Using the MiniRAE 2000 & ppbRAE PID

Firmware v. 1.20 (rev C)

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Training Agenda:

- MiniRAE 2000 & ppbRAE features
- Turning on the MiniRAE 2000 & ppbRAE
- Recommended Daily Start-up Procedure
- User modes & displays
- Alarm modes
- Programming displays
- Calibration

MiniRAE 2000/ppbRAE

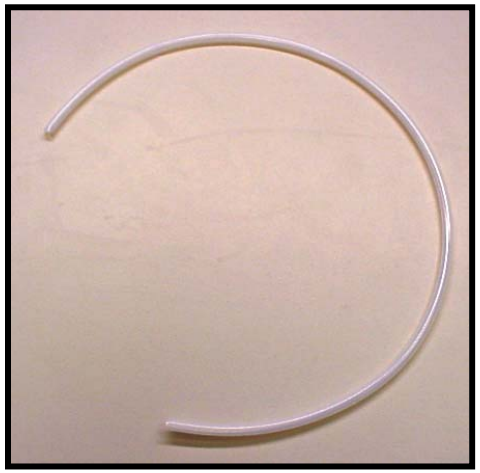
- ***MiniRAE 2000: 0.1-10,000 ppm***

- ***pppRAE: 1-9999 ppb/ 0.1-2000 ppm***

MiniRAE 2000: Internal Pump

- 500 cc/min makes remote sampling easy
- Sample draw over 100 feet!
- Use external white liquid water trap for added protection
- Pump stall feature: when moisture is detected or when pump is blocked the pump will shut off, protecting the MiniRAE 2000 from potential damage
- Runs 10 hours with pump
- Only use Teflon tubing

MiniRAE 2000: Tubing



- Never Use Tygon tubing!
  - Absorbs chemicals like a "sponge"
  - Reduces ppm readout when chemicals exist
  - Causes "false positives" when chemicals don't exist
- Always use Teflon or similar non-reactive tubing
  - Will not absorb chemicals but might get coated
  - Clean with anhydrous methanol if it gets dirty

MiniRAE 2000: External Prefilter

- Use the white external prefilter in high moisture environments like rain and saturated headspace sampling.
- Replace filter when it looks very dirty or when it introduces PID drift.
- Replace filter when in pump alarm with the filter on and you can clear the pump alarm with the filter off.
- Consider eliminating external prefilter & internal C-filter when measuring high-boiling/flashpoint chemicals (phenols, CWA)

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MiniRAE 2000: Reliability

- Extremely rugged for extensive field use
- Weather Proof Case with gasketed case breaks
- Temperature range of 14ºF to 113ºF (-10ºC to 40ºC)
- 4-Way power: NiMH, Alkaline or run continuously on 110 VAC and 12 VDC
- RFI protection against radio interference
- Intrinsically safe: Class I, Division I, Groups A, B, C, D

