. The number presented is a value 1 through 4 and corresponds to the GPS signal strength indicators

GPS failure/No Fix—the GPS was unable to get a line of sight lock on enough satellites. Or, it may be that it hasn't had time to get a lock

Poor to fair signal strength

Okay strength

Good Signal / Full Strength

Select soft-key 'Continue' and the operator is returned to the 'Main Gas Read Screen'.

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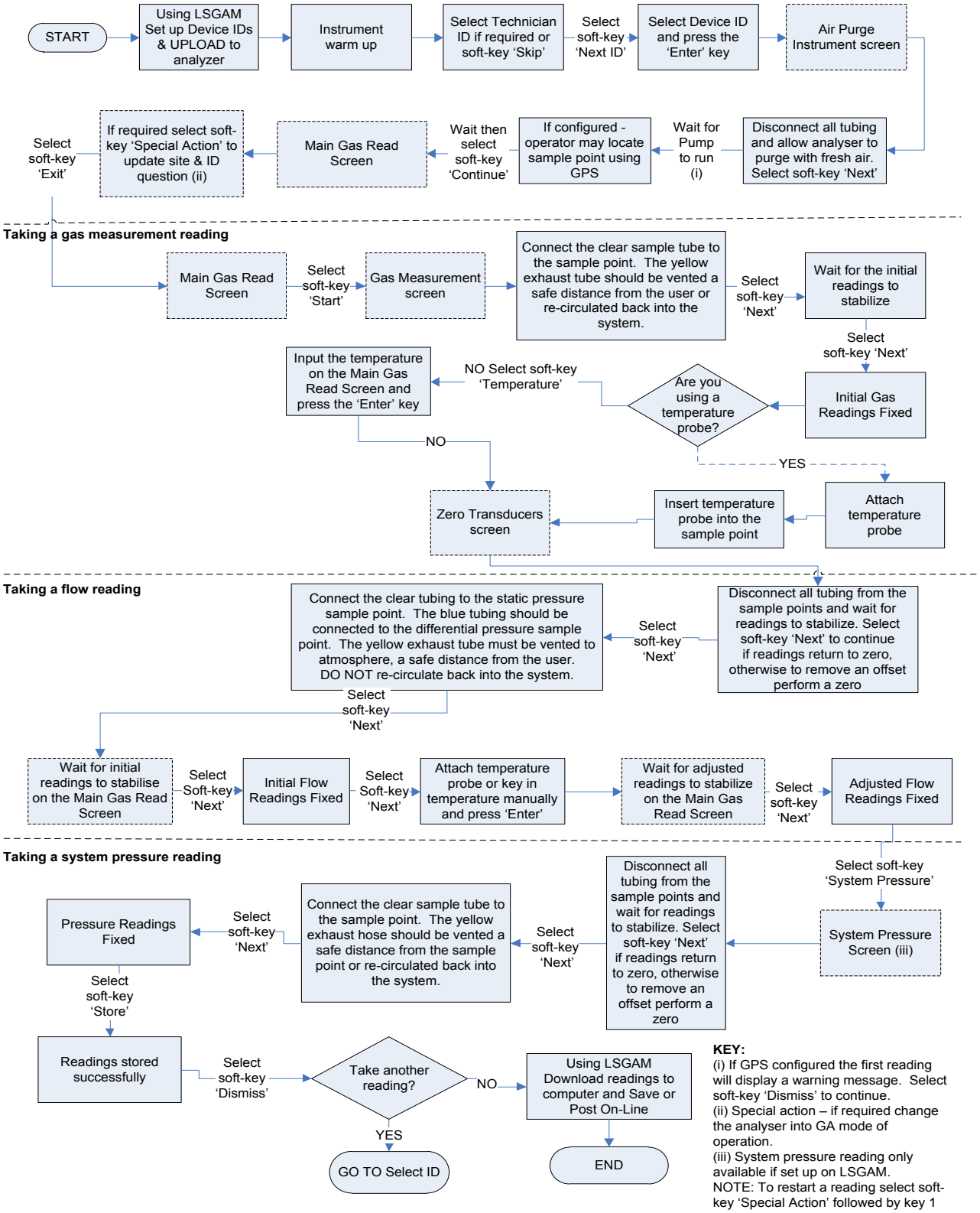
8.7.5 Taking gas and flow measurement



9 Calibration

9.1 *Calibration introduction*

The GEM5000 gas analyzer is carefully calibrated at time of manufacturer and when returned for service. However, it is desirable to be able to carry out a calibration process between services.

This section outlines the correct procedures to enable the field technician to field calibrate the gas analyzer.

✍ Note: This does not replace the factory service and calibration. If this calibration is completed incorrectly it may decrease the accuracy of the gas analyzer.

CH_4, CO_2 and O_2 can be measured by all GEM5000 gas analyzer models as a standard; these channels can be user calibrated. Optionally, the analyzers can have other gas channel specified at purchase; these channels can be calibrated as well. This section will describe in detail how to calibrate the three standard gas channels plus the CO channel.

The GEM5000 instrument can have a H_2 compensated CO channel. This option requires that H_2 is used in the calibration process and is also set out within this section.

For the other gas channel options contact LANDTEC for advice.

Two important terms that are used within this section are '**Zero'** and '**Span'**.

Zero: The point at which the gas analyzer is calibrated when there is none (Zero percent) of the target gases present.

Span: The point at which the gas analyzer is calibrated when a known quantity of the target gas is present.

9.2 *Frequency of calibration—best practice.*

The GEM5000 gas analyzers can be checked against a known concentration of gas, to give confidence that the analyzer is operating as expected at the time and conditions in which it is being used. A field calibration should be performed if the ambient temperature changes by more than 20° Fahrenheit over the course of a monitoring since the last field calibration.

It is recommended that the instrument is regularly serviced and calibrated by LANDTEC. Please refer to the instrument's calibration certificate for the last date of calibration.

When defining the frequency of user calibration, the following are factors to be considered:

- The frequency of use of the analyzer. (daily?/monthly?)
- The level of confidence and accuracy required for readings to be taken.
- Historical user calibration data.
- Site specific requirements or conditions.
- Historical understanding of expected readings on site.

Zeroing of the gas analyzer should be undertaken at the start of each day's monitoring.

Use historical data to drive your frequency of calibration.

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If there is no historical data a good starting point for a daily monitoring round is performing a calibration daily at the beginning of a monitoring event.

The results of the calibrations will need to be recorded to monitor over time whether the frequency of calibration needs to be increased or decreased relative to the confidence required.

The confidence required is most often driven by the site specific, user, and/or regulatory requirements.

When undertaking the monitoring with an understanding of the history of the gas levels of that site, a calibration check could be triggered if the readings measured are different to what is expected.

✍ Note: For assistance please contact Technical Support at +1 (909) 783-3636

9.3 *Calibration gases*

User calibration of a gas analyzer will greatly improve the data accuracy in the range of the calibration gases used. This may cause less accurate readings of concentrations outside this calibrated range. Users should select the correct calibration gas for the expected gas levels on their particular application.

- To improve calibration at lower levels requires the use of gas mixtures 1 and 2.
- To improve higher levels use gas mixture 3.
- For standard CO only 100ppm CO gas is needed.
- For CO (H_2 compensated) both CO 100ppm and H_2 1000ppm gases are needed.

The following table indicates a partial listing of gases sold by LANDTEC for calibration:

Calibration gas	**CH_4**	**CO_2**	**O_2**	**N_2**
Mixture 1	0%	0%	4%	Balance
Mixture 2	15%	15%	0%	Balance
Mixture 3	50%	35%	0%	Balance
Mixture 4	0%	0%	0%	100%

Calibration targets for gas cells are dependent on the gas/range and type of cell fitted. Contact Technical Support for assistance.

These are for general use but other gas concentrations can be used.

✍ Note: The above gases and most other gas concentrations can be supplied by LANDTEC. For further information please contact Sales on +1 (909) 783-3636 email sales@landtecna.com

⚠ **Warning**	Calibration gases can be dangerous. For each gas used the appropriate material safety data sheet must be read and understood before proceeding.

9.4 *Calibration set-up*

⚠ **Warning**	Do NOT attach the gas supply to the gas analyzer before putting the analyzer into the 'Gas Check' screen. Select 'Check Spans' from the 'Operation Settings' menu.

The regulator supplied with the calibration kit has been configured to deliver a fixed flow.

As the regulator's flow is factory set, it only requires a few turns to open, no adjustment is necessary.

⚠ **Warning**	**Exhaust port** When the gas analyzer is being calibrated, there are two possible exits for the gas, via the usual manner out of the exhaust (yellow) port of the analyzer or through the optional pressure relief valve. In cases of over-pressurization the port on the pressure relief valve will open. It is recommended that tubing is attached to the instrument during a calibration or gas check. The exhaust tubing must emerge in a well-ventilated area. Ensure there are no leaks in the tubing and connections. The calibration of the gas analyzer should be carried out in a safe area with all necessary precautions taken when using potentially dangerous, explosive or toxic gases.

9.5 *Calibration equipment*

The following diagram displays the regulator, tubing and carrying case used for user calibration:

Figure 32—LANDTEC Calibration Gas Kit

- Certified calibration gas cylinders are supplied with the LANDTEC calibration kit. The volume of gas is typically 34 liters. Certain gas mixtures may have different

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volumes. Please refer to the LANDTEC website www.landtena.com for further information.

- The regulator supplied with the calibration kit is pre-set for flow and pressure rates that are factory set. If using other gas sources and regulators please match the flow and pressure of the LANDTEC regulators. An optional pressure relief valve is suggested if using a NON-LANDTEC regulator just as a safety precaution. Over pressurization of the analyzer can cause damage to the analyzer and cause it to malfunction.

9.6 *Gas analyzer*

For the GEM5000 gas analyzer the calibration options can be found by selecting the 'Menu' key followed by soft-key 'Operation Settings'. Select 'Key 2 – Gas Check' then follow the instructions on the analyzer screen by selecting 'Key 2 – Check Spans'.

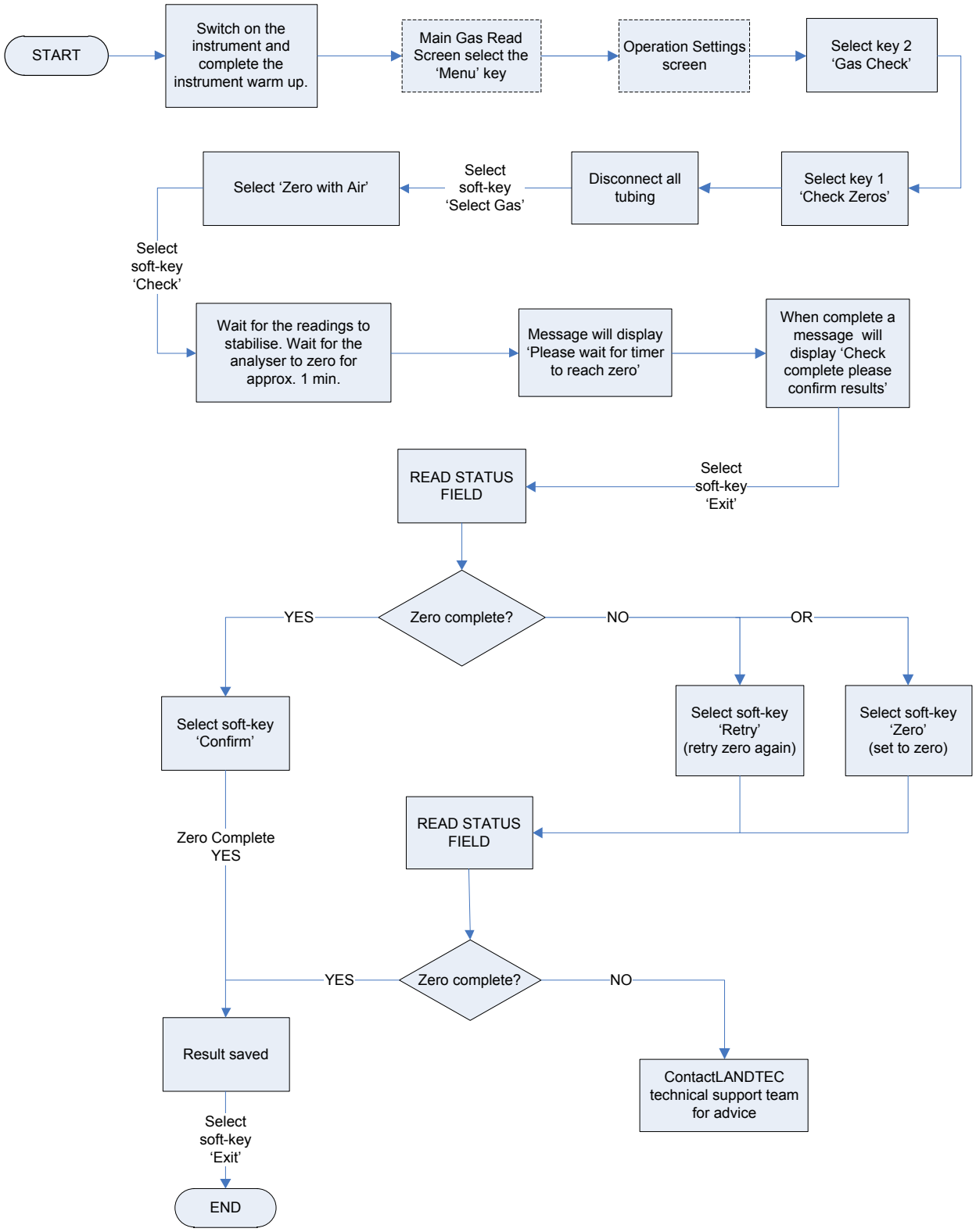
Figure 33—Gas Check

✍ Note: Certain gas channels (4 & 5) may not be active and will be shown without a label on the screen.

9.7 *Calibration processes – best practice*

The following process diagrams outline the calibration steps.

9.7.1 Check zeros – Zero using air (Flowchart)



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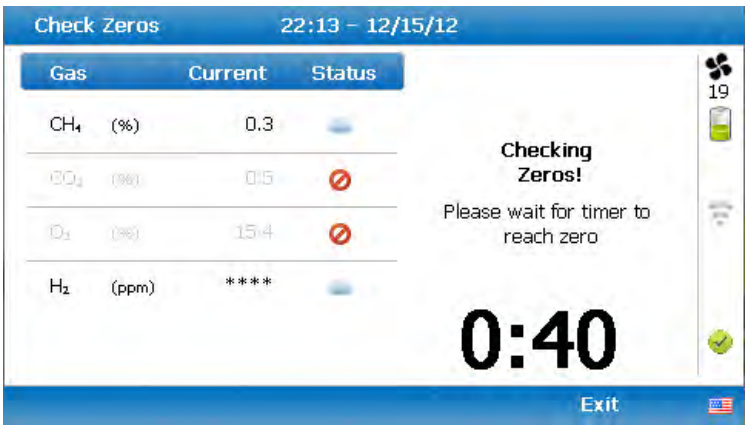
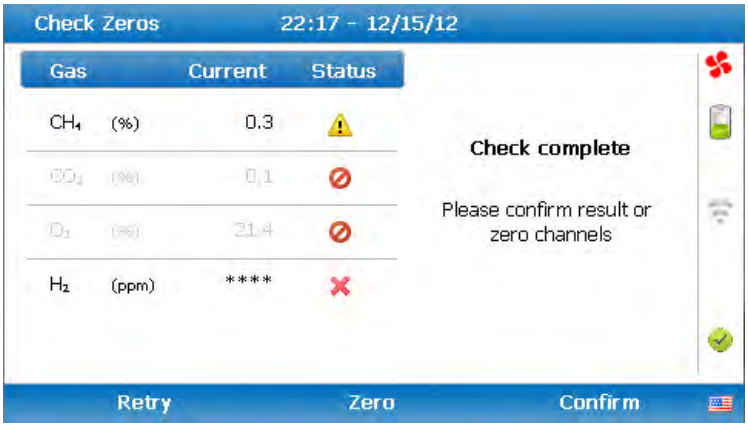
9.7.2 Check zeros – Zero using air (Step by Step)

From the Check Zeros screen press the soft-key “Select Gas” repeatedly until the “*Zero Using Air*” screen appears.

Press the soft-key **Check** to continue.



A timer will begin drawing in an air sample and checking the zeros for Methane and other non CO_2 or O_2 shown in bold.



Once the check is complete, Press the soft-key **Zero** to reset the zero point for the Gas.

Once the zero sets successfully, Press the soft-key **Exit** to return to the *Operations Settings Menu.*

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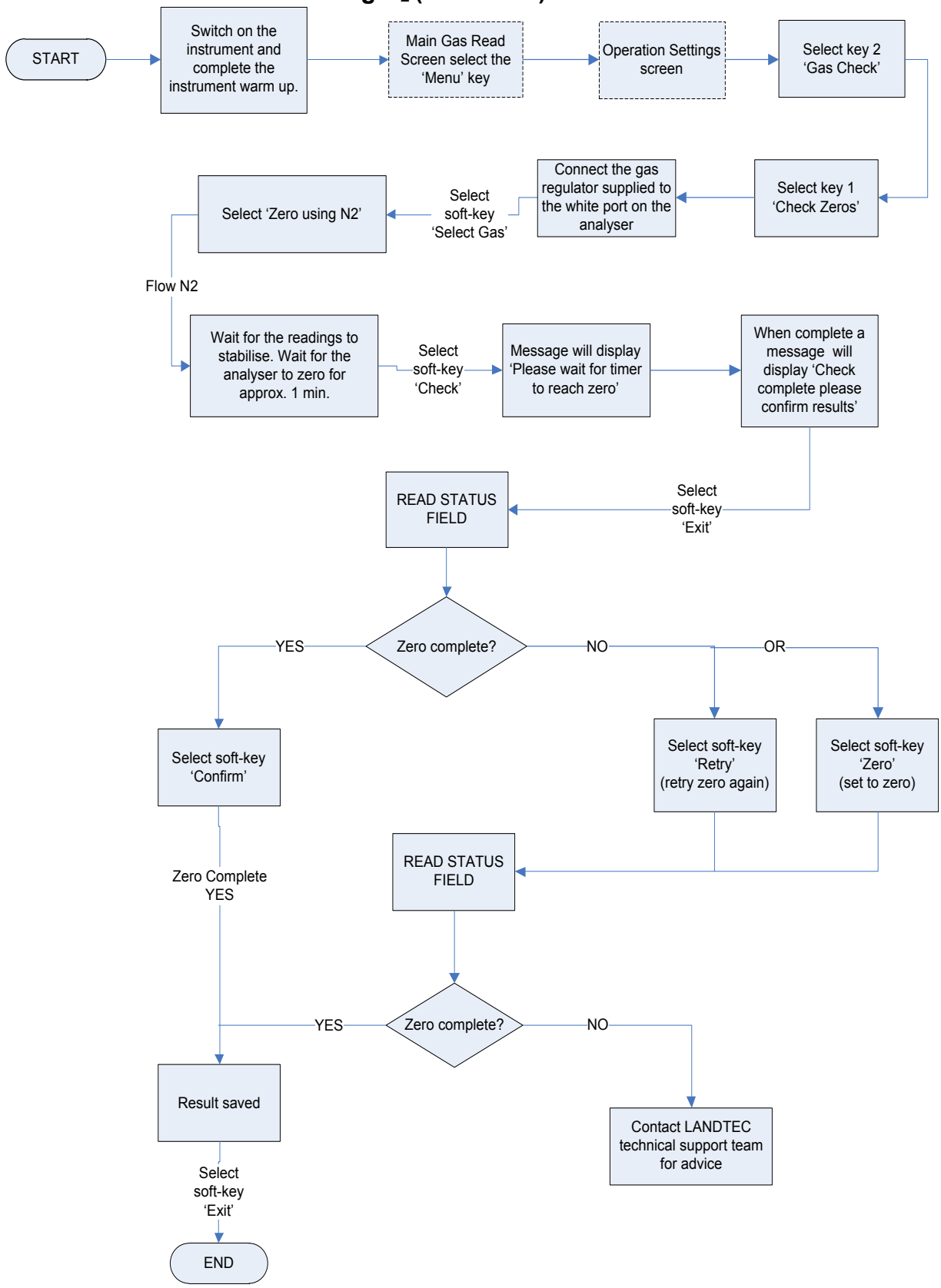
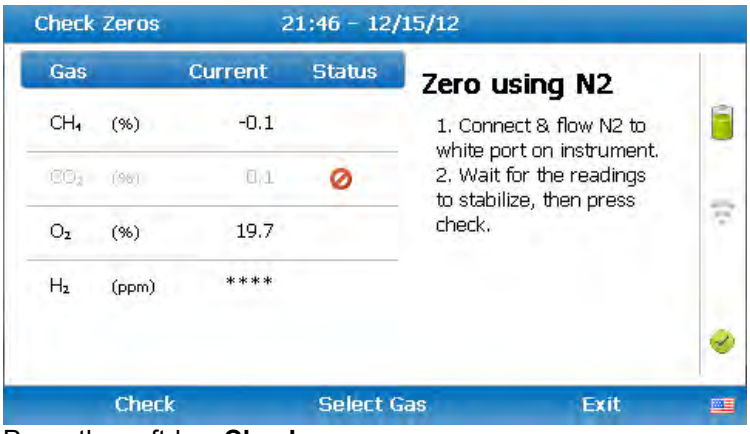
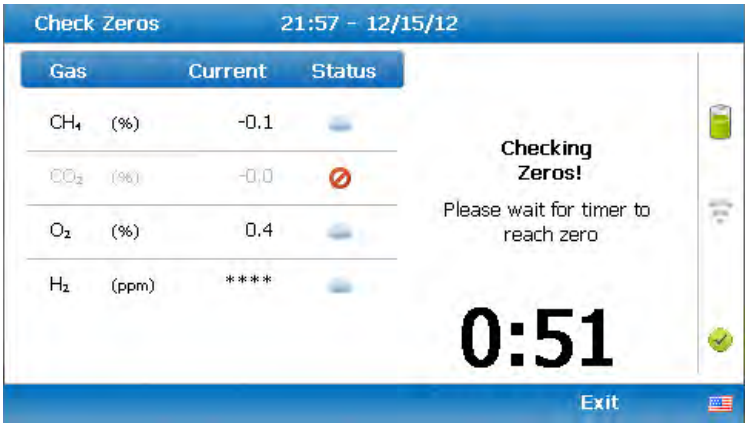
9.7.3 Check zeros – Zero using N_2 (Flowchart)



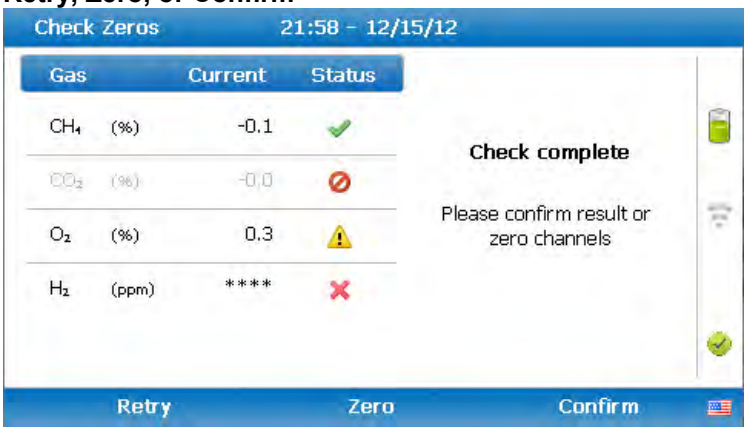
9.7.4 Check zeros—Zero Using Nitrogen (step by step)



Press the soft-key **Check.**



A countdown timer will begin. After the time has elapsed, you will be able to press one of the soft-keys **Retry, Zero, or Confirm**



- **Retry**—will take you to the previous count down screen to retry the check zero process
- **Zero—**will set the values to zero if they have a check mark indicating they are within tolerance or if they have an exclaimation point. Indicating the channel is out of tolerance but user zeroable.
- **Confirm**—accepts the values displayed on the screen

Press the soft-key **Zero**.

