Gas Detection Equipment Training

Presented by

All Safe Industries®

Training Segments

- Gas Detection 101: The Basics
- Rae Systems Product Overview
- Daily Use - Monthly Maintenance
- Wireless Gas Detection
- Practical Exercises
- Questions

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Gas Detection 101

Primary Goal:

"Get the air you're about to breathe or work in to the sensors in the meter."

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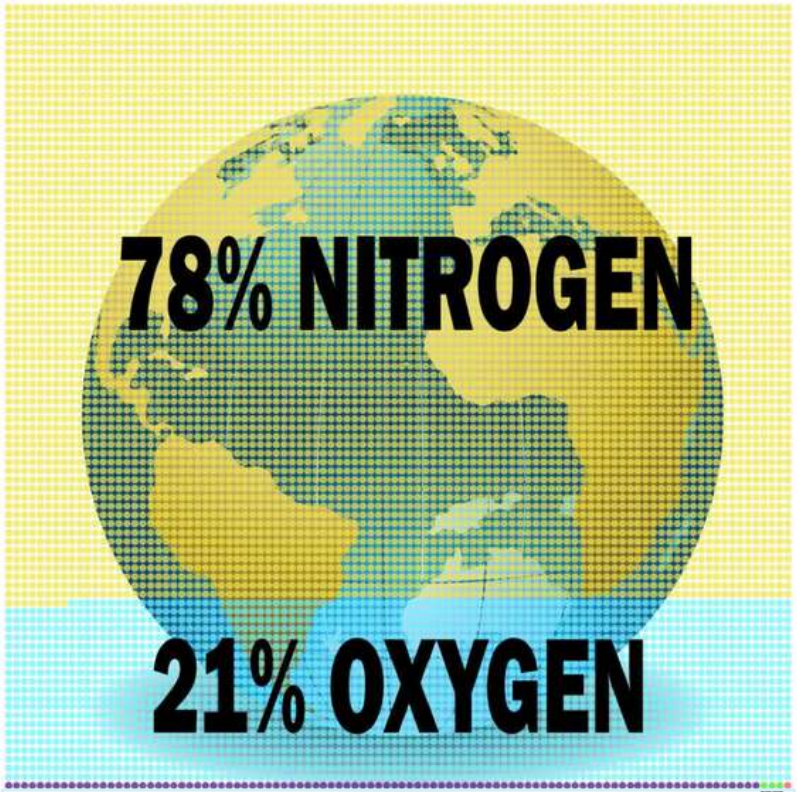
Gas Detection 101

Perfect atmosphere:

- 78% Nitrogen
- 20.9% Oxygen
- 1% Argon and CO2



We use Gas Detection to let us know when there's something else in the air we're breathing.

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Terminology

- 4-gas
- LEL
- PID
- IP
- Bump Check
- Cross Sensitivity

→

- Multi-gas
- TIC
- VOC
- CFs
- Calibration

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Types of Gas Meters

- Single Gas
- Basic 4-gas meter: O2/LEL/CO/H2S
- Multi-gas meter: Any combination of sensors to meet site specific needs.
- Diffusion vs Pumped
- Personal Monitoring vs Area Sampling
- Rechargeable vs Alkaline Batteries
- Datalogging vs Wireless

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Gas Meter Accessories

- Probes & Tubing
- Filters
- Chargers
- Calibration Gas
- Regulators

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Electro-Chemical Sensors

- Oxygen (O^2 measured in %)

- Carbon-monoxide (CO)
- Hydrogen Sulfide (H^2S)
- Ammonia (NH^3)
- Chlorine (CL^2)
- Hydrogen Cyanide (HCN)
- All these measure in PPM
- 28 sensors available from Rae Systems

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Measuring Range: % | ppm | ppb

Relationship between percent and parts per million (ppm) by volume

Percent	PPM
100	1,000,000
10	100,000
1	10,000
0.1	1,000
0.01	100
0.001	10
0.0001	1
etc.	etc.

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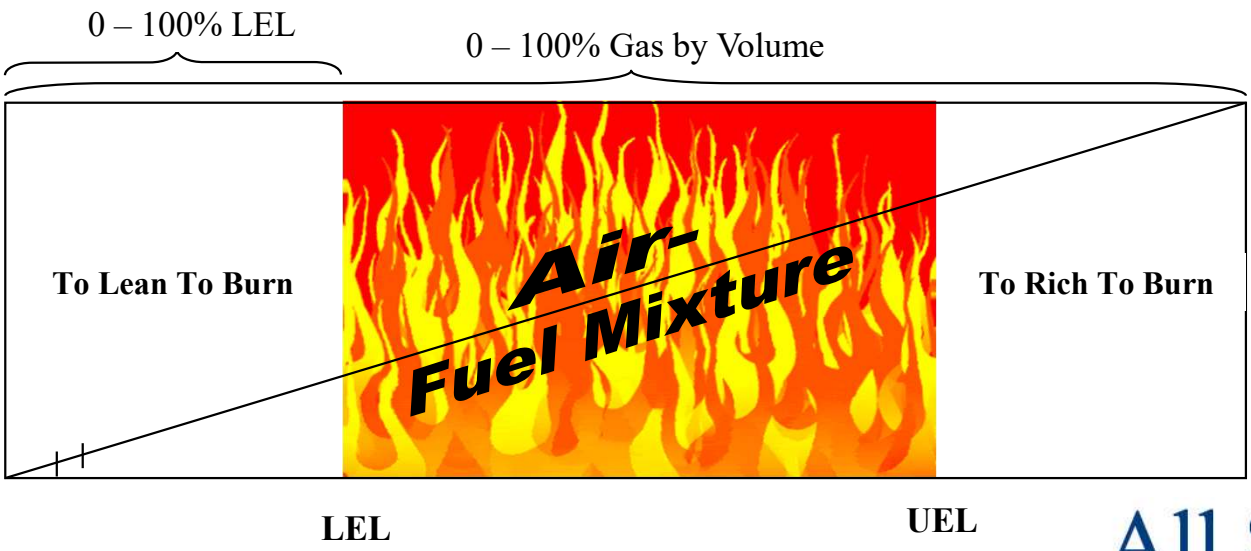
LEL Sensor

- LEL= Lower Explosive Limit: the lowest air-fuel mixture at which a gas can ignite.
- It is your Combustible Gas - Flammable Gas Sensor
- Reacts to a wide variety of vapors
- Measures FUEL on the Fire Triangle



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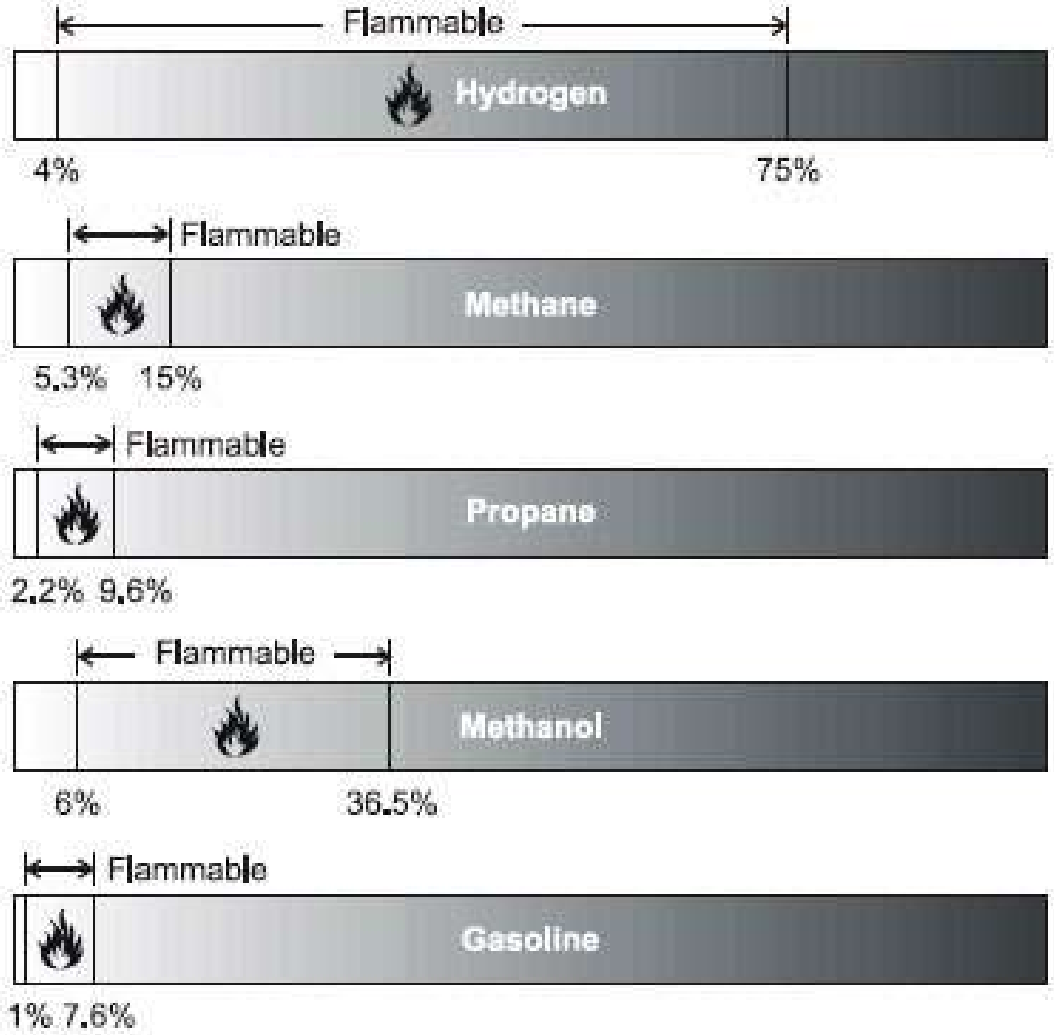
LEL Sensor

Each gas vapor has a specific LEL and UEL



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What is a VOC?

- VOC= Volatile Organic Compounds
- Includes Fuels, Degreasers, Heat Transfer Fluids, Paints, Solvents, Plastics, Resins
- The chemical compounds that keep industry going!
- Most Haz Mat calls involve VOCs

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What is a PID?

- PID = Photo Ionization Detector
- Best method to detect a wide-range of VOCs and toxic gases
- Measures in part per million (ppm) and parts per billion (ppb)
- Over 90% of HazMat incidents are fuel product related and are easily measured with a PID

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PID uses in HazMat

The PIDs sensitivity to VOCs make it an invaluable tool for HazMat Decisions:

- Initial PPE Assessment
- Leak Detection
- Perimeter Establishment & Maintenance
- Spill Delineation
- Decontamination
- Remediation

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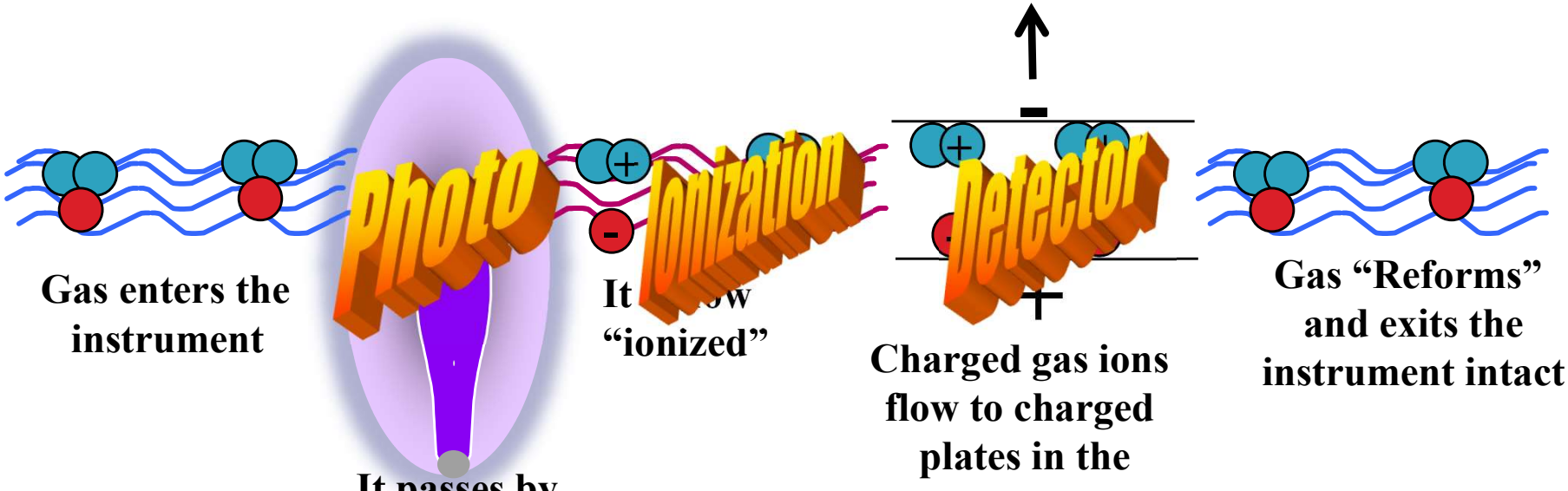
How does a PID work?

It's an optical system which uses an ultra-violet lamp to breakdown vapors and gases for measurement

Current is measured and concentration is displayed on the meter.



Gas enters the instrument

It passes by the UV lamp

It [illegible] "ionized"

Charged gas ions flow to charged plates in the sensor and current is produced

Gas "Reforms" and exits the instrument intact

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What does a PID measure?

- **Organic Compounds Containing Carbon (C)**
  - Aromatics - compounds containing a benzene ring
    - BETX: benzene (9.24), ethyl benzene (8.76), toluene (8.82), xylene (8.56)
  - Ketones & Aldehydes - compounds with a C+ Oxygen bond
    - acetone (9.71), methyl ethyl ketone or MEK (9.54), acetaldehyde (10.22)
  - Amines & Amides - compounds with a C+ Nitrogen bond
    - diethyl amine (8.01)
  - Chlorinated hydrocarbons - trichloroethylene (TCE)
  - Sulfur compounds - mercaptans
  - Unsaturated hydrocarbons - butadiene (9.07)
  - Saturated hydrocarbons
    - butane (10.63), octane (9.82)
  - Alcohol's - ethanol (9.51)
- **Inorganics: Compounds without Carbon**
    - Ammonia (10.18)
    - Semiconductor gases: Arsine (9.89)

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What PIDs do not measure:

- Radiation
- Air
  - N_2
  - O_2
  - CO_2
  - H_2O
- Toxics
  - CO
  - HCN
  - SO_2
- Natural gas
  - Methane CH_4
  - Ethane C_2H_6
- Acids
  - HCl
  - HF
  - HNO_3
- Others
  - Freons
  - Ozone O_3
- Dust

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What does a PID measure?

Ionization Potential

- IP determines if the PID can “see” the gas
- Aka Ionization Energy
- If the IP of the gas is less than the eV output of the lamp the PID can “see” the gas
- Ionization Potential (IP) measures the bond strength of a gas and does not correlate with the Correction Factor
- Ionization Potentials are found in RAE handouts (TN-106), NIOSH Pocket Guide and many chemical texts.

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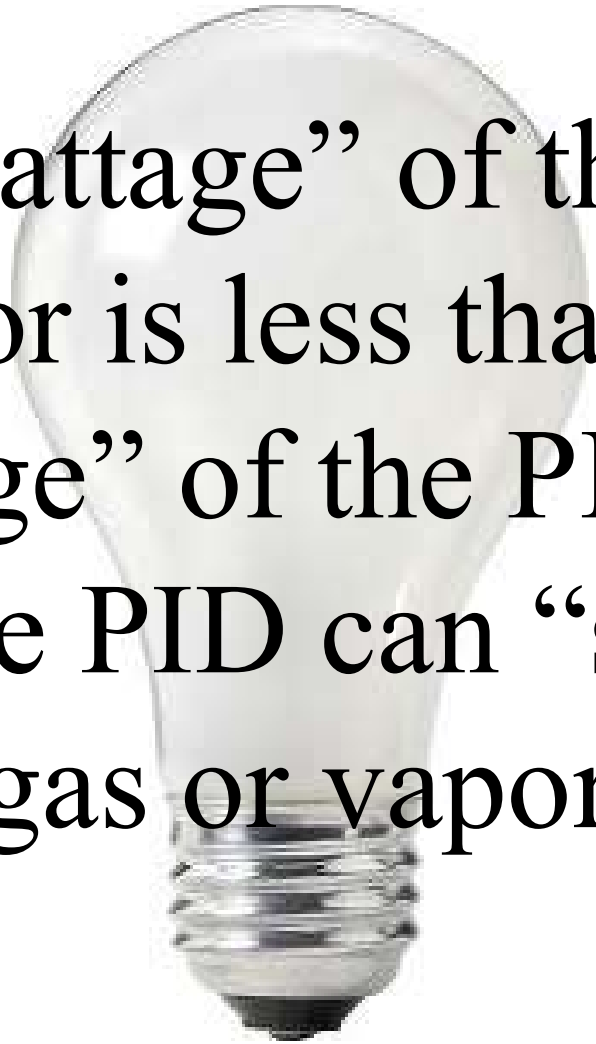
Remember This . . .