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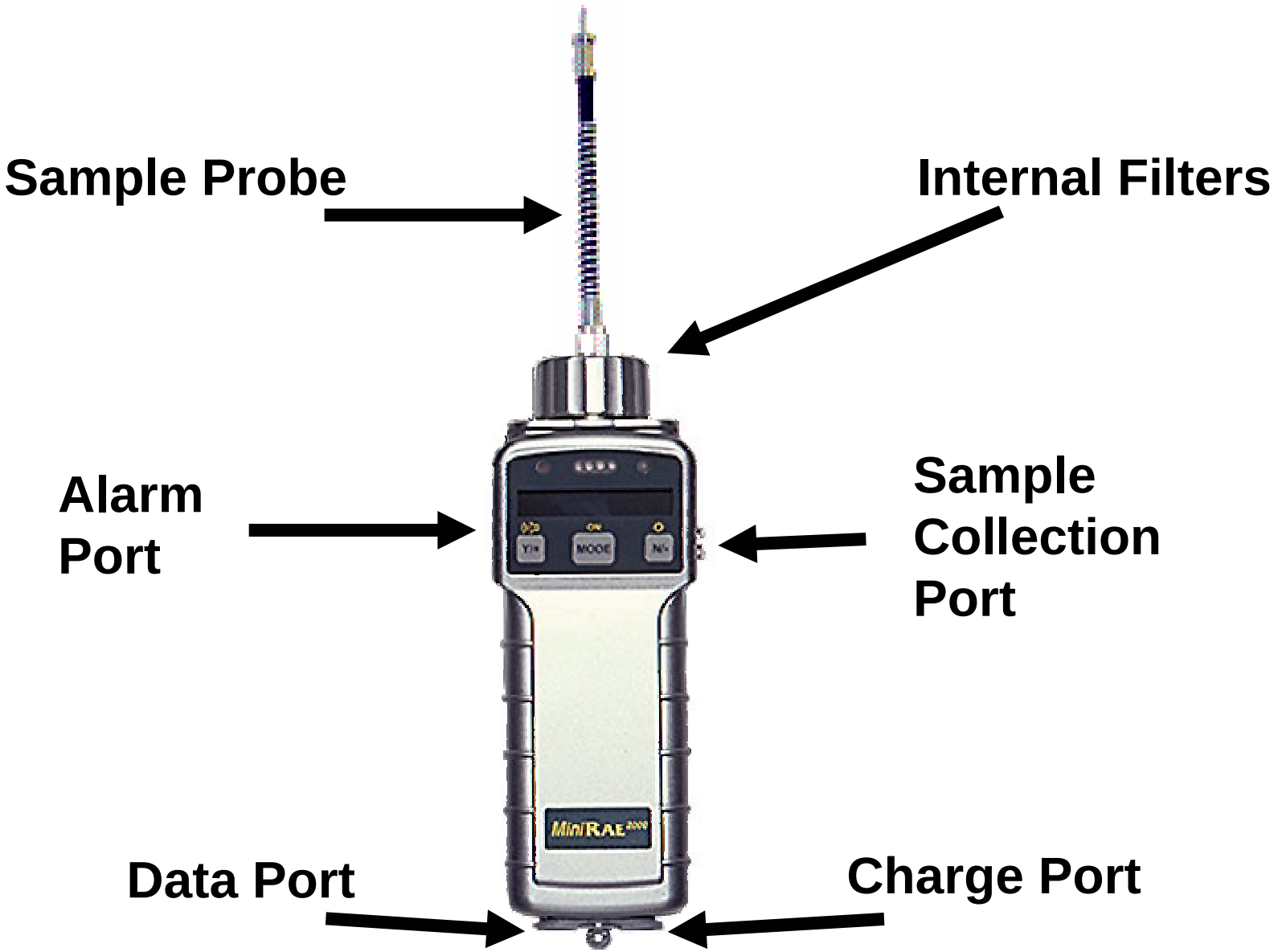
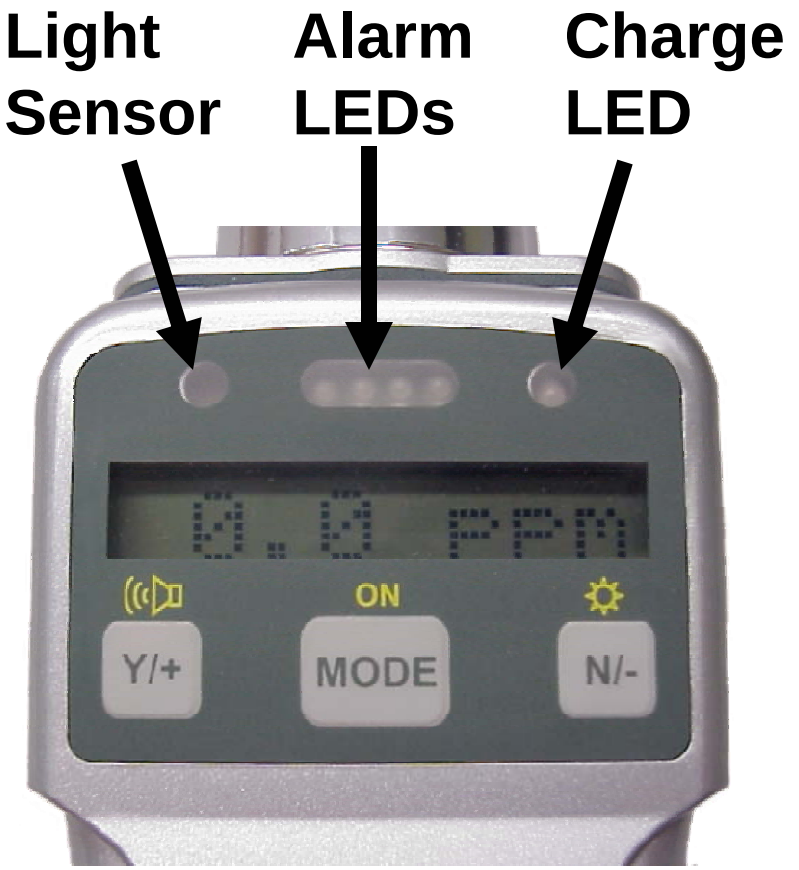
MiniRAE 2000: Physical Description