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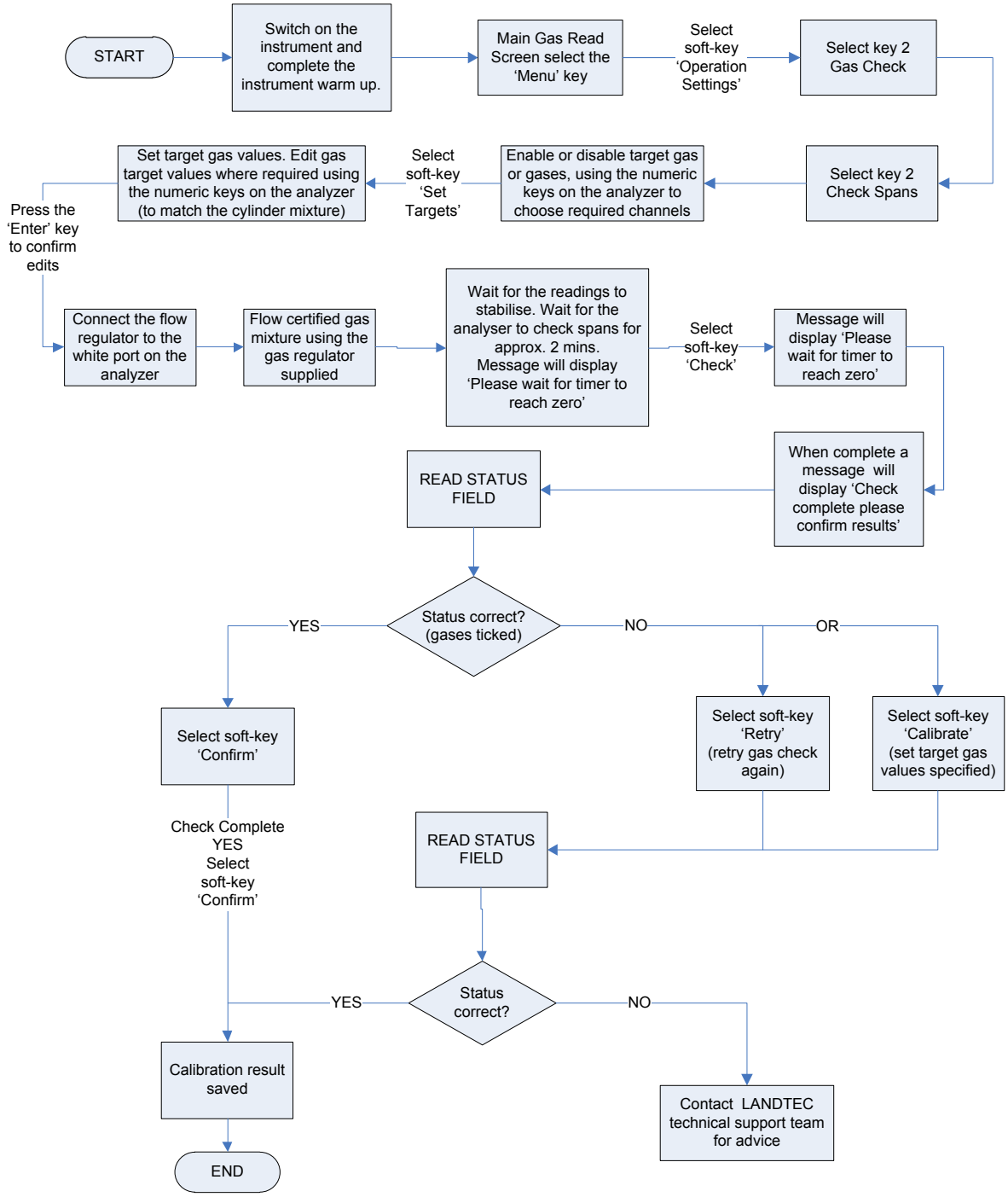
Press the soft-key **Exit**

9.7.5 Calibration (Check Spans) – mixtures 1, 2 & 3



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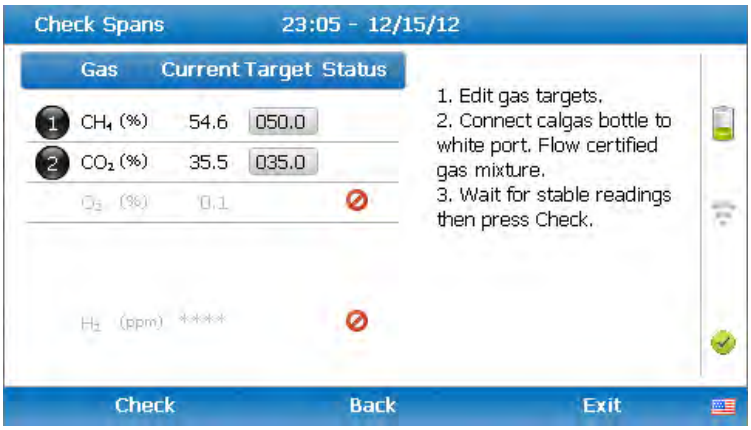
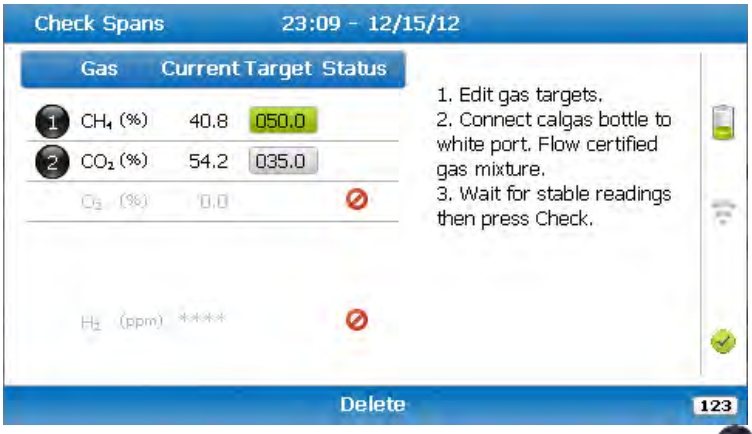
9.7.6 Calibrate/Span using CH_4, CO_2, Balance Nitrogen

Press 1 then 2, to specify the gases to be used for the calibration. The Circle-Slash icon will be removed from the status column.

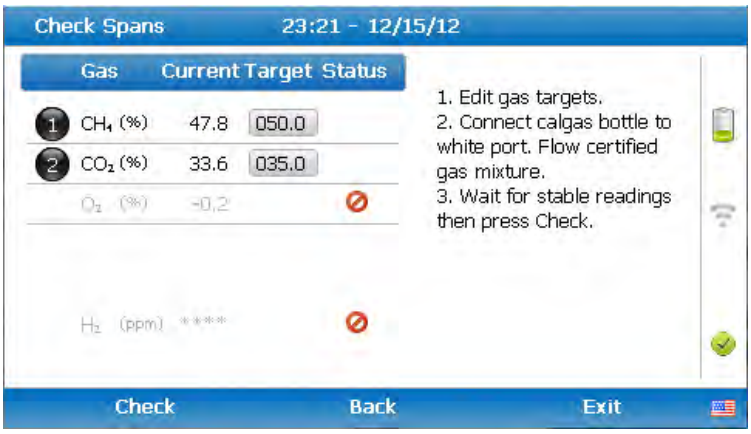
Press the soft-key Set **Targets**



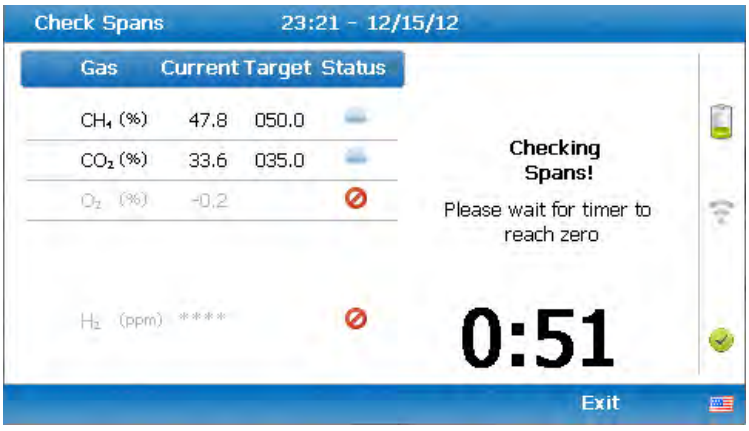
If the target gas needs changing, press the 1 or 2 keys to select the gas to target to edit. Once the editing is enabled you will be able to enter in the concentration. For 50.0% the value will be entered in as 0500.



After the value is keyed into the green entry box, press the key to accept the target. Repeat entering the target for each of the gases.



Once all values are entered press the soft-key **Check**



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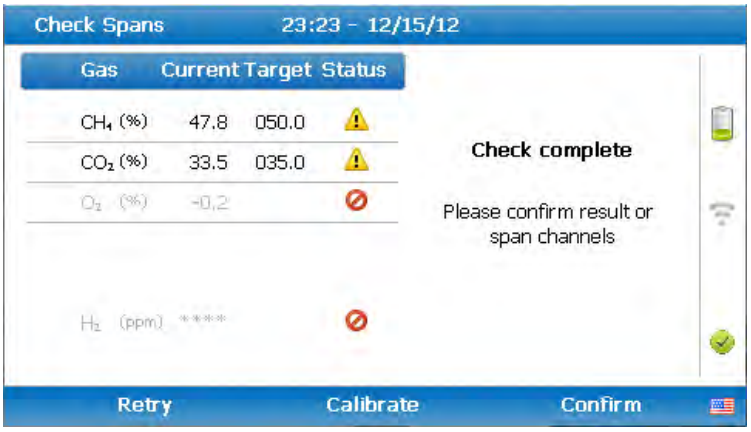
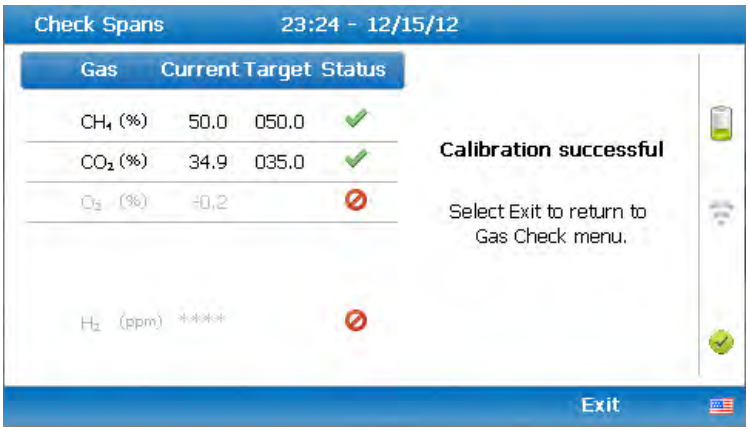


Press **Calibrate** to the span gases to their targets.

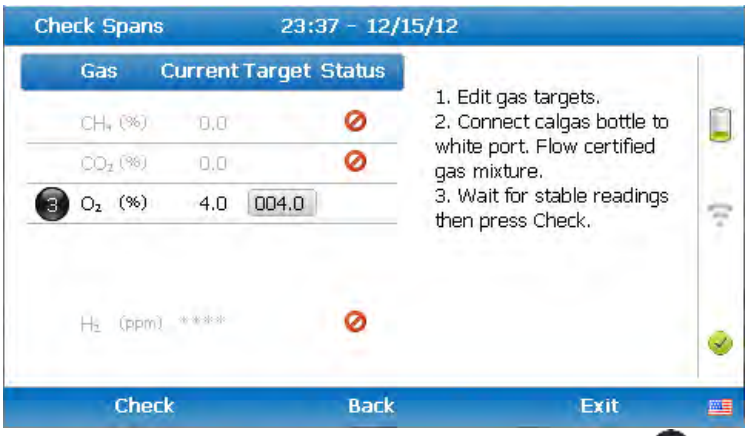


This has successfully calibrated the CH_4 and CO_2 gases. Now repeat the process using a certified bottle of O_2.

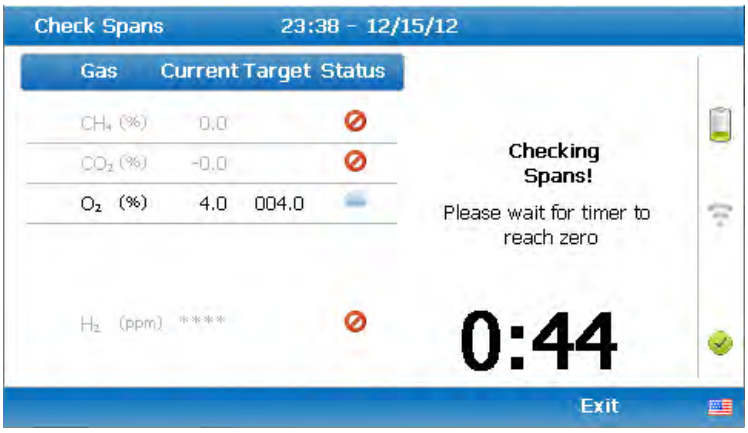
9.7.7 Calibrate using O_2, Balance Nitrogen.

Press 1 & 2 keys to place a circle slash in for the CH_4, CO_2 gases. Press 3 to remove the circle-slash.

Now press set the soft-key **Set Targets**.



If the target for oxygen needs to be changed press the 3 key. Otherwise press the soft-key **Check**



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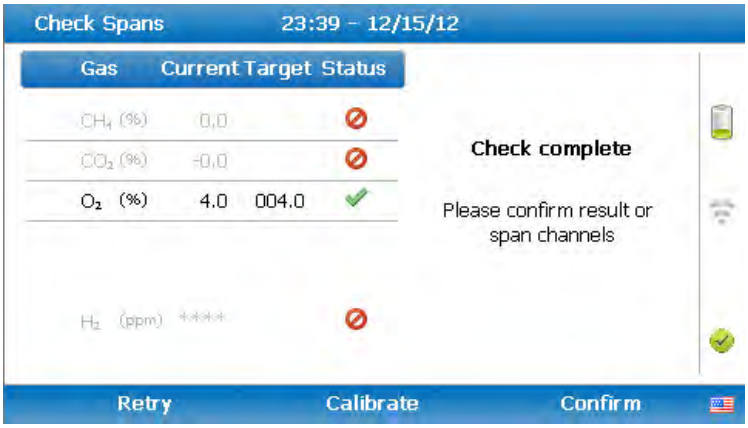

Press the soft-key **Retry** to begin checking the spans again.
Press the soft-key **Calibrate** to set the current span to the target gas.
Press the soft-key **Confirm** to accept the existing calibration.

Press the soft-key **Exit** to return to the ***Gas Check Screen***.

9.7.8 Restore to factory

This option will reset the gas analyzer to all of its factory programmed settings and will clear ALL the user defined calibration points.

If in any doubt please contact Technical Support at +1 (909) 783-3636 or email: technical@landtecna.com.

1) Select the 'Menu' key.

2) Select soft-key 'Operation Settings'.

3) Select 'Key 2 - Gas Check'.

4) Select 'Key 3 - Restore to factory' followed by the soft-key 'Confirm' or 'Cancel'.

5) A validation message is displayed 'Reset user calibration?' Press the soft-key 'Confirm' to continue with the factory settings or soft-key 'Cancel' to cancel the operation and return to the Gas Check menu.

9.8 *Calibration history*

The GEM5000 gas analyzer has the facility to log user calibrations in an 'Event Log' which is accessible to the user via the LANDTEC System Gas Analyzer Manager (LSGAM). This can be used as an aid to ensuring that gas measurements are valid and accurate. Both good and failed calibration results are recorded for each channel calibrated.

1) Select the 'Menu' key.

2) Select soft-key 'Operation Settings'.

3) Select 'Key 2 - Gas Check'.

4) Select 'Key 4 – History'.

5) The operator may view the calibration data stored. Use the soft-key 'Filter' to add a sort filter to the history enquiry.

9.9 *Calibration summary*

The GEM5000 gas analyzer has the facility to log the history of user calibrations.

1) Select the 'Menu' key.

2) Select soft-key 'Operation Settings'.

3) Select 'Key 2 - Gas Check'.

4) Select 'Key 5 – Summary'.

5) The operator may view the calibration data history stored by ID, technician, timestamp, type and calibration result. Use the soft-key 'Exit' to exit and return to the 'Gas Check' menu.

10 Problem solving

This section outlines various warning and error messages which the operator may receive during general operation of the instrument.

For further assistance please contact Technical Support at +1 (909) 783-3636 or email technical@landtecna.com

11 Warning and error display

When switched on the instrument will perform a pre-determined self-test sequence taking approximately 15 seconds. During this time many of the instrument's working parameters and settings are checked.

If any operational parameters are out of specification or the pre-programmed recommended calibration/service date has passed, errors or warnings may be displayed.

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Use the 'Scroll up' and 'Scroll down' keys to move through the list if required.

Only three warnings/errors can be displayed at any time.

To ascertain if more errors have occurred use 'Key 8' – Scroll down' and 'Key 2' - Scroll up' through the list.

Warnings displayed:

All warnings displayed will be prefixed by the word WARNING followed by a relevant description.

There are two types of warning that may be displayed:

1. General warnings that may not affect the instrument's function and those where the self-test has detected a function that is outside the usual programmed operating criteria, e.g. battery charge low, memory nearly full.

2. Operational parameters that could affect the performance of the analyzer: Cell out of calibration, CH_4 out of calibration, CO_2 out of calibration.

The most likely reason for the errors is either an incorrect user calibration or sensor failure. If an incorrect user calibration has caused the warning it should be correctable by way of returning the instrument to factory settings, zeroing or carrying out a user calibration as necessary for the relevant function.

12 Event log

The GEM5000 gas analyzer incorporates the facility to log significant events performed on the analyzer via the 'Event Log'. This can be used as an aid to LANDTEC service staff as a diagnostic tool.

Events are stored in the event log automatically. No user intervention is required. If the log becomes almost full, a warning will be given on the start-up screen. If the log becomes full then no further events will be stored.

At the present time, the log cannot be downloaded, viewed or cleared by the LANDTEC System Gas Analyzer Manager.

✍ Note: The event log cannot be viewed directly on the analyzer.

13 Service

The GEM5000 gas analyzer should be regularly serviced to ensure correct and accurate operation. LANDTEC recommends a service and recalibration every **12 months**.

The GEM5000 range is ATEX certified for use in potentially explosive areas. As such it should be serviced only by qualified engineers. Failure to observe this will result in the warranty becoming invalid and could invalidate the ATEX certification.

⚠ **Warning**	If the GEM5000 is to be serviced by trained LANDTEC personnel. Service by any untrained personnel will negate service technicians serviced by unqualified engineers the ATEX certification may be invalidated and the instrument may be unsafe for use in a potentially explosive atmosphere.

User serviceable parts:

There are no user serviceable parts inside the instrument.

The following parts can be user serviced:

In-line water filter	This should be regularly inspected for obstructions, moisture or damage and changed if needed. The instrument should never be operated without the in-line water filter as this may result in water entering the instrument.
Sample tubing	Always ensure that sample tubes are not contaminated or damaged.
Gas port connectors	Periodically check that the O-rings on the gas port connectors are not damaged. A damaged O-ring can let air into the sample gas and result in incorrect readings. If the O-ring is damaged the complete gas port connector should be replaced.
H_2S filter material	When the filter material changes color to a *light grey* color the filter should be replaced.

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13.1 *Warranty policy*

This instrument is guaranteed, to the original end user purchaser, against defect in materials and workmanship for a period of **1 year** from the date of the shipment to the user. The 1 year warranty may be extended up to 3 years with the purchase of a "Diamond Service Agreement". Please contact your LANDTEC representative for more details.

During this period LANDTEC will repair or replace defective parts on an exchange basis.

The decision to repair or replace will be determined by LANDTEC.

To maintain this warranty, the purchaser must perform maintenance and calibration as prescribed in the operating manual.

Normal wear and tear, and parts damaged by abuse, misuse, negligence or accidents are specifically excluded from the warranty.

✍ Note: Please contact Technical Support at +1 (909) 783-3636 for further information.

13.2 *Sample certificate of calibration*

This is a sample certificate of calibration supplied at the time of purchase and updated when the instrument is serviced.

CERTIFICATION OF CALIBRATION

ISSUED BY: Landtec North America Instrument Services Facility
Date Of Calibration: March 6, 2012
Certificate Number: G500038_6/6442

No. 66916

Page 1 of 2

Approved By Signatory

Landtec North America Instrument Services Facility
850 South Via Lata, Suite 112, Colton CA 92324
Web site: www.landtecna.com

Jose Munoz
Laboratory Inspector

Customer: ***LANDTEC Valued Customer***

850 S Via Lata
Suite 112
Colton, CA 92324

Sample

Description: GEM5000

Model: GEM5000
Serial Number: G500038

Accredited Results:

Methane (CH4)		
Certified Gas (%)	Instrument Reading (%)	Uncertainty (%)
50.01	50.01	1.10
15.02	15.02	0.66
5.00	5.00	0.42

Carbon Dioxide (CO2)		
Certified Gas (%)	Instrument Reading (%)	Uncertainty (%)
49.99	49.94	1.20
14.99	14.67	0.71
4.99	4.76	0.43

Oxygen (O2)		
Certified Gas (%)	Instrument Reading (%)	Uncertainty (%)
21.01	21.05	0.25

Gas cylinders are traceable and details can be provided if requested.

CH4, CO2 33.2°C/91.7°F Barometric Pressure: 28.73"hg

O2 readings recorded at: 24.1°C/75.4°F

Method of Test: The analyser is calibrated in a temperature controlled chamber using reference gases.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with NIST requirements.

This certificate is issued in accordance with the laboratory accreditation requirements of the National Institute of Standards and Technology. It provides traceability of measurement to recognized national standards, and to units of measurement realized at the National Institute of Standards and Technology or other recognized national standards laboratories. Certification only applies to results stated. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

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CERTIFICATION OF CALIBRATION

PILA ACCREDITED CALIBRATION LABORATORY NO. 66916

Certificate Number
G500038_6/6442
Page 2 of 2

Non-Accredited results:

Barometer (mb)	
Reference	Reading
0975mb / 28.80"hg	0973mb / 28.73"hg

Sample

As received gas check readings:

Methane (CH4)	
Certified Gas (%)	Instrument Reading (%)
60.01	59.72
15.02	14.98
5	4.98

Carbon Dioxide (CO2)	
Certified Gas (%)	Instrument Reading (%)
39.99	40.11
14.99	15.00
4.99	4.98

Oxygen (O2)	
Certified Gas (%)	Instrument Reading (%)
21.01	20.70

As received Gas readings recorded at: 24.28°C/75.7°F
As received Barometric Pressure recorded at: 29.01 "hg

As received gas check readings are only recorded if the instrument is received in a working condition. Where the instrument is received damaged no reading can be taken.

End of Certificate

13.3 *Important notice to all customers*

WEEE COMPLIANT

The recycle bin symbol now displayed on equipment supplied by LANDTEC signifies that the apparatus must not be disposed of through the normal municipal waste stream but through a registered recycling process.

The Waste Electrical and Electronic Equipment directive (WEEE) makes producers responsible from July 1st 2007 in meeting their obligations, with the fundamental aim of reducing the environmental impact of electrical and electronic equipment at the end of its life.

