EntryRAE

PGM-3000
Multi-Gas Monitor

ISO 9001
CERTIFIED

USER MANUAL

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!**

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

⚠ **Special Note**

When the EntryRAE monitor is removed from the transport case and is turned on for the first time, there may be residual vapors trapped inside the monitor, and the initial toxic gas sensors values may indicate a few ppm. After running the monitor for several minutes in clean air, the residual vapors should clear and readings should return to near zero.

⚠ **Attention! For European Applications**

A. Recharge batteries in non-hazardous locations.

B . Do not connect external cable to serial interface jack in hazardous locations.

C. Use RAE Systems Charging cradle (P/N 046-3059-001) for connection to communication port and charging jack only in a non hazardous area.

⚠ **Note**

Only the combustible gas detection portion of this instrument has been assessed for performance in accordance with C22.2 No.152-M1984.

Seulement la partie combustible de détection de gaz de cet instrument a été evaluée pour l'exécution selon C22.2 No. 152-M1984.

Protected by U.S. Patents 5,393,979 , 5,561,344 , 5,773,833 , 6,225,633, 6,313,638 , 6,333,632 , 6,320,388

⚠ **WARNING**

To prevent ignition of flammable or combustible atmospheres, disconnect power before servicing.

⚠ **WARNING**

Do not mix old batteries with used batteries or mix batteries from different manufacturers.

⚠ **WARNING**

Substitution of components may impair intrinsic safety.

⚠ Warnings ⚠

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

⚠ Battery Pack

Use only RAE Systems battery packs (P/N 046-3007-000 or 046-3051-000). 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/replace batteries only in non-hazardous atmospheres.

⚠ Computer Interface

Do not transfer data by means of the computer interface cable in hazardous atmospheres.

⚠ Static Hazard

Clean only with a damp cloth.

⚠ Calibration

While the EntryRAE has been factory calibrated prior to shipment, transport and storage after leaving the factory can affect the sensors. Therefore, any newly purchased RAE Systems Instrument should be fully calibrated by exposing it to known concentration calibration gases before the instrument is put into service for the first time. For safety, check the accuracy of the monitor by exposing the sensors to calibration gas(es) before each day's use. (Refer to "Calibration" on page 10.)

⚠ Caution!

Before each day's usage, sensitivity must be tested on a known concentration of methane gas equivalent to 20% to 50% of full-scale concentration. Accuracy must be within 0% to +20% of actual. Accuracy may be corrected by calibration. Refer to "Calibration" on page 10.)

⚠ Long-Term Storage

Reliable performance of this gas detector is based upon regular usage. For long term storage, the battery should be disconnected. Preparation for use after long storage requires installation of the batteries and a warm-up period of at least 10 minutes for the sensors to equilibrate. The user should recognize that sensor life is based upon the purchase date.

⚠ Readings

Any rapid up-scale reading followed by a declining or erratic reading may indicate a gas concentration beyond the upper scale limit, which may be hazardous.

CAUTION: HIGH OFF-SCALE READINGS MAY INDICATE AN EXPLOSIVE CONCENTRATION!

⚠ Avertissements ⚠

Pour des raisons de sécurité, cet équipement 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.

⚠ Ensemble de Batterie

Utiliser seulement de paquets batterie de RAE Systems (numéro de la pièce 046-3007-000 ou 046-3051-000). 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 intrinsèque. Ne charger les batteries que dans l'emplacement désigné non dangereux.

⚠ Câble de Computer

Connecter pas le câble externe que dans environnements non dangereux.

⚠ Danger Risque D'origine Electrostatique

Nettoyer uniquement avec un chiffon humide.

⚠ La Calibration

Les indications de toute instruments de RAE Systems doit être testé en exposant l'instrument à une concentration de gaz connue par une procédure diétalonnage avant de mettre en service l'instrument pour la première fois. Pour une sécurité maximale, la sensibilité du EntryRAE doit être vérifié en exposant l'instrument. (Référez la Calibration à la page 10.)

Attention!

Avant chaque utilisation journalière verifier la sensibilité avec une concentration connue de methane equivalante a 20% à 50% de la pleine échelle. La precision doit être comprise entre 0% à +20% de la valeur vraie et peut être corrigée par une procédure diétalonnage. (Référez la Calibration à la page 10.)

⚠ Stockage à Long Term

Le fonctionnement durable de ce détecteur de gas est conditionné par une utilisation régulière de celui ci. Lors d'un stockage à long terme, la batterie doit être déconnectée. Le rédémarrage après une longue période d'arrêt, nécessite la réinstallation de la batterie, et une période de chauffage de 10 mn afin que les capteurs se mettent à l'équilibre. L'utilisateur doit être conscient que la durée de vie indiquée pour le capteur démarre à sa date d'achat.

⚠ Les Lectures

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.

ATTENTION: DES LECTURES SUPÉRIEURES A L'ÉCHELLE PEUVENT INDIQUER DES CONCENTRATIONS EXPLOSIVES.

Table of Contents

SPECIAL NOTE: If the monitor needs to be serviced, contact either:

The **RAE Systems distributor** where the monitor was purchased; they will return the monitor on your behalf,

or

The **RAE Systems Technical Service department**. Before returning the monitor 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 monitor is returned for service or upgrade. ***Packages without RMA Numbers will be refused at the factory.***

General Information

The EntryRAE is a 4-gas plus PID (photoionization detector) gas monitor. Reliable, easy to operate and simple to calibrate, the EntryRAE delivers added protection without added complexity.

Simple, Modular, Durable PID

RAE Systems is the technology leader in PIDs. Our modular, plug & play, self-cleaning (patented) PID is the most reliable and durable PID available today.

Key Features

- Reliable self-cleaning PID
- Also includes CO, H_2S, LEL and O_2 sensors
- Built-in pump
- Interchangeable Li-Ion and alkaline battery adapter
- Up to 16 hours of continuous operation
- Large, easy-to-read display
- Datalogging
- Visual alarm with bright red flashing LEDs
- Loud audible alarms (95dB at 30 cm)
- Rugged weather-resistant composite case