MiniRAE 2000: Faceplate

- Three buttons on a sealed membrane faceplate:
  - Y/+ (horn): clears & tests alarms
  - N/- (light): turns on manual backlight for 60 seconds
  - MODE (on)



Start-up: Turning On

- Unplug MiniRAE 2000/ppbRAE from charger
- Hold “MODE” Key to turn on
- Alarm will beep once
- Watch display screen for configuration messages.
- Warm-up will take approximately 30 seconds

The MiniRAE 2000 and ppbRAE have two main operating modes:

- **Survey Mode:** the factory default mode. After warm-up the pump shuts off and “Ready” is displayed.
- **Hygiene Mode:** for health and safety applications. After warm-up the meter samples continuously (similar to MultiRAE & AreaRAE).

MiniRAE 2000: Survey Mode

- A discrete sampling mode can easily start/stop datalogging for many points
- Perfect for drum or headspace sampling

Survey Displays

- **Ready/Instantaneous reading**
- **Stop?**
- **Avg:** shows average reading
- **Peak:** holds highest reading
- **Run Time:**
- **Battery Voltage & Shut-Off**
- **Date/Time/Temperature:** (MiniRAE 2000 Only)
- **Log On/Off?** Starts Manual Datalog
- **Cancel/Show Background:** ppbRAE only
- **PC comm?**

Advance to next screen with "Mode" key

Survey Mode: Ready Screen

Ready...

- After warm-up the pump will stop and display will read “Ready...” The MiniRAE is in stand-by mode ready for sampling.
- To start sampling push the “Y” key

Site ID = Drum 043

- The Site ID screen will increase by one digit every time that the MiniRAE is started and stopped in Survey Mode.

Survey Mode: Ready Screen

Gas = Isobutylene

- The “Gas =“ screen shows the Correction Factor (CF) Gas currently in use.
- Stop sampling in survey mode by pressing the mode key. The display will show “Stop ?”

Stop ?

- Pressing “Y” will stop sampling and return to the “Ready” screen.

0.0 Lamp

- “Lamp” display along with audible alarm indicates that PID lamp has failed to light
- If after a few minutes the “Lamp” message remains, turn off MiniRAE 2000 and restart
- If after restart “Lamp” message disappears, MiniRAE 2000 is ready for use
- If after restart “Lamp” message remains, the PID needs service

0.0 Pump

- Every time the MiniRAE 2000 is used it is important to check pump flow
- Block the probe inlet, the MiniRAE 2000 will go into alarm and display “Pump”
- Reset pump alarm by pressing the “Y” key
- If pump does not go into alarm, check for leaks in the probe or service pump

Survey Mode: Alarms

50.0 ppm

- The MiniRAE 2000 will beep twice per second when the low alarm has been exceeded.
- The MiniRAE 2000 will beep three times per second when the low alarm has been exceeded.
- Press “Y/+” key to clear if latching alarm.