If the “wattage” of the gas or vapor is less than the “wattage” of the PID lamp then the PID can “see” the gas or vapor!

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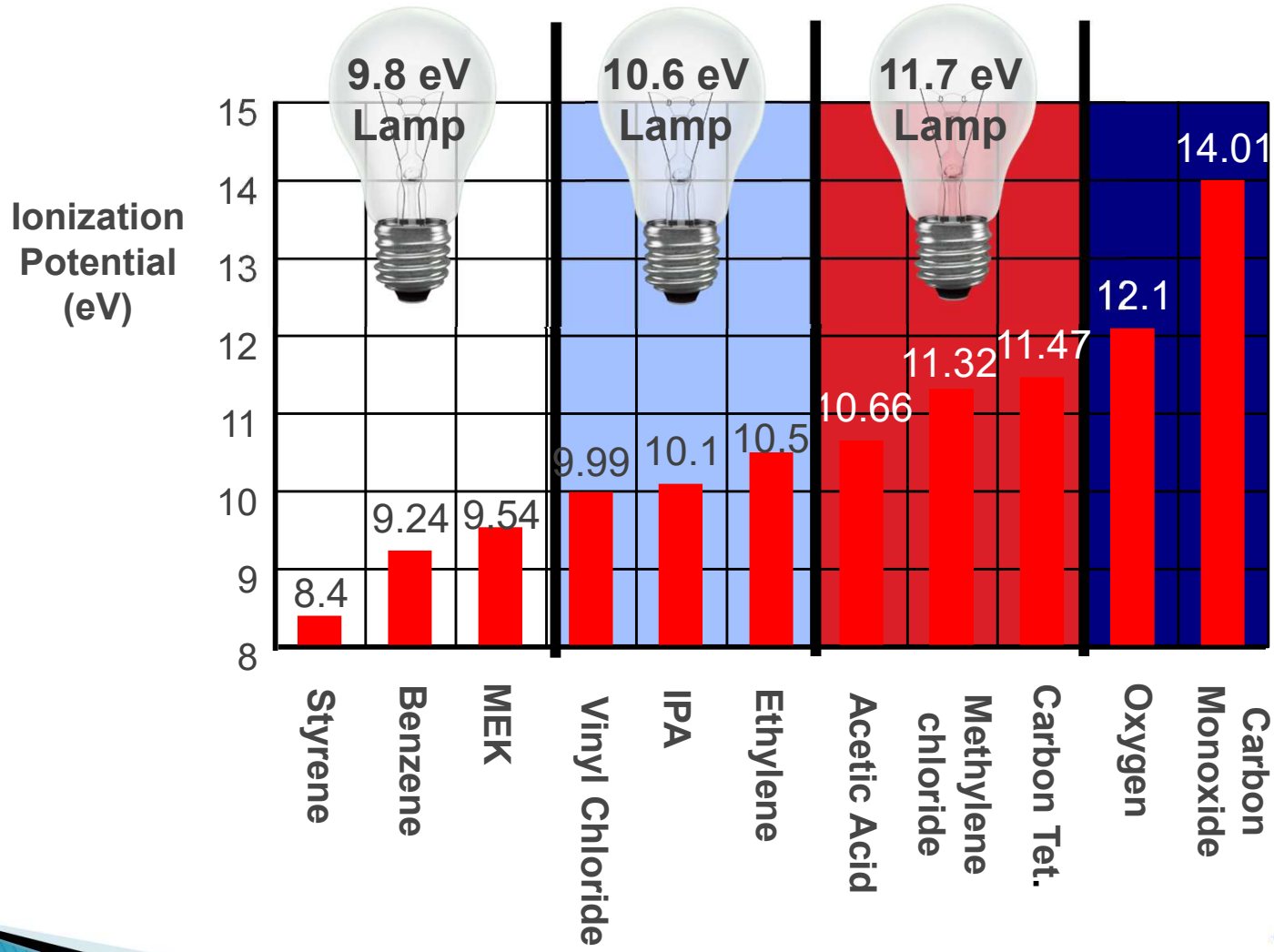
What does a PID measure?

Some Ionization Potentials (IPs) for Common Chemicals



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PID Lamps

Why not always use 11.7 eV Lamps?

- 9.8 & 10.6 provide more specificity / accuracy
- 10.6 Lamp
  - lasts 12-24 months (we've seen 4-5 years as well)
  - costs less
- 11.7 Lamp
  - required for high energy compounds like Methylene Chloride
  - Lithium Fluoride crystal absorbs moisture and degrades in UV
  - lasts only 2-3 months
  - costs more
- 11.7 only available on PID Only meters (MiniRAE3000)

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Selectivity vs Sensitivity

- PID is very sensitive and accurate
- But a PID is not selective
- So like a ruler can measure paper, but cannot tell you the color of the paper

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Selectivity vs Sensitivity

- A PID is sensitive to chemicals, but cannot identify the chemicals
- Use other clues to determine the compound
- Then Correction Factors can correct the PID to read that compound more accurately
- PID should remain on Isobutylene (Calibration gas) until unknowns are identified

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What is a Correction Factor?

- A Correction Factor (CF) is a measure of the sensitivity of the PID to a specific gas
- Correction Factors allow calibration on cheap, non-toxic “surrogate” gas.
- CFs are scaling factors, they do not make a PID specific to a chemical, they only correct the scale to that chemical based on the calibration gas.
- Check Rae Systems TN-106 for complete CF listings.

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Training Segments

- Gas Detection 101: The Basics
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- Wireless Gas Detection
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- Questions

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ToxiRAE Pro

- Advanced Single Gas Meter
- Choose 28 available sensors
- LEL, IR, PID and Toxic Gas
- Uses the same sensors as the MultiRae
- Audible, visual and vibration alarms
- Wireless capability

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QRAE3

- SUPER 4-Gas Meter
- Choose from 10 available sensors including O2, LEL, CO, H2S, CL2, NO2, SO2, HCN, NH3, PH3
- Diffusion and built-in pump versions (shown)
- Audible, visual, vibration and “Man-Down” alarms
- Wireless capability

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MultiRAE Family

- Five versions to choose from based on features and budget
- Large easy to read display
- Audible, visual, vibration and “Man-Down” alarms
- Wireless capability
- Parts Per Billion and Gamma sensor capability on MR Pro
- Benzene Specific version with RAE-Sep Cartridge

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MiniRAE Family

- Four versions to choose fron based on features/budget
- Large easy to read display
- Audible, visual and vibratior alarms
- Wireless capability
- Ranging from 1 ppb to 15,000 ppm
- Benzene Specific version with RAE-Sep Tube

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AreaRAE Plus and Pro

- Up to 7 gas detection sensors
- Pro version can include ppb resolution VOC sensor and gamma radiation sensor
- RAEMET sensor optional on Plus, standard on AreaRAE Pro
- GPS, long-range radio, short-range MESH and WiFi capable.
- Communicates directly with Host two miles away

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Rapid Deployment Kits

4 Unit Kit

2 Unit Kit

Host Kit

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AutoRAE2 Cal Station

- AutoRae2 performs Bump Test and Calibration
- Stand-alone cradle for up to 2 cylinders of gas
- Controller System for up to 5 cylinders of gases and 10 cradles (mix and match)
- Meters charge on cradle

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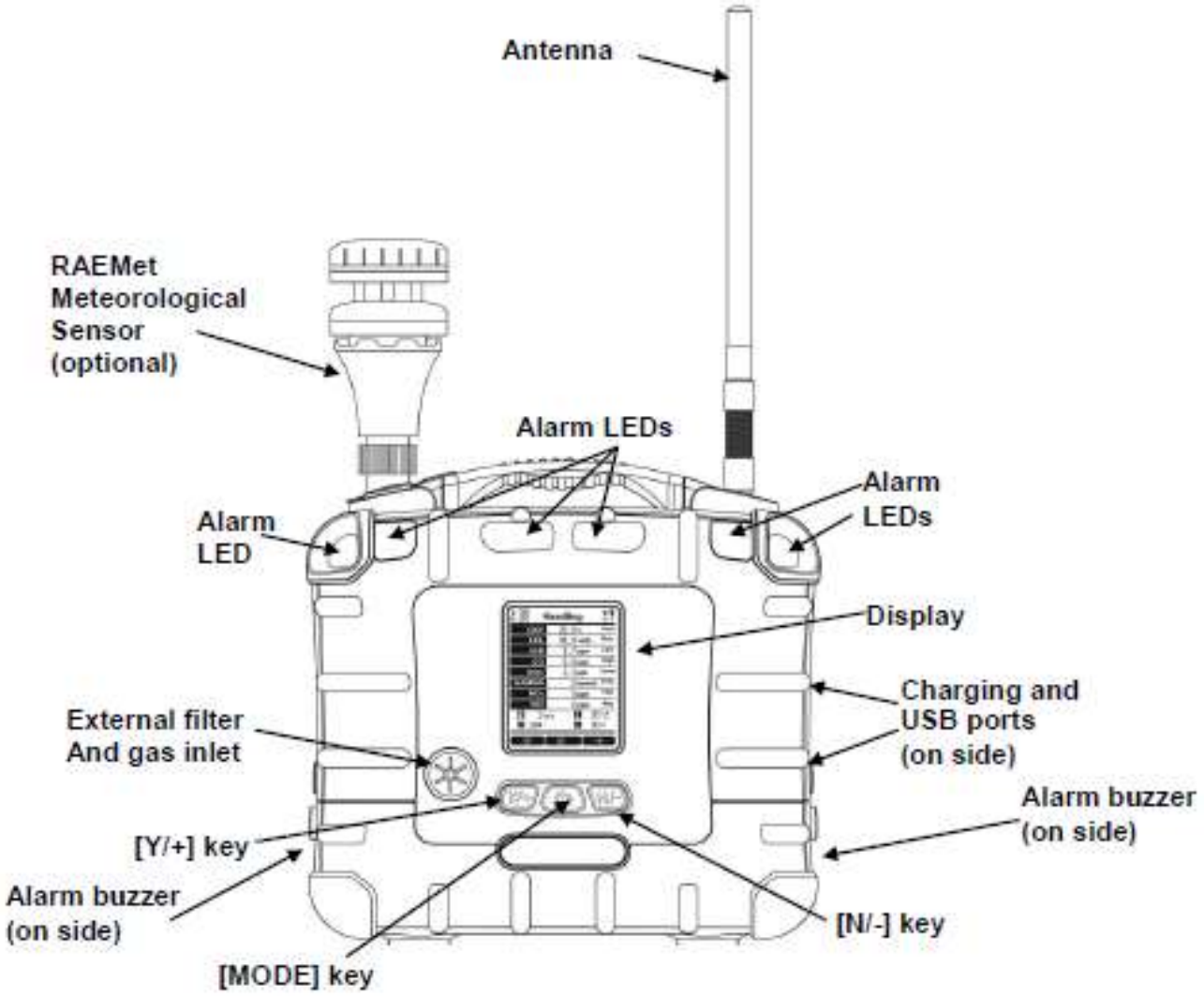
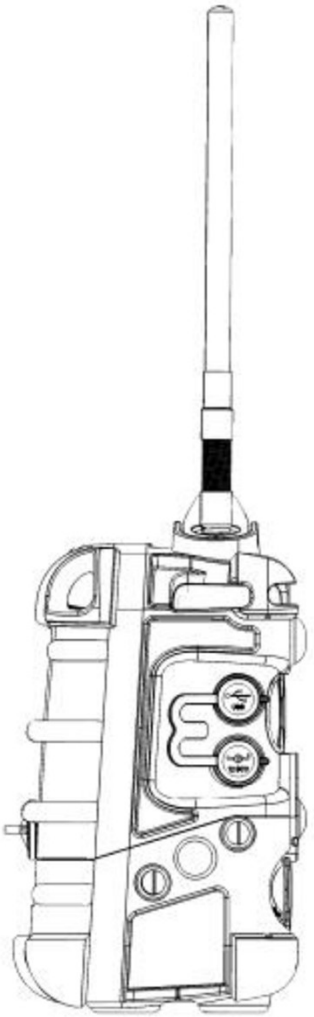
AreaRAE Pro





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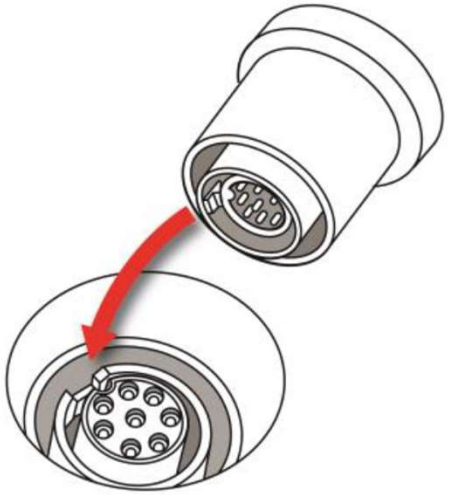
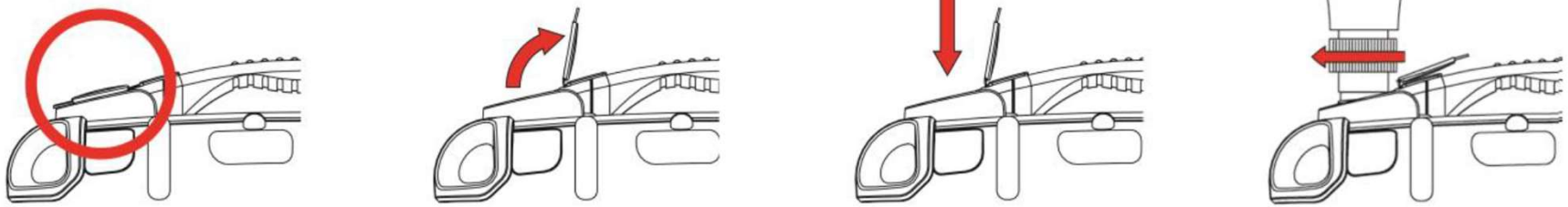
Installing the RAEMet Sensor

- Left side of carry handle
- Peel back port cover
- Align pins and seat the sensor
- Turn locking-ring ONLY to secure RAEMet to the AreaRAE