Geotech, a subsidiary of LANDTEC, is now registered with the Environmental Agency as a producer and has joined a recycling program provider who will manage and report on our electrical waste on our behalf. Geotech's Producer Registration Number is WEEE/NYN680

When your instrument is at the end of its life, please contact the Sales team at LANDTEC who will advise you on the next step in order to help us meet our obligations.

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14 Glossary of terms

5000 series	The 5000 series refers to the GA5000, GEM5000 and the Biogas5000 gas analyzers.
Accu-Flo	A flow device used to aid in accurate flow measurement. Accu-Flo is a wellhead flow measurement product manufactured by LANDTEC and its flow characteristics are pre-programmed in the GEM
Altitude	The height above sea level.
Analyzer error messages	Operational errors are prefixed on the analyzer by the word ERROR followed by an error code. Refer to the list of standard error codes for more information.
Analyzer warning	Analyzer warnings are prefixed by the word WARNING followed by a relevant description. There are two types of warning messages displayed; general warnings that may not necessarily affect the instrument's function (for example, battery power low) and operational parameters that could affect the performance of the analyzer(for example, CH_4 out of calibration).
ATEX certification	The GEM5000 is ATEX certified to zone 1 & 2 areas above ground not in mines.
Auxiliary channel	This refers to the channels where external devices will be connected or displayed.
Backlight	The analyzer has a built-in backlight for low ambient light conditions. This can be toggled on/off using the backlight key.
Barometric pressure	The atmospheric pressure at the given location.
Bearing	Direction for GPS.
Device ID, Well, Probe, or Sample Port	Typical location from which a gas sample is obtained.
Calibration	The gas analyzer is carefully calibrated against known standards.
Calibration record	The GEM5000 instrument has the facility to log user calibrations as a validation tool.

Calorific value	The amount of heat released during combustion. Simply thought of as Energy.
CH_4	Methane
Chemical cells	A method of gas detection that works on the basis of a chemical reaction with the target gas.
Clean air purge	Process used to clear out gas from the sample tube and analyzer prior to taking a new reading.
CO	Carbon monoxide
CO_2	Carbon dioxide
Device ID	See ID
Download	Terminology used for the movement of data from the analyzer to the LSGAM application on the PC.
Dual beam infrared absorption	Method of gas detection by measuring how much infrared is absorbed by the target gas.
Event log	Used as an aid to monitoring the use of the analyzer. It can also be used as a diagnostic tool. The event log can be viewed via LANDTEC System Gas Analyzer Manager. It cannot be viewed on the analyzer screen.
Exhaust port	The usual manner for the gas to exit the analyzer is via the exhaust port located on the top side of the analyzer. This port should have an exhaust tube attached.
Exhaust tube	Tubing used to expel gases from the exhaust port. LANDTEC supplies a yellow colored hose for this purpose.
Factory settings	Default settings preset at time of manufacture or service.
Firmware	Firmware is the term by which the internal analyzer software is known and is not accessible by the client. The firmware is updated to the latest version when the analyzer is returned to LANDTEC under a service agreement.
Flow measurement	Flow measurements are on a volume flow rate SCFM or m^3/hr.
Flow port	For the measurement of gas flow at the sample point.
Gas channels	The gases that are analyzed by the instrument.

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Gas velocity	The positional rate of change of the gas. Measured using the optional anemometer.
General warnings	Displayed throughout the documentation with a warning symbol. Warning information may affect the safety of operators.
H_2	Hydrogen
H_2S	Hydrogen sulfide
H_2S filter	Filter required for removal of H_2S. When the filter material changes color to a light grey color or if H_2S values are displayed, then the filter should be replaced.
HDOP	Horizontal Dilution of Precision—a measure of the position indicated by the GPS.
Horizontal Error (HError)	The estimated horizontal error for the position indicated by the GPS at a given moment in time.
Hydro-carbons	Organic compound consisting of only hydrogen and carbon.
ID or Device ID	The user definable identification tag "Device ID" allocated to a sample point (well, probe or sample port).
In-line water filter	The component used to help protect the instrument from liquid ingress.
LANDTEC System Gas Analyzer Manager	Also referred to as LSGAM. PC based software which enables the operator to upload and download information to/from the analyzer. LANDTEC System Gas Analyzer Manager enables operators to maximize the operation of their gas analyzer. It features a simple upload and download facility and is fully compatible with the latest Microsoft™ operating systems.
Latitude or LAT	Latitude displays as degrees, minutes, seconds and decimal seconds. The equator is zero.
LCD display	Liquid Crystal Display
LEL	Lower Explosive Limit. Lower explosive limit of methane in air. 5% methane in air is the point at which it becomes explosive. 100% LEL equates to 5% methane.

Longitude or LONG	E (East) or W (West) displays the longitude as degrees, minutes, seconds, and decimal seconds. The Greenwich meridian defines the zero point.
m^3/hr	Meters cubed per hour – volumetric flow rate measurement.
Main Gas Read Screen	The main analyzer screen for normal operations and all operations are carried out from this screen.
Material safety data sheet	Document from which information about a certain substance can be obtained. This document contains relevant health & safety information along with physical characteristics of the substance.
MCERTS certification	MCERTS is the UK Environment Agency's Monitoring Certification Scheme. The scheme provides a framework within which environmental measurements can be made in accordance with the Agency's quality requirements. The scheme covers a range of monitoring, sampling and inspection activities.
Memory	Location where data and ID information is stored. The analyzer memory should not be used as a permanent storage medium. Stored data should be regularly transferred using the LSGAM download software.
NO_2	Nitrogen dioxide
Operating language	The operator can choose the default operating language for the analyzer. Choices are English, Spanish, and Portuguese.
PPM	Parts per million
Pump	Used to draw the gas sample from the sample point to the analyzer. Select the pump key on the analyzer to activate.
Relative pressure	The pressure at the sample point 'relative' to atmospheric (barometric) pressure.
Relative pressure transducer	The internal component used to measure the relative pressure.
Sample tube	The tube used to obtain a sample of gas from the sample point to the analyzer.
Satellite	This is the number of satellites that the system can select. Four satellites will give a reasonable position. Eight or more satellites will increase the position of

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	the accuracy. (lower HError, VError and HDOP numbers)
SCFM	Standard Cubic Feet per Minute – Volumetric Flow Rate
Status	Overall representation of the GPS Signal Quality.
Span	The point at which the gas analyzer is calibrated when a known quantity of the target gas is present.
Span multi gas	Term by which the span calibration of the three main gas channels is known. This option must only be used when the calibration gas being used is a combination of CH_4 CO_2 O_2.
Technician ID	An alpha-numeric code tagged to each gas reading.
Temperature probe	External device used to measure the gas temperature at the sample point. This is optional.
Update site data	Enables the operator to answer pre-defined questions relating to the site, environment etc. These questions are defined via 5GAM software.
Upload	Terminology used for the movement of data from the PC via GAM software application to the analyzer.
UTC Time	Coordinated Universal Time (UTC) received from the satellite and displayed as Greenwich Mean Time (GMT).
Vertical (VError)	An estimate of the amount of vertical error on the GPS indicated position.
Volume flow rate	The volume of a gas that passes through a given surface per unit of time e.g. m^3/hr
Warm-up self-test	Pre-determined self-test sequence to test the analyzer functions which takes place after the analyzer is switched on.
Warranty	The instrument is under guarantee against defect in materials and workmanship for a period of 3 years from the date of shipment to the operator and is subject to the recommended service and recalibration requirements.
Water trap	Device used to protect the instrument from water or moisture ingress.
Zero	The point at which the gas analyzer is calibrated when there is none of the target gas present.
Zero transducers	This option allows the relative pressure transducer to be zeroed.

15 Appendix—Configuring Communication Connections

15.1 *Legacy Serial Communications Driver Installation*

The instrument supports two modes of communication “Legacy” and “GA5K”. At present the instrument communications software will only communicate in the “Legacy” communications mode.

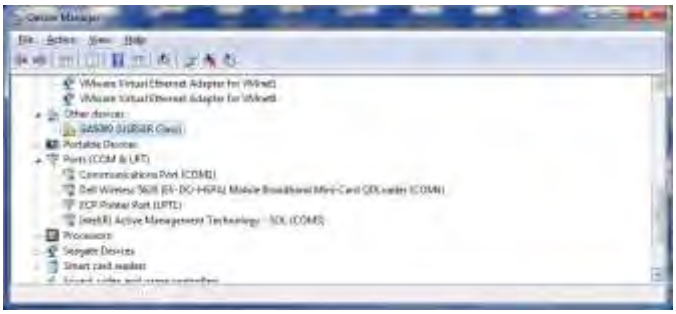
IMPORTANT: Irrespective of operating system, the instrument will need to be set to Legacy communications mode. The drivers will need to be installed using a Windows login account with administrative privileges. If more than one instrument is connected to the computer, it will automatically install the software for the second instrument because an administrator has already installed it initially. Each instrument on a given computer will have a unique COMxx port assigned to the instrument. COMxx port assignments are unique to the computer and not to the instrument. This means the one instrument may be COM17 on a desktop computer and COM6 on a laptop computer.

15.1.1 **Windows 7**

Upon plugging in the cable you’ll see the following bubble appear near the system tray.

Then you’ll see that the software fails.

After it fails, click **Start** then enter **devmgmt.msc** into the search box and press **Enter**. The device manager will open.



Look for any items in the tree with an exclaimation point.

Find an entry named **GA5000 (USBSER Class)**. Then **right click** and choose **Update Driver Software**.

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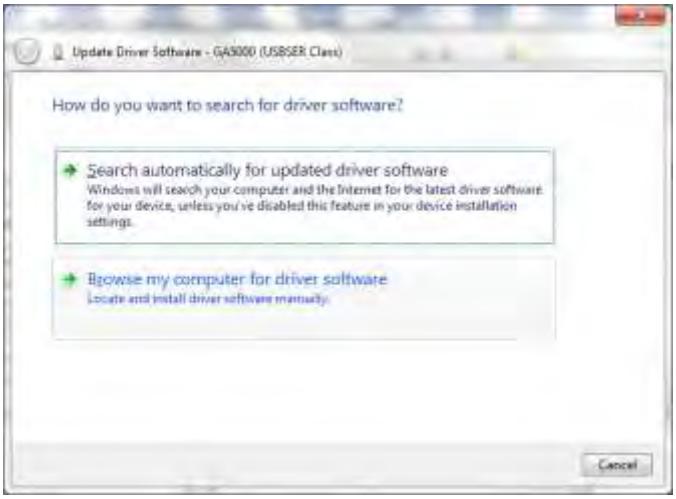
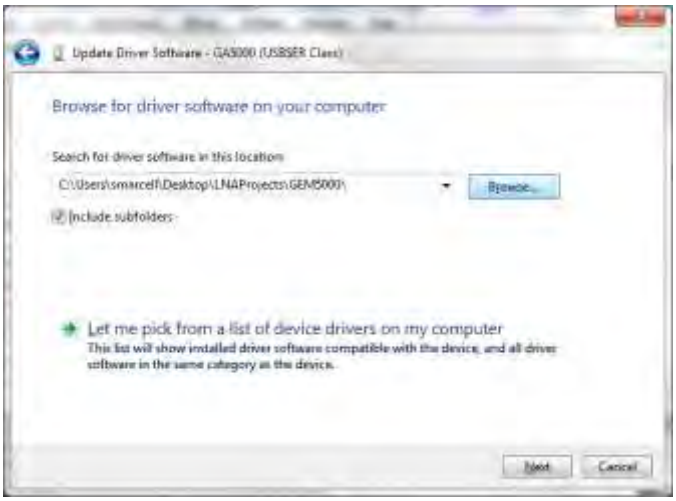


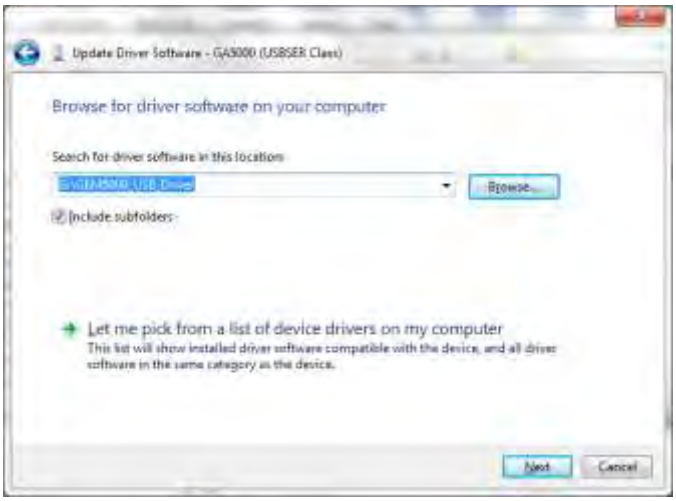
Click on the section titled "**Browse my computer for driver software**".



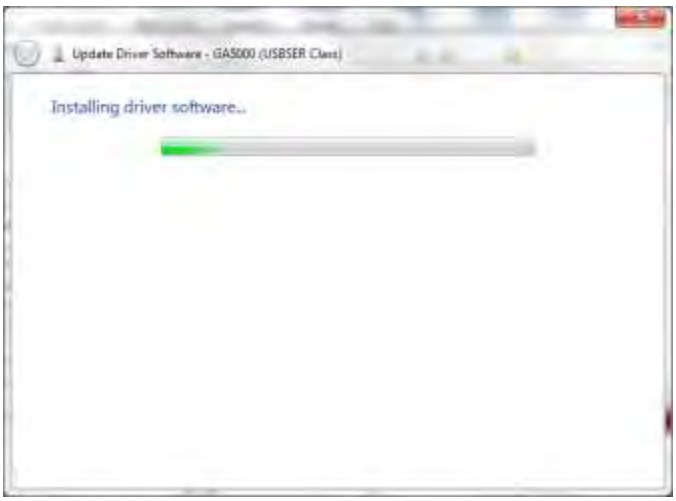
Click on the **Browse** button.

Browse to the drive containing your memory stick or CD-Rom for LSGAM.

Expand the memory stick or CD-Rom containing the **LANDTEC LSGAM & Products** and browse down one level and **click** on **GEM5000_USB_Driver** to select it. Once the GEM5000_USB_Driver is selected. **Click** on the **OK** button.



Click **Next** to continue.



The drivers will begin to install. Eventually a warning will pop-up indicating that the publisher of the deriver software can not be verified.

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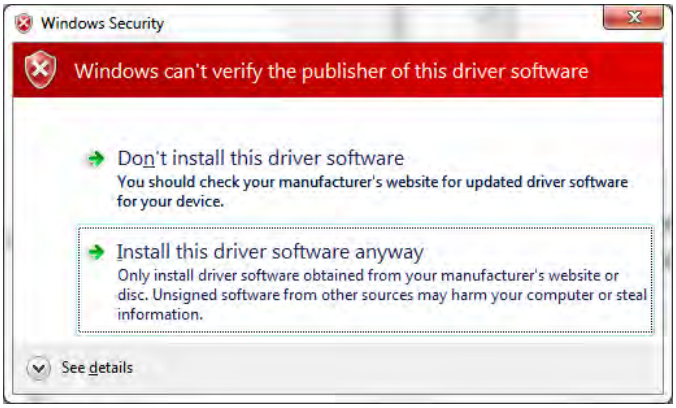
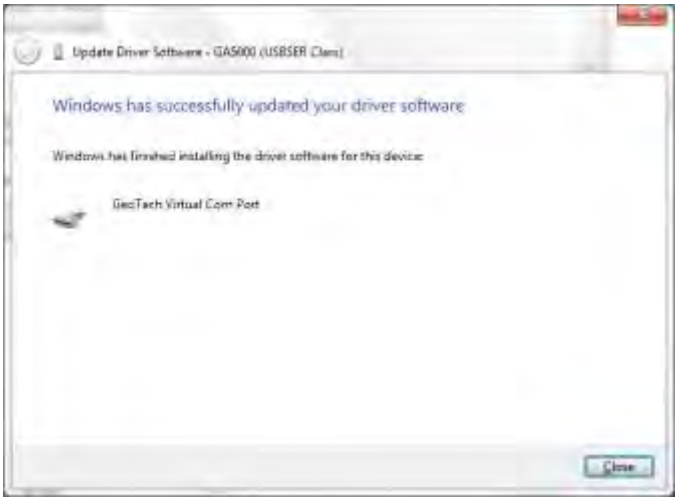


Click on the "**Install this driver software anyway**" section of the box.

The software will continue to install.



Eventually it will indicate "**GeoTech Virtual Com Port**" or "**LANDTEC Virtual Com Port**" has finished installing the driver software for the device.

In the systray a bubble will pop-up indicating "Installing device driver software". Unlike the first time this popped up, it will be able to complete the process.

The previous bubble will disappear and an additional bubble will appear indicating the **GeoTech Virtual Comp Port (COMxx)** or **LANDTEC Virtual Comp Port (COMxx)** is installed successfully.

15.1.2 **Windows XP**

To install the serial drivers you will need to do the following:

Turn on the instrument without the USB cable plugged in. Wait for the self test to complete and press the **Next** soft-key. On the instrument press the **menu** key. Then press the appropriate soft-key until you get to the **device settings** menu. Press 3 for Device Information. Ensure the Comms is set to Legacy. If not, press the soft-key **Comms Mode**. Press the Comms Mode soft-key until the Comms item is set to Legacy.

Now the instrument is ready to accept serial communications.

Plug the USB cable into the instrument and computer. The “Found new hardware” wizard should open.

Choose the second option **“install from a list or specific location (Advanced)”** and click the **Next** button.

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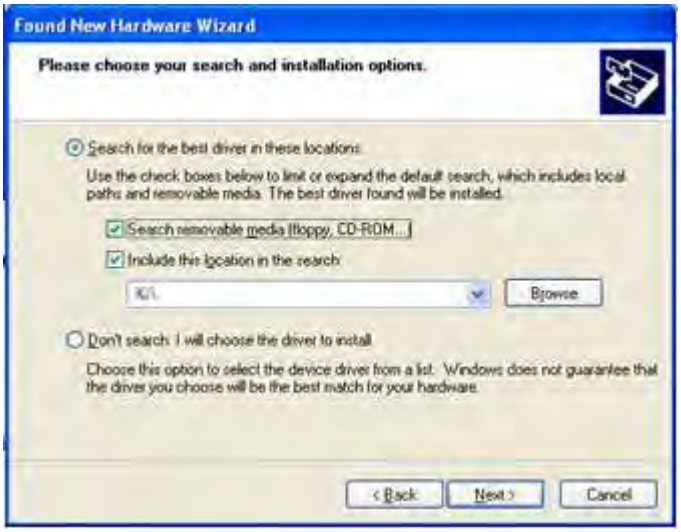
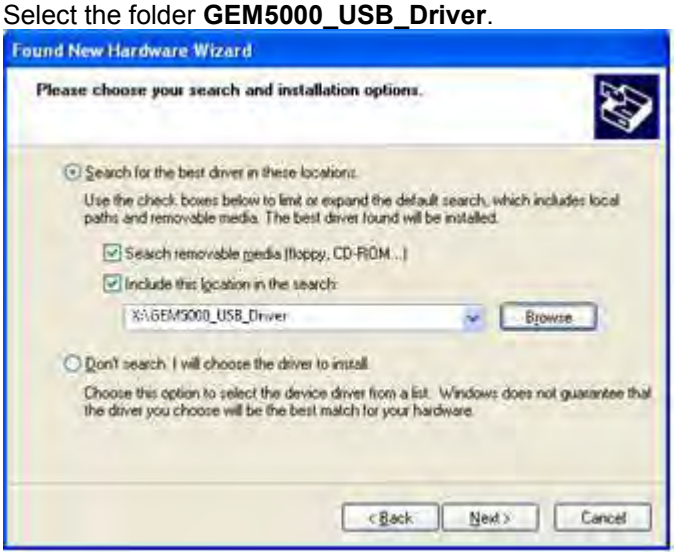


Click the browse button and navigate to the **memory stick** or **CD** with your software.

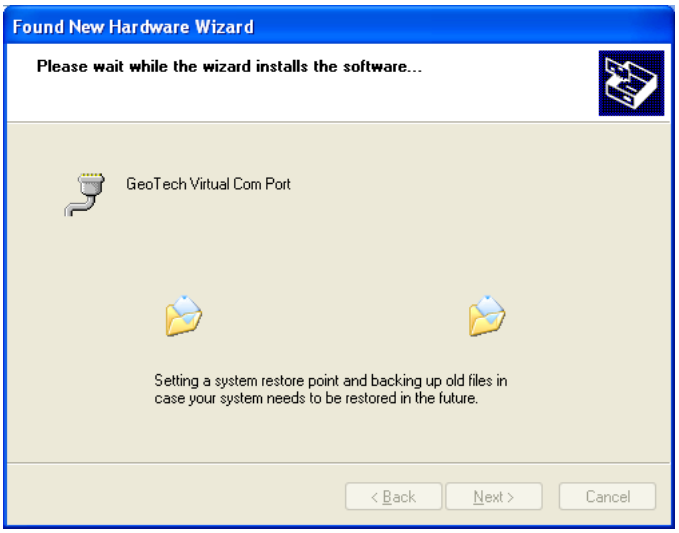
Select the folder **GEM5000_USB_Driver**.



Now click the **Next** button.

The wizard will begin the installation process and will install the GeoTech Virtual Com Port

During the installation process a warning box may appear discussing driver signing and authentication. Click the "**Continue Anyway**" button to allow Windows to complete the installation



A system restore point will be created and the process will continue.

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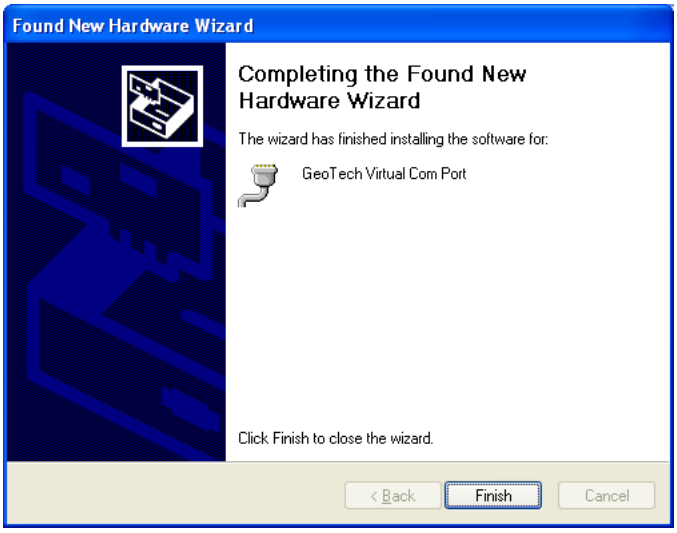


Eventually the installation process will complete and indicate it has finished installing "**GeoTech Virtual Com Port**". Click the **Finish** button.

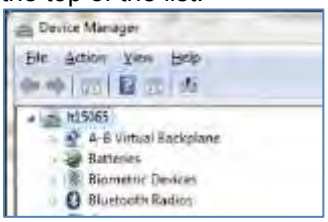
15.2 *Bluetooth Serial Communications*

Bluetooth communications is dependent upon having a Bluetooth radio transmitter connected to your computer. This is typically built in on many laptops by the manufacturer. Most desktop computers do not have the radio transmitter built in. In such a case a USB adapter is often the most cost effective solution.

15.2.1 **Windows 7**

To pair the GEM5000 to Windows 7 first ensure the following:

1) The Bluetooth radio is turned on in your laptop or desktop computer. To ensure your computer is seeing your Bluetooth radio verify this in Windows Device Manager.
   a. Click on **Start** → Search box → then type in **devmgmt.msc** and click on **OK**
      Device Manager will open and you should see an item named "Bluetooth Radios" towards the top of the list.