Equipment List

| Photo Item Number	Part Name	Part Number
	Monitor Only	
	*Shipping case	
2	Monitor	701-3040-000
	Sensors	
	Photoionization Detector	023-0102-000
	Oxygen (O_2)	046-1161-000
	Combustible (%LEL, %Vol)	014-0212-000
	Carbon Monoxide (CO)	032-0200-000
	Hydrogen Sulfide (H_2S)	032-0202-000
	Rechargeable Li-Ion Battery	046-3007-000
3	Charging Cradle	046-3059-000
	- 120 V AC to 12 V DC wall charger, US plug or	500-0036-000
	- 230 V AC to 12 V DC wall charger, Euro plug	500-0036-001
4	Alkaline Battery Adapter	046-3051-000
5	Calibration Adapter/Tubing Assembly	046-3040-000
7	External Filters (5-pack)	046-3022-005
	Charcoal Filters (for the CO Sensor)	008-3006-005
8	User Manual	046-4001-000
12	EntryRAE Resource CD	046-4013-000
	Computer Interface Cable - RS232 to RS232 with USB adapter	
	Optional Confined Space Kit II (CSK II)	046-0911-000
1	Hard Transport Case with precut foam	002-3009-000
9	Remote Sampling Probe with 15 feet (5 meters) of self-coiling Teflon (tm) tubing	008-3015-002
5	Tool Kit	081-0005-000
10	Four-Gas Mix in a 34-Liter cylinder (50% LEL, 20.9% O_2, 10 ppm H_2S, 50 ppm CO)	600-0050-004
11	100 ppm Isobutylene Gas in a 34 L cylinder	600-0002-000
6	Regulator (male) with tubing	007-3021-000
6	Regulator (female) with tubing	002-3011-000
	Optional Guaranteed Cost of Ownership	
	4-year repair and replacement guarantee	SVC-PTC4-046
	Optional Accessories (items sold separately)	
not shown	AutoRAE Docking Station Starter Kit	048-5900-000
not shown	Additional AutoRAE Cradle	048-0154-000
not shown	PID Cleaning Kit	500-0014-010

* Different shipping cases are used for monitor-only and calibration kits.

Figure 1. The EntryRAE Optional Confined Space Kit.

Physical Description

1. Display
2. Operation / Program keys
3. Charge status
4. Visual alarm
5. Gas plate
6. Buzzer
7. Gas inlet with external filter
8. Charging contacts
9. Charging cradle
10. Power jack
11. RS-232 port

monitor in cradle
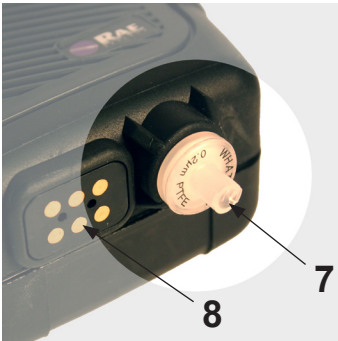
bottom of monitor

Figure 2. EntryRAE and Charging Cradle.

Display and Legend

1. PID lamp alarm
2. Alarm conditions (*page 18*)
3. Pump on (*page 19*)
4. Pump off
5. Time (*page 25*)
6. Date (Day, Month, Year)
7. Apply calibration gas (*page 12*)
8. Battery charge status (*page 19*)
9. Password protected (*page 11, 26*)
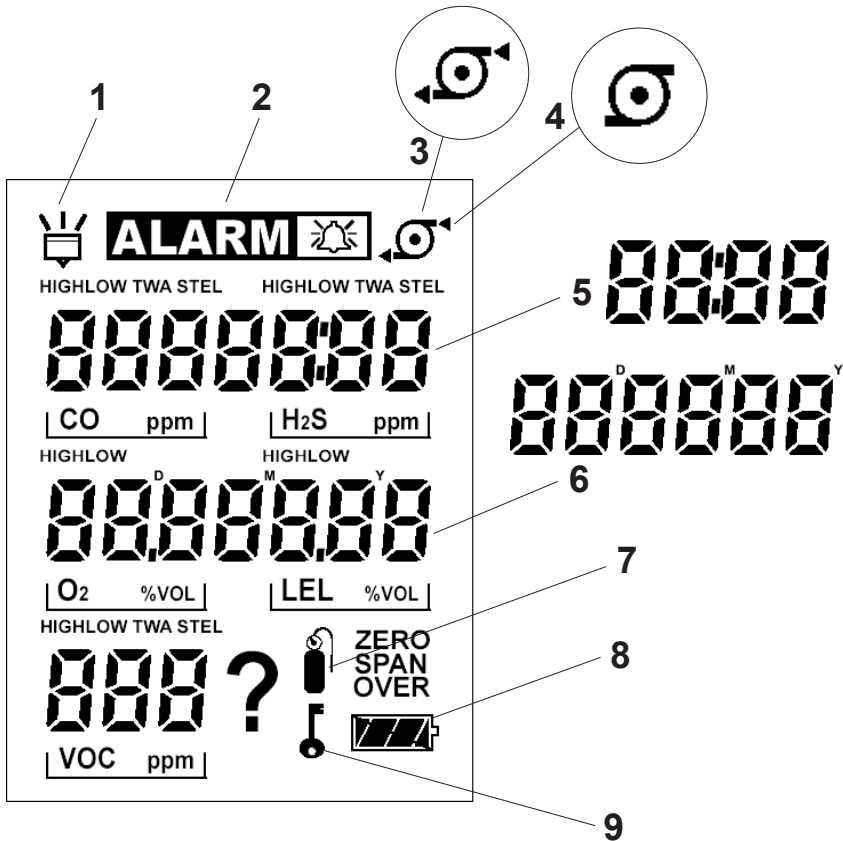
Figure 3. Display Overview.

Operating the EntryRAE

⚠ **The external filter must always be used with the monitor.**

Turning the Monitor On

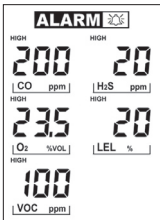**To turn the monitor on**:

1.0 Press the ⏻ (mode) key for 1 second.

2.0 The warm-up sequence begins:

2.1 The EntryRAE firmware version displays.
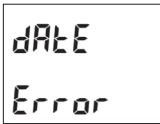

2.2 All of the display segments appear.

2.3 The buzzer sounds twice (if the unit has not been set to run silently; see page 24), the LEDs blink twice, and the vibration alarm turns on and off.

2.4 The preset alarm limits appear in order: HIGH, LOW, TWA, STEL.

3.0 The Time and Date settings are checked:
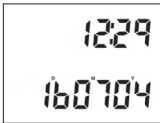
3.1 The time is shown in 24-hour format, and the date is shown in "ddmmyy" format.


3.2 If the monitor has never been programmed, you will see a "date error" message. Press ⏻ to acknowledge the error. (Refer to "Adjust Date?" on page 20 to reset the time and date.)

4.0 PID Warm-up:

4.1 If the monitor has not been used recently, PID warm-up of up to three minutes (180 seconds) occurs. During this time, the PID lamp icon appears, as well as a countdown from 180 to 1.