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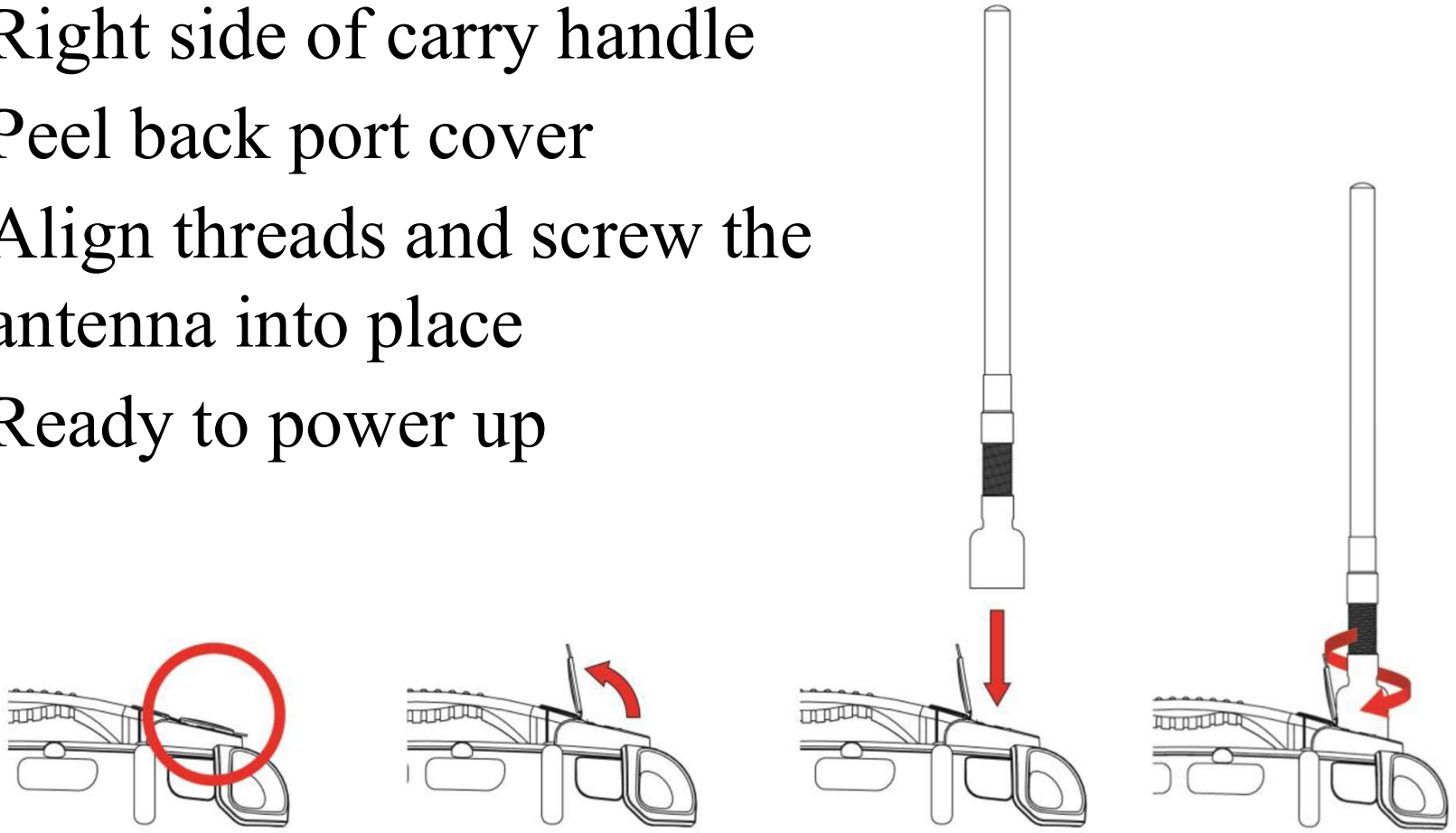
Installing the Antenna

- Right side of carry handle
- Peel back port cover
- Align threads and screw the antenna into place
- Ready to power up



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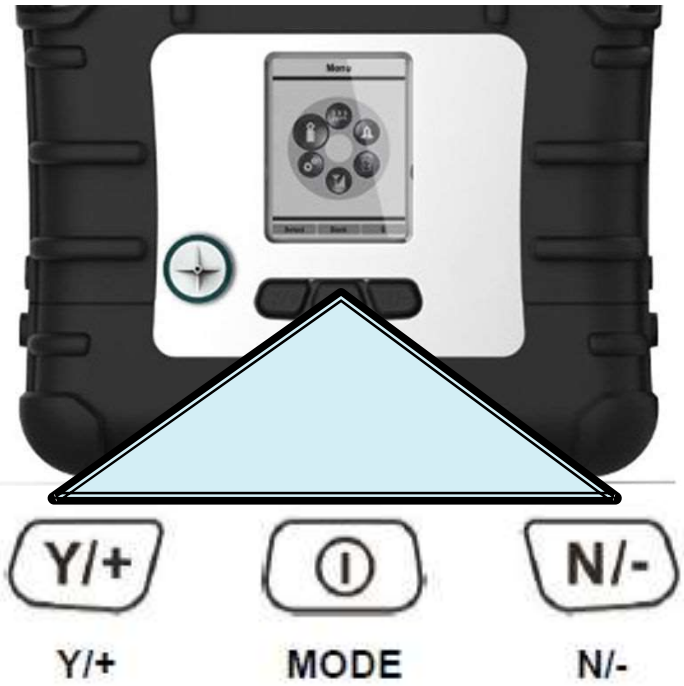
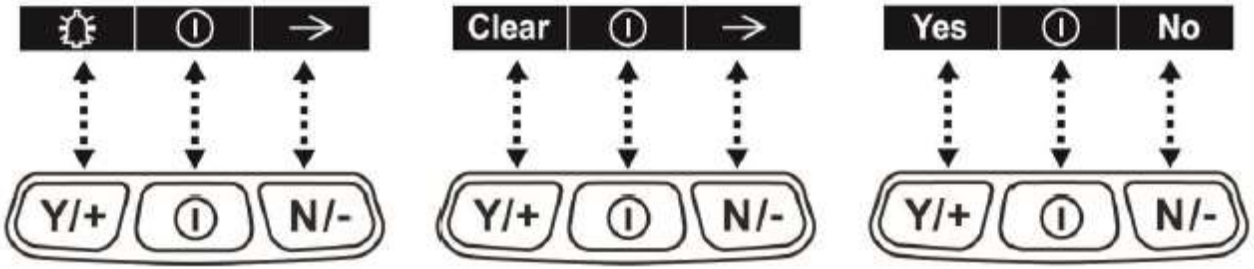
AreaRAE Power Up

- Familiar 3 button interface
- Power/Mode, Yes/+ and No/-
- Buttons function as soft keys on different display screens





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3 Steps before each days' use:

1. Fresh Air Calibration
2. Pump Stall
3. Bump Check (Function Test)

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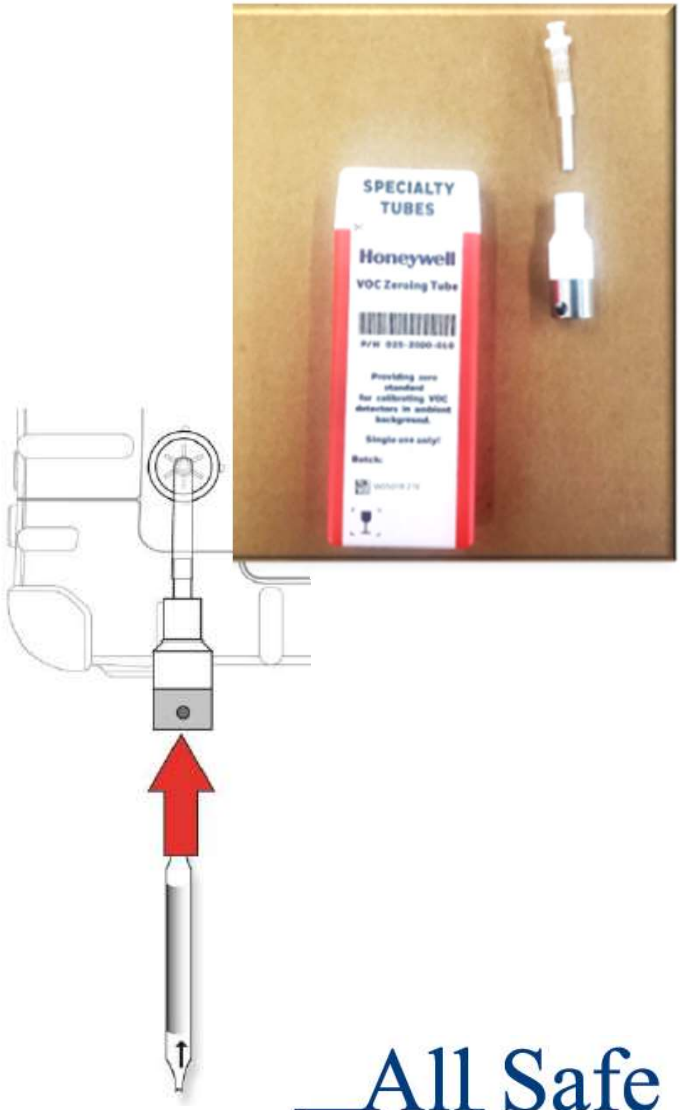
Step 1: Fresh Air Cal

- Turn meter on; after 90 second warm-up, AreaRAE will ask to perform a fresh air calibration.
- If you are in clean, ambient air, press START to zero the sensors.
- For ppb VOC sensors, use Zeroing Tubes or Zeroing Filter
- A Fresh Air Cal is like hitting a reset button; all sensors reset to zero except Oxygen (20.9%).



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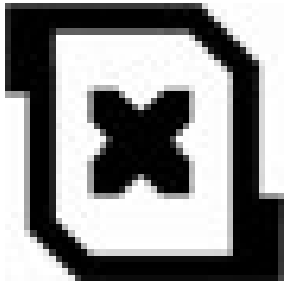
Step 2: Pump Stall

- Next, check the function of the pump by blocking the inlet
- The pump should bog down, stall and go into alarm
- (From main page) push the “Y/+” button to restart the pump
- If the pump does not go into alarm, check for loose connections or service the pump



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Step 3: Bump Check

- Perform a quick function test by applying gas to the meter.
- To clear the Bump Check icon, test must be preformed through the instrument menus.
- If readings are within 10-20% of the calibration gas values, the meter is ready for use.
- If not, perform a calibration to adjust the accuracy.

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Step 3: Continued

- Bump check each sensor in your AreaRAE using the correct cal gas cylinder.
- Be sure to separate Chlorine and Ammonia as they are cross-sensitive to one another.
- Suggested order: CL2/Quad Mix/HCN/Isobutylene/NH3
- Best to use a dedicated regulator with each cylinder of exotic gas. You might label them to keep them organized.

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Using the AreaRAE

- Golden Rule: Always-Always use a filter!
- Use sample tubing to draw samples from a distance.
- Tygon® vs Teflon® tubing
- Add 1 second per foot of tubing for gas to reach the meter.
- Replace dirty tubing and filters

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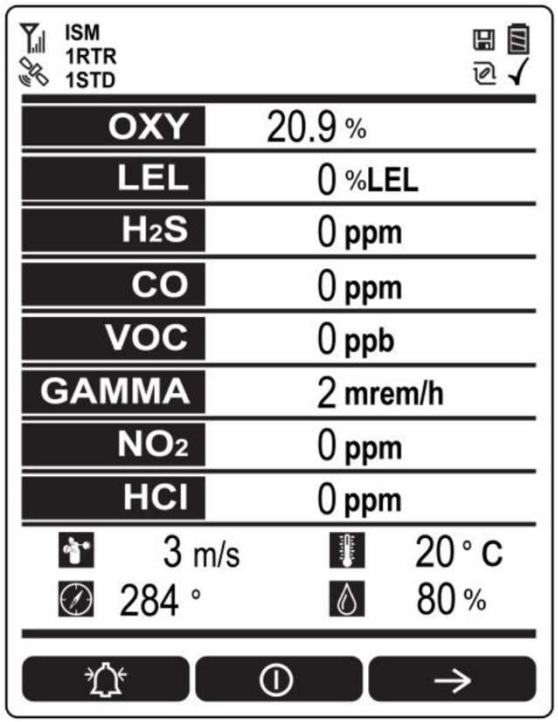
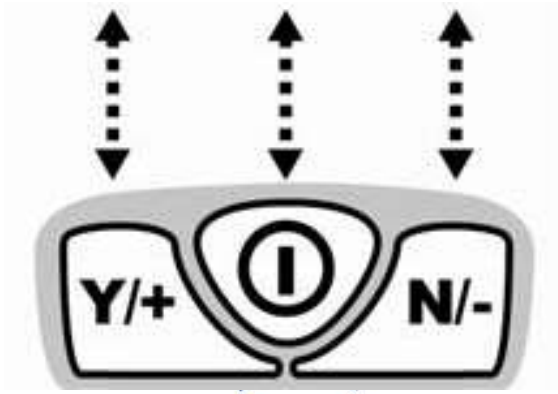
Using the AreaRAE

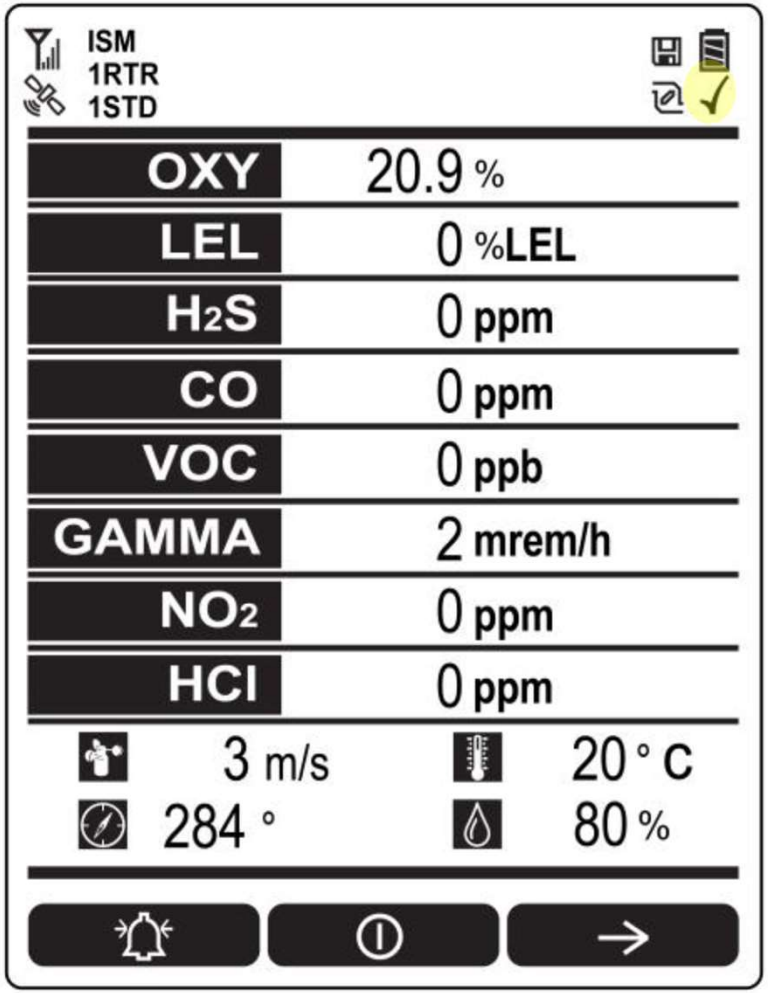
- Top left corner displays wireless and GPS status
- Top right corner displays datalog, battery, pump and test status
- Center display shows all sensor data
- Bottom shows soft key icons that align with the 3 buttons on the meter
- Press N/- to advance to next page





Using the AreaRAE

- Check mark denotes all sensors have been Bump Checked or Calibrated
- Cylinder icons next to sensor names indicate service is required
- Filled in cylinder = calibration due
- Cylinder outline = bump check due



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Using the AreaRAE

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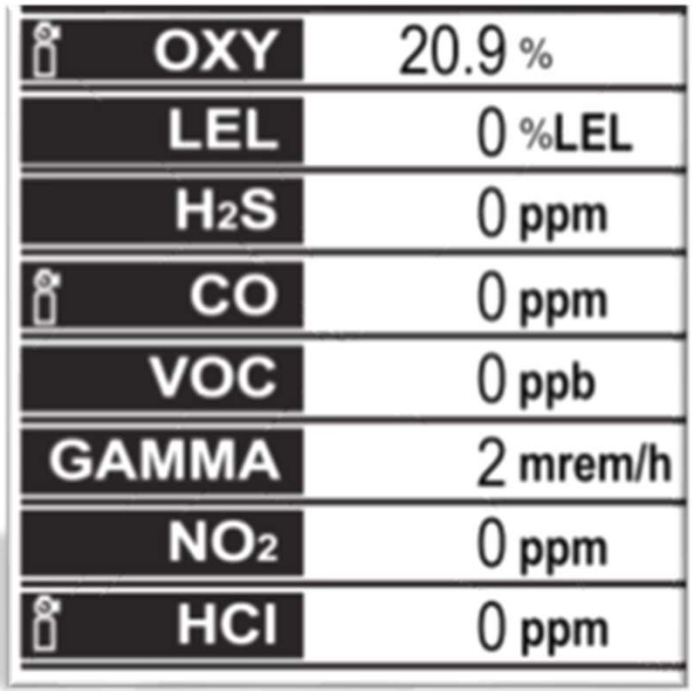