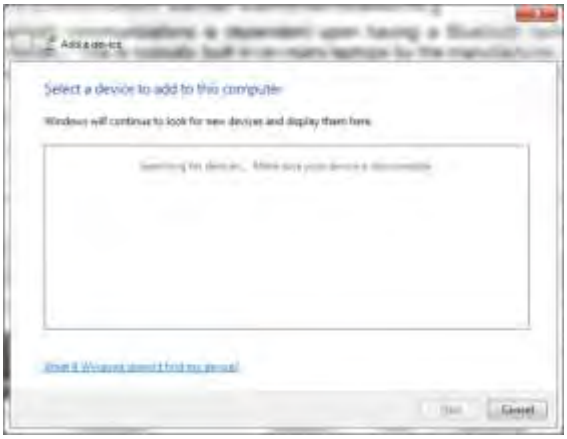
      If you do not see the Bluetooth Radios button you may not have your Bluetooth turned on. If using a Bluetooth dongle you can unplug it and plug it back in. If using a laptop, there may be a physical switch, keyboard shortcut, or other utility to turn the Bluetooth on and off. Please toggle the Bluetooth off and then on again. The Device manager should refresh and display the Bluetooth Radios menu item. If this doesn't resolve the Bluetooth radio from appearing, please consult your computer hardware manufacturer's documentation.

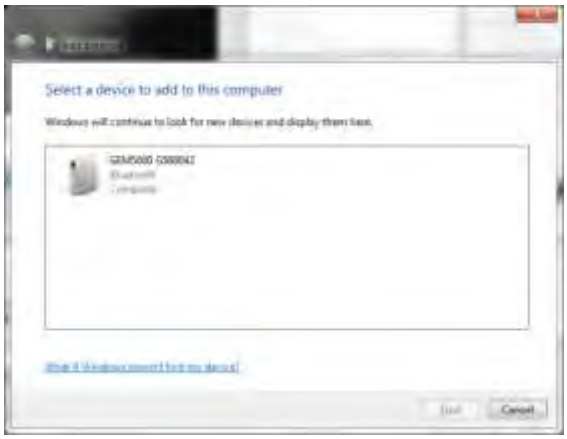
1)
2) The GEM5000 is turned on and has a green battery status indicator.
3) The GEM5000's Bluetooth discover is enabled. To check this, press the Menu button and then press the left or middle soft-key repeatedy until the "Device Settings" menu is displayed. Next press key-2 Bluetooth. (keep this screen open on the instrument as you will need information

from it during the pairing process).

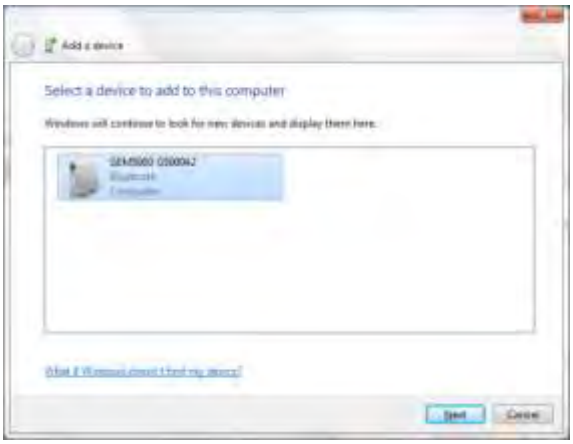
Click on **Start→Devices and Printers**.

Click the “Add a device” link





Once your instrument is seen by the computer it will appear in the Add a device dialog box. Click on the GEM5000 to select it then click the next button to complete the pairing process.



Click Next to continue

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Select the option “Enter the device’s pairing code”, then click next.

The pairing code can be found on the Bluetooth screen of the Instrument.

Note: the pairing code is cAsE sEnSitive and must be entered exactly as shown on the instrument.

Click Next.

The device should successfully add to the computer. Click the close button.

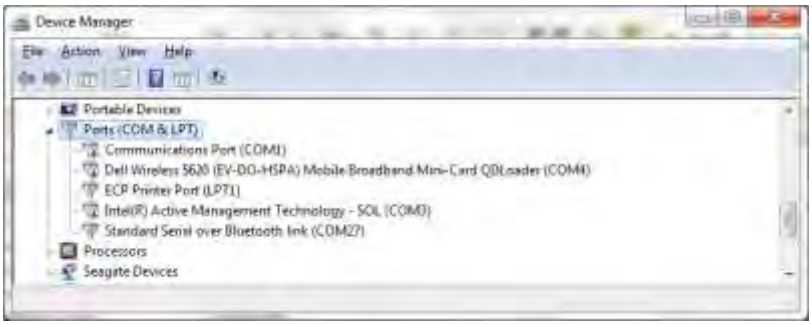
A new icon will appear in the printers and devices window under the section Devices.

To verify the hardware configuration, you can goto device manager to see the comport which it added as. To do this you will goto "**Start**" then in the seach box type in

devmgmt.msc

And press the enter key or click on OK.

Windows Device Manager will open



Navigate down the tree and expand the noted titled "Ports (COM & LPT).

You will see a "Standard Serial over Bluetooth link (COMxx)" entry in the list. This will be the communications port which LSGAM will connect to your instrument. At this point LSGAM can be started and should automatically connect. Refer to the section on LSGAM Startup.

15.2.2 **Bluetooth on Windows XP**

To pair the GEM5000 to Windows XP first ensure the following:

2) The Bluetooth radio is turned on in your laptop or desktop computer. To ensure your computer is seeing your Bluetooth radio verify this in Windows Device Manager.
   a. Click on **Start** → **Run** → then type in **devmgmt.msc** and click on OK
      Device Manager will open and you should see an item named "Bluetooth Raidos" towards the top of the list.

If you do not see the Bluetooth Radios button you may not have your Bluetooth turned on. If using a Bluetooth dongle you can unplug it and plug it back in. If using a laptop, there may be a physical switch, keyboard shortcut, or other utility to turn the Bluetooth on and off. Please toggle the Bluetooth off and then on again. The Device manager should refresh and display the Bluetooth Radios menu item. If this doesn't resolve the Bluetooth

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radio from appearing, please consult your computer hardware manufacturer's documentation.

3) The GEM5000 is turned on and has a green battery status indicator.
4) The GEM5000's Bluetooth discover is enabled. To check this, press the Menu button and then press the left or middle soft-key repeatedly until the "Device Settings" menu is displayed. Next press key-2 Bluetooth. (keep this screen open on the instrument as you will need information from it during the pairing process).

In Windows XP there are several ways to start the Bluetooth device manager. The simplest is to Click **Start→Run** then type in **bthprops.cpl** and click **OK.** The Bluetooth Devices dialog box will appear

Once it appears click the **Add** button to begin the process of pairing the GEM5000 to your Windows XP computer.

Check the checkbox in front of "My Device is setup and ready to be found."

Click the **Next** button to continue.

The Bluetooth Device Wizard will begin searching for devices. Depending upon the computer, other devices in the area, and other factors it may take several minutes for your computer to detect the GEM5000 instrument.

Once the search is complete it will display all discoverable devices within range of the computer.

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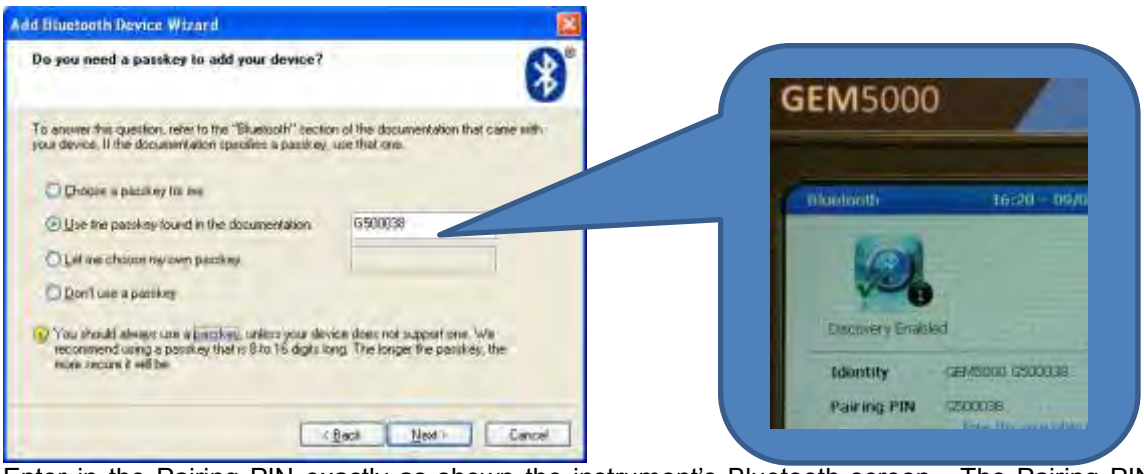
Click on the GEM5000 computer icon. Now click the Next button to continue.



Enter in the Pairing PIN exactly as shown the instrument's Bluetooth screen. The Pairing PIN is cAse SeNsITivE. Click **Next** to continue.

Click the **Finish** button to complete the wizard. You can now start LSGAM to connect to the instrument. **Refer to section titled Start-up**.

There are many varied scenarios related to Bluetooth devices. Should you have difficulty in pairing your instrument to the computer you may search the internet for troubleshooting articles specific to your brand of computer. A general resource to refer to is http://support.microsoft.com/kb/883259 for additional information related to Bluetooth on Windows XP.

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16 Appendices – safety instructions

16.1 *Instructions for safe use – Spanish language*

Instrucciones de seguridad

⚠ **Advertencia**	La serie 5000 de analizadores de gas puede usarse para medir gases de vertederos y otras fuentes de la forma descrita en este manual. El operario puede estar expuesto a gases perjudiciales durante el uso del instrumento. La inhalación de estos gases puede ser nociva para la salud y, en algunos casos, incluso mortal. El usuario es responsable de garantizar que está debidamente formado en los aspectos de seguridad de los gases utilizados y que se respetan los procedimientos adecuados, especialmente en los lugares en los que se usan gases peligrosos, en los cuales el gas emitido por el analizador debe conducirse por un tubo hasta una zona en la que pueda liberarse con seguridad. El instrumento también puede emitir gases peligrosos si se purga con aire limpio.

✍ Nota: los analizadores de gas son instrumentos especialmente delicados del equipamiento científico y deben tratarse con especial cuidado. Un uso del equipo no conforme a las especificaciones del fabricante podría afectar al sistema de protección.

La serie 5000 de los analizadores de gas cumple las estipulaciones establecidas en la Parte 15 de la normativa de la FCC. El funcionamiento depende de las dos condiciones siguientes:

1) El instrumento no debe causar interferencias perjudiciales.

2) El instrumento debe admitir cualquier interferencia que pueda recibir, incluidas aquellas que podrían causar un funcionamiento no deseado.

En cuanto a las directivas ATEX e IECEx, la serie 5000 de analizadores de gas ha recibido la certificación de clasificación de área peligrosa

Ex II 2G Ex ib IIA T1 Gb (Ta = de -10 ºC a +50 ºC)

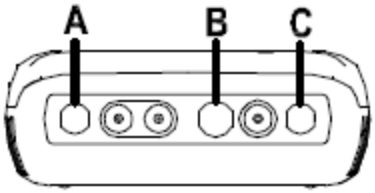
Es de vital importancia que se sigan rigurosamente las instrucciones. El operario es responsable de determinar la noción de protección y la clasificación necesaria para cada aplicación específica.

Instrucciones de seguridad (español)

(Directiva europea ATEX de referencia 94/9/CE, anexo II, 1.0.6.)
Las siguientes instrucciones se aplican a los instrumentos cubiertos por los números de

certificado SIRA 11ATEX2197X y la norma IECEx SIR 11.0089X:

- El instrumento puede utilizarse con gases y vapores inflamables con el grupo de aparatos IIA y la clase de temperatura T1.
- El instrumento sólo está certificado para su uso a temperatura ambiente, comprendida entre -10 ºC y +50 ºC, y no debe utilizarse a diferentes temperaturas.
- El instrumento no debe usarse en lugares con una concentración de oxígeno superior al 21 %.
- La reparación del instrumento ha de realizarse de acuerdo con el código profesional aplicable.
- Si se utiliza en un área peligrosa, utilice solo la sonda de temperatura TP-5000 (SIRA 11ATEX2197X e IECEx SIR11.0089X). En cuanto al conector C, utilice el anemómetro GF5.4 (BVS 04ATEXE194) únicamente con ATEX. En las mencionadas zonas de riesgo, el analizador no debe conectarse a ningún otro aparato en el área peligrosa, incluidos el cable USB-5000 (conector A) o el cargador de batería GEM5000 BC (conector B) suministrados con el propio analizador.



No cargar, recargar o abrir en lugares en los que exista riesgo de explosión.
En áreas peligrosas, utilice solo la "sonda de temperatura TP-5000" en el conector B.
Conector C (Uo=10 V, Io=5 mA, Po=50 mW, Ci=0, Li=0, Co=100 uF, Lo=1000 mH),
Conector B (Uo=5 V, Io=6 mA, Po=7 mW, Ci=0, Li=0, Co=100 uF, Lo=1000 mH)

SUMINISTROS MÁXIMOS NO PELIGROSOS:
Conector A - Um=6 V Conector B - Um=10,1 V

- En caso de riesgo de contacto con sustancias agresivas, p. ej. líquidos o gases ácidos que pueden atacar a los metales o disolventes que pueden afectar a los materiales poliméricos, el usuario es responsable de adoptar las medidas de precaución adecuadas, como las comprobaciones periódicas que sean necesarias como parte de las inspecciones rutinarias o determinar, a partir de la hoja de especificaciones del material, su resistencia a determinados productos químicos que puedan anular sus cualidades de protección, gracias a lo cual se asegura que el tipo de protección no queda comprometido.

- El intervalo de presión relativa es +/- 500 mbar. Tenga en cuenta que, sin embargo, la presión de entrada no debería exceder +/- 500 mbar ni la presión de salida +/- 100 mbar en relación a la presión atmosférica.

<u>Con respecto a la CSA (Canadá), la serie 5000 de analizadores de gas cuenta con la certificación de clasificación de área peligrosa</u>

CLASE 2258 03 - EQUIPO DE CONTROL DE PROCESOS - Sistemas intrínsecamente seguros y no inflamables - Para ubicaciones peligrosas

C US M.C.#243446
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Ex ib IIA:

Detectores de metano modelos GA 5000, GEM 5000 y BIOGAS 5000; paquete de batería portátil, alimentado por batería no recambiable en el lugar de uso N/P 20087; intrínsecamente seguro y con circuitos intrínsecamente seguros ("[ib]" para zona 1) a la sonda de temperatura (conector B) modelo TP-5000 y con los parámetros de salida de entidad como se indica en la siguiente tabla; código de temperatura T1; temperatura ambiente de -10 ºC a +50 ºC.≤≤

Conector	Parámetros de entidad						
	Uo (V)	Io (mA)	Po (mW)	Co (uF)	Lo (mH)	Ci (uF)	Li (mH)
B	5,0	6	7	100	1000	0	0
C	10,0	5	50	100	1000	0	0

✍ Nota: Se ha investigado este instrumento únicamente en relación a las características de seguridad eléctrica.

Con respecto a la CSA (EE. UU.), la serie 5000 de analizadores de gas cuenta con la certificación de clasificación de área peligrosa

CLASE 2258 83 - EQUIPO DE CONTROL DE PROCESOS - Sistemas intrínsecamente seguros y no inflamables - Para ubicaciones peligrosas - CERTIFICADO PARA LA NORMATIVA DE EE. UU.

AEx ib IIA:

Detectores de metano modelos GA 5000, GEM 5000 y BIOGAS 5000; paquete de batería portátil, alimentado por batería no recambiable en el lugar de uso N/P 20087; intrínsecamente seguro y con circuitos intrínsecamente seguros ("[ib]" para zona 1) a la sonda de temperatura (conector B) modelo TP-5000 y con los parámetros de salida de entidad como se indica en la siguiente tabla; código de temperatura T1; temperatura ambiente de -10 ºC a +50 ºC.≤≤

Conector	Parámetros de entidad						
	Uo (V)	Io (mA)	Po (mW)	Co (uF)	Lo (mH)	Ci (uF)	Li (mH)
B	5,0	6	7	100	1000	0	0
C	10,0	5	50	100	1000	0	0

✍ Nota: Se ha investigado este instrumento únicamente en relación a las características de seguridad eléctrica.

MCERTS

MCERTS es el Esquema de certificación de control de la Agencia del Medio Ambiente del

Reino Unido. Dicho esquema constituye el marco en el que realizar las mediciones medioambientales de acuerdo con los requisitos de calidad de la Agencia, y engloba toda una serie de actividades de control, recogida de muestras e inspección.

El instrumento GEM5000 cuenta con la certificación de MCERTS solo si:

- Aparece el logotipo de MCERTS en la pantalla al encenderlo.

✍ Nota: MCERTS - no se han llevado a cabo en este instrumento pruebas de sensibilidad cruzada con sulfuro de hidrógeno. Por lo tanto, el usuario debe tener en cuenta la posibilidad de interferencias en caso de presencia de H_2S.

El MCERTS proporciona fiabilidad y confianza a la supervisión de datos y ofrece a la industria un marco contrastado para la elección de los sistemas de supervisión y servicios conformes con las exigencias de rendimiento de la Agencia del Medio Ambiente.

El objetivo de la creación del Esquema de certificación de control (MCERTS) de la Agencia del Medio Ambiente es realizar controles medioambientales de calidad. El MCERTS ofrece certificaciones de productos de acuerdo con las normas de rendimiento de la Agencia del Medio Ambiente, tomando como base normas relevantes CEN, ISO y nacionales.

Los instrumentos con la certificación MCERTS han sido evaluados por un organismo independiente con el fin de garantizar el cumplimiento con determinadas exigencias de rendimiento. Además, el fabricante de un producto con certificación MCERTS está sometido a auditorías periódicas que garantizan el constante cumplimiento con las exigencias de rendimiento del certificado.

La serie 5000 de analizadores de gas cuenta con la certificación de la versión 3.1 de las Normas de rendimiento para sistemas portátiles de control de emisiones.

Batería y carga

La batería de la serie 5000 de analizadores de gas es un paquete de hidruro metálico de níquel compuesto por seis células individuales. Este tipo de batería es menos susceptible a los "efectos de memorización" en las cargas máximas que las baterías de níquel-cadmio, si bien no es recomendable cargar la unidad al máximo.

No desconecte el cargador hasta que se indique que el instrumento está totalmente cargado.

⚠ **Advertencia**	NO se aplica la certificación Ex al cargador de la batería. Cargue siempre la batería en lugares seguros.

El cargador inteligente de la batería indica el estado de carga de la unidad y el fin de la carga.

El instrumento debe cargarse SÓLO con el cargador suministrado con el instrumento. El cargador de batería está concebido para su uso en interior. Asegúrese de que la ventilación es adecuada mientras carga la unidad.

Cargador: Voltaje de entrada: 100-240 V CA +/- 10%
Frecuencia de entrada: 50-60 Hz +/- 10%
Corriente de entrada: 0,4 A a 100 VCA .. 0,2 A a 240 VCA

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Tensión de salida:	10,1 VCC máx.
Corriente de salida:	1,5 A máx.

✍ Nota: Conecte el cargador a la red eléctrica con el adaptador apropiado. Para más información, póngase en contacto con el fabricante.

Instrucciones de limpieza

NO utilice agentes limpiadores para limpiar el analizador o el cargador de la batería, ya que podrían tener efectos adversos en el uso seguro de los dispositivos.

Consejos de utilidad para efectuar lecturas

⚠ **Advertencia**	La inhalación de sulfuro de hidrógeno (H_2S) o de otros gases nocivos puede ser mortal. El usuario es responsable de garantizar que está debidamente formado en aspectos de seguridad en cuanto al uso de H_2S y de otros gases nocivos especialmente en los lugares en los que se usan gases peligrosos, en los cuales el gas emitido por el analizador debe conducirse por un tubo hasta una zona en la que pueda liberarse con seguridad. El instrumento también puede emitir gases peligrosos si se purga con aire limpio.

Consejos de utilidad

- En los desplazamientos, el analizador de gas debe llevarse en el interior del vehículo (nunca en el maletero), con objeto de evitar daños por temperaturas extremas o posibles impactos. No coloque el analizador de gas sobre superficies calientes (p. ej., tuberías de extracción de gas, carrocerías o vehículos aparcados a altas temperaturas); el aumento de la temperatura del analizador de gas afectaría a la precisión de las lecturas.

- Cuando se mueva por una zona, proteja el analizador de gas de la luz solar directa y la lluvia intensa.

Utilice siempre el colector de agua. Si rebosa, cambie el filtro y asegúrese de que ningún tubo esté húmedo antes de volver a usarlo.

✍ Nota: Si el escape de un analizador de gas de la serie GA5000 se conecta a un sistema presurizado, el gas se saldrá del orificio de entrada.

Calibrado

⚠ **Advertencia**	Los gases de calibrado pueden ser peligrosos. Lea atentamente las especificaciones de seguridad de cada gas utilizado antes de proceder al calibrado.

El regulador suministrado con el juego de calibrado está configurado para proporcionar un caudal fijo.

Dado que el caudal del regulador se ajusta en fábrica, solo hay que girarlo unas vueltas

para abrirlo; no es necesario ajustarlo.

⚠ **Advertencia**	**Orificios de escape** Durante el calibrado del analizador de gas, existen dos salidas posibles para el gas: por la vía habitual, es decir, el orificio de escape del analizador (amarillo) o, en caso de sobrepresión, el orificio de 1,58 mm de la válvula roja de alivio de la presión situado en el regulador. Se recomienda conectar tubos de escape en ambos orificios. Los tubos de escape deben llegar a un área con ventilación suficiente. Asegúrese de que no haya fugas en los tubos ni las conexiones. El calibrado del analizador de gas debe realizarse en un área segura con todas las precauciones necesarias en el uso de gases potencialmente peligrosos, explosivos o tóxicos.

✍ Nota: También es posible que salga gas del orificio de caudal interno (azul) del analizador de gas (solo se aplica al GA5000).

Mantenimiento

Debe realizarse regularmente el mantenimiento de la serie 5000 de analizadores de gas con el fin de garantizar el funcionamiento correcto y preciso. Geotech (UK) Limited recomienda que se lleve a cabo el mantenimiento y el recalibrado cada 6 meses.

La serie 5000 de analizadores de gas cuenta con la certificación ATEX para su uso en lugares con riesgo de explosión. Por lo tanto, únicamente los ingenieros cualificados pueden realizar el mantenimiento. En caso contrario, la garantía quedará anulada y podría invalidar la certificación ATEX.

⚠ **Advertencia**	Toda operación de mantenimiento del analizador de gas realizada por personal no cualificado puede dar lugar a la invalidación de la certificación ATEX, pudiendo igualmente afectar a la seguridad del uso del instrumento en lugares con riesgo de explosión.

Mantenimiento realizable por el usuario:

Este instrumento no contiene ninguna pieza o componente interior de cuyo mantenimiento pueda encargarse el usuario.

No obstante, el usuario puede encargarse del mantenimiento de los siguientes elementos:

Filtro de agua en línea	Comprobar periódicamente obstrucciones, humedad o daños y cambiar en caso necesario. No usar el instrumento sin el filtro de agua en línea; de lo contrario, podría penetrar agua en el interior.

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Tubo de muestreo	Comprobar que no están contaminados ni dañados.
Conectores de los orificios de gas	Comprobar periódicamente que las juntas tóricas de los conectores de los orificios de gas no están dañadas. Una junta tórica dañada puede dejar pasar el aire en el gas de muestra y afectar a la precisión de las lecturas. En caso de daños en la junta tórica, sustituir todo el conector.
Material filtrante de H_2S	Si observa que el material filtrante cambia a un color *gris claro*, sustituir el filtro.