Survey Mode: Peak Clearing

Peak 78.0 ppm

- Press the “Y” key once during the “Peak” display

Reset Peak?

- Pressing the “Y” key once during the “Reset Peak?” screen will clear the Peak Hold feature

Survey/Hygiene Mode: Datalog Indicator

0.0 L ppm

- The small “L” indicates that the MiniRAE 2000 is datalogging.

Survey/Hygiene Mode: Wireless Indicator

0.0 ^{T} ppm

- The small “T” indicates that the MiniRAE 2000 or ppbRAE is communicating to a host computer running ProRAE Remote software via the optional wireless RAELink modem.

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ppbRAE: Canceled Background

0.0 + ppm

- The ppbRAE has the ability to cancel the background without recalibration.
- When background is canceled, alarms are still based upon actual levels. Datalogging records actual levels.
- The small “+” indicates that the background has been canceled.

MiniRAE 2000: Hygiene Mode

- A continuous sampling mode for health & safety applications like confined space entry.
- Alarms are just like those on the MultiRAE, QRAE and ToxiRAE

Hygiene Displays

- ***Instantaneous reading***
- ***TWA:*** *Time Weighted Average*
- ***STEL:*** *Short Term Exposure Limit (displays "****" unit 15 minutes of run time have elapsed)*
- ***Peak:*** *holds highest reading*
- ***Run Time***
- ***Battery Voltage***
- ***Date/Time/Temperature:*** *(MiniRAE 2000 only)*
- ***Log On/Off?*** *Starts Manual Datalog*
- ***Cancel/Show Background:*** *(ppbRAE only)*
- ***Gas=*** *Correction Factor Gas (MiniRAE 2000 only)*
- ***PC comm?***

Advance to next screen with "Mode" key

Hygiene Mode: High Alarm

9999 High

- “High” display along with 3 beep audible alarm, flashing alarm LEDs and flashing display backlight indicates that the High alarm setpoint has been exceeded.
- Press “Y/+” key to clear if latching alarm.

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Hygiene Mode: Low Alarm

50.0 Low

- “Low” display along with 2 beep audible alarm, flashing alarm LEDs and flashing display backlight indicates that the Low alarm setpoint has been exceeded.
- Press “Y/+” key to clear if latching alarm.

Hygiene Mode: STEL Alarm

50.0 STEL

- “STEL” display along with 1 beep per second audible alarm, flashing alarm LEDs and flashing display backlight indicates that the Short Term Exposure alarm setpoint has been exceeded.
- This alarm will only clear if the average concentration dips below the STEL alarm setpoint or the PID is turned off.

Hygiene Mode: TWA Alarm

50.0 TWA

- "TWA" display along with 1 beep per second audible alarm, flashing alarm LEDs and flashing display backlight indicates that the Time Weighted Average alarm setpoint has been exceeded.
- This alarm will only clear if the average concentration dips below the TWA alarm setpoint or the PID is turned off.

Survey/Hygiene Mode: Pump Alarm

0.0 Pump

- “Pump” display along with 3 beep audible alarm indicates that pump has stopped due to line clog or a clogged sample port.
- Pump alarm is a latching alarm
- Press “Y/+” key to clear alarm and restart pump

Survey/Hygiene Mode: Battery Alarm

0.0 Bat

- A flashing “Bat” display along with a 1 beep alarm every 10 seconds indicates that the battery voltage is low and MiniRAE 2000 or ppbRAE will shut down in 20-30 minutes
- Full battery is over 4.8 volts
- Low Bat alarm at 4.4 volts
- Shut down at 4.2 volts

Getting Into Programming

- *Hold "MODE" and "N/-" keys for 5 sec. to get in Programming Mode*
- If MiniRAE 2000 asks a question "?"
  - Answer "Y" or "N"
- To Accept or Escape
  - Use "MODE" Key
  - repeatedly pushing the "MODE" key will always eventually return user to main display