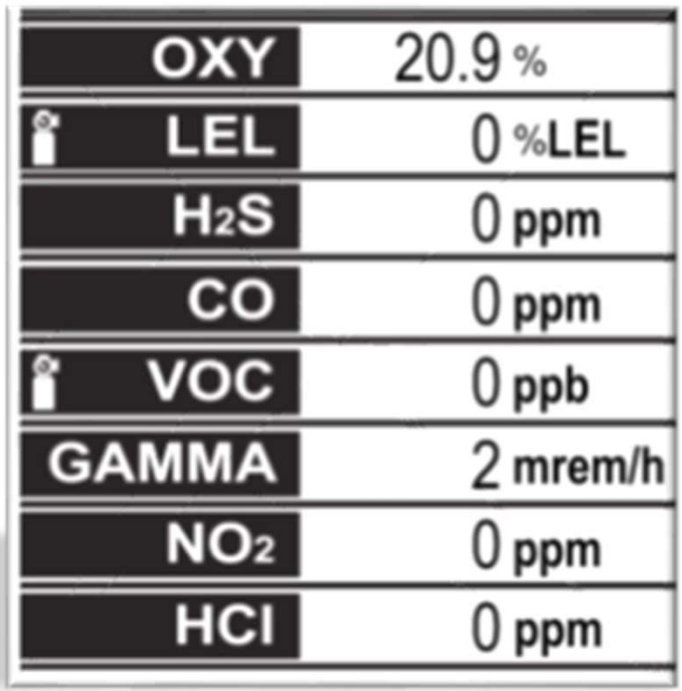

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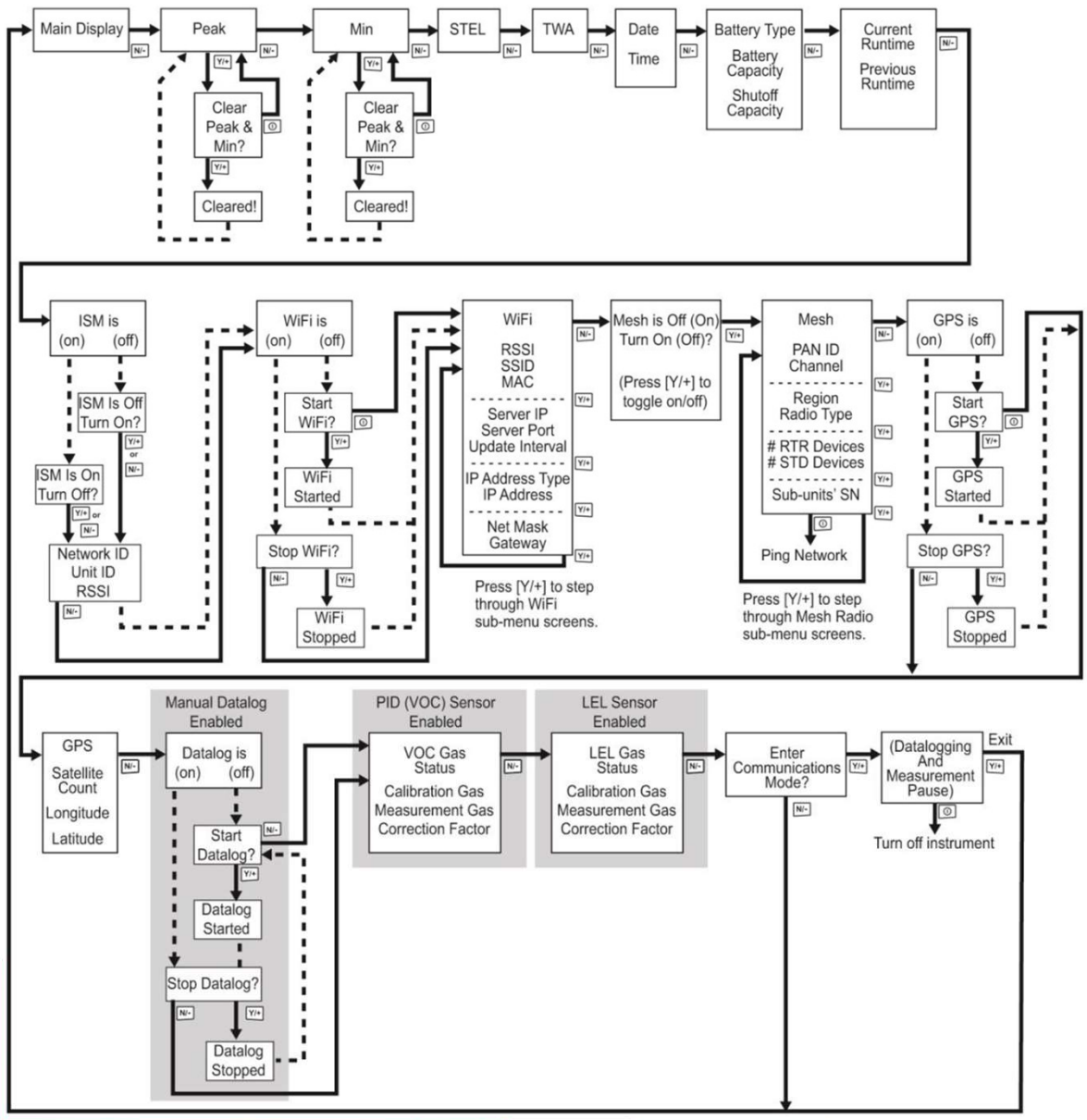
Using the AreaRAE



- Several additional pages of information
- Use the right arrow button to scroll
- Some pages allow for additional functions
- Display will return to gas readings page after 60 seconds

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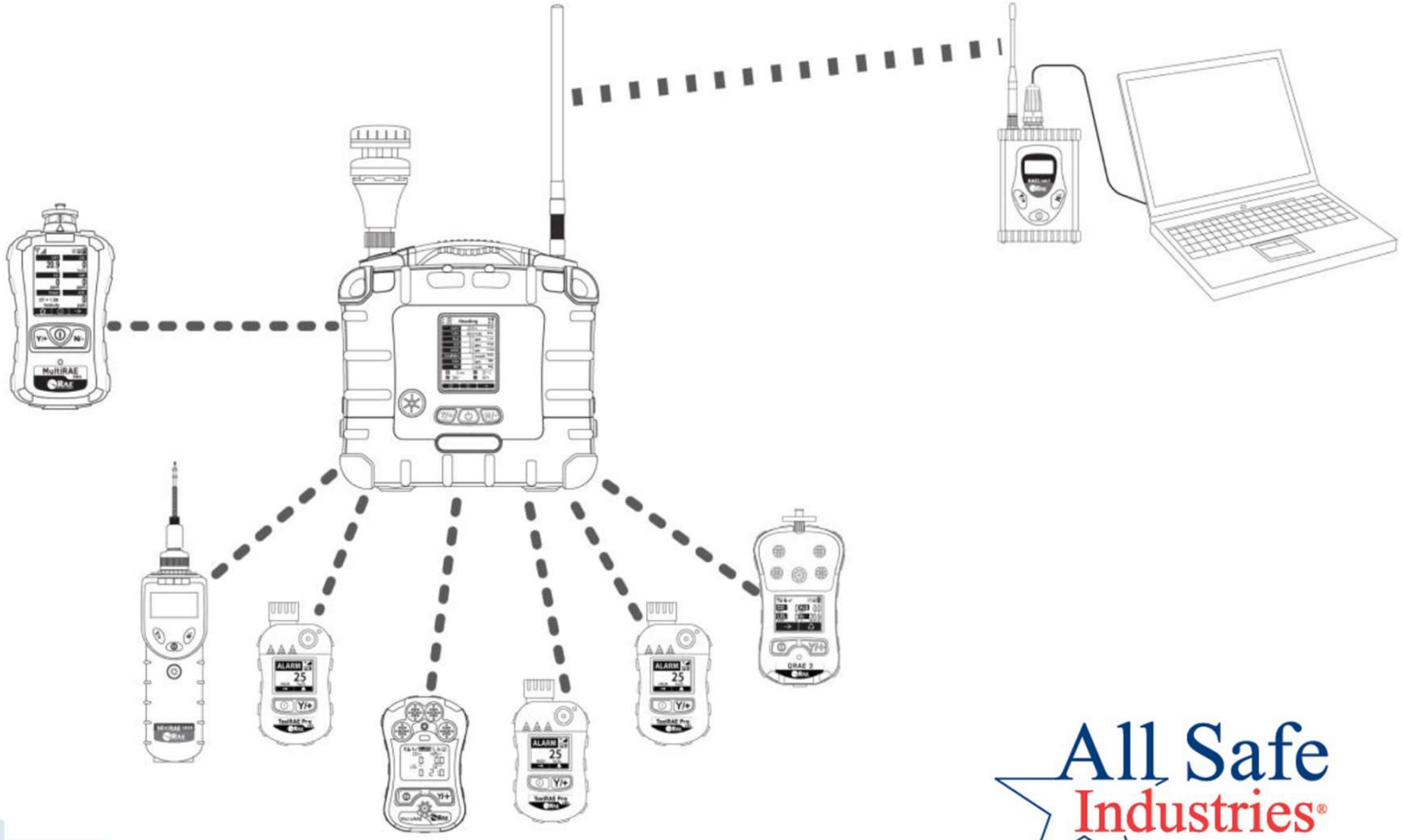
AreaRAE Alarms

Alarm Type	Buzzer & LED	Display	Reading	Backlight	Priority
Fail	3 beeps/sec	"Lamp" at PID location "Off" at LEL location	Blinking reading	On	Highest
Pump	3 beeps/sec	Blinking pump symbol	Reading	On	
Max	3 beeps/sec	"Max" at sensor location	Blinking reading	On	
Over Range	3 beeps/sec	"Over" at sensor location	Blinking 9999	On	
High	3 beeps/sec	"High" at sensor location	Reading	On	
Low	2 beeps/sec	"Low" at sensor location	Reading	On	
Negative	1 beep/sec	"Neg" at sensor location	0	On	
STEL	1 beep/sec	"STEL" at sensor location	Reading	On	
TWA	1 beep/sec	"TWA" at sensor location	Reading	On	
Calibration Fail	1 beep/sec	"Cal" at sensor location	Reading	On	
Bump Fail	1 beep/sec	"Bump" at sensor location	Reading	On	
Datalog Full	1 beep/sec	Blinking datalog symbol	Reading	On	
Calibration Req'd	-	"Full" Bottle symbol	Reading	On	
Bump Req'd	-	"Empty" Bottle symbol	Reading	On	
Battery	1 beep/min	Blinking battery symbol	Reading	On	
Comfort Beep	1 beep/min no LED flash	-	Reading	On	Lowest

Wireless Features of the AreaRAE

- Long-range 900 mHz radio
- Short-range MESH radio
- GPS
- WiFi
- Bluetooth



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Wireless Features of the AreaRAE

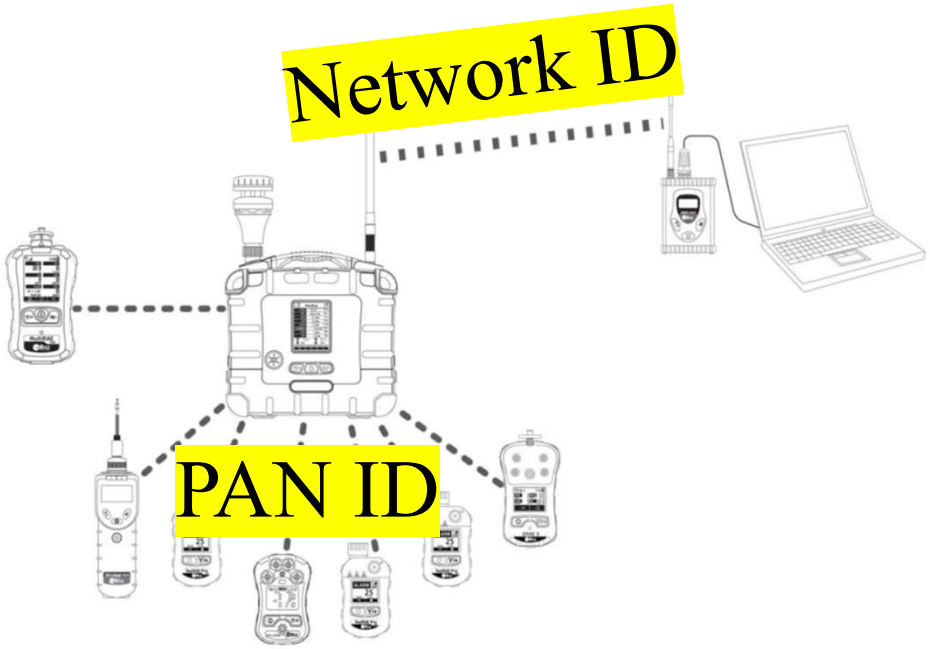
Choose WiFi OR Radio as Primary

Long-range 900 mHz radio

- Must be on the same Network ID to communicate
- Unit IDs should be different

Short-range MESH radio

- Must be on the same PAN ID and same Channel to communicate



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Using the MultiRAE

- Golden Rule: Always-Always use a filter!
- Use sample tubing to draw samples from a distance.
- Tygon® vs Teflon® tubing
- Add 1 second per foot of tubing for gas to reach the meter.
- Test all levels of confined spaces
- Replace dirty tubing and filters

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Start-up using AutoRAE2

- While the meter is OFF, install it in the cradle face down
- Close the capture mechanism to activate the cradle
- Wait for two green lights, then push Bump or Cal button
- Fresh Air Cal, Pump Stall, Bump Check and alarms are tested
- If the meter fails the bump check, a calibration is initiated

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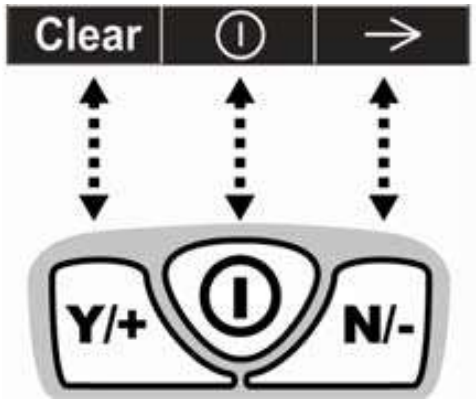
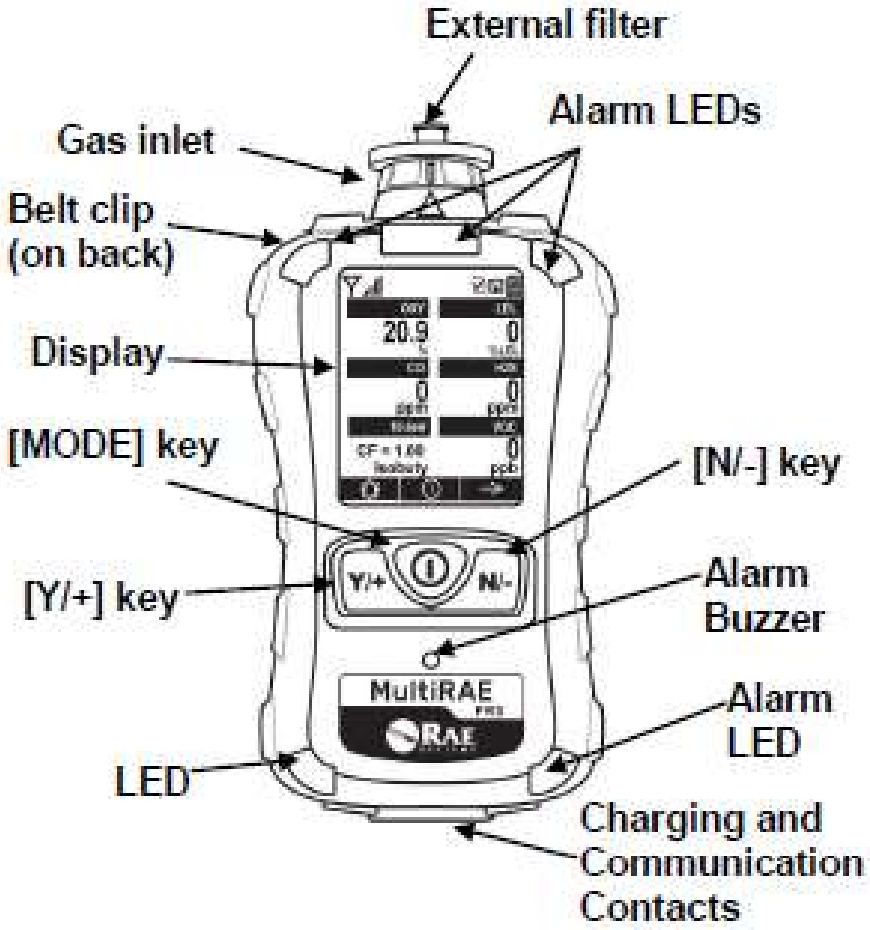
Start-up Manually



- Push the middle button until the meter beeps
- 90 second warm-up sequence
- Watch for last calibration date of sensors



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3 Steps before each days' use

1. Fresh Air Cal
2. Pump Stall
3. Bump Check (Function Test)

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Step 1: Fresh Air Cal

- Turn meter on; after 90 sec. warm-up, the MultiRAE will ask to perform a fresh air calibration
- If you are in clean, ambient air, press START
- The sensors will be zeroed
- A Fresh Air Calibration is like hitting a reset button, in which all sensors reset to zero except Oxygen which resets to 20.9%.