Declaración de conformidad (español)

Productos	• GA5000: analizador de gas para vertederos • GEM5000: analizador de gas para vertederos y monitor de extracción • BIOGAS 5000: analizador de gas para digestores anaerobios

Geotechnical Instruments (UK) Limited declara la conformidad de los productos descritos con las siguientes normas:

Directiva ATEX 94/9/CE

Organismo de certificación	Servicio de certificación SIRA
Número de organismo notificado	0518
Dirección	Rake Lane, Eccleston (Chester) - CH4 9JN
Número de certificado SIRA	SIRA 11ATEX2197X
Normas aplicadas	EN60079-0 :2006 EN60079-0 :2009 EN60079-11 :2007

IECEx

Organismo de certificación	Servicio de certificación SIRA
Número de organismo notificado	0518
Dirección	Rake Lane, Eccleston (Chester) - CH4 9JN
Número de certificado IECEx	SIR 11.0089X
Normas aplicadas	IEC60079-0 :2004 Ed4 IEC60079-0 :2007 Ed5 IEC60079-11 :2006 Ed5

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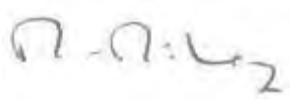
CSA (Canadá y EE. UU.)

Organismo de certificación	CSA International
Dirección	178 Rexdale Boulevard, Toronto, ON, Canadá M9W 1R3
Número de certificado CSA	CSA 11 2445306
Normas aplicadas	C22.2 N° 0-10 - Requisitos generales – Código Eléctrico Canadiense, Parte II CAN/CSA-C22.2 N° 60079-0:07 - Aparatos eléctricos para atmósferas explosivas - Parte 0: Requisitos generales CAN/CSA-C22.2 N° 60079-1:07 - Aparatos eléctricos para atmósferas explosivas - Parte 1: Compartimiento ignífugo "d" CAN/CSA-E60079-11:02 - Aparatos eléctricos para atmósferas explosivas - Parte 11: Seguridad intrínseca "i" ANSI/UL 60079-0:09 - Aparatos eléctricos para atmósferas explosivas - Parte 0: Requisitos generales ANSI/UL 60079-1:09 - Aparatos eléctricos para atmósferas explosivas - Parte 1: Compartimiento ignífugo "d" ANSI/UL 60079-11:09 - Aparatos eléctricos para atmósferas explosivas - Parte 11: Seguridad intrínseca "i"

Directiva CEM 2004/108/CEE

EN 301 489 Pt 1 (V1.9.1 – 2011-04)	Compatibilidad electromagnética y espectro radioeléctrico (ERM); Normativa de compatibilidad electromagnética (CEM) para equipos y servicios de radio; Parte 1: Requisitos técnicos comunes
EN 301 489 Pt 17 (V1.9.1 – 2009-04)	Compatibilidad electromagnética y espectro radioeléctrico (ERM); Normativa de compatibilidad electromagnética (CEM) para equipos de radio; Parte 17: Condiciones específicas para sistemas de transmisión de datos de banda ancha CEM para sistemas de transmisión de datos de banda ancha
EN 301 489 Pt 19 (V1.2.1 – 2002-11)	Compatibilidad electromagnética y espectro radioeléctrico (ERM); Normativa de compatibilidad electromagnética (CEM) para equipos y servicios de radio; Parte 19: Condiciones específicas para estaciones terrenas móviles de solo recepción (ROMES) que funcionan en la banda de 1,5 GHz proporcionando comunicaciones de datos CEM para estaciones terrenas móviles de solo recepción (ROMES)
BS EN 61000-3-2: 2006 + A2:2009	Compatibilidad electromagnética (CEM). Límites. Límites para las emisiones de corriente armónica (equipos con corriente de entrada ≤ 16 A por fase)
BS EN 61000-3-3: 2008	Compatibilidad electromagnética (CEM). Límites. Límites de las variaciones de tensión, fluctuaciones de tensión y flicker en las redes públicas de alimentación de baja tensión para equipos con corriente asignada ≤ 16 A por fase y no sujetos a una conexión adicional.

Firmado:



Dr. Roger Riley

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16.2 *Instructions for safe use – French language*

Instructions concernant la sécurité

⚠ **Avertissement**	Les analyseurs de gaz de la série 5000 sont conçus pour mesurer les gaz des sites d'enfouissement et d'autres sources, comme le décrit le présent manuel. L'opérateur risque d'être exposé à des gaz nocifs pendant l'utilisation de l'instrument. L'inhalation de ces gaz peut être nuisible à la santé et, dans certains cas, mortelle. Il incombe à l'utilisateur de s'assurer qu'il a reçu une formation adaptée aux aspects de la sécurité des gaz utilisés et de s'assurer du respect des procédures appropriées. En particulier, lors de l'utilisation de gaz dangereux, les gaz en sortie de l'analyseur doivent être évacués dans une zone où ils ne présentent aucun danger. Des gaz dangereux peuvent être également expulsés de l'instrument lors d'une purge à l'air propre.

✍ Remarque : Les analyseurs de gaz sont des instruments scientifiques sensibles qu'il convient de traiter en conséquence. Toute utilisation du matériel non conforme aux instructions du fabricant risque d'amoindrir la protection assurée par l'instrument.

Les analyseurs de gaz de la série 5000 sont conformes à l'article 15 de la réglementation FCC (Federal Communications Commission - Conseil supérieur de l'audiovisuel américain). Son utilisation est soumise aux deux conditions suivantes :

1) Cet appareil ne doit pas provoquer d'interférences nuisibles.

2) Cet appareil doit accepter toutes les interférences reçues, y compris celles qui pourraient provoquer un fonctionnement indésirable.

Dans le cadre des certifications ATEX et IECEx, l'analyseur de gaz de la série 5000 est certifié pour la catégorie zone dangereuse.

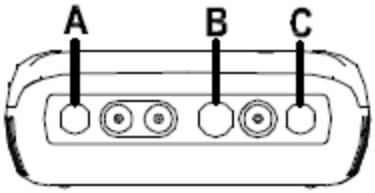
Ex II 2G Ex ib IIA T1 Gb (Ta = -10ºC à +50ºC)

Il est absolument indispensable de respecter les instructions contenues dans ce manuel. Il incombe à l'utilisateur de déterminer le type et la classification de protection requise pour une application spécifique.

Instructions pour une utilisation sûre– Français

(Référence Directive européenne ATEX 94/9/CE, Annexe II, 1.0.6.)
Les instructions suivantes s'appliquent au matériel couvert par les numéros de certificat SIRA 11ATEX2197X et IECEx Directive SIR 11.0089X :

- Le matériel est utilisable avec des gaz et des vapeurs inflammables et des appareils de groupe IIA et de classe de température T1.
- Le matériel est certifié uniquement pour une utilisation à température ambiante entre -10ºC et +50ºC et ne doit pas être utilisé en dehors de cette plage.
- Le matériel ne doit pas être utilisé dans une atmosphère contenant plus de 21% d'oxygène.
- Ce matériel devra être réparé conformément au code de pratique applicable.
- Lors d'une utilisation en zone dangereuse, utiliser exclusivement une sonde de température TP-5000 (SIRA 11ATEX2197X et IECEx SIR11.0089X). Pour le connecteur C, l'anémomètre GF5.4 (BVS 04ATEXE194) ne s'utilise qu'avec les dispositifs certifiés ATEX. L'analyseur ne doit être raccordé à aucun autre dispositif dans la zone dangereuse, ni au câble 5000-USB (connecteur A) ni au chargeur de batterie GEM5000 BC (connecteur B) fourni avec l'analyseur.



Ne pas charger, recharger ni ouvrir en atmosphère potentiellement explosive.
Dans une zone dangereuse, utiliser exclusivement la sonde de température TP-5000 branchée dans le connecteur B.
Connecteur C (Uo=10 V, Io=5 mA, Po=50 mW, Ci=0, Li=0, Co=100 uF, Lo=1 000 mH),
Connecteur B (Uo=5 V, Io=6 mA, Po=7 mW, Ci=0, Li=0, Co=100 uF, Lo=1 000 mH)

ALIMENTATIONS MAXIMALES NON DANGEREUSES :
Connecteur A - Um=6 V Connecteur B - Um=10,1 V

- Si le matériel est amené à être en contact avec des substances corrosives, par exemple des liquides ou des gaz acides susceptibles d'attaquer les métaux, ou des solvants pouvant affecter des polymères, il incombe alors à l'utilisateur de prendre des précautions appropriées, par exemple des contrôles réguliers dans le cadre d'inspections systématiques, ou des vérifications sur la fiche technique de la résistance du matériau à des produits chimiques spécifiques, ceci afin de préserver l'intégrité de la protection.

- La plage de pression relative est de +/-500 mbar. Cependant, il convient de noter que la pression d'entrée ne doit pas dépasser +/- 500 mbar par rapport à la pression atmosphérique et la pression de sortie ne doit pas dépasser +/- 100 mbar par rapport à la pression atmosphérique.

<u>Pour CSA (Canada), l'analyseur de gaz de la série 5000 est certifié pour la catégorie zone dangereuse</u>

CLASSE 2258 03 - ÉQUIPEMENT DE CONTRÔLE DES PROCÉDÉS - Appareils à sécurité intrinsèque et appareils non incendiaires pour emplacements dangereux

Ex ib IIA :

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Détecteurs de méthane Modèle GA 5000, GEM 5000 et BIOGAS 5000 ; appareils portatifs, avec batterie alimentée par bloc de batterie (numéro de pièce 20087) non remplaçable sur place ; à sécurité intrinsèque et fournissant des circuits à sécurité intrinsèque (« [ib] » pour zone 1) pour sonde de température modèle TP-5000 (connecteur B) et avec paramètres de sortie comme indiqué au tableau ci-dessous ; code de température T1; -10 ºC ≤ Tamb. ≤ +50 ºC.

Connecteur	Paramètres						
	Uo (V)	Io (mA)	Po (mW)	Co (uF)	Lo (mH)	Ci (uF)	Li (mH)
B	5,0	6	7	100	1 000	0	0
C	10,0	5	50	100	1 000	0	0

✍ Remarque : Les tests effectués sur cet appareil concernaient uniquement la sécurité électrique.

<u>Pour CSA (États-Unis), l'analyseur de gaz de la série 5000 est certifié pour la catégorie zone dangereuse</u>

CLASSE 2258 83 - ÉQUIPEMENT DE CONTRÔLE DES PROCÉDÉS - Appareils à sécurité intrinsèque et appareils non incendiaires pour emplacements dangereux - CERTIFICATION AUX NORMES AMÉRICAINES (ÉTATS-UNIS)

AEx ib IIA :

Détecteurs de méthane Modèle GA 5000, GEM 5000 et BIOGAS 5000 ; appareils portatifs, avec batterie alimentée par bloc de batterie (numéro de pièce 20087) non remplaçable sur place ; à sécurité intrinsèque et fournissant des circuits à sécurité intrinsèque (« [ib] » pour zone 1) pour sonde de température modèle TP-5000 (connecteur B) et avec paramètres de sortie comme indiqué au tableau ci-dessous ; code de température T1; -10 ºC ≤ Tamb. ≤ +50 ºC.

Connecteur	Paramètres						
	Uo (V)	Io (mA)	Po (mW)	Co (uF)	Lo (mH)	Ci (uF)	Li (mH)
B	5,0	6	7	100	1 000	0	0
C	10,0	5	50	100	1 000	0	0

✍ Remarque : Les tests effectués sur cet appareil concernaient uniquement la sécurité électrique.

<u>MCERTS</u>

MCERTS est le programme de certification de la surveillance, établi par l'agence britannique à l'Environnement. Ce programme forme le cadre dans lequel des mesures environnementales peuvent être effectuées conformément aux exigences de qualité de

l'agence. Il couvre un ensemble d'activités de surveillance, d'échantillonnage et d'inspection.

L'instrument GEM5000 n'est certifié MCERTS que si :

- Le logo MCERTS s'affiche à l'écran après la mise sous tension de l'instrument.

✍ Remarque : MCERTS - Cet instrument n'a pas fait l'objet de tests de sensibilité croisée utilisant le sulfure d'hydrogène. Par conséquent, les utilisateurs doivent être conscients qu'en cas de présence de H_2S sur les sites, il peut y avoir un effet d'interférence.

Le programme MCERTS contribue à renforcer la confiance du public vis-à-vis des données de surveillance et donne à l'industrie des paramètres sûrs pour le choix de systèmes et de services de surveillance répondant aux exigences de performance de l'agence.

L'agence à l'Environnement a établi ce programme MCERTS (Monitoring Certification Scheme) pour fournir des valeurs mesurées environnementales de qualité. La certification MCERTS concerne les produits aux normes de performance de l'agence à l'Environnement, sur la base des normes nationales, CEN et ISO pertinentes.

Les instruments certifiés MCERTS sont testés par un organisme indépendant pour assurer leur conformité à certaines exigences de performance. En outre, le fabricant de produits MCERTS fait l'objet d'audits réguliers pour s'assurer du respect continu des exigences de performance de ses produits aux fins de certification.

Les analyseurs de gaz de la série 5000 ont été certifiés conformément à la version 3.1 des « Normes de performance des systèmes portatifs de surveillance des émissions de substances dans l'atmosphère ».

Batterie et mise en charge

Les analyseurs de gaz de la série 5000 sont dotés d'une batterie au nickel-métal-hydrure, à six cellules individuelles intégrées. Ce type de batterie n'est pas aussi sensible à « l'effet de mémoire » qui affecte les capacités des piles au nickel cadmium. Il est cependant déconseillé de recharger la batterie par à-coups.

Débrancher le chargeur uniquement après indication de pleine charge.

⚠ **Avertissement**	Le chargeur de batterie n'est PAS couvert par la certification Ex. La batterie ne doit être chargée que dans un endroit sûr.

Le chargeur de batterie est intelligent et indique que la batterie est en cours de chargement ou chargée.

La batterie doit être chargée UNIQUEMENT à l'aide du chargeur fourni avec l'instrument. Le chargeur de batterie doit être utilisé uniquement à l'intérieur. Veiller à assurer une ventilation adéquate pendant le chargement.

Chargeur :	Tension d'entrée :	100-240 V CA +/- 10 %
	Fréquence d'entrée :	50-60 Hz +/- 10 %

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Courant d'entrée : 0,4 A@100 V CA.. 0,2 A@240 V CA

Tension de sortie : 10,1 V CC max
Courant de sortie : 1,5 A max

✍ Remarque : connecter le chargeur à l'alimentation secteur à l'aide de l'adaptateur approprié. Contacter le fabricant pour de plus amples informations.

Instructions de nettoyage

Ne PAS utiliser d'agents nettoyants pour nettoyer l'analyseur ou le chargeur de batterie car ces produits risquent d'avoir un effet préjudiciable sur l'utilisation sûre de ces appareils.

Bonnes pratiques lors des mesures

⚠ **Avertissement**	L'inhalation de sulfure d'hydrogène (H_2S) ou d'autres gaz dangereux peut entraîner la mort. Il incombe à l'utilisateur de s'assurer qu'il a reçu la formation adaptée aux aspects sécurité de l'utilisation de H_2S et d'autres gaz dangereux. En particulier, lors de l'utilisation de gaz dangereux, les gaz en sortie de l'analyseur doivent être évacués dans une zone où ils ne présentent aucun danger. Des gaz dangereux peuvent aussi être expulsés de l'instrument lors d'une purge à l'air propre.

Bonnes pratiques

- Lors d'un déplacement vers un site d'utilisation, transporter l'instrument dans l'habitacle du véhicule, et non pas dans le coffre où il pourrait être soumis à des températures extrêmes, voire à des chocs risquant de l'endommager. Ne pas placer l'analyseur de gaz contre des surfaces chaudes (conduite d'extraction de gaz, carrosserie d'une voiture ou voiture laissée sans surveillance en été, par exemple) car les effets de la chaleur sur l'analyseur risquent d'entraîner des valeurs mesurées incorrectes.

- Lors du déplacement sur site, protéger l'analyseur de gaz de la lumière solaire directe et des fortes intempéries.

Toujours utiliser le piège à eau ! Si le piège à eau déborde, changer le filtre et vérifier que tous les tuyaux ne présentent aucune trace d'humidité avant toute utilisation.

✍ Remarque : si l'évacuation d'un analyseur de gaz de la série GA5000 est connectée à un système sous pression, un flux de gaz s'échappera du port de débit d'entrée.

Étalonnage

⚠ **Avertissement**	Les gaz d'étalonnage peuvent être dangereux. Pour chaque gaz utilisé, il convient de lire et de comprendre la fiche de données de sécurité correspondante avant de poursuivre.

Le régulateur fourni avec le kit d'étalonnage a été configuré pour assurer un débit fixe.

Le débit du régulateur étant réglé en usine, il ne faut que quelques tours pour l'ouvrir et aucun réglage n'est nécessaire.

⚠ **Avertissement**	**Orifice d'évacuation** Lors de l'étalonnage de l'analyseur de gaz, le gaz peut être évacué par deux orifices : par l'orifice d'évacuation normal (jaune) de l'analyseur ou, dans les cas de surpression, par l'orifice de 1/16 de pouce de la soupape de surpression rouge située sur le régulateur. Il est recommandé de raccorder des tuyaux d'évacuation à ces deux orifices. Le tuyau d'évacuation doit laisser les gaz s'échapper dans un endroit bien ventilé. Vérifier que les tuyaux et les raccords ne présentent aucune fuite. L'étalonnage de l'analyseur de gaz doit s'effectuer dans un endroit sûr, en observant toutes les précautions nécessaires en présence de gaz potentiellement dangereux, explosifs ou toxiques.

✍ Remarque : le gaz peut être aussi expulsé au niveau du port de débit interne (bleu) de l'analyseur de gaz (applicable uniquement au modèle GA5000).

Entretien

Pour un fonctionnement correct et précis, l'analyseur de gaz de la série 5000 doit faire l'objet d'un entretien régulier. Geotech (UK) Limited recommande un entretien et un réétalonnage tous les 6 mois.

Les analyseurs de gaz de la série 5000 sont certifiés ATEX pour l'utilisation en environnements potentiellement explosifs. En conséquence, leur entretien doit être effectué uniquement par des techniciens qualifiés. Le non-respect de cette exigence entraînera l'annulation de la garantie, voire de la certification ATEX.

⚠ **Avertissement**	Si l'analyseur de gaz fait l'objet d'un entretien par des techniciens non qualifiés, la certification ATEX risque d'être annulée et l'appareil peut ne pas être sûr en cas d'utilisation dans un environnement potentiellement

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	explosif.

Composants pouvant faire l'objet d'un entretien par l'utilisateur :

L'appareil ne contient aucun composant interne pouvant faire l'objet d'un entretien par l'utilisateur.

Les composants suivants peuvent faire l'objet d'un entretien par l'utilisateur :

Filtre à eau en ligne	Contrôler ce filtre régulièrement pour rechercher la présence d'obstructions, d'humidité ou de dommages ; le remplacer si besoin est. L'appareil ne doit jamais être utilisé sans le filtre à eau en ligne pour prévenir la pénétration d'eau dans l'appareil.
Tuyau d'échantillonnage	Toujours vérifier que les tuyaux d'échantillonnage ne sont ni contaminés ni endommagés.
Raccords d'orifices de gaz	Contrôler périodiquement les joints toriques des raccords d'orifices de gaz pour s'assurer qu'ils ne sont pas endommagés. Un joint torique endommagé peut laisser passer l'air dans le gaz d'échantillonnage et entraîner des valeurs mesurées incorrectes. Remplacer le raccord complet si le joint torique est endommagé.
Matériau du filtre à H_2S	Remplacer le filtre lorsque le matériau du filtre change de couleur et devient *gris clair.*

Déclaration de conformité – English Language [Français]

Produits	• GA5000 - Analyseur de gaz de sites d'enfouissement • GEM5000 - Analyseur de gaz de sites d'enfouissement et moniteur d'extraction • BIOGAS 5000 – Analyseur de gaz de digesteur anaérobie

Geotechnical Instruments (UK) Ltd déclare que les articles décrits ci-dessus sont conformes aux normes suivantes :

ATEX Directive 94/9/EC

Certification body	SIRA Certification Service [Service de certification SIRA]
Numéro d'organisme notifié	0518
Adresse	Rake Lane, Eccleston, Chester, CH4 9JN, Royaume-Uni
Numéro de certificat SIRA	SIRA 11ATEX2197X
Normes appliquées	EN60079-0 :2006 EN60079-0 :2009 EN60079-11 :2007

IECEx

Organisme de certification	SIRA Certification Service [Service de certification SIRA]
Numéro d'organisme notifié	0518
Adresse	Rake Lane, Eccleston, Chester, CH4 9JN, Royaume-Uni
Numéro de certificat IECEx	SIR 11.0089X
Normes appliquées	IEC60079-0 :2004 Ed4 IEC60079-0 :2007 Ed5 IEC60079-11 :2006 Ed5

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CSA (Canada et États-Unis)

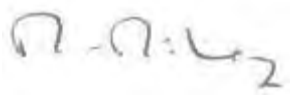
Organisme de certification	CSA International
Adresse	178 Rexdale Boulevard, Toronto, ON, Canada M9W 1R3
Numéro de certificat CSA	CSA 11 2445306
Normes appliquées	C22.2 No. 0-10 - Règles générales - Code canadien de l'électricité, Deuxième partie CAN/CSA-C22.2 No. 60079-0:07 - Matériel électrique pour atmosphères gazeuses explosives - Partie 0 : Règles générales CAN/CSA-C22.2 No. 60079-1:07 - Matériel électrique pour atmosphères gazeuses explosives - Partie 1 : Enceintes antidéflagrantes « d » CAN/CSA-E60079-11:02 - Matériel électrique pour atmosphères gazeuses explosives - Partie 11 : Sécurité intrinsèque « i » ANSI/UL 60079-0:09 - Matériel électrique pour atmosphères gazeuses explosives - Partie 0 : Règles générales ANSI/UL 60079-1:09 - Matériel électrique pour atmosphères gazeuses explosives - Partie 1 : Enceintes antidéflagrantes « d » ANSI/UL 60079-11:09 - Matériel électrique pour atmosphères gazeuses explosives - Partie 11 : Sécurité intrinsèque « i »

Directive CEM 2004/108/CEE

EN 301 489 Partie 1 (V1.9.1 – 2011-04)	Compatibilité électromagnétique et spectre radioélectrique (ERM) ; Norme de compatibilité électromagnétique (CEM) pour les équipements et services radio ; Partie 1: Exigences techniques communes
EN 301 489 Partie 17 (V2.1.1 – 2009-05)	Compatibilité électromagnétique et spectre radioélectrique (ERM) ; Norme de compatibilité électromagnétique (CEM) pour les équipements et services radio ; Partie 17 : Conditions particulières pour

EN 301 489 Partie 19 (V1.2.1 – 2002-11)	Les systèmes de transmission de données à large bande CEM pour les systèmes de transmission de données à large bande
BS EN 61000-3-2 : 2006 + A2:2009	Compatibilité électromagnétique et spectre radioélectrique (ERM) ; Norme de compatibilité électromagnétique (CEM) pour les équipements et services radio ; Partie 19 : Conditions particulières pour les stations terriennes mobiles fonctionnant seulement en réception (ROMES) dans la bande de fréquences de 1,5 GHz pour la réception de données
BS EN 61000-3-3 : 2008	CEM pour les stations terriennes mobiles fonctionnant seulement en réception (ROMES) Compatibilité électromagnétique (CEM) Limites. Limites pour les émissions de courant harmonique (courant appelé par les appareils ≤16 A par phase) Compatibilité électromagnétique (CEM) Limites. Limitation des variations de tension, des fluctuations de tension et de l'oscillation dans les réseaux publics d'alimentation basse tension, pour les matériels ayant un courant assigné ≤16 A par phase et non soumis à un raccordement conditionnel

Signature:



Dr. Roger Riley

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16.3 *Instructions for safe use – German language*

Sicherheitsvorschriften

⚠ **Warnhinweise**	Die Gasanalysatoren der 5000er Serie können zum Messen der Gase von Deponien und anderen Quellen wie in diesem Handbuch beschrieben verwendet werden. Der Bediener kann bei Verwendung des Geräts schädlichen Gasen ausgesetzt werden. Das Einatmen dieser Gase kann gesundheitsschädlich und in manchen Fällen sogar tödlich sein. Es liegt in der Verantwortung des Benutzers sicherzustellen, dass er/sie angemessen über die Sicherheitsaspekte der eingesetzten Gase geschult ist und geeignete Verfahren befolgt werden. Vor allem beim Einsatz gefährlicher Gase muss das vom Analysator ausströmende Gas in einen Bereich geleitet werden, in dem das Gas sicher abgeführt werden kann. Gefährliches Gas kann ebenso vom Gerät ausgestoßen werden, wenn es mit sauberer Luft gereinigt wird.