5.0 The date of the last calibration is checked:
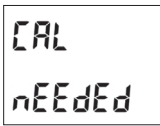
5.1 Calibration Needed

```
CAL
nEEdEd
```

This message appears if the number of days since the last calibration is greater than the "Cal Due Day" setting. (Refer to "Calib Due Day?" in the Calibration section on page 24.)

NOTE: If the Time and Date are invalid or were recently updated, then calibration is automatically due. Press ⏻ to acknowledge the message.

6.0 A Fresh Air Calibration is requested

```
FrESh
A ir
CAL ?
```
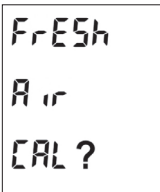
6.1 Perform a fresh air calibration before each use.

6.2 The monitor must be in clean ambient air during fresh air calibration.
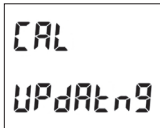
6.3 Press **Y** and the calibration begins. The display counts down from 5 to 0 (6 seconds), at which time the process is complete.

```
CAL
UPdAtn9
```

6.4 "Cal Updating." The calibration data is updated, the monitor warm-up is complete, and the EntryRAE is in **Monitor Mode**.
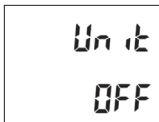
Turning the Monitor Off

The monitor cannot be turned off until after the warm-up sequence is completed.

To **turn the monitor off**:

1.0 Press the ⏻ button for 5 seconds.

```
321
```
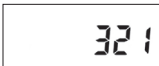
1.1 The display counts down from 3 to 1 (3 seconds), and flashes the LED for each count.

```
Un it
OFF
```

1.2 Release ⏻ when "Unit Off" appears on the display.

Monitor Mode

In Monitor Mode, the EntryRAE samples the environment and displays real-time readings for each enabled sensor.

The Pump Cycle

Under normal operating conditions, when the monitor is not in an alarm state, the pump cycles on and off about every 8 seconds. This on/off cycle improves the reliability of the PID and saves battery life.

The pump runs continuously when:

1.0 The concentration of any measured gas or vapor triggers an alarm condition.

2.0 When the concentration of VOCs is nearing an alarm condition.

Continuous Operation of the Pump

Pressing the **Y** key and the **N** key simultaneously causes the pump to run continuously for 5 minutes. This value can be changed using the ProRAE Studio software.

Detecting Gases and Vapors Real-time

CAUTION: HIGH OFF-SCALE READINGS MAY INDICATE AN EXPLOSIVE CONCENTRATION.

ATTENTION: LES LECTURES HORS ÉCHELLE ÉLEVÉES PEUVENT INDIQUER UNE CONCENTRATION EXPLOSIVE.

In Monitor Mode, the EntryRAE samples the environment and displays the current measured readings for each enabled sensor.

It also calculates and stores the High, Low, STEL and TWA for the sensors. Press ⏻ to scroll through these readings:
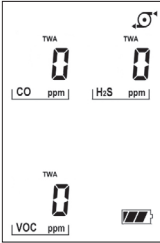
TWA - The Time Weighted Average for CO, H_2S, and VOC gases only; the accumulated reading of the gas concentration since the monitor was turned on, divided by 8 hours. Updated every minute.
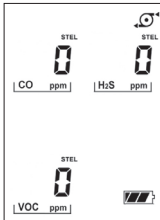
STEL - The Short Term Exposure Limit for CO, H_2S, and VOC gases only; the average reading of the gas concentration for the last 15 minutes, which is updated every minute. Dashes ("- - -") appear for the first 15 minutes.
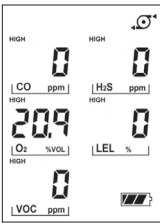
HIGH - The highest reading for each gas concentration since the monitor was turned on; updated every second. Press **Y** to reset the high values.
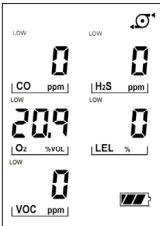
LOW – The lowest reading for each gas concentration since the monitor was turned on; updated every second. Press **Y** to reset the minimum values.

Calibration

⚠ **While EntryRAEs are calibrated prior to leaving the factory, temperature extremes and/or shocks during shipment can cause sensor drift. Therefore, the accuracy of any newly purchased RAE Systems monitor should be tested by exposing the sensor(s) to known concentration calibration gas before the monitor is used or put into service. For maximum safety, the accuracy of the monitor should be checked by exposing the sensor(s) to known concentration calibration gas before each day's use.**

⚠ **Les indications de toute instruments de RAE Systems doit être testé en exposant l'instrument à une concentration de gaz connue par une procédure dietalonnage avant metre en service l'instrument pour la première fois. Pour une sécurité maximale, la sensibilité du EntreRAE doit être vérifie en exposant l'instrument à une concentration de gaz connue par une procédure diétalonnage avant chaque utilisation journaliere.**

Information regarding sensor expiration is listed in Technical Note TN-114, available at www.raesystems.com.

Calibration Equipment

The sensors are calibrated using both fresh air and calibration (span) gas. The EntryRAE span gas mixtures are fixed. To calibrate an EntryRAE, the following items are needed:

A. A cylinder of four-gas mix containing:

  ⬥ 50% LEL methane

  ⬥ 20.9% O_2

  ⬥ 10 ppm H_2S

  ⬥ 50 ppm CO

B. A cylinder of 100 ppm isobutylene.

C. A calibration adapter to connect the monitor to the outlet of the gas cylinder.

Calibration Procedure

The calibration procedure is broken down into three steps. All steps should be performed whenever calibration is needed.
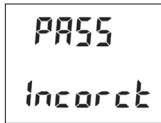
Step One: Enter Programming Mode

```
PASS

0000
```

1.0 The monitor must be in Programming Mode for calibration.

1.1 Press and hold ⏻ and **N** for 3 seconds to enter Programming.

1.2 Password Enabled Monitors.

```
PASS
Incorct
```

1.2.1 *If a password is enabled*, you are prompted to enter one.

1.2.2 Use **Y** to increase the digit and **N** to decrease the digit.

1.2.3 Use ⏻ to move to the next digit.

1.2.4 Press ⏻ and **Y** to enter the password.

1.2.5 If the password is incorrect, the monitor returns to Monitor mode.

Step Two: Fresh Air Calibration

The monitor must be in clean ambient air during fresh air calibration.

```
FrESh
A ir
CAL ?
```
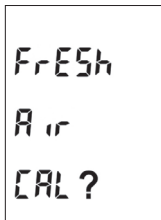
2.1 Press **Y** and the calibration begins. The display counts down from 5 to 1 (5 seconds), at which time the process is complete.

```
CAL
UPdAtn9
```

2.2 **Calibration Updating**

The monitor is in the process of calibrating the sensors. As it completes, the display shows the sensors registering zero (or 20.9% for O_2), before it moves to the next step, "Span Cal?"