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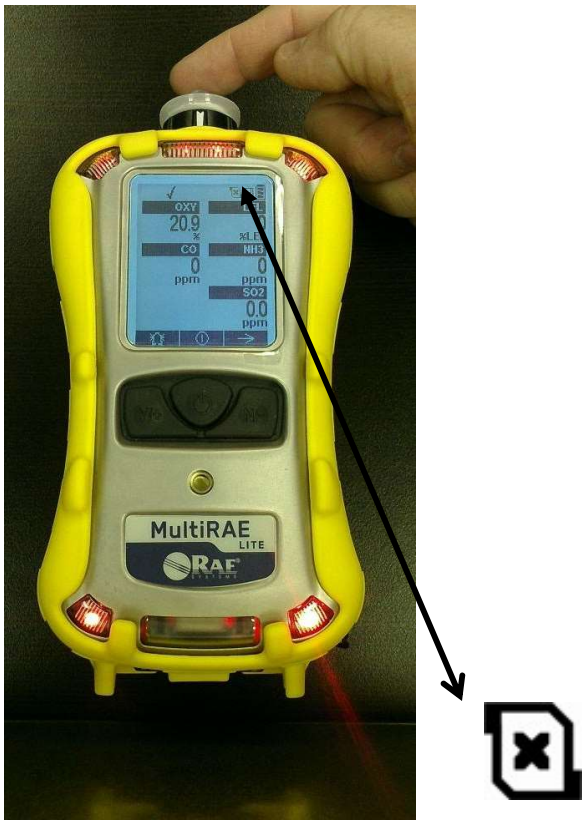
Step 2: Pump Stall

- Next, check the pump by blocking the inlet
- The pump should bog down, stall and go into alarm
- Push the “Y/+” button to restart the pump
- If the pump does not go into alarm, check for loose connections or service pump



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Step 3: Bump Check

- Perform a function test by applying gas to the meter
- Use calibration gas to check the sensor reactions
- Test all the sensors in the meter
- If readings are within 10-20% of the calibration gas values, the meter is ready for use.
- If they are not +/- 20%, perform a calibration to adjust the accuracy.

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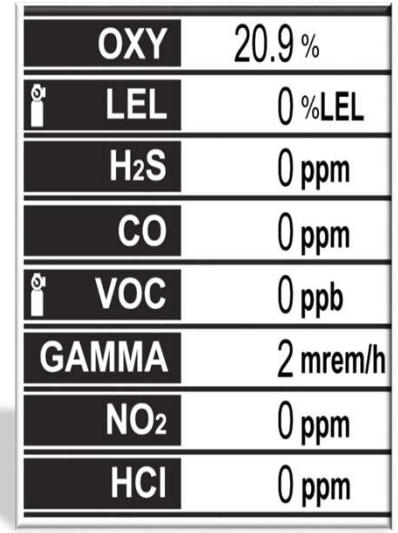
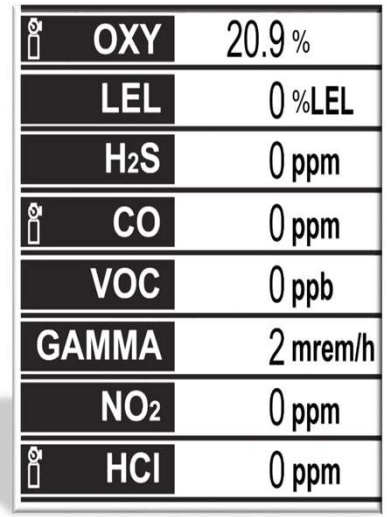
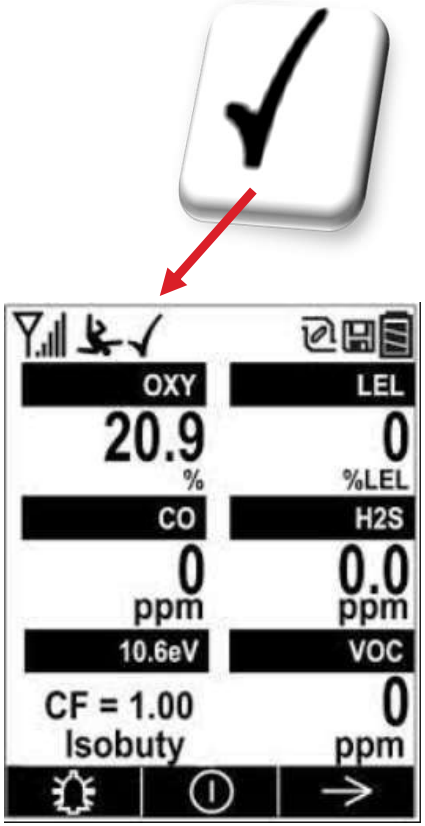
Using the MultiRAE

- Check mark at the top of the screen denotes all sensors have been Bump Checked or Calibrated
- Cylinder icons next to sensor names indicate service required
- Filled in cylinder = Calibration Due
- Cylinder outline = Bump Check Due







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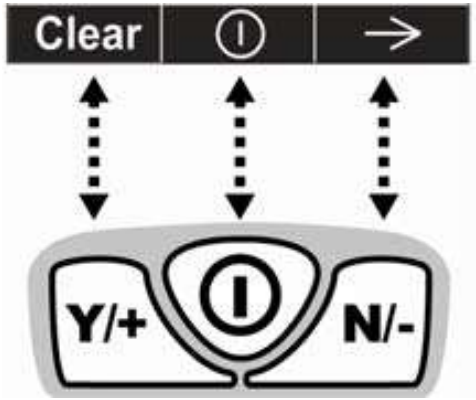
Alarms

Alarm Signal	Condition	Response
HIGH/Sensor Name/Reading + 3 beeps/flashes per second	Gas exceeds “High Alarm” limit	Alarm will continue as long as gas is present
LOW/Sensor Name/Reading + 2 beeps/flashes per second	Gas exceeds “Low Alarm” limit	Alarm will continue as long as gas is present
NEG/Sensor name + 1 beep/flash per second	Sensor is drifting to negative numbers	Turn meter off and on again, do Fresh Air Cal
PUMP + 2 beeps/flashes per second	Pump failure	Clear obstruction and press Y/+ to restart pump
OFF/LEL Sensor + 3 beeps/flashes per second	LEL sensor off because gas exceeds sensor range	Alarm will lock. Turn meter off for recovery
BAT + 1 beep/flash per minute	Low Battery	Put meter on charge or switch to Alkaline batteries
MEM + 1 beep/flash per minute	Datalogging Memory is full	Meter still functional, but will not log current data
 Appears @ Sensor Label	A change has occurred or the time to next calibration is due	Calibrate the meter

Using the MultiRAE

- Several pages of additional information
- Soft keys perform the function listed on the screen like a cell phone
- After use, put the meter back on charge or on the cradle
- Notice the new charger set-up.



MultiRae Pro

Charger

?

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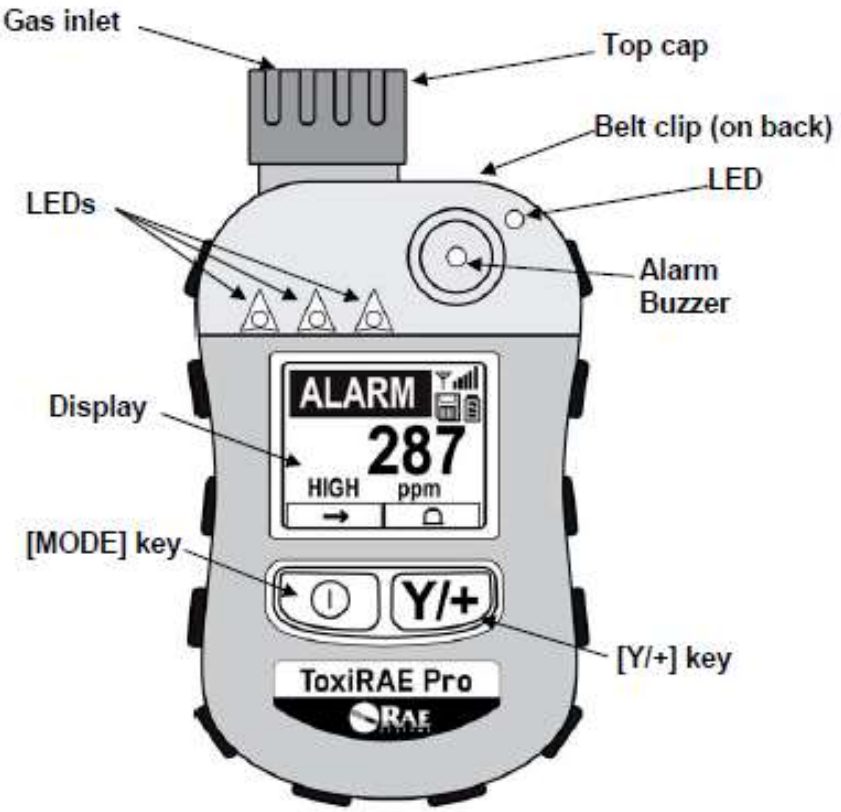
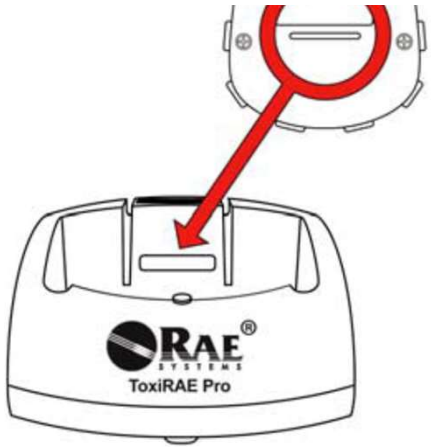
Using the ToxiRAE Pro

- Same user interface as MultiRAE
- Two button operation
- Uses same sensors as MultiRAE
- Snap into charging cradle, press latch in back to release





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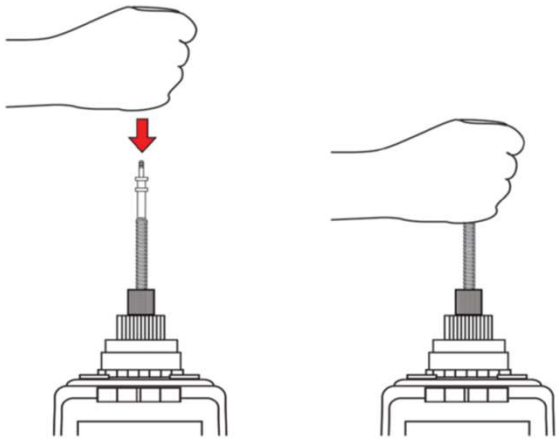
Using the MiniRae

- High range readings up to 15,000 ppm
- Same 3 step start-up process, except during Fresh Air Calibration, use a zeroing filter or tube
- Manual or automoatic bump test and calibration with AutoRAE2
- To test response to moisture, cup you hand over the inlet. If that results in a reading, clean the lamp.



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IMPORTANT

This is a life safety piece of equipment

Advanced programming and maintenance functions should only be attempted after thoroughly reading the instrument manual and understanding that information.

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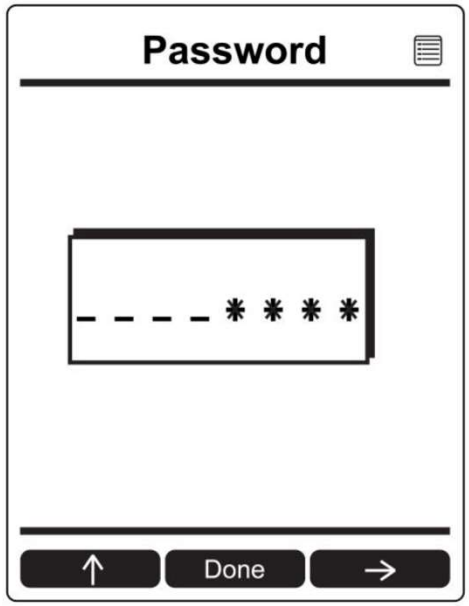
Enter Programming

- Hold “Power” and “N/-” keys for 5 sec. to get in Programming Mode
  - *Default password is 0000*
- Buttons follow commands at the bottom of the display
- Meter can also be programmed from Safety Suite or Device Configurator.
- Connect to your PC through USB cable
- Meter must be in “ Communicate with PC Mode"



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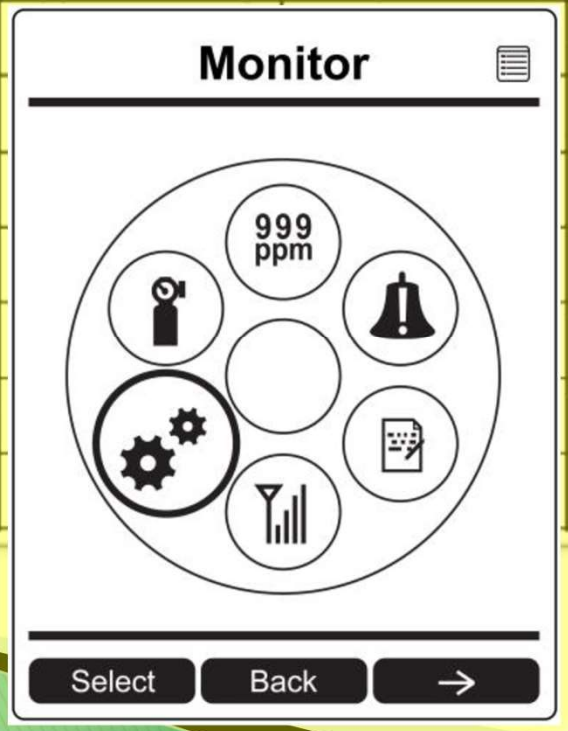
AreaRAE Menus

Calibration	Measurement	Alarms	Datalog	Wireless	Monitor
Fresh Air	Sensor On/Off	Alarm Limits	Clear Datalog	Sel Primary Radio	LCD Contrast
Multi Sensor Span	Change Meas. Gas	Alarm Mode	Datalog Interval	GPS	Zero At Start
Single Sensor Zero	Measurement Unit	Alarm Settings	Sensor Selection	Mesh	Fast Startup
Single Sensor Span		Comfort Beep	Data Selection	ISM	Language
Multi Sensor Bump			Datalog Type	Wi-Fi	Site ID
Single Sensor Bump			Memory Full Action	Message*	User ID
Cal. Reference					Secure In Place
Change Cal. Gas					
Multi Cal. Select					
Change Span Value					
Change Span 2 Value**					