✍ Hinweis: Gasanalysatoren sind empfindliche wissenschaftliche Geräte und sollten entsprechend behandelt werden. Wenn das Gerät anders als vom Hersteller spezifiziert verwendet wird, kann der vom Gerät gebotene Schutz beeinträchtigt werden.

Die Gasanalysatoren der 5000er Serie erfüllen Abschnitt 15 der FCC-Vorschriften. Der Betrieb unterliegt den folgenden zwei Bedingungen:

1) Dieses Gerät darf keine schädlichen Funkstörungen verursachen.

2) Dieses Gerät muss mögliche empfangene Funkstörungen und dadurch verursachte Funktionsstörungen dulden.

Für ATEX und IECEx sind die Gasanalysatoren der 5000er Serie für den Einsatz in explosionsgefährdeten Bereichen zertifiziert.

Ex II 2G EX ib IIA T1 Gb (Ta = -10°C bis +50°C)

Die Vorschriften müssen unbedingt genau befolgt werden. Es liegt in der Verantwortung des Betreibers, das Schutzkonzept und die erforderliche Schutzklasse für eine bestimmte Anwendung festzulegen.

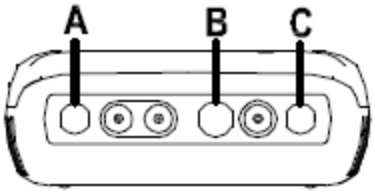
Vorschriften zur sicheren Verwendung - Deutsch

(Siehe Europäische ATEX-Richtlinie 94/9/EC, Anhang II, 1.0.6.)
Die folgenden Vorschriften gelten für Geräte, die in den Zertifikaten Nr. SIRA 11ATEX2197X und IECEx Richtlinie SIR 11.0089X behandelt werden:

- Die Geräte dürfen mit brennbaren Gasen und Dämpfen mit Apparategruppe IIA und

Temperaturklasse T1 eingesetzt werden.

- Die Geräte sind nur für den Einsatz bei Umgebungstemperaturen im Bereich von -10 °C bis +50 °C zertifiziert und sollten nicht außerhalb dieses Bereichs eingesetzt werden.
- Die Geräte dürfen nicht in einer Atmosphäre mit mehr als 21 % Sauerstoffgehalt eingesetzt werden.
- Die Reparatur dieser Geräte darf nur entsprechend der maßgeblichen Anleitung durchgeführt werden.
- Bei Einsatz in einem explosionsgefährdeten Bereich darf nur Temperaturfühler TP-5000 (SIRA 11ATEX2197X und IECExSIR11.0089X) verwendet werden. Anemometer GF5.4 (BVS 04ATEXE194), nur für den Einsatz mit ATEX, in Anschluss C. Der Analysator darf nicht an andere Geräte im explosionsgefährdeten Bereich angeschlossen werden, einschließlich des im Lieferumfang enthaltenen 5000-USB-Kabels (Anschluss A) bzw. Ladegeräts GEM5000 BC (Anschluss B).



In einer explosionsgefährdeten Atmosphäre nicht laden, wieder aufladen oder öffnen.
In einem explosionsgefährdeten Bereich nur „Temperaturfühler TP-5000" in Anschluss B verwenden.
Anschluss C (Uo=10 V, Io=5 mA, Po=50 mW, Ci=0, Li=0, Co=100 uF, Lo=1000 mH),
Anschluss B (Uo=5 V, Io=6 mA, Po=7 mW, Ci=0, Li=0, Co=100 uF, Lo=1000 mH)

MAXIMALE VERSORGUNG IN NICHT EXPLOSIONSGEFÄHRDETEN BEREICHEN:
Anschluss A - Um=6 V Anschluss B - Um=10,1 V

- Falls die Möglichkeit besteht, dass die Geräte mit aggressiven Substanzen in Berührung kommen, z. B. mit sauren Flüssigkeiten oder Gasen, die Metalle angreifen können, oder mit Lösungsmitteln, die Polymerwerkstoffe schädigen können, liegt es in der Verantwortung des Benutzers, geeignete Sicherheitsvorkehrungen zu treffen, z. B. regelmäßige Kontrollen als Teil der Routineinspektionen oder die Prüfung des Materialdatenblatts darauf, ob das Gerät mit speziellen Chemikalien kompatibel ist, die es vor Schäden schützen, um zu gewährleisten, dass diese Art des Schutzes nicht beeinträchtigt wird.

- Der relative Druckbereich ist +/-500 mbar. Es ist jedoch zu beachten, dass der Eingangsdruck +/- 500 mbar relativ zum Atmosphärendruck nicht überschreiten darfund dass der Ausgangsdruck +/- 100 mbar relativ zum Atmosphärendruck nicht überschreiten darf.

Für CSA (Kanada) sind die Gasanalysatoren der 5000er Serie für den Einsatz in explosionsgefährdeten Bereichen zertifiziert.

KLASSE 2258 03 - PROZESSKONTROLLGERÄT - Eigensichere und nicht zündgefährliche Systeme - Für explosionsgefährdete Standorte

C US
M.C.#243446

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Ex ib IIA:

Methandetektoren Modell GA 5000, GEM 5000 und BIOGAS 5000; tragbar, batteriebetrieben mit nicht im Feld austauschbarem Akkupack Teilenr. 20087; eigensicher, bietet eigensichere Kreise („[ib]" für Zone 1) für Temperaturfühler Modell GFS.2 (Anschluss B), mit Entitätsausgabenparameter wie unten aufgeführt; Temperaturcode T1; -10 °C ≤ Tamb. ≤ +50 °C.

Anschluss	Entitätsparameter						
	Uo (V)	Io (mA)	Po (mW)	Co (uF)	Lo (mH)	Ci (uF)	Li (mH)
B	5,0	6	7	100	1000	0	0
C	10,0	5	50	100	1000	0	0

✍ Hinweis: Dieses Gerät wurde nur auf elektrische Sicherheitsfunktionen untersucht.

Für CSA (USA) sind die Gasanalysatoren der 5000er Serie für den Einsatz in explosionsgefährdeten Bereichen zertifiziert.

KLASSE 2258 83 - PROZESSKONTROLLGERÄT - Eigensichere und nicht zündgefährliche Systeme - Für explosionsgefährdete Standorte - NACH US-AMERIKANISCHEN NORMEN ZERTIFIZIERT

C US
M.C.#243446

AEx ib IIA:

Methandetektoren Modell GA 5000, GEM 5000 und BIOGAS 5000; tragbar, batteriebetrieben mit nicht im Feld austauschbarem Akkupack Teilenr. 20087; eigensicher, bietet eigensichere Kreise („[ib]" für Zone 1) für Temperaturfühler Modell GFS.2 (Anschluss B), mit Entitätsausgabenparameter wie unten aufgeführt; Temperaturcode T1; -10 °C ≤ Tamb. ≤ +50 °C.

Anschluss	Entitätsparameter						
	Uo (V)	Io (mA)	Po (mW)	Co (uF)	Lo (mH)	Ci (uF)	Li (mH)
B	5,0	6	7	100	1000	0	0
C	10,0	5	50	100	1000	0	0

✍ Hinweis: Dieses Gerät wurde nur auf elektrische Sicherheitsfunktionen untersucht.

MCERTS

MCERTS ist das Monitoring Certification Scheme (Zertifizierungsprogramm für Überwachungsgeräte) der britischen Umweltagentur. Das Programm bietet einen Rahmen, in dem Umgebungsmessungen gemäß den Qualitätsanforderungen der Agentur durchgeführt werden können. Es umfasst eine Reihe von Überwachungs-, Probenahme-

und Prüfaufgaben.

Das Instrument GEM5000 ist nur MCERTS-zertifiziert, falls:

- Das MCERTS-Logo nach dem erstmaligen Einschalten auf dem Bildschirm erscheint.

✍ Hinweis: MCERTS - Bei diesem Gerät wurden keine Störempfindlichkeitsprüfungen mit Schwefelwasserstoff durchgeführt. Daher sollten Benutzer wissen, ob H_2S vor Ort vorhanden ist, da dies eine Störwirkung zur Folge haben könnte.

MCERTS fördert das öffentliche Vertrauen in Überwachungsdaten und liefert der Industrie einen erprobten Rahmen zur Auswahl von Überwachungssystemen und -dienstleistungen, die die Leistungsanforderungen der Umweltagentur erfüllen.

Die britische Umweltagentur hat MCERTS (Monitoring Certification Scheme) initiiert, um hochwertige Umweltmessungen bereitzustellen. Das MCERTS Produktzertifizierungsprogramm ermöglicht die Zertifizierung von Produkten gemäß den Leistungsstandards der Umweltagentur basierend auf den entsprechenden CEN-, ISO- und nationalen Normen.

MCERTS-zertifizierte Geräte wurden durch eine unabhängige Stelle geprüft, um zu gewährleisten, dass bestimmte Leistungsanforderungen erfüllt werden. Darüber hinaus wird der Hersteller eines MCERTS-Produkts regelmäßig geprüft, um zu gewährleisten, dass die Leistungsanforderungen der Zertifizierung durchgehend erfüllt werden.

Die Gasanalysatoren der 5000er Serie wurden gemäß Version 3.1 der „Leistungsanforderungen für tragbare Emissionsüberwachungssysteme" zertifiziert.

Akku und Aufladen

Bei dem Akku, der in den Gasanalysatoren der 5000er Serie verwendet wird, handelt es sich um einen Nickel-Metallhydrid-Akku, der als Akkupack aus sechs einzelnen Zellen hergestellt wird. Dieser Akkutyp ist weniger stark für den Memoryeffekt anfällig als Nickel-Kadmium-Akkus. Trotzdem wird davon abgeraten, das Gerät mit kleinen Ladungen nachzuladen.

Das Ladegerät sollte nur getrennt werden, wenn komplette Ladung angezeigt wird.

⚠ **Warnhinweise**	Das Akkuladegerät ist NICHT in der ATEX-Zertifizierung enthalten. Der Akku darf nur in einem sicheren Bereich aufgeladen werden.

Das Akkuladegerät ist intelligent und zeigt an, wenn die Einheit aufgeladen wird bzw. wenn sie vollständig aufgeladen ist.

Das Gerät darf NUR mit dem mitgelieferten Akkuladegerät aufgeladen werden. Das Akkuladegerät ist nur für den Gebrauch in Innenräumen vorgesehen. Bitte sorgen Sie für ausreichende Belüftung während des Aufladens.

Ladegerät:	Eingangsspannung:	100-240 V AC +/- 10 %
	Eingangsfrequenz:	50-60 Hz +/- 10 %
	Eingangsstromstärke:	0,4 A bei 100 VAC .. 0,2 A bei 240 VAC

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Ausgangsspannung:	Max. 10,1 VDC
Ausgangsstromstärke:	Max. 1,5 A

✍ Hinweis: Schließen Sie das Ladegerät durch Verbinden des entsprechenden Adapters an das Stromnetz an. Wenden Sie sich für weitere Informationen an den Hersteller.

Reinigungsanweisungen

Ve vrwenden Sie KEINE Reinigungsmittel zum Reinigen des Analysegeräts oder Akkuladegeräts, da sie die sichere Verwendung dieser Geräte beeinträchtigen können.

Good Practice beim Ablesen

⚠ **Warnhinweise**	Das Einatmen von Schwefelwasserstoffgas (H_2S) oder anderer schädlicher Gase kann tödlich sein. Es liegt in der Verantwortung des Benutzers sicherzustellen, dass er/sie angemessen über die Sicherheitsaspekte beim Einsatz von H_2S und anderer schädlicher Gase geschult ist. Vor allem beim Einsatz gefährlicher Gase muss das vom Analysator ausströmende Gas in einen Bereich geleitet werden, in dem das Gas sicher abgeführt werden kann. Gefährliches Gas kann ebenso vom Gerät ausgestossen werden, wenn es mit sauberer Luft ausgeblasen wird.

Good Practice

- Transportieren Sie den Gasanalysator im Inneren des Fahrzeugs an den Einsatzort - nicht auf der Ladefläche, wo er Temperaturschwankungen und möglichen Stößen ausgeliefert ist. Platzieren Sie den Gasanalysator nicht direkt an oder auf etwas Heißem (z. B. Gasleitung, Karosserie oder in einem unbeaufsichtigten Auto während des Sommers), da dies einen Temperaturanstieg im Gasanalysator verursacht und zu fehlerhaften Messwerten führen kann.

- Schützen Sie den Gasanalysator am Einsatzort vor starkem, direktem Sonnenlicht und starkem Regen.

Verwenden Sie stets den Wasserabscheider! Wenn der Wasserabscheider überschwemmt wird, tauschen Sie den Filter aus, und stellen Sie sicher, dass alle Schläuche frei von Feuchtigkeit sind, bevor Sie sie erneut verwenden.

✍ Hinweis: Wenn der Auslass eines Gasanalysators der Serie GA5000 an ein druckbeaufschlagtes System angeschlossen ist, dann führt dies zu einem Gasstrom aus dem Einlassstromanschluss.

Kalibrieren

⚠ **Warnhinweise**	Eichgase können gefährlich sein. Vor dem Verfahren müssen die Materialsicherheitsdatenblätter aller verwendeten Gase

	gelesen und verstanden werden.

Der mit dem Kalibrierset gelieferte Regulator wurde so konfiguriert, dass er einen unveränderlichen Durchfluss liefert.

Da der Durchfluss des Regulators werkseitig eingestellt ist, lässt der Regulator sich mit nur wenigen Drehungen öffnen; eine Einstellung ist nicht erforderlich.

⚠ **Warnhinweise**	**Austrittsöffnung** Wenn der Gasanalysator kalibriert wird, gibt es zwei mögliche Ausgänge für das Gas: auf die übliche Art über die Austrittsöffnung (gelb) des Analysators oder bei Überdruck über die 1/16″Öffnung des roten Druckentlastungsventils, das sich am Regler befindet. Für beide Öffnungen wird das Anbringen von Auslassrohrleitungen empfohlen. Die Auslassrohrleitungen müssen in einen gut belüfteten Bereich führen. Stellen Sie sicher, dass es in den Rohrleitungen und an den Verbindungen keine Undichtigkeiten gibt. Das Kalibrieren des Gasanalysators muss in einem sicheren Bereich unter Anwendung aller notwendigen Sicherheitsvorkehrungen durchgeführt werden, wenn möglicherweise gefährliche, explosive oder toxische Gase eingesetzt werden.

✍ Hinweis: Es besteht außerdem die Möglichkeit, dass Gas aus dem internen Strömungsanschluss (blau) des Gasanalysators ausgestoßen wird (gilt nur für GA5000).

Wartung

Die Gasanalysatoren der 5000er Serie müssen regelmäßig gewartet werden, um den korrekten und genauen Betrieb zu gewährleisten. Geotech (UK) Limited empfiehlt ein Wartungs- und Neukalibrierungsintervall von 6 Monaten.

Die Gasanalysatoren der 5000er Serie sind für den Einsatz in explosionsgefährdeten Bereichen ATEX-zertifiziert. Daher dürfen sie nur von qualifizierten Technikern gewartet werden. Im Falle der Nichtbefolgung erlischt die Garantie, und die ATEX-Zertifizierung kann ihre Gültigkeit verlieren.

⚠ **Warnhinweise**	Falls derGasanalysator von unqualifizierten Technikern gewartet wird, kann die ATEX-Zertifizierung ihre Gültigkeit verlieren, und das Gerät ist möglicherweise für den Einsatz in einer explosionsgefährdeten Atmosphäre nicht mehr sicher.

Teile, die durch den Benutzer gewartet werden können:

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Im Gerät gibt es keine Teile, die durch den Benutzer gewartet werden können.

Die folgenden Teile können durch den Benutzer gewartet werden:

Wasserleitungsfilter	Er muss regelmäßig auf Verstopfungen, Feuchtigkeit bzw. Beschädigungen untersucht und, falls erforderlich, ausgetauscht werden. Das Gerät darf nie ohne den Wasserleitungsfilter betrieben werden, da dies dazu führen könnte, dass Wasser in das Gerät eindringt.
Probenrohrleitungen	Stellen Sie stets sicher, dass die Probenrohrleitungen weder verunreinigt noch beschädigt sind.
Gasausgangsanschlüsse	Prüfen Sie periodisch, ob die O-Ringe an den Gasausgangsanschlüssen beschädigt sind. Durch einen beschädigten O-Ring kann Luft in das Messgas eindringen und zu falschen Messwerten führen. Falls der O-Ring beschädigt ist, muss der gesamte Gasausgangsanschluss ausgetauscht werden.
H_2S Filtermaterial	Sobald die Farbe des Filtermaterials *leicht grau* wird, muss der Filter ausgetauscht werden.

Konformitätserklärung - Deutsch

Produkte	• GA5000 - Deponiegasanalysator • GEM5000 - Deponiegasanalysator und Extraktionsüberwachungsgerät • BIOGAS 5000 - Gasanalysator für anaerobe Biogasanlage

Geotechnical Instruments (UK) Limited erklärt, dass das/die oben beschriebene(n) Produkt(e) den folgenden Normen entsprechen:

ATEX-Richtlinie 94/9/EG

Zertifizierungsstelle	SIRA Certification Service
Nummer der benannten Stelle	0518
Adresse	Rake Lane, Eccleston, Chester, CH4 9JN, UK
SIRA Bescheinigungsnummer	SIRA 11ATEX2197X
Angewendete Normen	EN60079-0 :2006 EN60079-0 :2009 EN60079-11 :2007

IECEx

Zertifizierungsstelle	SIRA Certification Service
Nummer der benannten Stelle	0518
Adresse	Rake Lane, Eccleston, Chester, CH4 9JN, UK
IECEx Bescheinigungsnummer	SIR 11.0089X
Angewendete Normen	IEC60079-0 :2004 Ed4 IEC60079-0 :2007 Ed5 IEC60079-11 :2006 Ed5

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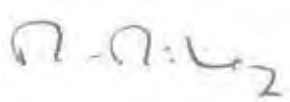
CSA (Kanada und USA)

Zertifizierungsstelle	CSA International
Adresse	178 Rexdale Boulevard, Toronto, ON, Kanada M9W 1R3
CSA Bescheinigungsnummer	CSA 11 2445306
Angewendete Normen	C22.2 Nr. 0-10 – Allgemeine Anforderungen – Kanadische Elektrorichtlinie, Teil II CAN/CSA-C22.2 Nr. 60079-0:07 - Elektrisches Gerät für explosionsfähige Gasatmosphären - Teil 0: Allgemeine Anforderungen CAN/CSA-C22.2 Nr. 60079-1:07 - Elektrisches Gerät für explosionsfähige Gasatmosphären - Teil 1: Druckfeste Kapselung „d" CAN/CSA-E60079-11:02 - Elektrisches Gerät für explosionsfähige Gasatmosphären - Teil 11: Eigensicherheit „i" ANSI/UL 60079-0:09 - Elektrisches Gerät für explosionsfähige Gasatmosphären - Teil 0: Allgemeine Anforderungen ANSI/UL 60079-1:09 - Elektrisches Gerät für explosionsfähige Gasatmosphären - Teil 1: Druckfeste Kapselung „d" ANSI/UL 60079-11:09 - Elektrisches Gerät für explosionsfähige Gasatmosphären - Teil 11: Eigensicherheit „i"

EMC Richtlinie 2004/108/EG

EN 301 489 Teil 1 (V1.9.1 - 2011-04)	Elektromagnetische Verträglichkeit und Funkspektrumangelegenheiten (ERM); Elektromagnetische Verträglichkeit (EMV) für Funkeinrichtungen und -dienste; Teil 1: Gemeinsame technische Anforderungen
EN 301 489 Teil 17 (V2.1.1 - 2009-05)	Elektromagnetische Verträglichkeit und Funkspektrumangelegenheiten (ERM); Elektromagnetische Verträglichkeit (EMV) für Funkeinrichtungen; Teil 17: Spezifische Bedingungen für Breitband-Datenübertragungssysteme EMV für Breitbandübertragungssysteme
EN 301 489 Teil 19 (V1.2.1. - 2002-11)	Elektromagnetische Verträglichkeit und Funkspektrumangelegenheiten (ERM); Elektromagnetische Verträglichkeit (EMV) für Funkeinrichtungen und -dienste; Teil 19: Spezifische Bedingungen für mobile Empfangs-Erdfunkstellen (ROMES) zur Datenübertragung im 1,5-GHz-Frequenzband EMV für mobile Empfangs-Erdfunkstellen (ROMES)
BS EN 61000-3-2: 2006 + A2:2009	Elektromagnetische Verträglichkeit (EMV). Grenzwerte. Emissionsgrenzwerte für Oberschwingungsstrom (Geräteeingangsstrom ≤ 16 A je Leiter)
BS EN 61000-3-3: 2008	Elektromagnetische Verträglichkeit (EMV). Grenzwerte. Begrenzung von Spannungsänderungen, Spannungsschwankungen und Flimmern in öffentlichen Niederspannungs-Versorgungsnetzen für Geräte mit einem Bemessungsstrom ≤ 16 A je Leiter, die keiner Sonderanschlussbedingung unterliegen.

Unterschrift:



Dr. Roger Riley

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16.4 *Instructions for safe use – Italian language*

Istruzioni per la sicurezza

⚠ **Avvertenza**	Gli analizzatori di gas serie 5000 possono essere utilizzati per misurare i gas provenienti da discariche o da altre fonti, come descritto in questo manuale. L'operatore può essere esposto a gas nocivi durante l'utilizzo dello strumento. L'inalazione di questi gas può danneggiare la salute e in alcuni casi essere letale. Spetta all'utente controllare di essere sufficientemente informato sugli aspetti riguardanti la sicurezza dei gas utilizzati e di seguire le procedure appropriate. In particolare nel caso di gas pericolosi, quelli scaricati dall'analizzatore devono essere convogliati in un'area in cui lo scaricotale operazione possa essere effettuatao in condizioni di sicurezza. È possibile che lo strumento scarichi gas pericolosi anche durante lo spurgoquando viene utilizzato per spurgare con aria pulita.

✍ Nota: gli analizzatori di gas sono apparecchi scientifici delicati e vanno trattati come tali. Utilizzando l'apparecchio in modo diverso da quanto specificato dalla casa produttrice, l'apparecchio stesso potrebbe non fornire più la protezione prevista.

Gli analizzatori di gas serie 5000 sono conformi alla Parte 15 delle norme FCC. L'utilizzo è soggetto alle seguenti due condizioni:

1) il dispositivo non deve causare interferenze dannose

2) il dispositivo deve accettare le interferenze che riceve, anche se possono causare effetti indesiderati per il suo funzionamento.