Using External Zeroing Organic Filters

Use an external zero organic filter (P/N 008-3024-000, 3-pack) if the ambient air may be contaminated with hydrocarbons. Attach the filter to the EntryRAE during fresh air calibration. The filter can be used up to 20 times before disposing. This filter removes most heavier organic and inorganic compounds, but may not completely remove lighter compounds such as methane, propane and CO. Note that the filter should be attached to the EntryRAE before the calibration adapter.

Step Three: Span Gas Calibration for Multiple Sensors

3.0 For this calibration step, the LEL, CO and H_2S sensors are calibrated using the 4-gas mix (P/N 600-0050-004).

Figure 4. Gas Cylinded with Regulator.

Figure 5. Calibration Adapter.

3.1 Connect the calibration adapter to the EntryRAE and put a regulator (500 cc per minute flow rate) on the 4-gas mix cylinder.

Figure 6. EntryRAE Connected to Calibration Gas.
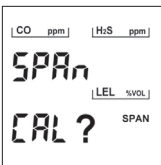
3.2 After "Span Cal?" appears on the display with the CO, H_2S, and LEL sensors indicated, press **Y.**

3.3 Turn the gas all the way on.

3.3 Connect the open end of the calibration adapter to the regulator. The monitor starts to countdown from 70 seconds.

3.4 When the countdown timer reaches zero, turn off the gas, and disconnect the calibration adapter from the regulator.

3.5 Compare the readings displayed to the span gas values indicated on the gas cylinder. The readings should closely agree with the span gas values.
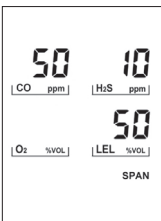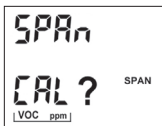
3.6 If calibration fails, the monitor briefly displays "Err" above each failed sensor.

> **NOTE:** Stop calibration in the event that the gas runs out or is disconnected. To interrupt calibration, press ⏻. When calibration stops, the sensors revert to their previous calibration values.
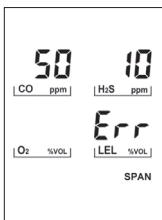
3.7 After briefly displaying the concentration, the monitor moves on to calibrating the PID.

Step Four: Span Gas Calibration for the PID Sensor

4.1 The final step is to calibrate the PID sensor.

4.2 Connect the EntryRAE calibration adapter to the monitor (see Figure 6) and put a regulator (500 cc per minute flow rate) on the cylinder of isobutylene.

4.3 Connect the open end of the calibration adapter to the regulator.

4.4 When "Span Cal?" appears on the display with the VOC sensor indicated, press **Y** and turn the gas all the way on. The monitor counts down from 30 seconds.

4.5 Turn off the gas, dicsconnect from the adapter, and remove the calibration adapter from the monitor.

If the calibration fails, the monitor briefly displays "Err" above the failed sensor.

> **NOTE:** Stop calibration if the gas runs out or is disconnected. To interrupt calibration, press ⏻ When calibration stops, the sensors revert to their previous calibration values.

Optional Step: Zero Calibration for the Oxygen Sensor

Zero calibration for the oxygen sensor is not required under normal use. A span calibration using ambient air (20.9% O_2) is usually sufficient to establish its performance. However, zero calibration may be required for special applications. Zero gas (100% nitrogen) is not included in the standard calibration kit and may be ordered separately (P/N 600-0062-000).

Zeroing the O_2 Sensor

* Connect the calibration adapter to the EntryRAE and put a regulator (500 cc per minute flow rate) on the cylinder of nitrogen.
* Connect the open end of the calibration adapter to the regulator.

The display reads "Zero Cal?" and only the O_2 segment appears.

* Press **Y** and turn on the gas.

If the calibration fails, the monitor briefly displays "Err" above the failed sensor.

NOTE: Stop calibration in the event that gas runs out or is disconnected. To interrupt calibration, press ⏻. When calibration stops, the sensors will revert back to their previous calibration values.

Note that each sensor has cross-sensitivities to several gases. These gases, sensor sensitivity, and other sensor specifications are listed in Technical Note TN-114, Sensor Specifications And Cross-Sensitivities, available at www.raesystems.com. Information regarding LEL sensor poisons is located in Technical Note TN-144, Handling LEL Sensor Poisons, also available at www.raesystems.com.

After the optional zero calibration for the O_2 sensor, "Calib due day?" is displayed. Press **Y** to set a new date, or N to skip.

When setting a new day, **Y** increases the digit, **N** decreases the digit, and ⏻ moves to the next digit. After the third digit is set, the question mark ("?") blinks. Press **Y** to accept the changes. Press **N** to discard the changes. Press ⏻ to change the due date.

Calibration Period

The EntryRAE should have a fresh air calibration before each use and should be fully calibrated:

  • no less than every 30 days
  • if it does not pass a fresh air reading
  • if it does not pass a field calibration.

EntryRAE Usage Overview

After the EntryRAE is warmed up, calibrated, and charged, it is ready for use to enhance your personal safety.

CAUTION: HIGH OFF-SCALE READINGS MAY INDICATE AN EXPLOSIVE CONCENTRATION.

Storage

Always keep the EntryRAE on its charging cradle in a dry indoor area when it is not in use. See page c for long-term storage warnings and procedures.

Confined Space Pre-Entry Test

It is important to always test the atmosphere inside a confined space before entering. Be aware of any hazardous chemicals you may be bringing into the space. Remember that many cleaners, paints, adhesives, degreasers and other modern industrial products (even treated wood) contain volatile organic compounds that may be hazardous to your health and safety.

Test the atmosphere in the confined space by sampling air at three levels (top, middle and bottom) in the confined space. Give the instrument time to sample the gas at each level - the correct sampling time is 60 seconds plus 1 second for every foot of tubing.

Alarms

If there are any gas **ALARMS** at any level in the confined space, that space is not safe. **DO NOT ENTER!** Identify the alarm condition and then start your preventive actions according to your company's confined space entry procedures.
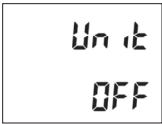
No Alarms

If there are no alarms, the confined space may be safe to enter. Disconnect the tubing before carrying the EntryRAE into the confined space. If monitoring is to be done by a confined space attendant, they should continue to monitor while you enter the area. If the monitor alarms and "BAT" is displayed, the battery needs to be charged: There are 15 minutes

or less of run time remaining. ***Leave the Confined Space immediately!***
(Refer to the Applications and Technical Notes Guide, P/N 000-4001-000,
for more information regarding confined space entry and other applications.)