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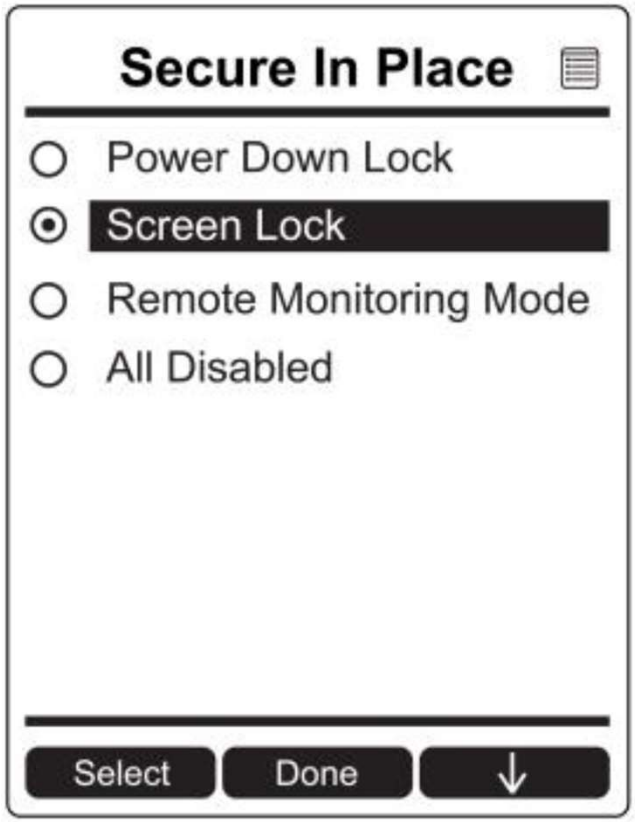
Secure In Place Menu

- Power Down Lock requires the password to turn off the meter
- Screen Lock allows only the instantaneous reading screen
- In Remote Monitoring Mode, screen displays “Monitor Active” until an alarm condition and then reverts to Screen Lock mode



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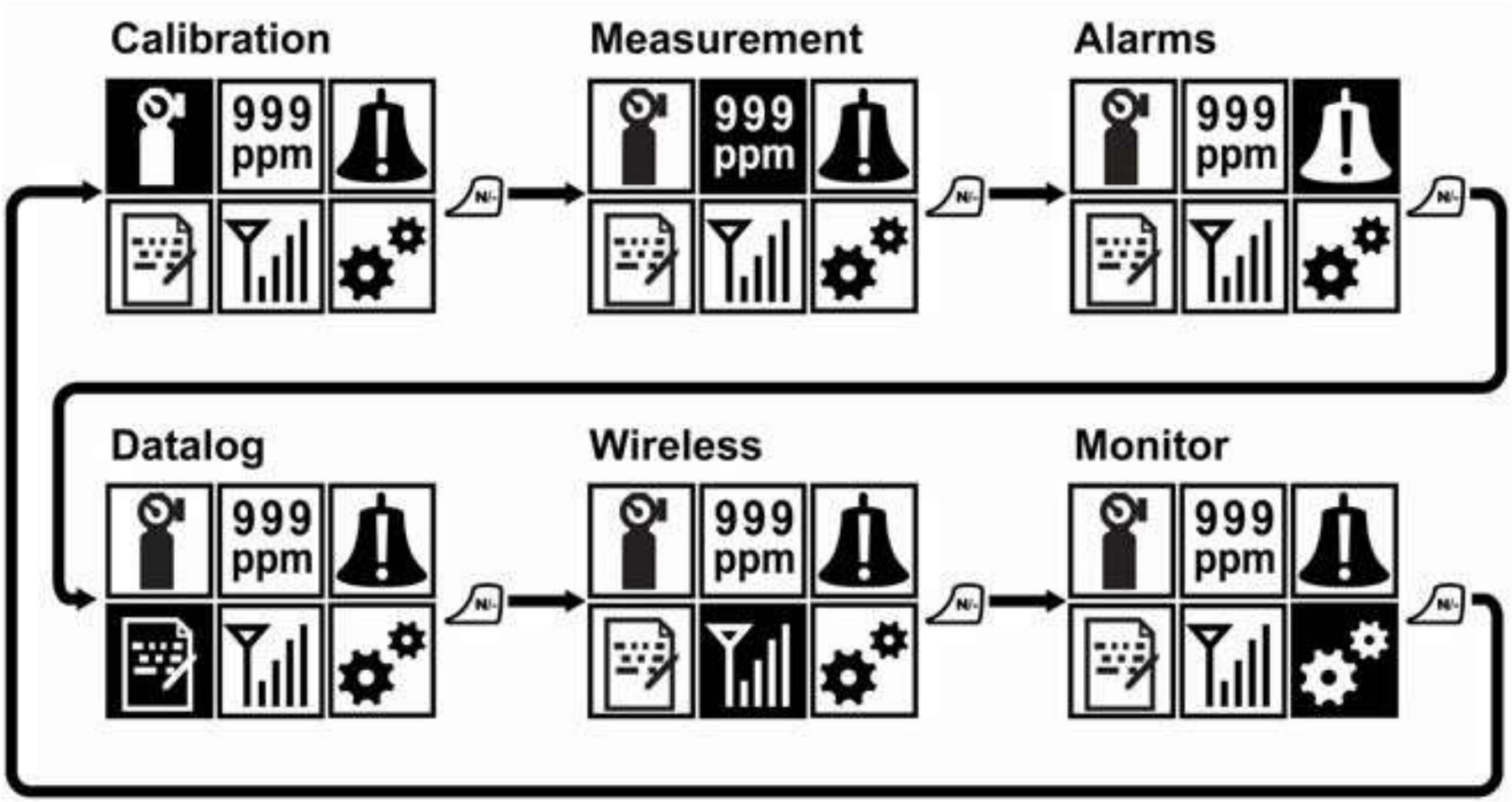
MultiRAE Menus



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Monthly Maintenance

- Calibration
- Datalogging

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Calibration

- Remember the 3 Step Test includes a Fresh Air Cal and a Bump Check
- When the sensors are not reading properly, a calibration will adjust their accuracy
- Use the proper calibration gases, regulators and tubing to calibrate each sensor in your meter
- Perform calibrations at least monthly
- Be sure Date/Time are correct for accurate “Last Cal Date” stamp

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Calibration Gas

- Available in various cylinder volumes
- Disposable and reusable cylinders available
- Volume required based on number of meters and usage

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Regulators

- Basic regulators have a preset flow rate and on-off control knob
- Demand Flow Regulators allow pumped instruments to automatically draw gas
- Other variations are available (trigger, stainless steel, etc)

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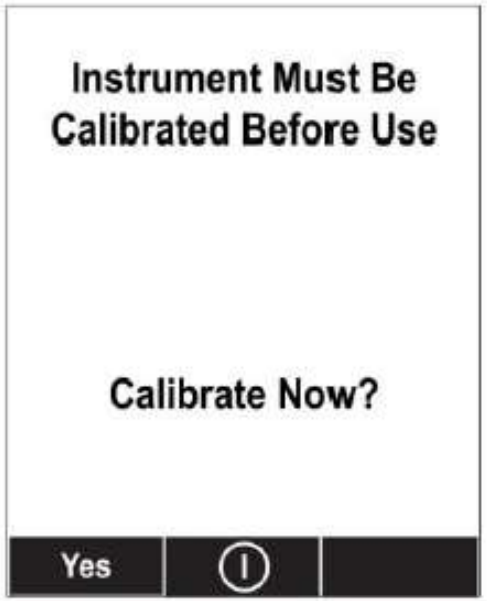
Policy Enforcement

- AreaRAE can be set to enforce Bump Check and Calibration policies
- Once set the meter will prompt for the required action at the end of the warm-up sequence
- The Policy can be set to CAN or CAN'T Bypass
- If set to CAN'T Bypass, the action must be performed in order to use the meter



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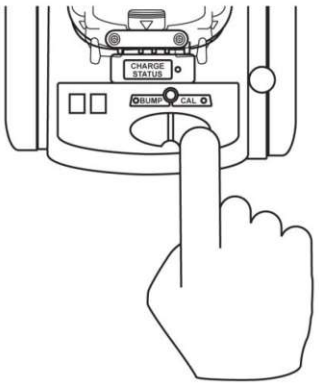
Calibrate with AutoRae2

- Automatic Bump Check and Calibration by pressing a button
- Configure system using ProRae Studio2
- Once set up properly, AutoRae2 will perform all maintenance functions.



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inCase Calibration™

- The system for your gas detection instruments
- Designed for one meter, multiple instruments and full Calibration Stations
- Available exclusively from All Safe Industries®

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Datalogging

- During monthly maintenance, we recommend downloading your data
- Requires Safety Suite Device Configurator on your PC or Device Manager with Safety Suite
- Data files provide historical reference
- Once file is saved, clear data from the meter
- Can choose Overwrite or Stop Datalog as Memory Full options

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Replacing Parts

- Gas meters are basically small computers with sensors, pumps and batteries
- Periodically, these items will need to be replaced
- Refer to the manual or send the meter to All Safe for repair.

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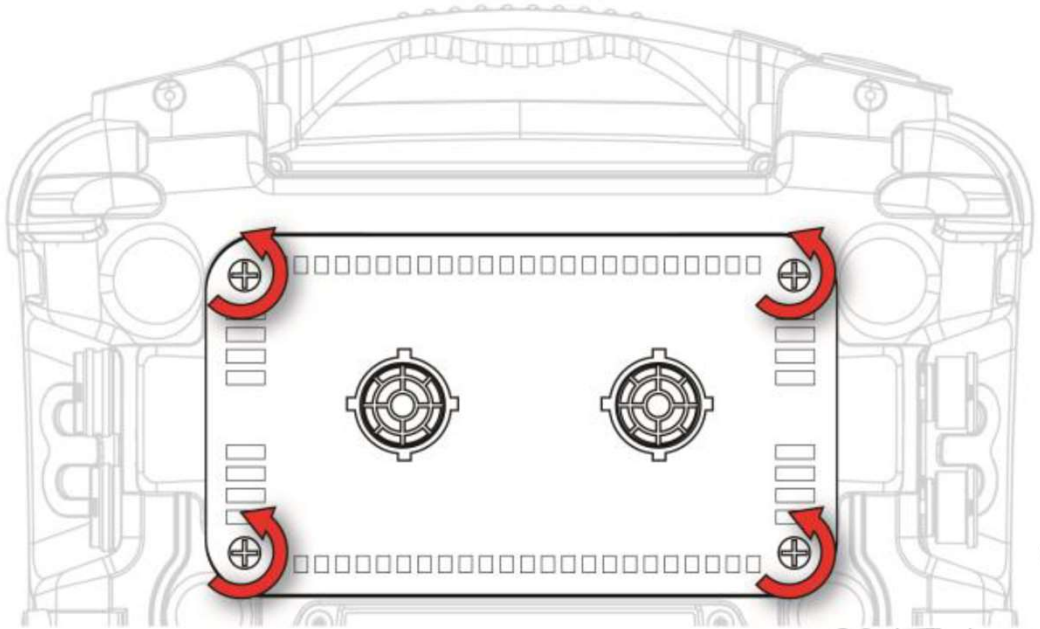
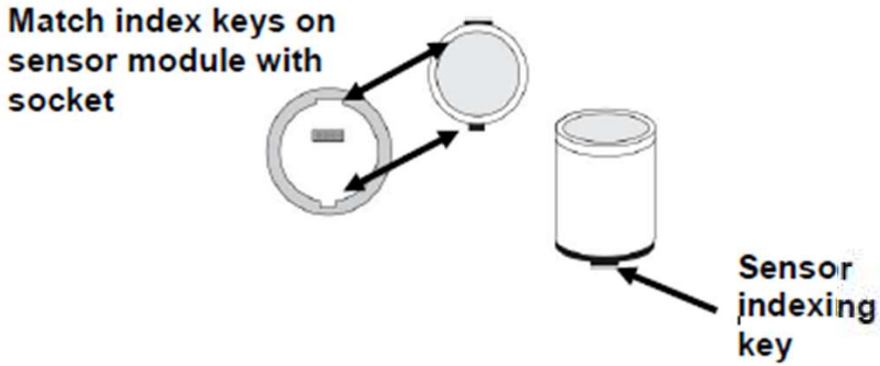
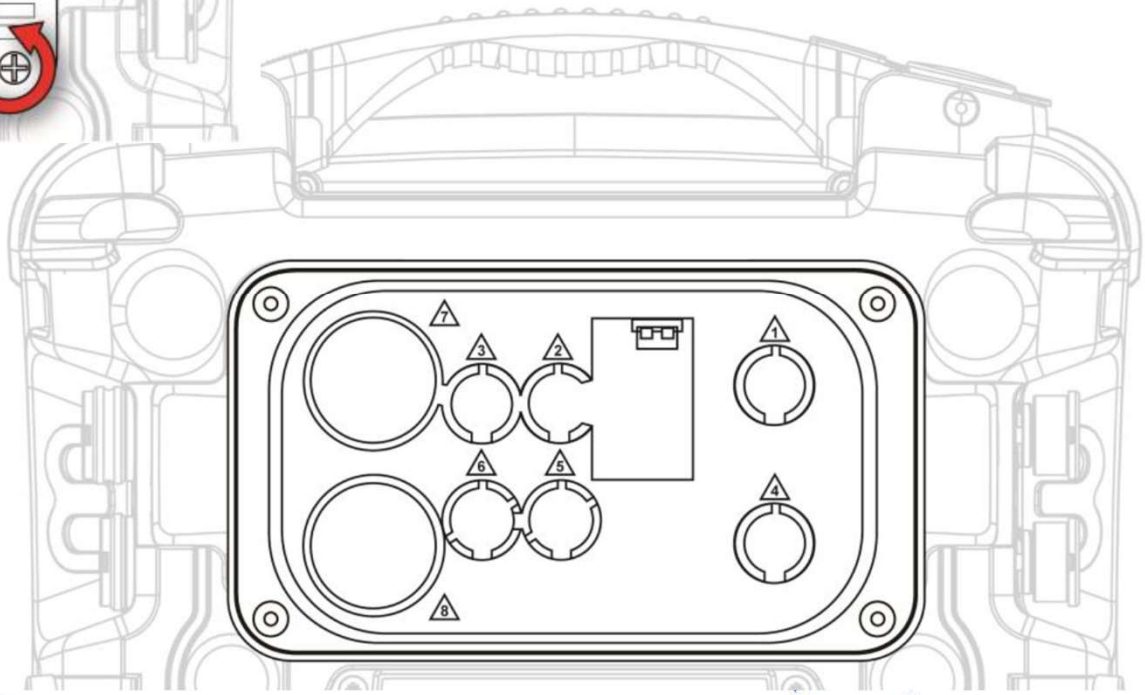
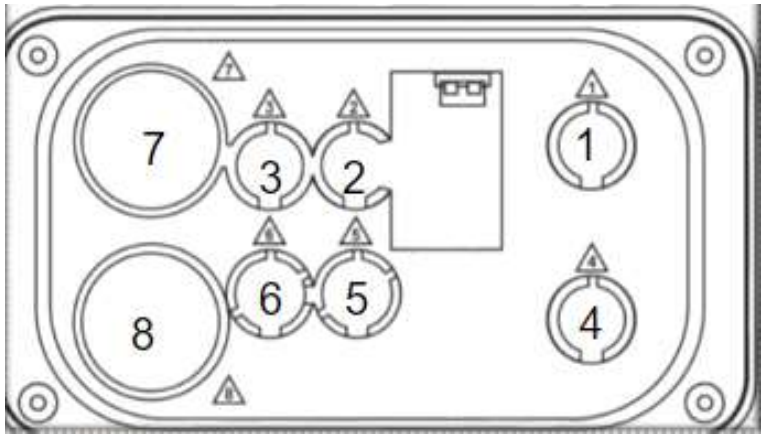
AreaRAE: Easy Sensor Access







AreaRAE: Sensor Positions



Location	Sensor type(s)
1	4R+ EC --- O_2 (this is the preferred slot)
2	4R+ EC or 4R+ PID or 4R+ CO_2 (For best results, do not use HF or HCl sensors in this slot.)
3	4R+ EC (avoid placing the O_2 sensor in this slot)
4	4R+ EC
5	4R+ EC or LEL (For best results, do not use HF or HCl sensors in this slot.)
6	4R+ EC (avoid placing the O_2 sensor in this slot)
7	7R+ sensors
8	7R+ sensors