Gli analizzatori di gas della serie 5000 sono certificati con riferimento alla classificazione delle aree pericolose secondo ATEX e IECEx.

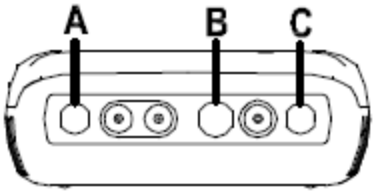
Ex II 2G Ex ib IIA T1 Gb (Ta = da -10ºC a +50ºC)

È essenziale seguire scrupolosamente le istruzioni. Spetta all'operatore definire il concetto di protezione e la classificazione richiesta per una data applicazione.

Istruzioni per l'uso in sicurezza - Italiano

(Riferimento alla Direttiva europea ATEX 94/9/CEC, Allegato II, 1.0.6.)
Le seguenti istruzioni si applicano agli apparecchi coperti dai certificati SIRA 11ATEX2197X e SIR 11.0089X della Direttiva IECEx:

- Gli apparecchi possono essere utilizzati con gas e vapori infiammabili di gruppo IIA e temperature di classe T1.
- Gli apparecchi sono certificati solo per l'uso a temperatura ambiente compresa tra -10ºC e +50ºC e non vanno utilizzati al di fuori di questo intervallo.
- Gli apparecchi non vanno utilizzati in un'atmosfera che contenga più del 21% di ossigeno.
- Le riparazioni di questi apparecchi vanno effettuate in conformità al codice professionale rilevante.
- In aree pericolose, utilizzare solo la sonda di temperatura TP-5000 (SIRA 11ATEX2197X e IECEx SIR11.0089X). Per il connettore C, l'anemometro GF5.4 (BVS 04ATEXE194) da usare esclusivamente con apparecchi ATEX. Nella zona pericolosa, l'analizzatore non va collegato ad altri dispositivi in dotazione, come il cavo 5000-USB (per il connettore A) o il caricabatteria GEM5000 BC (per il connettore B).



Non caricare, ricaricare o aprire in un'atmosfera potenzialmente esplosiva.
In aree pericolose, utilizzare solo la "sonda di temperatura TP-5000" con il connettore B.
Connettore C (Uo=10V,Io=5mA,Po=50mW,Ci=0,Li=0,Co=100uF,Lo=1000mH),
Connettore B (Uo=5V,Io=6mA,Po=7mW,Ci=0,Li=0,Co=100uF,Lo=1000mH)

ALIMENTAZIONI MASSIME NON PERICOLOSE:
Connettore A - Um=6V Connettore B - Um=10,1V

- Se esiste la possibilità che l'apparecchio potrebbe venirevenga in contatto con sostanze aggressive, ad esempio liquidi acidi o gas che possono attaccare i metalli o solventi che possono agire su materiali polimerici, spetta all'utente adottare le precauzioni necessarie, ad es. controlli regolari come da programma o verifica della resistenza a sostanze chimiche specifiche consultando la scheda tecnica, per evitare effetti negativi e non compromettere il tipo di protezione di cui è dotato l'apparecchio.

- L'intervallo di pressione relativa è di +/-500 mbar. Si noti tuttavia che la pressione in entrata non deve superare +/- 500 mbar relativamente alla pressione atmosferica e la pressione in uscita non deve superare +/- 100 mbar relativamente alla pressione atmosferica.

Gli analizzatori di gas della serie 5000 sono certificati con riferimento alla classificazione delle aree pericolose secondo CSA (Canada)

CLASSE 2258 03 - APPARECCHIATURE DI CONTROLLO DEI PROCESSI - Sistemi intrinsecamente sicuri e ignifughi - Per luoghi pericolosi.

C US
M,C,#243446

Ex ib IIA

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Rilevatori di metano Modello GA 5000, GEM 5000 e BIOGAS 5000; portatili, a batteria, con pacco batterie non sostituibile sul campo, cod. parte 20087; intrinsecamente sicuri, per circuiti intrinsecamente sicuri ("[ib]" per Zona 1) fino alla sonda di temperatura Modello TP-5000 (Connettore B) e con parametri di entità in uscita come indicato nella tabella sottostante; Codice temperatura T1; -10 ºC ≤ Tamb. ≤ +50ºC.

Connettore	Parametri entità						
	Uo (V)	Io (mA)	Po (mW)	Co (uF)	Lo (mH)	Ci (uF)	Li (mH)
B	5.0	6	7	100	1000	0	0
C	10,0	5	50	100	1000	0	0

✍ Nota: questo dispositivo è stato controllato solo per quanto riguarda le caratteristiche di sicurezza elettrica.

<u>Gli analizzatori di gas della serie 5000 sono certificati con riferimento alla classificazione delle aree pericolose secondo CSA (USA)</u>

CLASSE 2258 83 - APPARECCHIATURE DI CONTROLLO DEI PROCESSI - Sistemi intrinsecamente sicuri e ignifughi - Per luoghi pericolosi - CERTIFICATE PER USA NORME

C US
M.C.#243446

AEx ib IIA

Rilevatori di metano Modello GA 5000, GEM 5000 e BIOGAS 5000; portatili, a batteria, con pacco batterie non sostituibile sul campo, cod. parte 20087; intrinsecamente sicuri, per circuiti intrinsecamente sicuri ("[ib]" per Zona 1) fino alla sonda di temperatura Modello TP-5000 (Connettore B) e con parametri di entità in uscita come indicato nella tabella sottostante; Codice temperatura T1; -10 ºC ≤ Tamb. ≤ +50ºC.

Connettore	Parametri entità						
	Uo (V)	Io (mA)	Po (mW)	Co (uF)	Lo (mH)	Ci (uF)	Li (mH)
B	5,0	6	7	100	1000	0	0
C	10,0	5	50	100	1000	0	0

✍ Nota: questo dispositivo è stato controllato solo per quanto riguarda le caratteristiche di sicurezza elettrica.

<u>MCERTS</u>

MCERTS sta per Monitoring Certification Scheme, il programma di certificazione della Environment Agency, l'enteistituzione britannicoa per la protezione ambientale. Il programma offre uno schema in base al quale effettuare le misurazioni ambientali rispettando i requisiti qualitativi dell'Environment Agency e comprende varie attività di monitoraggio, campionatura e ispezione.

Lo strumento GEM5000 ha la certificazione MCERTS solo se:

- Dopo l'accensione iniziale, sullo schermo compare il logo MCERTS.

✍ Nota: MCERTS - Su questo strumento non si sono effettuati test di sensibilità incrociata con l'utilizzo di idrogeno solforato. Pertanto gli utenti devono accertare la presenza di H_2S, che potrebbe avere un effetto interferenziale.

MCERTS promuove fiducia nel monitoraggio dei dati e offre al settore una struttura sperimentata per scegliere sistemi e servizi di monitoraggio che soddisfino i requisiti dell'Environment Agency.

L'Environment Agency ha istituito il Monitoring Certification Scheme (MCERTS) per conseguire misurazioni ambientali qualitativamente valide. Il programma MCERTS offre la certificazione dei prodotti secondo gli standard qualitativi dell'Environment Agency, in base alle norme CEN, ISO e nazionali.

Gli strumenti con certificazione MCERTS sono stati testati da un organismo indipendente per verificare che soddisfino determinate caratteristiche di prestazione. Inoltre le aziende dei prodotti MCERTS vengono regolarmente controllate per accertare che le caratteristiche di prestazione da attestare nel certificato siano sempre conseguite.

Gli analizzatori di gas della serie 5000 sono stati certificati secondo la versione 3.1 delle 'Caratteristiche di prestazione dei sistemi portatili di monitoraggio delle emissioni'.

Batteria e ricarica

La batteria utilizzata negli analizzatori di gas della serie 5000 è al nichel-idruro metallico e viene prodotta come pacco con sei celle individuali. Anche se questo tipo di batteria non è soggetta all^effetto memoria' della ricarica come quelle al nichel cadmio, non è consigliabileraccomandabile effettuare piccole ricariche parziali.

Il caricabatteria va scollegato solo quando indica la carica completa.

⚠ **Avvertenza**	Il caricabatteria NON è coperto dalla certificazione Ex. La batteria va caricata solo in un'area sicura.

Il caricabatteria è intelligente e indica lo stato di carica in corso o avvenuta.

Lo strumento va caricato utilizzando ESCLUSIVAMENTE il caricabatteria fornito in dotazione, che è inteso solo per l'uso in un locale interno. Effettuare la ricarica in un locale ventilato.

Caricabatteria:	Tensione d'ingresso:	100-240V CA +/- 10%
	Frequenza d'ingresso:	50-60Hz +/- 10%
	Corrente d'ingresso:	0,4A@100VCA .. 0,2A@240VCA
	Tensione d'uscita:	10,1VCC max
	Corrente d'uscita:	1,5A max

✍ Nota: collegare il caricabatteria all'elettricità di rete utilizzando l'adattatore

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necessario. Per ulteriori informazioni rivolgersi alla casa produttrice.

Istruzioni per la pulizia

NON utilizzare detergenti per pulire l'analizzatore o il caricabatteria, perché potrebbero avere un effetto negativo sulla sicurezza del loro uso.

Prassi ottimali per rilevare le letture

⚠ **Avvertenza**	L'inalazione del gas di solfuro d'idrogeno (H_2S) o di altri gas nocivi può causare la morte. Spetta all'utente accertarsi di essere sufficientemente addestrato negli aspetti della sicurezza relativi all'uso di H_2S e altri gas nocivi. In particolare nel caso di gas pericolosi, quelli scaricati dall'analizzatore devono essere convogliati in un'area in cui lo scaricotale operazione possa essere effettuatao in condizioni di sicurezza. È possibile che lo strumento scarichi gas pericolosi anche durante lo spurgoquando viene utilizzato per spurgare con aria pulita.

Prassi ottimali

- Nel recarsi al luogo di utilizzo, collocare l'analizzatore di gas nell'abitacolo del veicolo, non nel bagagliaio, dove potrebbe essere soggetto a estremi di temperatura e danneggiarsi per eventuali urti. Non appoggiare l'analizzatore di gas contro superfici calde (ad es. tubo di aspirazione del gas, carrozzeria di un'autovettura o interno di un'autovettura incustodita in estate), perché ciò fa aumentare la temperatura dell'analizzatore di gas e può falsare le letture.

- Negli spostamenti nell'area di utilizzo dell'analizzatore di gas, proteggerlo dalla luce diretta del sole e dagli scrosci di pioggia.

Usare sempre il sifone per lo scarico della condensa!. Se il sifone si allaga, cambiare il filtro e controllare che tutti i tubi siano liberi dalla condensa prima di riutilizzarlo

✍ Nota: se lo scarico di un analizzatore di gas serie GA5000 è collegato ad un sistema pressurizzato, ciò fa uscire un flusso di gas dall'entrata.

Taratura

⚠ **Avvertenza**	I gas di taratura possono essere pericolosi. Per ciascun gas da utilizzare, leggere preventivamente la relativa scheda tecnica di sicurezza, accertandosi di comprenderne il contenuto.

Il regolatore fornito col kit di taratura è stato configurato per permettere l'erogazione di un flusso fisso.

Dato che il flusso del regolatore è impostato in fabbrica, può essere aperto con una semplice rotazione, senza effettuare regolazioni.

⚠ **Avvertenza**	**Luce di scarico** Durante la taratura dell'analizzatore, vi sono due possibili uscite per il gas: come di norma dalla luce di scarico (gialla)dell'analizzatore o, in caso di sovrapressione, dalla luce di 1/16″ della valvola limitatrice di pressione rossa situata sul regolatore. Si raccomanda che entrambe le luci siano dotate di tubi di scarico, che devono sboccare in un'area ben ventilata. Controllare che i tubi e i raccordi non presentino perdite. La taratura dell'analizzatore di gas va eseguita in un'area idonea, adottando tutte le precauzioni necessarie per l'utilizzo di gas potenzialmente pericolosi, esplosivi o tossici.

✍ Nota: è possibile anche che il gas esca dall'uscita del flusso interno (blu) dell'analizzatore di gas (vale solo per GA5000).

Manutenzione

Gli analizzatori di gas della serie 5000 devono essere sottoposti a regolare controllo di manutenzione per accertare che il funzionamento sia corretto e preciso. Geotech (UK) Limited raccomanda che la manutenzione e la taratura siano effettuate ogni 6 mesi.

Gli analizzatori di gas della serie 5000 hanno la certificazione ATEX per l'utilizzo in aree potenzialmente esplosive. In quanto tali, la loro manutenzione deve essere affidata esclusivamente a tecnici qualificati. La mancata osservanza di questa regola invalida la garanzia ed eventualmente anche la certificazione ATEX.

⚠ **Avvertenza**	Se la manutenzione dell'analizzatore di gas viene effettuata da tecnici non qualificati, la certificazione ATEX può venirne compromessa, pregiudicando così l'utilizzo in condizioni di sicurezza dello strumento in un'atmosfera potenzialmente esplosiva.

Parti riparabili dall'utente:

Non vi sono parti riparabili dall'utente all'interno dello strumento.
Le parti seguenti possono essere riparate:

Filtro acqua in linea	Va controllato regolarmente per evidenziare eventuali ostruzioni, condensa o danneggiamenti e sostituito se necessario. Lo strumento non va mai usato senza il filtro in linea, per evitare possibili infiltrazioni dperché vi entrerebbe l'acqua.
Tubi di campionamento	Controllare sempre che i tubi di campionamento non siano contaminati o danneggiati.
Raccordi del gas	Controllare periodicamente che i gommini O-ring dei

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	raccordi del gas non siano danneggiati. Se danneggiati, gli O-ring lasciano entrare aria nei tubi di campionamento, sfalsando le letture. Se l'O-ring risulta danneggiato, è necessario sostituire tutto il raccordo.
Materiale del filtro H_2S	Quando il materiale del filtro cambia colore e diventa *grigio chiaro*, il filtro va sostituito.

Dichiarazione di conformità – Italiano

Prodotti	• GA5000 – Analizzatore di gas per discariche • GEM5000 - Analizzatore di gas e monitor di estrazione per discariche e monitor per l'estrazione • BIOGAS 5000 – Analizzatore di gas per impianti di digestione anaerobica

Geotechnical Instruments (UK) Limited dichiara che gli articoli sopra descritti sono conformi ai seguenti standard:

Direttiva ATEX 94/9/CE

Organismo di certificazione	SIRA Certification Service Servizio di certificazione SIRA
Numero dell'organismo notificato	0518
Indirizzo	Rake Lane, Eccleston, Chester, CH4 9JN, GB
N° certificazione SIRA	SIRA 11ATEX2197X
Norme applicate	EN60079-0 :2006 EN60079-0 :2009 EN60079-11 :2007

IECEx

Organismo di certificazione	SIRA Certification Service Servizio di certificazione SIRA
Numero dell'organismo notificato	0518
Indirizzo	Rake Lane, Eccleston, Chester, CH4 9JN, GB
N° certificazione IECEx	SIR 11.0089X

Norme applicate	IEC60079-0 :2004 Ed4 IEC60079-0 :2007 Ed5 IEC60079-11 :2006 Ed5

CSA (Canada e USA)

Organismo di certificazione	CSA International
Indirizzo	178 Rexdale Boulevard, Toronto, ON, Canada M9W 1R3
N° certificazione CSA	CSA 11 2445306
Norme applicate	C22.2 No. 0-10 - Requisiti generali – Codice elettrico canadese, Parte II CAN/CSA-C22.2 No. 60079-0:07 - Apparecchi elettrici per atmosfere con gas esplosivi - Parte 0: Requisiti generali CAN/CSA-C22.2 No. 60079-1:07 - Apparecchi elettrici per atmosfere con gas esplosivi - Parte 1: Custodie a prova di esplosione "d" CAN/CSA-E60079-11:02 - Apparecchi elettrici per atmosfere con gas esplosivi - Parte 11: Sicurezza intrinseca "i" ANSI/UL 60079-0:09 - Apparecchi elettrici per atmosfere con gas esplosivi - Parte 0: Requisiti generali ANSI/UL 60079-1:09 - Apparecchi elettrici per atmosfere con gas esplosivi - Parte 1: Custodie a prova di esplosione "d" ANSI/UL 60079-11:09 - Apparecchi elettrici per atmosfere con gas esplosivi - Parte 11: Sicurezza intrinseca "i"

Direttiva EMC 2004/108/CE

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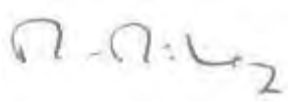
EN 301 489 P. 1 (V1.9.1 – 2011-04)	Compatibilità elettromagnetica e questioni relative allo spettro delle radiofrequenze (ERM) Norma di compatibilità elettromagnetica (EMC) per apparecchiature e servizi radio Parte 1: Prescrizioni tecniche comuni
EN 301 489 P. 17 (V2.1.1 – 2009-05)	Compatibilità elettromagnetica e questioni relative allo spettro delle radiofrequenze (ERM) Norma di compatibilità elettromagnetica (EMC) per apparecchiature radio Parte 17: Condizioni specifiche per sistemi di trasmissione dati su banda larga EMC per sistemi di trasmissione dati su banda larga
EN 301 489 P. 19 (V1.2.1 – 2002-11)	Compatibilità elettromagnetica e questioni relative allo spettro delle radiofrequenze (ERM) Norma di compatibilità elettromagnetica (EMC) per apparecchiature e servizi radio Parte 19: Condizioni specifiche per soli ricevitori di stazioni mobili terrestri (ROMES) operativi nella banda 1,5 GHz che forniscono comunicazioni di dati EMC per soli ricevitori di stazioni mobili terrestri (ROMES)
BS EN 61000-3-2: 2006 + A2:2009	Limiti di compatibilità elettromagnetica (EMC) . Limiti per le emissioni di corrente armonica (apparecchiature con corrente di ingresso ≤ 16 A per fase)
BS EN 61000-3-3: 2008	Limiti di compatibilità elettromagnetica (EMC) . Limitazione delle fluttuazioni di tensione e del flicker in sistemi di alimentazione in bassa tensione per apparecchiature con corrente nominale ≤ 16 A e non soggette ad allacciamento su condizione

Firmato



Dr. Roger Riley

Geotech Geopump Peristaltic Pump

Installation and Operation Manual

Rev 7/14/2011 Part # 81350020

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DOCUMENTATION CONVENTIONS

This uses the following conventions to present information:

WARNING

An exclamation point icon indicates a **WARNING** of a situation or condition that could lead to personal injury or death. You should not proceed until you read and thoroughly understand the **WARNING** message.

CAUTION

A raised hand icon indicates **CAUTION** information that relates to a situation or condition that could lead to equipment malfunction or damage. You should not proceed until you read and thoroughly understand the **CAUTION** message.

NOTE

A note icon indicates **NOTE** information. Notes provide additional or supplementary information about an activity or concept.

NOTICES

In order to ensure your Geopump has a long service life and operates properly, adhere to the following cautions and read this manual before use.

- **Disconnect from power source when not in use.**
- **Power input source must not exceed maximum ratings.**
- **Equipment must be wired to a negative ground system.**
- **Equipment may not operate properly with excess wiring not supplied by manufacturer .**
- **Avoid spraying fluid directly at equipment.**
- **Never submerge equipment.**
- **Avoid pulling on wires to unplug equipment wiring.**
- **Avoid using equipment with obvious physical damage.**
- **To prevent equipment damage, avoid dropping it.**

The Geotech Geopump Peristaltic Pump cannot be made dangerous or unsafe as a result of failure due to EMC interference.

WARNING

Do not operate this equipment if it has visible signs of significant physical damage other than normal wear and tear.

Notice for consumers in Europe:

This symbol indicates that this product is to be collected separately.

The following applies only to users in European countries:

- This product is designated for separate collection at an appropriate collection point. Do not dispose of as household waste.
- For more information, contact the seller or the local authorities in charge of waste management.

Section 1: System Description

Function and Theory

The Geotech Series I and II Peristaltic Pumps (Geopump) are designed for single and multi-stage pressure or vacuum pumping of liquids for field or laboratory use. Since the Geopump can operate to a depth of 27 feet (8m) at sea level, it is ideally suited for sample removal from shallow wells and all surface water sources.

The Geopump operates by mechanical peristalsis, therefore the sample only comes in contact with the tubing. This allows for sample integrity as well as easy cleaning and tubing replacement. Tubing can also be lowered to a specific depth without curling or floating on the surface of the water with the use of an optional stainless steel tubing weight.

Differences between the two models affect the number of pump heads which may be used with the Geopump at one time and the speed(s) at which the pump heads operate. Therefore, the instructions for general operations will be covered only once.

System Components

SERIES I Peristaltic Pumps are available in AC only, DC only, or an AC/DC combination. These units have one pumping station which can also be piggy-backed for multi-station pumping. The variable speed range is from 0 RPM to 350 RPM.

SERIES II Peristaltic Pumps are available in AC only, DC only, or an AC/DC combination. They have two pumping stations which can also be piggy-backed. The first pumping station is rated at 0 RPM to 350 RPM and the second station at 0 RPM to 600 RPM. Each pumping station works in conjunction with the other.

Section 2: System Installation

Standard Pump Head Instructions

1. Separate the pump halves. Hold the pump head as shown with the rollers in the 2, 6, and 10 o'clock positions and the rotor shaft facing down.

2. Place the tubing around the rollers.

3. Turn rotor counterclockwise until tubing completely surrounds the rotor.

4. The tubing is now in place. Next, position other pump half onto the motor shaft and snap shut. Be careful not to pinch tubing between plastic halves.

Easy-Load II Pump Head Instructions

1. Attach the Easy-Load II pump to the Geopump with the screws provided.
2. Set the lever to the left to open the pump. Place the tubing left to right.

3. Set the lever to the right to close the pump housing onto the tubing.

Section 3: System Operation

The Geopump arrives packed in a hard-shell peristaltic pump carry case with the pump head properly attached to the pump (purchased separately). See Section 8 on available pump parts.

To place the pump into service:

1. Remove the pump from the case and verify the pump is switched to “OFF” (red, open circle)

2. For AC/DC combination units, plug in the appropriate power cord into the outlet in the back of the pump and the other end of the power cord into the power source.

3. Insert the tubing into the pump head.

4. Put one end of the tubing into the sample source (well, river, ditch, lagoon, etc.) and the other end into the sample container.

5. Determine the desired direction of flow and set the toggle switch for the flow direction.

6. Turn the pump “ON” (the black filled circle).

7. Once pumping has begun, the speed dial can be adjusted to increase or reduce the fluid pumping speed as needed.

Section 4: System Maintenance

The Geopump has a strong reputation for durability and being virtually maintenance free. The following maintenance steps will assure your pump's long-term reliability:

Pump Tubing:

Depending on the pump head design, different sizes of tubing may be used. Use of incorrect tubing, size, or type, will cause damage to the pump and/or the pump head and void the warranty. Geotech recommends regular tubing replacement for optimum performance. Using the proper size and type of tubing for the pump head is essential. If you are unsure of the tubing type for your application, please call Geotech.

Pump:

Keep your Geopump clean and dry. In the event that the Geopump is subjected to significant splashing or immersion, discontinue use and wipe the unit down immediately with a clean dry cloth.

To keep your Geopump reliable follow these simple guidelines:

- Do not drop your Geopump.
- Do not immerse your Geopump.
- Do not subject your Geopump to poor power supplies.
- Do not subject your Geopump to extreme heat or cold when in use.

Power Cords:

Always replace a kinked or damaged power cord. Replacement power cords are available for AD/DC combination units. Units with a hard-wired power cord are to be sent back to Geotech for proper repair. Refer to the Geotech Warranty and Repair page in the back of this manual.

Pump Head:

Clean the Geopump pump head periodically using a phosphate-free cleaning detergent and water solution.