After Usage

```
321
```

- Press the ⏻ button for 5 seconds.
- The display counts down from 3 to 1
  (3 seconds).

```
Un it
OFF
```

- Release ⏻ when "Unit Off" appears on the
  display.
- Return the EntryRAE to the dry, indoor storage
  area and put it in its charger.

Alarm Signals

When an alarm condition occurs, the monitor provides audible, visible
and vibration alarms to alert users of unsafe conditions.

Auto Reset and Latched Alarm

The EntryRAE comes from the factory with "Auto Reset Alarm" turned
on. This means that the alarms cease when the alarm condition is no
longer present. Alternatively, this feature can be changed and set up as a
"Latched Alarm." When the alarm system is "Latched," **Y** must be pressed
to acknowledge the alarm condition and to reset the alarms.

The Auto Reset function does not automatically reset if a sensor fails
calibration and goes into alarm. The sensor must be successfully
calibrated in order to clear this alarm.

Testing Alarm Signals

Press **Y** while in monitoring mode**.** If the alarm is functional, the buzzer
beeps once (if the monitor is *not* set to run silently; see page 24), the
alarm LED flashes once, and the vibration alarm turns on and off.

Alarm Conditions

Alarm Condition	Beep/sec Flash/sec	Vibration Alarm	Screen Message	Reset Alarm
Pump Failure	3	Yes	alarm symbol on, pump symbol blinks	unblock inlet, press Y to restart pump
Lamp Failure	3	Yes	alarm symbol on, lamp symbol blinks	turn off/on or wait
Over Range	3	Yes	alarm symbol on, OVER symbol on, blink "999"	move away from gas
Max	3	Yes	alarm symbol on, OVER symbol on, blink reading	possible sensor failure; cal sensor to verify
High	3	Yes	alarm and HIGH symbol on, sensor name blinks	move away from gas
Low	2	Yes	alarm and LOW symbol on, sensor name blinks	move away from gas
TWA	1	Yes	alarm and TWA symbol on, sensor name blinks	move away from gas & turn unit off/on
STEL	1	Yes	alarm and STEL symbol on, sensor name blinks	move away from gas & wait 15 min.
Negative	1	Yes	alarm symbol on, blink "nEg"	perform zero calibration
Battery Low	1 beep/min	No	battery symbol blinks	charge battery

Preset Alarm Limits and Calibration

Gas	Cal Gas/ Balance	Unit	TWA	STEL	LOW	HIGH
CO	50/Air	ppm	35	100	35	200
H_2S	$10/N_2$	ppm	10	15	10	20
O_2	$20.9/N_2$	%Vol	-	-	19.5	23.5
LEL	50/Air	%LEL	-	-	10	20
VOC	100/Air	ppm	-	-	-	100

Back Light

The back light makes it easy to read the display in poor lighting conditions. It automatically turns on in low lighting conditions.

NOTE: Heavy back light usage can shorten battery life 20% to 30%.

Sampling Pump

Under normal operating conditions, when the monitor is not in an alarm state, the pump cycles on and off about every eight seconds. This on/off cycle improves the reliability of the PID and saves battery life. Press the **Y** key and the **N** key simultaneously and the pump will run continuously for five minutes. The pump also runs continuously when:

1.0 The concentration of any measured gas or vapor triggers an alarm condition.

2.0 The concentration of VOCs approaches alarm conditions.

The monitor can detect any obstructions in the external filter that causes a pump stall. The alarm activates and the pump symbol blinks in the upper right corner of the display. Clear the obstruction.

Press **Y** to start the pump again.

Datalogging

Datalogging occurs automatically for all enabled sensors at one-minute intervals, allowing five days' continuous data storage. When the end of the storage memory is reached, the monitor automatically wraps around to the beginning of the log and overwrites the oldest stored data.

NOTE: Datalogging pauses when the monitor goes into Programming Mode.

Charging the EntryRAE

The battery charge is indicated on the EntryRAE screen by the battery charge status icon on the monitor's LCD. When the icon's segments are filled in, the battery is charged. As the battery is discharged, the segments disappear, indicating that the unit should be charged before use. Refer to "Maintenance" for instructions on changing/removing the battery.

The Li-Ion battery pack can be charged alone or while it is installed in the monitor. To charge an installed battery, simply plug the transformer into the cradle and into an AC electrical outlet. Place the monitor in the cradle. The monitor (or battery) is fully charged when:

  ⬩ The LED on the charging cradle is green
  ⬩ The "Fully Charged" message appears on the display
  ⬩ The segments of the battery icon are blinking.

The monitor (or battery) is still in charging mode when:

 * The LED on the charging cradle is red
 * The "Monitor Charging" message appears on the display
 * The segments of the battery icon are scrolling.

Figure 6. Installing the battery pack into the charging cradle.

To charge the battery pack alone, place the battery pack on the charging cradle, matching the contacts on the battery pack to the contacts on the charging cradle.

Figure 7. Contacts on the battery pack.

The Li-Ion Battery Pack

The factory-supplied Li-ion battery pack is designed to last for 16 hours of normal operation between charges (without alarm or back light conditions). The rechargeable batteries have a 1-year warranty. Age, ambient temperature, and heavy usage may impact battery life.

Battery packs slowly drain even if the monitor is turned off. Therefore, it is strongly recommended that the EntryRAE be stored on its charging cradle. The battery can trickle-charge when not in use.

If the battery packs have not been charged for 10 days, the battery voltage will be low. Fully charge battery packs before going into the field, and recharge them upon returning from the field.

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

Ne charger les batteries que dans emplacement désignes non dangereux.

Programming Mode

In addition to calibration, authorized users may change the monitor settings to their requirements using the Programming Mode.

Note: Monitoring gas concentrations pauses during Programming Mode and during calibration. Datalogging also pauses during Programming Mode, but resumes when programming is finished.

Security

EntryRAE provides the option of securely enabling a password to access Programming Mode. The default password is "0000." To enable password access, change the "0000" to a desired password. (Refer to "Change Pass?" on page 26.)

Programming Menus

Monitor Mode (Sensor Reading Display)

Press MODE & N

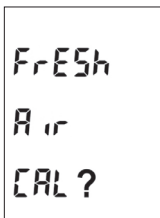| Menu Item	Description
Fresh Air Calibration?	Must be in clean ambient air.
Span Calibration?	Must use four-gas calibration mix (CO, H_2S, O_2 and LEL).
Span Calibration?	Must use 100 ppm Isobutylene gas (PID).
Zero Calibration?	Must use Nitrogen 100%.
Calibration Due Day?	Sets a reminder. Default: 30 days, Max: 365 days
Set Type?	Auto Alarm Reset or Latch. Default: Auto
Set Run Silent?	Runs in Silent Mode. Default: No
Adjust HIGH?	Adjusts High Alarm presets.
Adjust LOW?	Adjusts Low Alarm presets.
Adjust TWA?	Adjusts TWA presets.
Adjust STEL?	Adjusts STEL presets.
Enable Sensor?	Enable or disable sensor.
Adjust Date?	Adjust date and time.
Set LEL Unit?	Select % volume or % LEL
Change Password?	Change the password. Default: 0000
Secure Beep?	Lets user know monitor is on. If on, beeps once per minute.