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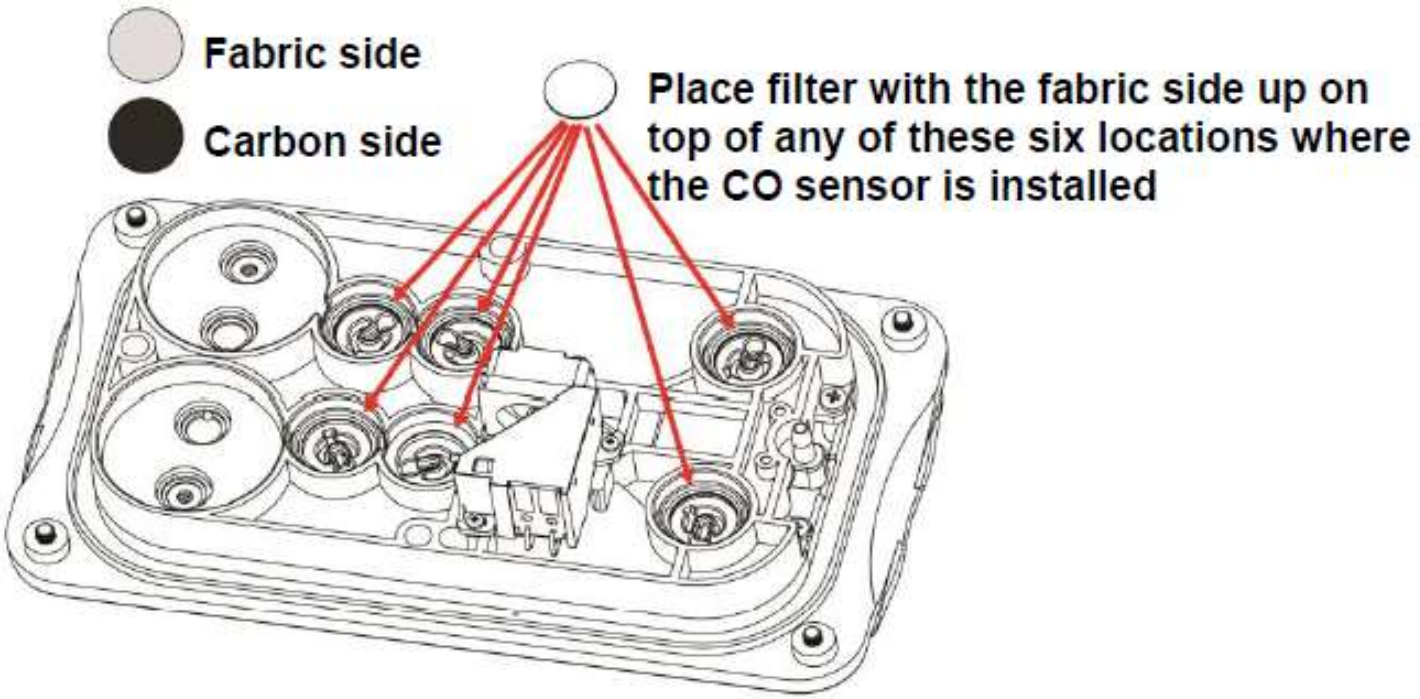
AreaRAE: Sensor Filters

For CO sensors exposed to VOCs, it is recommended to use a carbon filter to absorb excess VOCs.



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AreaRAE: Sensor Bias

Some electrochemical sensors (NO, NH3, Liquid O2) require a bias voltage and a warm-up time of at least 6 hours upon installation. Sensor bias stays on once installed and the equilibration time is needed only when first installed.

Unbiased sensors require at least 10 minutes to stabilize.

The SensorRAE 4R+ can be used to maintain bias current so that long warm-up times can be avoided.

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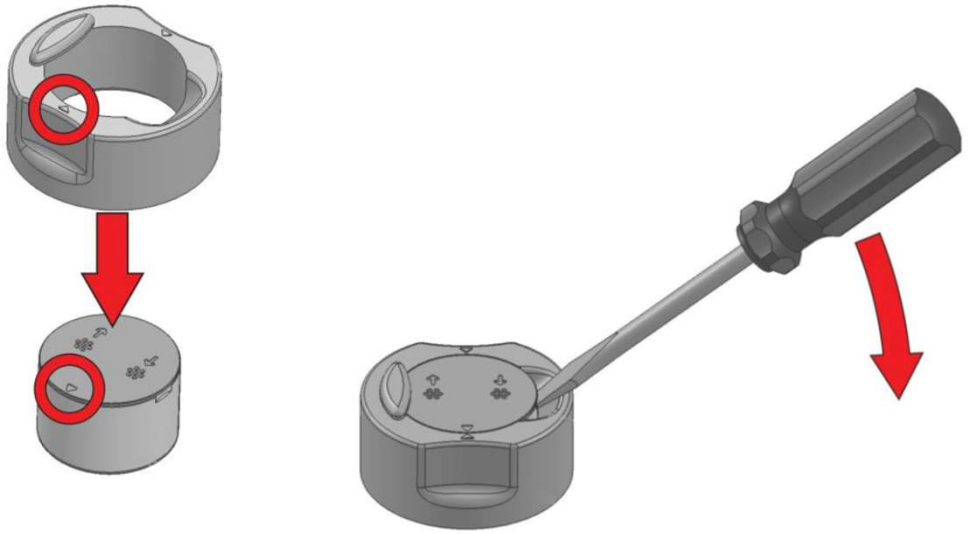
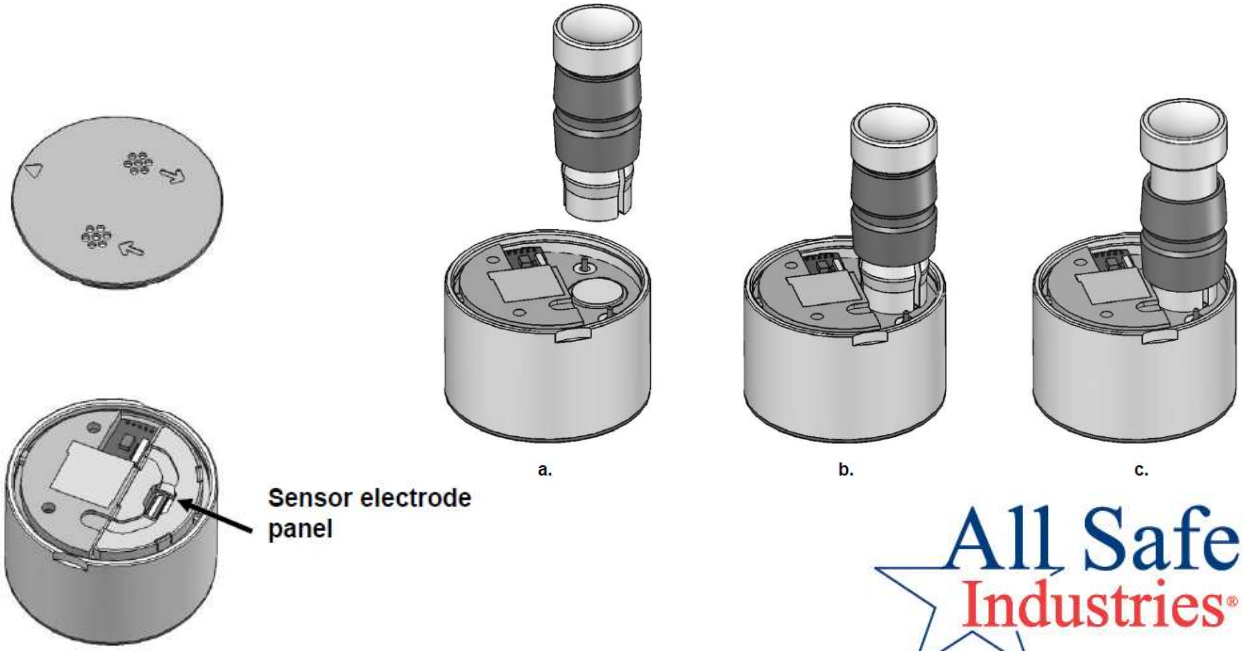
Cleaning / Replacing 7R+ PID

- Remove PID sensor from meter
- Open PID sensor with provided tool
- Remove electrode panel
- Remove PID lamp with provided tool
- Clean lamp and electrode panel with isopropanol





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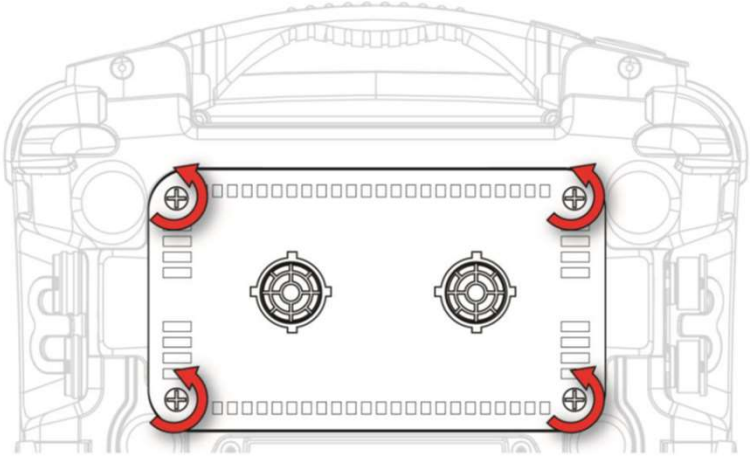
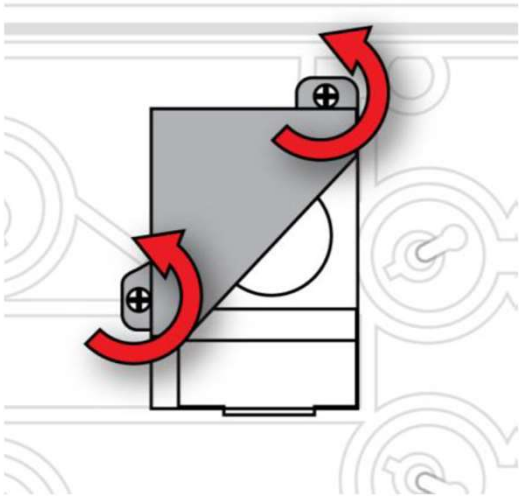
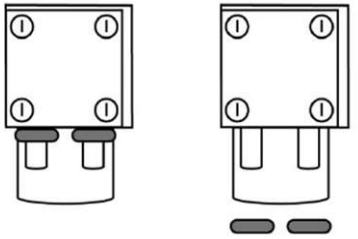
Cleaning / Replacing the Pump

- Remove sensor compartment cover
- Remove two Phillips screws attaching pump to the cover and remove
- Remove o-rings from pump and re-seat onto sensor cover
- Clean or replace pump module
- Reconnect to sensor cover and replace







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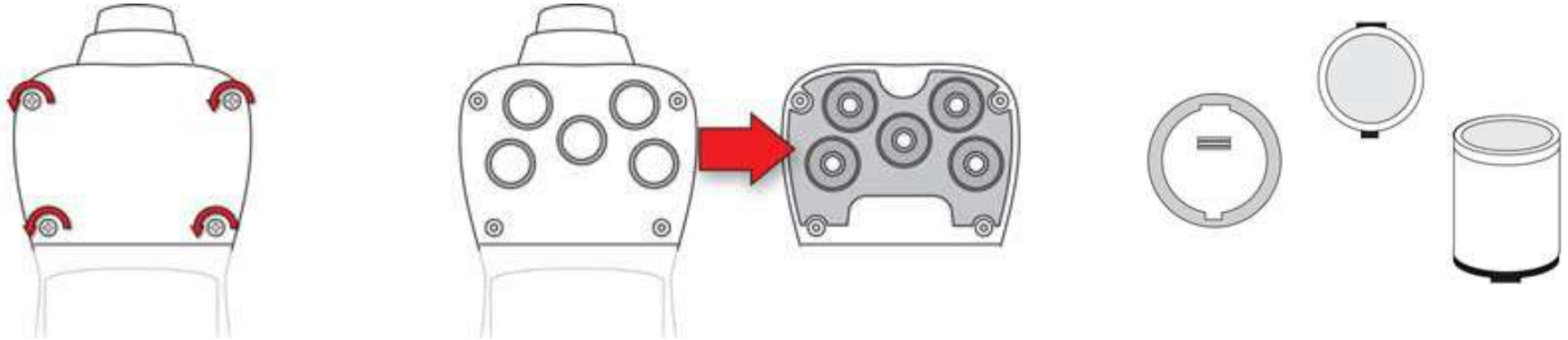
MultiRAE: Easy Sensor Access



- Remove the rubber boot, remove the battery and remove the four screws holding the sensor compartment cover in place.
- Remove the cover exposing the sensors and remove/replace as necessary.
- Match index keys on sensor with sockets in the meter.
- Reassemble the meter and then recalibrate.

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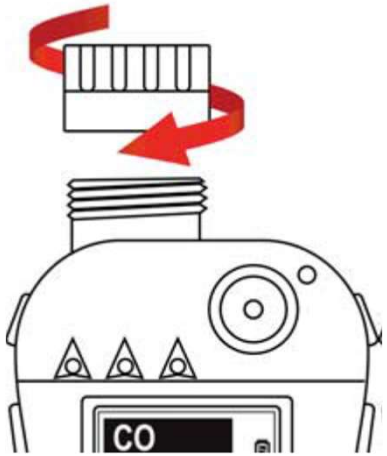
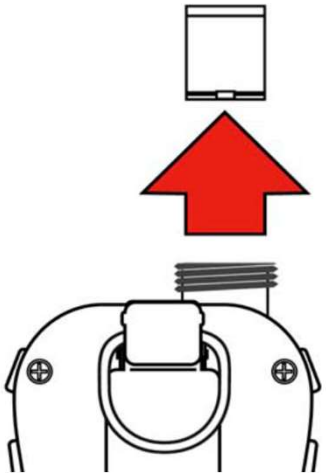
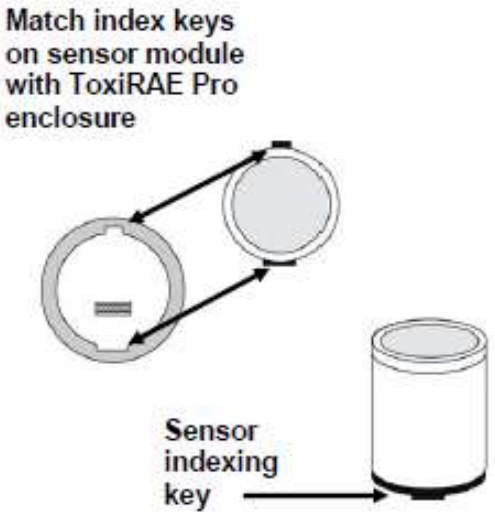
ToxiRAE Pro: Easy Sensor Access







- Remove the rubber boot and unscrew the sensor cap.
- Remove the sensor and replace.
- Match index keys on sensor with sockets in the meter.
- Reinstall the sensor cap and rubber boot.
- Recalibrate the meter.