Section 5: System Troubleshooting

Problem: Unit will not turn on.

Solution:

1. No power to unit: (rollers not moving):
   - Check power source and compatibility.
   - Check connections.

2. Speed control not set fast enough to overcome tubing resistance:
   - Check speed setting; if too low turn it up.

3. Check tubing size and type. Make sure it is the correct size and type for the pump head.

4. Check circuit breaker; if tripped press it in to reset.

Problem: Unit turns on, but not pumping (pump head rollers are moving).

Solution:

1. Verify fluid level in well (max suction lift unit can pump from is 27 feet (8m) below ground at sea level).

2. Water level is below down well tubing intake. Increase tubing length.

3. If using a combination of flexible and rigid tubing, check connection between tubing. A poor connection may cause a vacuum leak. Secure tubing connection.

4. Flexible tubing in pump head compromised or worn out:
   - Replace flexible tubing regularly.

5. Obstruction in tubing:
   - Check for clogs and kinks.
   - Clear any obstructions.

6. Using incorrect tubing type for pump head:
   - Tubing may have collapsed.
   - Replace with proper tubing type.

Problem: Pump head rollers are not moving .

Solution:

1. Pump head is loose from the pump housing:
   - Tighten pump head screws to engage pump head to gear.
   - Possible internal damage, call Geotech for consultation.

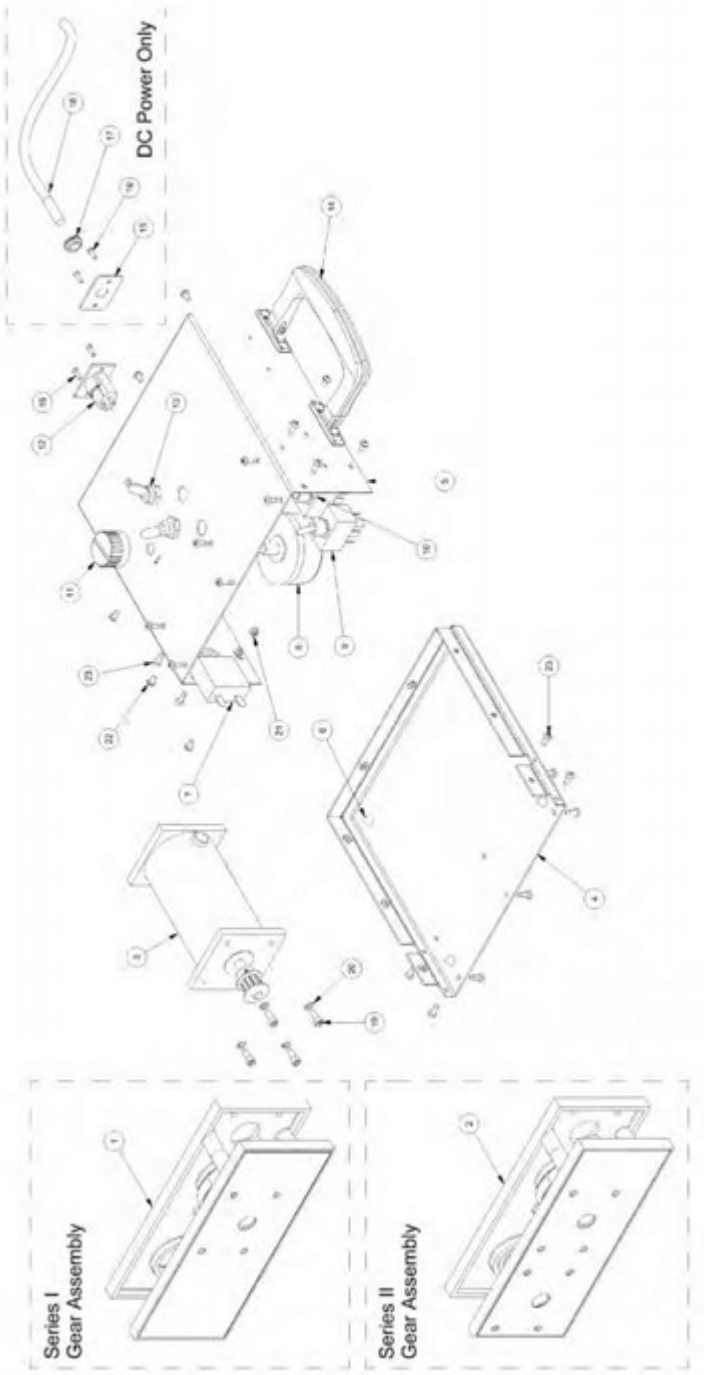
Section 6: System Specifications

Operating range	27 feet (8m) (at sea level)
Principle of Operation	Mechanical peristalsis
Dimensions	3.5 x 8 x 8 inches (9 x 20 x 20cm)
Power source (DC)	Any rated external 12-18 VDC @ 70 Watts
Power source (AC)	90-260 VAC, 47-65 Hz
Nominal operating current	3 amps DC
Over current Protection	5 amps DC
Power cord	12 VDC cord
Range of speed: Series I	0 to 350 RPM
Range of speed: Series II	First pumping station 0 to 350 RPM Second pumping station 0 to 600 RPM
Speed control	Step-less variable speed control
Liquid delivery rate	1.67 ml per revolution (for size 15 tubing)
Pumping options	Pressure or vacuum (reversible flow)
Pump head rotor	Cold rolled steel

OPTIONS

Models:	Geopump 1, Geopump 2
Tubing:	Silicone, Tygon, Viton, C-Flex
Pump Heads:	Standard, Easyload, Easyload 2

Section 7: System Schematics



Section 8: Parts and Accessories

Schematic Parts Listing (Section 7)

Item	QTY	Part Number	Part Description
1	1	51350001	Assy, Gear Housing, Series I
2	1	51350002	Assy, Gear Housing, Series II
3	1	51350003	Assy, Motor, PP
4	1	51350012	Assy, Housing, Bottom, PP
5	1	51350023	Housing, Top, Silk Screened
6	4	17500042	Foot, RBR, 9/32” Hole Dia
7	1	11350005	Breaker, Thermal, 5amp, Circuit 250V
8	1	51350011	Assy, Rheostat
9	1	11350020	Switch, Toggle, Dpdt, Frwd/Rvrs
10	1	11350021	Switch, Toggle, Dpst, On/Off
11	1	11350010	Knob, Plastic, Rheostat
12	1	51350033	Assy, Wiring Harness, PP
13	2	17500037	Boot, RBR, Toggle Switch, Grey
14	1	11350009	Handle, PE, NI
15	1	11350015	Plate, AL, 1.5x1.5, Hardwire, Cord, Painted
16	2	00114	Screw, SS8, 4-40x3/8”, FHD
17	1	11350019	Grommet, RBR, 5/16x1/2”, ¼” Thick Hole
18	1	17500040	Cord, SJOW, DC Power, 18-2
19	4	17500366	Screw, SS8, 8-32x3/8”, SHCS
20	4	17200081	Washer, SS8, #8, Lock
21	2	17200046	Nut, Hex, 4-40, Nyloc
22	8	17200078	Screw, SS8, 6-32x.25”, PNH, M/S
23	20	17200077	Screw, SS8, 6x3/8”, PNH, TEK Self Drilling

Additional Parts Listing

Part Number	Part Description
17500035	Adaptor, Cigarette to Clips
51350030	Power Supply, AC Adapter, PP, 18V, 70W, CE
57500008	Assy, Power Cord, DC w/Amp
51350015	Case, Peristaltic Pump with foam
51350026	Faceplate, Gear, Hsng, Series II, Painted
51350025	Faceplate, Gear, Hsng, Series I, Painted
17200079	Screw, SS8, 8-32x1.25”, Fillister, Peristaltic Pump
17200199	Screw, ZNC, 6-32x2.5”, Thumb, Peristaltic Pump
71350030	Screw, SS8, 8-32x3”, Phil

Old Style Non-CE Parts

Part Number	Part Description
57500007	Assy, Power Cord, AC, w/Amp
51350007	Assy, Diode, PP
57500009	Assy, Rectifier Bridge, PP-Logic
51350013	Assy, Transformer w/Jumper, PP
51350004	Assy, Wiring Harness, PP

The Warranty

For a period of one (1) year from date of first sale, product is warranted to be free from defects in materials and workmanship. Geotech agrees to repair or replace, at Geotech's option, the portion proving defective, or at our option to refund the purchase price thereof. Geotech will have no warranty obligation if the product is subjected to abnormal operating conditions, accident, abuse, misuse, unauthorized modification, alteration, repair, or replacement of wear parts. User assumes all other risk, if any, including the risk of injury, loss, or damage, direct or consequential, arising out of the use, misuse, or inability to use this product. User agrees to use, maintain and install product in accordance with recommendations and instructions. User is responsible for transportation charges connected to the repair or replacement of product under this warranty.

Equipment Return Policy

A Return Material Authorization number (RMA #) is required prior to return of any equipment to our facilities, please call our 800 number for appropriate location. An RMA # will be issued upon receipt of your request to return equipment, which should include reasons for the return. Your return shipment to us must have this RMA # clearly marked on the outside of the package. Proof of date of purchase is required for processing of all warranty requests.

This policy applies to both equipment sales and repair orders.

FOR A RETURN MATERIAL AUTHORIZATION, PLEASE CALL OUR SERVICE DEPARTMENT AT 1-800-833-7958.

Model Number: _____

Serial Number: _____

Date of Purchase: _____

Equipment Decontamination

Prior to return, all equipment must be thoroughly cleaned and decontaminated. Please make note on RMA form, the use of equipment, contaminants equipment was exposed to, and decontamination solutions/methods used. Geotech reserves the right to refuse any equipment not properly decontaminated. Geotech may also choose to decontaminate the equipment for a fee, which will be applied to the repair order invoice.

Declaration of Conformity

Geotech Environmental Equipment, Inc.
2650 E 40th Avenue
Denver, CO 80205

Following products are covered:
Geotech product PN

These products comply with the directive 2004/108/EC (EMC),
harmonized standard EN 61010-1 2001-12-07, emissions class A.
These products comply with harmonized standard EN 61326-1 May 2006.

Signatory:
Joe Leonard

Product Development

Year of manufacture:
EMC conformity established 8/14/2009.
This declaration is issued under the sole responsibility of
Geotech Environmental Equipment, Inc.

Model _____

Serial number _____

Geotech Environmental Equipment, Inc.
2650 East 40th Avenue Denver, Colorado 80205
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email: international@geotechenv.com website: www.geotechenv.com/spain.html
Printed in the United States of America

Series 477A Handheld Digital Manometer

Specifications - Installation and Operation Instructions

Series 477A Digital Manometers are versatile, hand-held, battery operated manometers available in several basic ranges from 0-20 in. w.c. up to 100 psi. All models measure either positive, negative or differential pressures with ±0.10% of full scale accuracy. You can select from up to seven common English and metric pressure units so conversions are not necessary. A memory function allows storage of up to 40 readings for later recall and a backlight provides auxiliary lighting for hard-to-see locations. Also standard are a hold feature plus both visual and audible overpressure alarms.

SPECIFICATIONS

Service: Air and compatible gases.
Wetted Parts: Consult factory.
Accuracy: ±0.10% of full scale from 60 to 78°F (15.6 to 25.6°C); ±1% of full scale from 32 to 60 and 78 to 104°F (0 to 15.6 and 25.6 to 40°C).
Pressure Hysteresis: ±0.1% of full scale.
Pressure Limits: See chart.
Temperature Limits: 32 to 104°F (0 to 40°C).
Storage Temperature Limits: -4 to 176°F (-20 to 80°C).
Display: 4-digit LCD (.425"H x .234"W digits).
Resolution: See chart.
Power Requirements: 9 volt alkaline battery. Battery included but not connected.
Weight: 10.2 oz. (289 g).
Connections: Two barbed connections for use with 1/8" (3.18 mm) or 3/16" (4.76 mm) I.D. tubing for 477A-1, 477A-2, 477A-3, 477A-4 and 477A-5 only. Two compression fittings for use with 1/8" (3.18 mm) I.D. x 1/4" (6.35 mm) O.D. tubing for 477A-6 and 477A-7 only.

Model Number	English Range	Metric Range
477A-1	0-20.00 in. w.c.	0-4.982 kPa
477A-2	0-40.00 in. w.c.	0-9.96 kPa
477A-3	0-200.0 in. w.c.	0-49.82 kPa
477A-4	0-10.00 psi	0-68.95 kPa
477A-5	0-30.00 psi	0-206.9 kPa
477A-6	0-50.00 psi	0-344.8 kPa
477A-7	0-100.0 psi	0-689.5 kPa

Maximum Pressure	
477A-1	3 psi (0.21 bar)
477A-2	3 psi (0.21 bar)
477A-3	15 psi (1.03 bar)
477A-4	30 psi (2.07 bar)
477A-5	60 psi (4.13 bar)
477A-6	100 psi (6.89 bar)
477A-7	200 psi (13.78 bar)

Available Pressure Units:

477A-1 & 477A-2: psi, in. w.c., mm w.c., in. Hg, mm Hg, Pa, kPa, bar, mbar

477A-3 & 477A-4: psi, in. w.c., mm w.c., in. Hg, mm Hg, kPa, bar, mbar

477A-5, 477A-6 & 477A-7: psi, in. w.c., in. Hg, mm Hg, kPa, bar, mbar

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INSTRUCTIONS

Battery Installation

The unit is shipped with a separate 9 volt alkaline battery which must be installed before operation. Remove the two screws holding the bottom endcap in place and remove the endcap. Connect the battery to the enclosed battery clip observing correct polarity. Be careful not to trap wires between the battery, case or foam pads which retain the battery. This could make it difficult to install the battery or remove it later for replacement. Be sure the rubber gasket is properly seated in the gasket channel of the endcap and replace endcap. Note that the endcap will only fit one way because the holes are slightly off-center. Place the "Z" shaped wrist strap clip in one of the screw recesses and replace the screws. Do not overtighten the screws. Attach wrist strap to clip.

When battery replacement becomes necessary, use only a 9 volt alkaline type such as a Duracell® MN1604, Eveready® 522 or equivalent. Zinc-carbon types, often labeled Heavy-duty are not recommended because of the increased potential for leakage. Alkaline batteries are also a better value because they last up to three times longer in this device.

On-Off Operation

The on-off control is a toggle function. Press and release the ON/OFF key once to turn unit on; again to turn it off. If the manometer is left on with no activity for approximately 20 minutes, unit will turn itself off to conserve the battery.

Display Backlight

The Model 477A includes a display backlight to allow use in the dark or in poor lighting conditions. Manometer must be switched off before this feature can be activated. Next, press and hold the ON/OFF key down. After about 1 second the backlight will come on and remain lighted for approximately 2 minutes after which it will turn itself off to conserve battery life.

Zeroing Pressure Reading

Potential inaccuracy due to temperature effects can be minimized by re-zeroing immediately before use. To zero the display, vent both ports to atmosphere so no pressure is applied to either port. Press the ZERO/STORE key and - - - - will be momentarily displayed as zeroing occurs. Zeroing is not possible when the memory mode is in use. It must be done before selecting that function.

If the unit is accidently zeroed with pressure applied to one of the ports, the pressure reading might display incorrectly. To correct, vent the pressure ports to atmosphere and press the ZERO/STORE key to zero the unit.

Pressure Connections

To measure single positive pressure, connect tubing to port marked + and vent opposite port to atmosphere. To measure differential positive pressure, connect higher positive pressure to port marked + and lower positive pressure to port marked -. Manometer will indicate the difference between the two.

Selecting Pressure Units

Up to seven pressure units are available. The display will indicate the current selection. To change to different units, use the UNITS/LOC key. Each touch will cause an advance to the next choice. The selected units will remain in memory even when power is shut off. This way, your preference will always be displayed after the initial selection.

Display Hold

There may be situations where you want to temporarily retain a reading. The Model 477A includes a Display Hold feature which freezes the current reading and holds it in the display until cleared. To activate this operation, momentarily press the HOLD/MEMORY key when the pressure you want to save is displayed. A HOLD indicator will appear in the display to indicate that the reading shown is frozen. To return to normal operation, press the HOLD/MEMORY key again. The HOLD indicator will disappear and the current pressure will again be shown.

Memory Function

A memory function is included in the Model 477A that allows you to store up to 40 pressure readings for later review or recording. This feature is especially valuable for making a traverse of duct velocity pressures with a Pitot tube or for multipoint pressure measurements. The readings are stored in non-volatile memory so they will be retained even if the unit is shut off or the battery is removed.

Storing Pressure Readings

To store a reading, press and hold the HOLD/MEMORY until ST01 is displayed then release the key. Next, press ZERO/STORE key to save current reading to ST01 memory location. A beep will sound indicating that the reading has been saved. As each reading is saved, the memory location display will advance to the next number. To resume pressure measurement, press the HOLD/MEMORY key again. Note that in the memory mode, the display zero function is not available. To zero the display, you must first exit the memory mode and then press the ZERO/STORE key.

Viewing Stored Readings - Selecting a Location

To view the contents of memory, press and hold the HOLD/MEMORY until RD01 is displayed then release the key. Next, press UNITS/LOC to view other memory location. To resume pressure measurement, press the HOLD/MEMORY key again.

Clearing Memory

To clear the contents of memory, press and hold the HOLD/MEMORY until CLR is displayed then release the key. Next, press ZERO/STORE key to clear all previously stored readings. During this operation - - - - will be displayed. Once memory is cleared, the current pressure will be displayed.

Exiting Memory Mode

To exit the memory mode press the HOLD/MEMORY key again and the unit will return to normal operation.

Dampening Function

The dampening feature allows the user to enter a dampening number from 1 to 16 (default value = 2). Entering a larger number increases the amount of readings that are averaged for each display update.

In order to access the dampening feature, follow the instructions below.

1. Press and hold the HOLD/MEMORY button. The upper right portion of the LCD scrolls through a menu selection (HOLD, ST01, RD01, CLR, and DAMP). When "DAMP" is shown, release the HOLD/MEMORY button. This selects the dampening feature.

2. Once "DAMP" is selected, a number is shown in the upper right portion of the LCD, along with the current pressure reading. This number is the dampening number. Adjust the number up by pressing the ZERO/STORE button or down by pressing the UNITS/LOC button. The LCD update rate slows as the number increases from 1 to 16. Therefore, for best results, choose the smallest number that provides a stable pressure reading.

Once the pressure reading is stable, press and release the HOLD/MEMORY button to store the dampening value.

Overpressure Alarm

A visual indicator and audible alarm are provided to alert the operator that pressure has exceeded the operating range of the unit. Exceeding the range will not damage it or affect calibration as long as the maximum rated pressure is not exceeded. ***Do not exceed the maximum rated pressure of the manometer. Doing so will cause permanent damage to the sensor, may rupture the housing and/or cause injury.*** The maximum pressure is shown on the rear label and on page 1 of these instructions.

Low Battery Indicator

A weak battery can cause improper operation or inaccurate measurements. A low battery indicator is provided on the display to show when the battery needs replacement. Although the unit might appear to function and indicate properly, the accuracy of readings cannot be guaranteed when the LOW BAT indicator is illuminated. Replace the battery with a fresh one. Do not leave an exhausted battery in the unit due to potential leakage.

MAINTENANCE

The Series 477A handheld digital manometers are not field repairable and should be returned if repair is needed (field repair should not be attempted and may void warranty). Be sure to include a brief description of the problem plus any relevant application notes. Contact customer service to receive a return goods authorization number before shipping.

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Dwyer®

Series 475 Mark III Digital Manometer

BATTERY INSTALLATION

Remove the two screws holding the bottom endcap and remove it. Connect the battery to the enclosed battery clip, observing the correct polarity.
When replacing the cover be sure the rubber sealing gasket is properly seated in the gasket channel of the endcap. Note the endcap will only fit one way. The holes are slightly offset to center. Replace the screws, **DO NOT OVERTIGHTEN.**

LOW BATTERY INDICATOR

A weak battery can cause improper operation or inaccurate measurements. When "LOW BAT" indicator is illuminated replace the battery. Do not leave exhausted battery in the unit due to risk of leakage.

475-AV AIR VELOCITY KIT

Complete kits include a Series 475 manometer (standard ranges as shown on back of card), (2) No. A-303 static pressure tips, (2) nine ft. lengths of 3/16" I.D. rubber tubing, a Model 166-6-CF, 6" Pitot tube, No. A-397 step drill, No. A-532 air velocity slide chart and instructional bulletin H-11. All items are packed in a tough molded plastic carrying case with die cut foam liner.

☐ 475-000-FM ☐ 475-0-FM ☐ 475-2-FM ☐ 475-4-FM ☐ 475-6-FM ☐ 475-8-FM
☐ 475-00-FM ☐ 475-1-FM ☐ 475-3-FM ☐ 475-5-FM ☐ 475-7-FM

MADE IN U.S.A.

SPECIFICATIONS:

Service: Air and compatable gases.
Wetted Materials: Consult Factory.
Accuracy: ±0.5% F.S., 60 - 78°F (15.6 to 25.6°C); 1.5% F.S. from 32 to 60°F and 78 to 104°F (0 to 15.6°C and 25.6 to 40°C).
Pressure Hysteresis: ±0.1% of full scale
Pressure Limits: See chart.
Temperature Limits: 0 to 140°F (-17.8 to 60°C)
Compensated Temperature Limits: 32 to 104°F (0-40°C)
Storage Temperature Limits: -4 to 176°F (-20 to 80°C)
Display: 4-digit LCD (.425 H x .234 W digits)
Power Requirements: 9 volt alkaline battery. Battery included but not connected.
Weight: 10.8 oz. (306 g).
Pressure Connections: Two barbed connections for use with 1/8" or 3/16" I.D. tubing. Two compression fittings for use with 1/8" I.D. x 1/4" O.D. tubing. (for 100 psi or higher pressure ranges)
Agency Approvals: FM, CE.

MODEL/RANGE CHART

MODEL	PRESSURE RANGES	MAX. PRESSURE
475-000-FM	0-1.000 IN W.C. (0-.2491 kPa)	5 PSI (34.5 kPa)
475-00-FM	0-4.000 IN W.C. (0-0.996 kPa)	5 PSI (34.5 kPa)
475-0-FM	0-10.00 IN W.C. (0-2.491 kPa)	5 PSI (34.5 kPa)
475-1-FM	0-20.00 IN W.C. (0-4.982 kPa)	10 PSI (68.9 kPa)
475-2-FM	0-40.00 IN W.C. (0-9.96 kPa)	10 PSI (68.9 kPa)
475-3-FM	0-200.0 IN W.C. (0-49.82 kPa)	30 PSI (207 kPa)
475-4-FM	0-10.00 PSI (0-.6895 bar)	30 PSI (2.07 bar)
475-5-FM	0-20.00 PSI (0-1.379 bar)	60 PSI (4.14 bar)
475-6-FM	0-30.00 PSI (0-2.069 bar)	60 PSI (4.14 bar)
475-7-FM	0-100.0 PSI (0-6.895 bar)	150 PSI (10.3 bar)
475-8-FM	0-150.0 PSI (0-10.34 bar)	200 PSI (13.8 bar)

OPERATING INSTRUCTIONS:

ON/OFF:

Press ON/OFF to turn the unit on. Press and hold ON/OFF for about 2 seconds to turn it off. Device will automatically shut off after 20 minutes if not in use.

ZERO:

Vent both pressure ports to atmosphere. Press ZERO button until the LCD displays "---" then release it. The LCD reads 0 if the zero offset is less than 10% of FS.

UNITS:

To change units, press both ON/OFF and ZERO buttons simultaneously.

BATTERY:

Remove retaining screws on end cap at base of instrument to replace battery when LOW BAT is displayed.
Use 9volt alkaline battery DURACELL MN 1604, EVEREADY 522, or equivalent.

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