Press Y or N

Press MODE

Entering Program Mode

FrESh

Air

CAL ?

1. Press ⏻ and **N** together until the first program menu, "Fresh Air Calibration?" appears.
2. Press **N** to cycle through the submenu options.
3. Press **Y** to enter a submenu.
4. To modify a value, use **Y** to increase and **N** to decrease.
5. Use ⏻ to move from character to character and/or from sensor to sensor.
6. When the "?" appears at the bottom of the display, press **Y** to save changes (or **N** to cancel changes) and exit the submenu.
7. To discard changes or exit the Programming Mode, press ⏻ to return to the Reading Display.
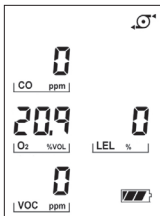
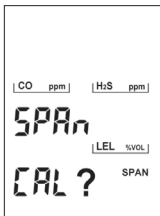## Change Monitor Setup

The following submenus represent the programmable setup of the monitor.

FrESh
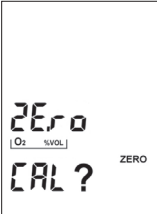
Air

CAL ?
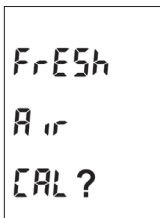
Fresh Air Calibration? Refer to "Fresh Air Calibration" on page 11.
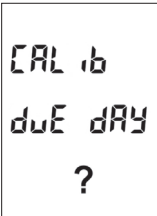
SPAn

CAL ?

Span Calibration CO, H_2S, LEL? Refer to "Span Gas Calibration for Multiple Sensors" on page 11 to calibrate the CO, H_2S and LEL sensors.

Span Calibration VOC? Refer to "Span Gas Calibration for the PID Sensor" on page 13.

```
SPAn
CAL ?   SPAN
| VOC  ppm |
```

Zero Calibration? Refer to "Zero Calibration for the Oxygen Sensor" on page 14.

```
2Ero
| O₂   %VOL |
CAL ?   ZERO
```

Calib Due Day? Use this feature to set a reminder to calibrate regularly. Enter the number of days between calibrations per your company's standards. After 30 days of no calibration, the monitor sounds. Once the monitor is calibrated, the counter resets.

```
CAL ib
duE dAY
        ?
```
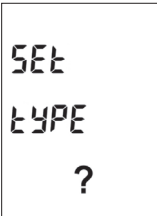
Set Type? Choose either automatic alarm reset or latched (constant) alarm. To acknowledge and reset a latched alarm, press **Y.**

```
SEt
tYPE
        ?
```
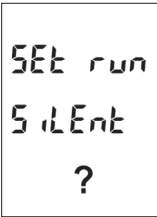
Set Run Silent? Press **Y** to let the monitor run in silent mode. In this mode, the audible alarm does not sound during alarm conditions.

Press **N** to let the audible alarm sound during alarm conditions.

```
SEt run
5 iLEnt
        ?
```

Adjust Alarm Limits?
HIGH - The highest reading for each gas concentration since the monitor was turned on; updated every second.

Press **Y** to reset the high values.

```
ALARM ☼
HIGH        HIGH

HIGH        HIGH
AdJuSt
HIGH
        ?
```

LOW – The lowest reading for each gas concentration since the monitor was turned on, updated every second. Press **Y** to reset the minimum values.

TWA - The Time Weighted Average for CO, H_2S, and VOC gases only; the accumulated reading of the gas concentration, divided by 8 hours, since the monitor was turned on. Updated every minute.

STEL - The Short Term Exposure Limit for CO, H_2S, and VOC gases only; the average reading of the gas concentration for the last 15 minutes, which is updated every minute. Dashes "- - -" appear in the display for the first 15 minutes.
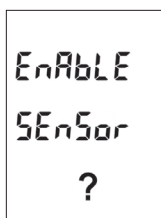
Enable/Disable Sensor? Enable or disable sensor(s); a disabled sensor does not measure or display the gas concentration. Use this if a sensor has failed or is providing erroneous readings. Use ⏻ to move from sensor to sensor. "Yes" means the sensor is enabled; likewise, "No" means the sensor is disabled. Press **Y** to enable or press **N** to disable.
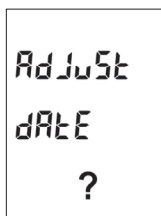
Adjust Date? Set the date and time using the standard 24-hour format.

```
SEt LEL
un it
    ?
```

Set LEL Unit? The EntryRAE provides the option of displaying the concentration of combustibles gases in %LEL or %Vol.

```
ChAnGE
PASS
    ?
```

Change Pass? (Password) Set a four-digit password, which is used to access Programming Mode. (Refer to "Security" on page 21.)

```
SECurE
bEEP
    ?
```

Secure Beep? If "yes," a security beep sounds every minute when the monitor is on.

Maintenance

Replacing the Li-Ion Battery Pack

⚠️ **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.**

Ne charger les batteries que dans emplacements désignes non dangereux.

⚠️ **Do not use the battery outside the operating temperature range of -4º to 122º F / -20º to 50º C (UL/cUL) or -4º to -116º F / -20º to 47º C (ATEX).**

Ne faites aucune utilisation l'extérieur de batterie la gamme de température de fonctionnement entre -4º à 122º F / -20º à 50º C (UL/cUL) or -4º à -116º F / -20º à 47º C (ATEX).