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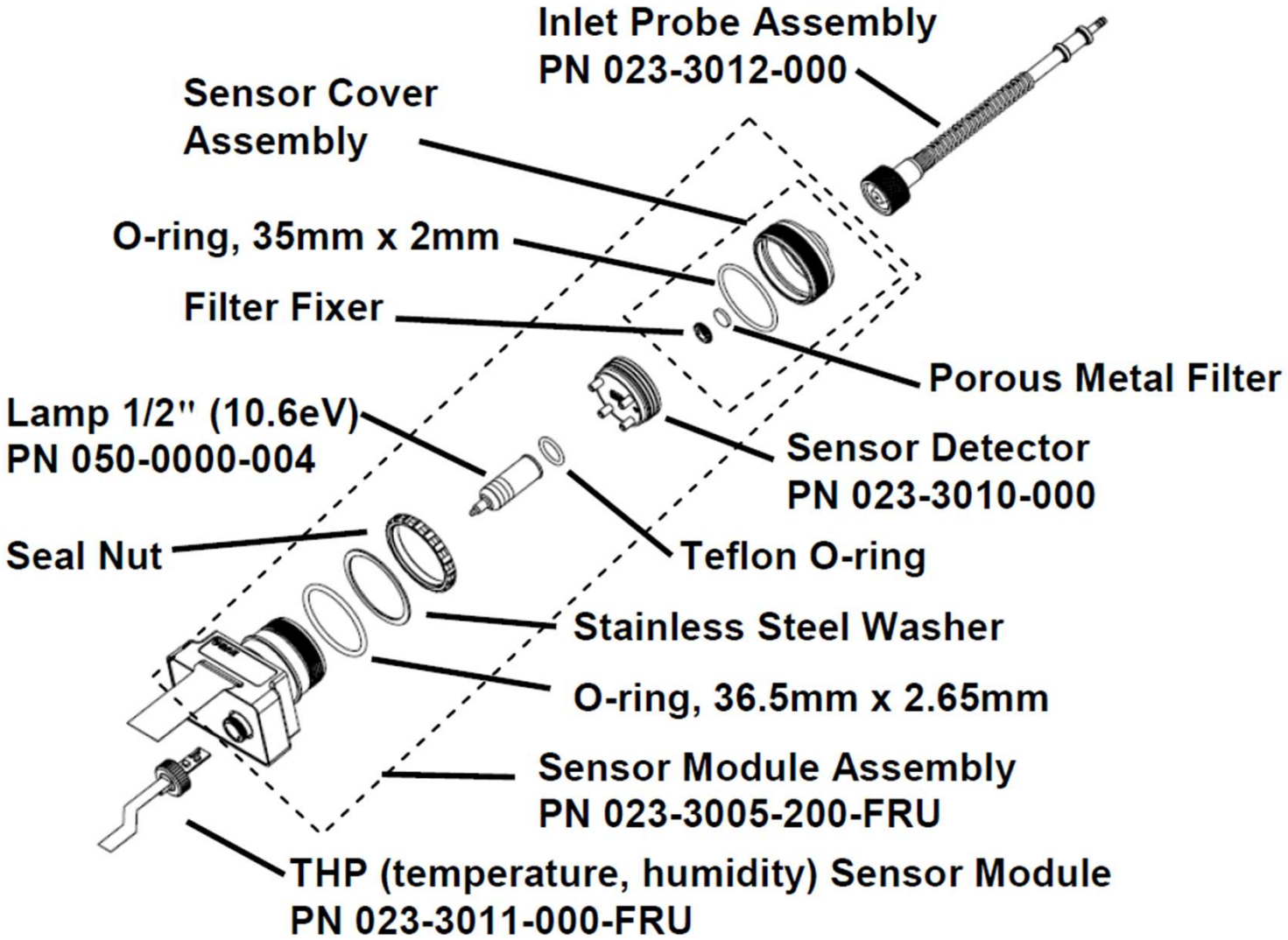
MiniRAE: Parts View



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Diagnostic Mode

- For Service Technicians ONLY
- Provides raw counts for sensors, battery, and other readings, as well as a list of installed sensors and information about them (expiration date, serial number, etc.)
- With meter turned off, press and hold Y/+ and MODE until meter beeps. At the end of the warm-up, enter password.
- Diagnostic Mode allows adjustments for;
  - Alarm LEDs and Buzzer
  - LCD Contrast
  - Pump Threshold
- Test new settings before returning meter to service

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Training Segments

- Gas Detection 101: The Basics
- Rae Systems Product Overview
- Daily Use - Monthly Maintenance
- Wireless Gas Detection
- Practical Exercises
- Questions

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Wireless Gas Detection

A complete wireless system consists of

- Host computer running Safety Suite Responder with an active license for the number of devices you want to connect.
- RaeLink3 Host
- Wireless devices
- RaeLink3 as a Remote or Repeater (if needed)

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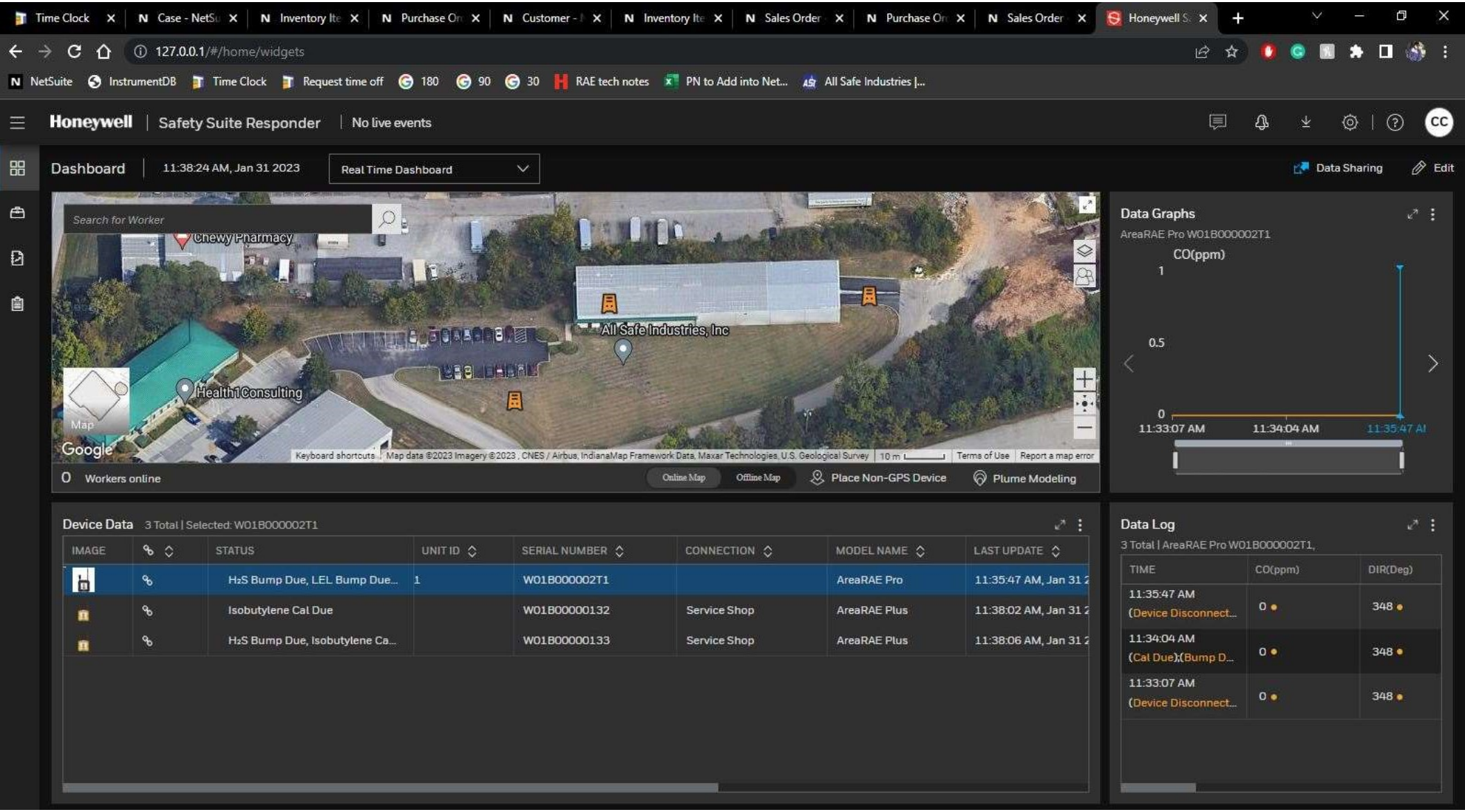
Wireless Gas Detection

Safety Suite Responder



RAELink3 MESH Radio

- Provides wireless connectivity between portable instruments and a Host Computer running Safety Suite Responder
- Long range wireless covering 2 - 8 miles*
- Field programmable Network ID, PAN ID and Operation Mode

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RAELink3 MESH Radio

Three (3) Modes of Operation

1. Remote. Functions as a slave modem and communicates data from up to eight (8) meters to a host modem or RAELink3 with the same Network ID.

2. Host. Functions as a host modem and communicates with up to 64 RAELink3-compatible radio-enabled RAE Systems products with the same Network ID. Must be connected via cable to a PC running Safety Suite software.

3. Repeater. Functions as a repeater for RAELink3 Mesh modems in Remote mode or other RAELink3 modems with the same Network ID.

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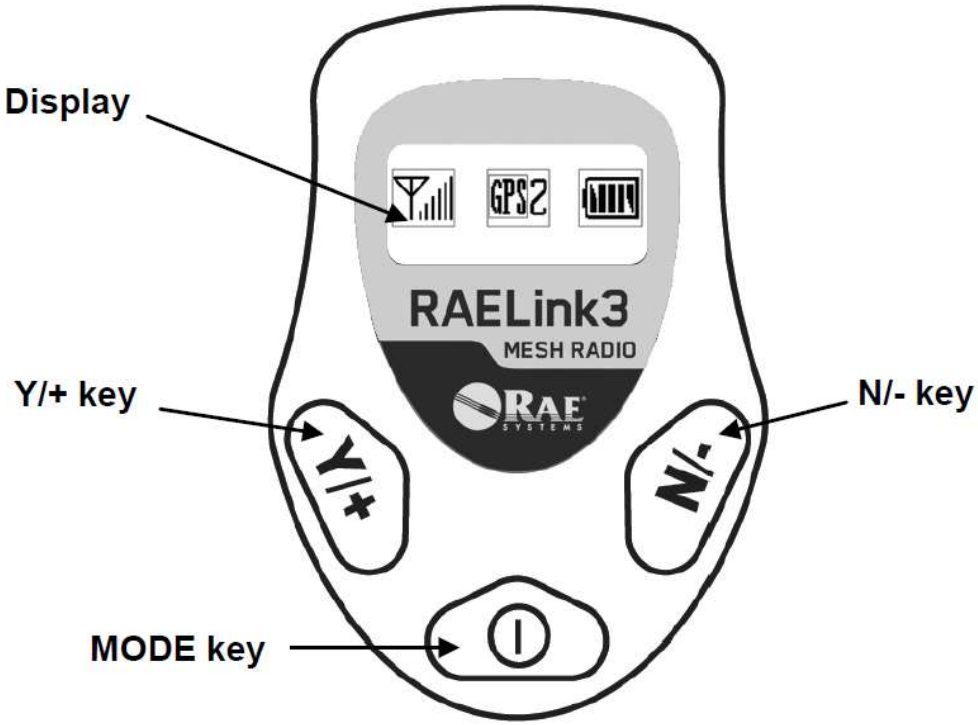
RAELink3 MESH Radio

- Display shows signal strength, GPS status and battery strength and current mode
- Familiar 3-button Rae interface
- Programming: press Mode and N/- to enter menus



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RAELink3 MESH Menus

- Network ID
- Operation Mode
- Unit ID
- MESH Radio Power
- PAN ID
- Channel
- Cable Menu
- Baudrate
- GPS Status / Coordinates
- Modem Configuration

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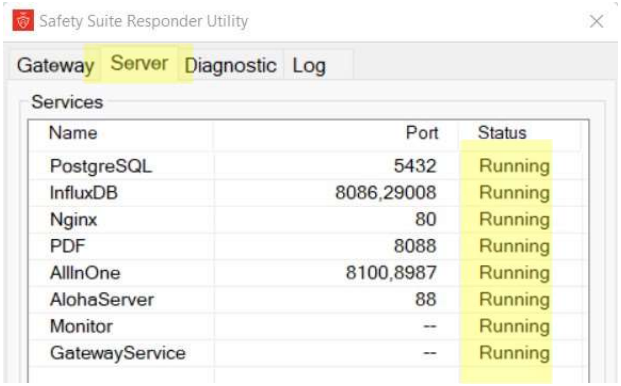
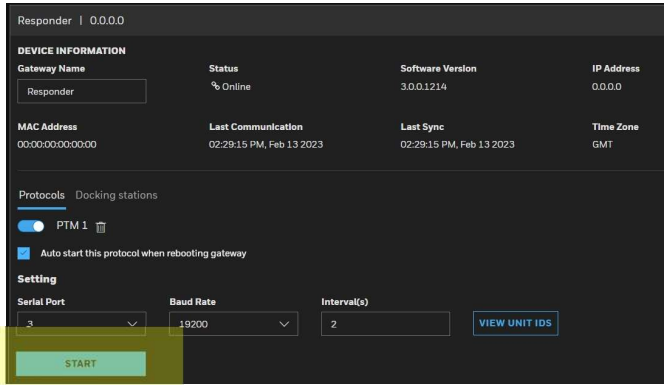
Wireless Troubleshooting

Is everything turned ON and running (Started)???

- Safety Suite Responder Utility Started/Connected/Running
- Safety Suite Responder PTM Protocol Started (Gateway Menu)
- RAELink3 Host On (and only one (1) host running?)
- Wireless Gas Detection On (not on a menu or FAC?)





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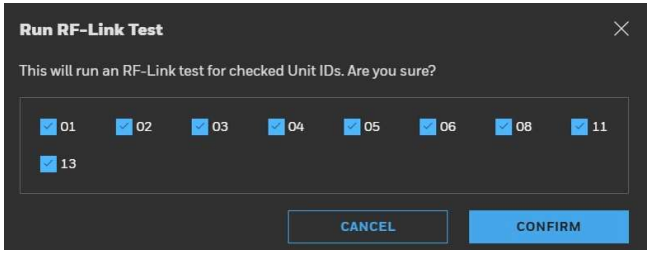
Wireless Troubleshooting

Are the SOFTWARE settings correct???

- Communicating with the correct USB port?
  - Check Device Manager – Ports (COM and LPT)
- Polling the correct AreaRAE Unit IDs?
  - Check Gateway Menu
- Does RF Test Link show 100%?
- Are you connected to the web to plot map location?
- Are the serial #s you want to see set to Active RT?
  - Check Asset Management Screen
- Do you have Real Time Licenses available?
  - Check Organization Menu



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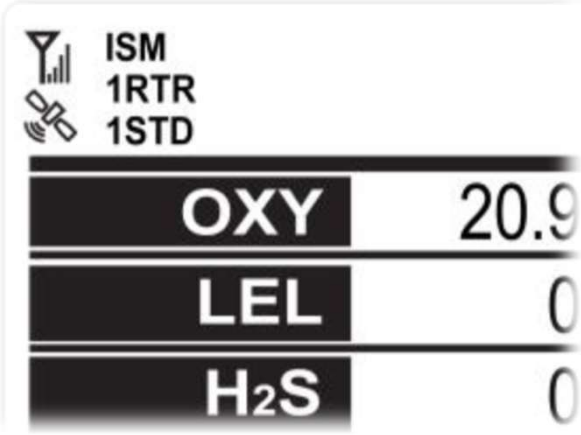
Wireless Troubleshooting

Are the METER settings correct???



- Is the ISM radio ON?
- Is ISM set to the same Network ID as the RAELink3 Host?
- Are all the Unit IDs different?
- Have the meters established radio connection?
  - Is the antenna icon steady [not blinking] and showing signal strength bars?
- Have AreaRAEs established GPS connection?
  - Is the GPS icon and showing signal strength echoes?
- Are MESH radios set to the same PAN ID and Channel?
- Are no more than three (3) AreaRAEs set as REPEATER?

All Safe Industries®

Training Segments

- Gas Detection 101: The Basics
- Rae Systems Product Overview
- Daily Use - Monthly Maintenance
- Wireless Gas Detection
- Practical Exercises
- Questions

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Practical Exercises

- Power-on AreaRAEs;
  - demonstrate 3 Step Process
- Start Safety Suite Responder and connect AreaRAEs and at least one MultiRAE
  - Confirm COM Port and Unit IDs being polled
- Set one AreaRAE to Secure In Place feature
- Demonstrate Data Sharing with meters on another Network ID
- Deploy one unit out of range and re-connect via AreaRAE Repeater
- Put meters to sleep/awake

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Remember, when you have gas . . .

- *Portable Gas Detection*
- *Fixed Gas Detection*
- *Wireless Instruments*
- *inCase Calibration™*
- *Service and Repair*
- *CBRNE Detection*

All Safe Industries®

Thank you!

All Safe Industries®