⚠️ **Do not store the battery outside the temperature range of -4º to 122º F (-20º to 50º C).**

Ne faites aucune magasin la batterie en dehors de la température entre -4º à 122º F (-20º à 50º C).

case screws for battery compartment
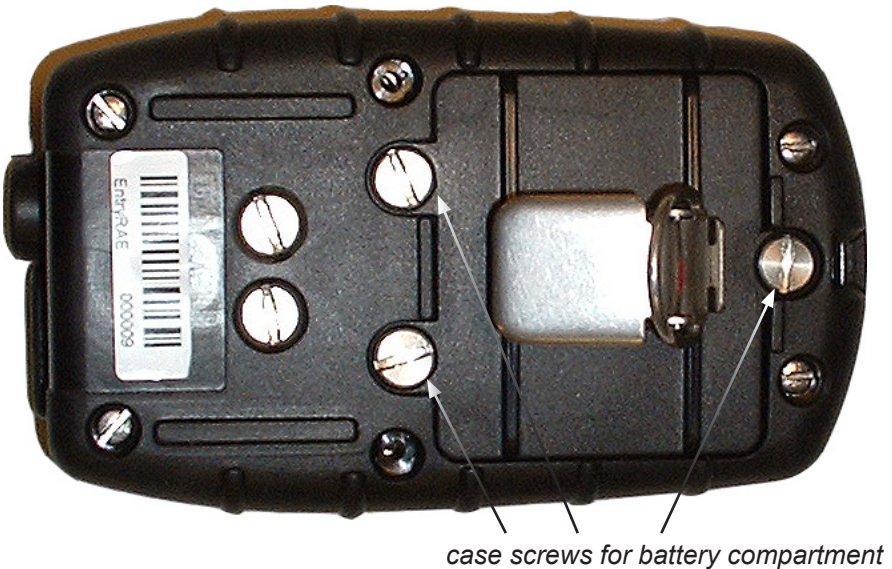
Figure 8. Battery Compartment Screw Locations

The battery compartment is located on the back of the monitor.

Remove the battery compartment cover by loosening the three case screws with a screwdriver or a coin.

Remove the battery pack from the monitor.

Figure 9. Removing the Battery Pack Cover.

Figure 10. Removing the Li-Ion Battery Pack.

Replace the battery compartment cover and tighten the screws.

The spent battery pack may be charged on the charging cradle by itself. (Refer to "Charging the Li-Ion Battery Pack" on page 19.)

Emergency Alkaline Battery Adapter

Figure 11. Installing the Alkaline Battery Pack.

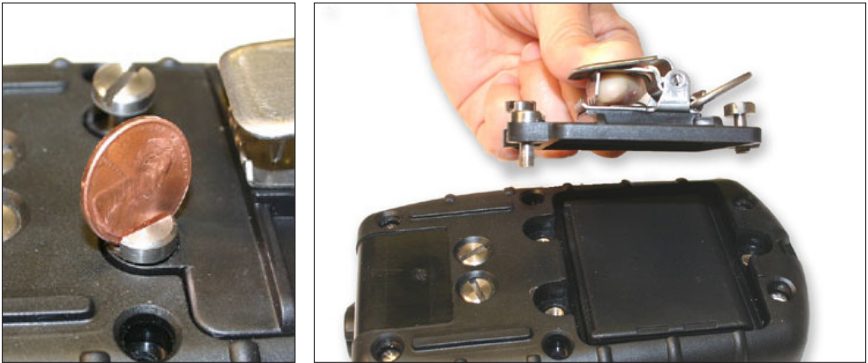Use the adapter when there isn't time to recharge the Li-Ion battery pack. The adapter (P/N 046-3051-000) accepts four AA alkaline batteries (use only Duracell MN1500 or Energizer 91) to provide approximately 12 to 14 hours of operation.

Remove the Li-Ion battery pack from the monitor.

Install four AA alkaline batteries into the battery

adapter, making sure the battery polarity is correct.

Replace the battery cover and tighten the screws.

The monitor automatically detects the alkaline batteries.

Sensor Replacement

Under normal operating conditions, most sensors lose their original sensitivity after the expected operating life and need to be replaced.

Warranties: The oxygen (O_2), combustible gas (LEL), hydrogen sulfide (H_2S) and carbon monoxide (CO) sensors all have a 2-year warranty. The PID sensor has 1 year warranty.

Replace a sensor when it fails to calibrate.

The sensors are located inside the front of the monitor.

See Technical Note TN-114, Sensor Specifications And Cross-Sensitivities, for additional information, available at www.raesystems.com.

Figure 12. Sensor Locations.

Figure 13. Loosening rear screws.

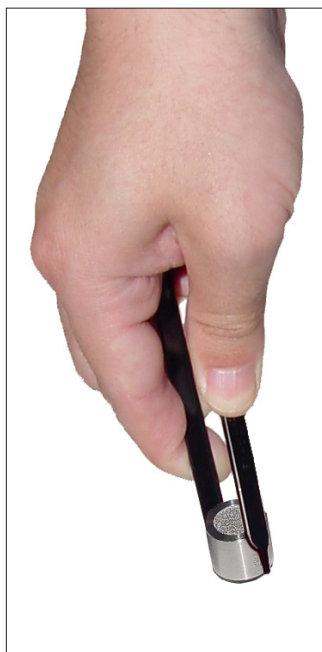**Figure 14. Pushing screws to remove sensor cover.**

Figure 15. Using sensor puller to handle sensor.

To replace a sensor:

1. Turn the monitor off.

2. Remove the front sensor cover by loosening the two screws on the *back* of the monitor below the battery cover. See Figure 13.

3. Push the screws from the back of the monitor to pop the cover off the front (Figure 14).

4. Using the sensor puller, remove the sensor by carefully pulling straight out (Figure 15).

   The colored dots marked next to each sensor socket should match the color of the sensors.

5. To install new sensors, re-align the dots on the sensors with the dots on the monitor.

6. Press the sensors all the way into the socket.

7. Replace the monitor cover and tighten the screws in the back.

8. Turn the monitor on and the newly installed sensors should be properly identified by the EntryRAE in the start-up screen. Let the monitor run for 15 minutes before calibration.

9. Calibrate all sensors prior to use.

CO Sensor Charcoal Filter

The carbon monoxide (CO) sensor may be sensitive to hydrocarbons, so use a charcoal filter (P/N 008-3006-005) to reduce or eliminate organic vapor contamination or cross-sensitivity. The charcoal filter is installed in the gas plate above the CO sensor. Under normal operation conditions, the charcoal filter lasts from four to six weeks before it needs to be replaced. If the monitor has been exposed to high concentrations of VOC gases for a prolonged period of time, the carbon filter needs to be replaced more frequently.

Place the carbon filter above the CO sensor on the gas plate.

NOTE: The CO charcoal filter lowers the reading if it is accidentally used on other sensors.
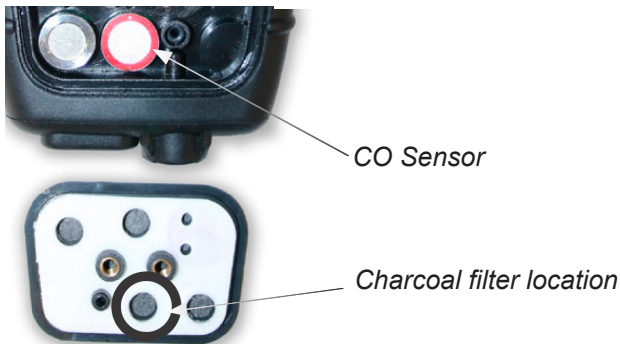

CO Sensor

Charcoal filter location

Figure 16. CO and charcoal filter locations.

Cleaning the PID

If the PID does not calibrate, it may need to be cleaned. Be sure to use the specially shaped swab included in the PID Cleaning Kit (p/n 500-0014-010), shown in the Equipment List, to clean the PID.

1. Open the sensor compartment.
2. Remove sensor with sensor puller (follow procedure on page 31).
3. Using a swab, drip a little bit methanol on the lamp window through the openings on the top of the PID.
4. Use the swab to carefully clean the lamp window through the two openings.
5. Leave the PID to dry by itself for five minutes.

Figures 19. Cleaning the PID.

Pump Replacement

The pump in the EntryRAE is not field replaceable. Call RAE Systems Technical Support or an authorized service center when the pump needs to be replaced.

Setting Pump Stall Threshold

Note: This section should only be used by authorized technical users. Monitoring continues while EntryRAE is in Diagnostic Mode.

Diagnostic mode allows users to set the pump stall setpoint. This should only be done if your EntryRAE is going into a pump alarm when the pump is not blocked, or if the EntryRAE does not go into pump alarm when you block the pump inlet by holding your finger over it.

Entering Diagnostic Mode
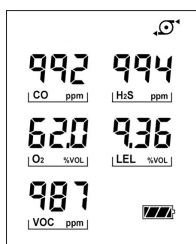
1. Press ⏻ and Y simultaneously until the first diagnostic screen blanks. Then release the keys and the values reappear.

2. Press ⏻ 7 times to cycle through the diagnostic screens until you reach the pump diagnostic screen. The first, CO, H_2S, O_2, LEL, VOC, and run time screens are used for factory operation and testing only. The pump diagnostic screen displays a high and low pump rate. The first digit of the last number blinks.

3. To set the pump stall alarm, write down the "Hi" value as found, and then block the pump inlet while the pump is running (about 5 seconds), until the "Hi" reading stabilizes.

4. Write down the new "Hi" value. Add the two "Hi" values together, and then divide by two to get the average value.

5. Enter the average into the bottom number on the screen using the Y and N keys to increase and decrease the digits, and ⏻ to move between digits.

6. Once the average is entered, press ⏻ until you see the blinking "?". Press Y to save the pump stall threshold value.

7. Exit the diagnostic mode by pressing @ and Y together until the screen changes. Gas readings may take a second to appear.

Specifications

Size	5.9" L x 3.3" W x 1.9" H (15 x 8.5 x 1.9 cm) without clip
Weight	20 oz with battery (567 g) and clip
Sensors (5)	Protected catalytic bead for combustible gases Electrochemical sensors for oxygen and toxic gases Photoionization detector for VOC broadband detection using 10.6 eV lamp
Battery	Drop-in rechargeable Li-ion battery pack Standard alkaline battery adapter Charging cradle doubles as external battery changer
Operating Hours	16 hours continuous with Li-ion (typical), 12 hours with alkaline
Battery Operation Temperature	-4º to 122º F (-20º to 50º C) UL/cUL -4º to 116º F (-20º to 47º C) ATEX
Battery Storage Temperature	-4º to 122º F (-20º to 50º C)
Display	Large 1.4" x 1.8" (3.5 x 4.5 cm) segmented display with LED back light
Keypad	Three-button operation
Direct Readout	Instantaneous for 5 values: Oxygen as percentage by volume Combustible gas as %LEL or %Vol VOCs, CO and H_2S as parts per million TWA and STEL values for VOCs, CO and H_2S High and low values for all gases Battery life displayed as icon in 1/4 increments
Alarms	Audible: 95dB at 30 cm Visible: Bright LED bar visible from top, front and sides Sensory: Built-in vibration alarm High: 3 beeps and flashes per second Low: 2 beeps and flashes per second STEL and TWA: 1 beep and flash per second Low battery displays empty battery symbol, beep per second
EMI/RFI	Highly resistant to EMI/RFI. Compliant with EMC directive 89/336/EEC
IP Rating	IP-55: protected against dust, protected against low pressure jets of water from all directions
Datalogging	Wrapping 120 hours (five days) of data at one minute intervals for all five sensors
Communication	PC-to-EntryRAE via RS-232 through charging cradle, with USB adapter
Calibration	Two-point field calibration for zero and span gas
Sampling Pump	Internal pump, flow rate typical 200 cc per minute
Low Flow Alarm	Auto shut-off at low-flow condition
Minimum Pump Flow	100 cc per minute
Operation Temperature	-4º to 122º F (-20º to 50º C), UL/cUL -4º to 116º F (-20º to 47º C), ATEX
Storage Temperature	-4º to 122º F (-20º to 50º C)
Humidity	0% to 95% relative humidity (non-condensing)
Pressure	1 Atmosphere ±10%
Attachments	Stainless steel alligator clip (installed), wrist strap
Warranty	Lifetime on non-consuming components (per RAE Standard Warranty), 2 years for O_2, LEL, CO, and H_2S sensors, 1 year for PID, 1 year for pump, 1 year for battery

Certification

UL/cUL: Class I, Groups A, B, C, D, T3C
CE   0575 ⟨Ex⟩ II 2G
DEMKO 04 ATEX 0419092X
EEx ia d IIC T4

Monitor label (enlarged).

Sensor Range and Resolution

Sensor	Range	Resolution
PID	0-999 ppm VOC	1 ppm VOC
Oxygen (O_2)	0-30.0%	0.1
Combustible Gas (LEL)	0-100% LEL	1% LEL
Carbon Monoxide (CO)	0-500 ppm	1 ppm
Hydrogen Sulfide (H_2S)	0-100 ppm	1 ppm

Note that each sensor has cross-sensitivities to multiple gases. Information on these sensitivities is available in Technical Notes TN-114 and TN-144, available at www.raesystems.com. Additional information about sensor calibration and expiration is also available in these Technical Notes.

Service and Repair Record

Date	Service / Repair Type

RAE Systems World Headquarters
3775 N. First St.
San Jose, CA 95134-1708 USA
Phone: 408.952.8200
Fax: 408.952.8480

E-mail: customerserv@raesystems.com
Web Site: www.raesystems.com

RAE Systems Technical Support
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+1.888.723.4800 (toll-free)
email: tech@raesystems.com

RAE Systems Tubes: 888.RAE.TUBE (888.723.8823)

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