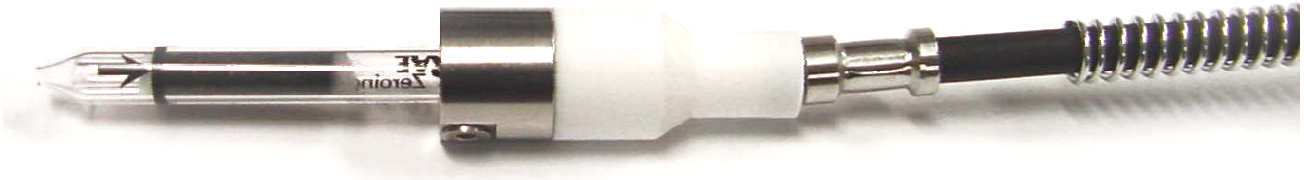
Programming Menus

- Calibrate/select Gas? *(alarms are silenced when in this menu)*
- Change alarm limits?
- View/change datalog?
- Change monitor setup?
- *Choose (Y) to accept or (N) to move on*

If you get lost, refer to Appendix A-1 in MiniRAE 2000 Manual

Calibrate Monitor?

- Fresh air/Zero cal?
  - *Make sure air is clean or use Charcoal filter*



  - *From v1.20 on, ppbRAEs do not use an electronic zero, so make sure to use a VOC Zeroing tube or Ultra-zero air*
  - *Refer to TN-150 for ppbRAE zeroing*
- Span cal?

Choose (Y) to accept or (N) to move on, MODE to escape

Basic Span Calibration

Cal gas = Isobutylene

Span value = 0100.0

- These two screens MUST match the type and concentration of cal gas used (MiniRAE is ppm, ppbRAE in ppb)
- If they do not, reset the MiniRAE to “Cal Memory 0” under the “Select Cal Memory” menu.

Apply gas now!

- Attach calibration hose to MiniRAE 2000 and make sure it is tight
- Turn on calibration gas and it will be automatically detected by the MiniRAE
- Follow instructions on screen
- Disconnect regulator when finished calibration

Basic Span Calibration

NO Gas!

- If you get this screen check for gas flow
- Try span calibration again after you have verified that the gas is correct and is flowing properly through the regulator
- Press [Y/+] if gas is OK to override the message and start the calibration

Matched Flow Calibration

For best accuracy a matched flow calibration is required!

- Use matched flow regulator
- Fill Tedlar bag with calibration gas and then draw down with MiniRAE 2000
- Use “T” or open tube connection with excess flow

ppbRAE always requires matched flow calibration!

Calibrate Monitor?

- Select cal memory?
  - *For most uses, leave on "Cal Memory 0", which is for Isobutylene calibration and optional correction factors*
  - *Changing the cal memory lets you calibrate using a gas other than Isobutylene*
  - *Lets you load 7 frequently used gases*
  - ***For advanced users only***

Calibrate Monitor?

- Change span value? (*NOTE: the value in the ppbRAE is in parts per billion not ppm! 10000 ppb = 10 ppm)*
- Modify cal memory?
  - *Changes Measurement Gas name, Correction Factor* ***AND ALARM POINT***
- Change correction factor?

Choose (Y) to accept or (N) to move on, MODE to escape

Change Alarm Limits?

- High limit?
- Low limit?
- STEL limit?
- TWA limit?
  - *These values are set to the default values for each gas selected under "Modify Cal Memory" but can be modified in these menus.*

Choose (Y) to accept or (N) to move on, MODE to escape

View/Change Datalog?

- Reset Peak? (not in ppbRAE)
- View data?
- Clear data?
- Change data period?
- Change average type?

Choose (Y) to accept or (N) to move on, MODE to escape

Change Monitor Setup?

- Change Op Mode? *Survey or Hygiene*
- Change Site ID?
- Change User ID?
- Change Alarm Mode? *Reset or Latched*
- Change User Mode? *Program/Display*
- Change Date?
- Change Time?

Choose (Y) to accept or (N) to move on, MODE to escape

Change Monitor Setup?

- Change Lamp? *(9.8, 10.6, 11.7 eV)*
  - *ppbRAE 10.6 eV only*
- Change Lamp Duty Cycle?
  - For self-cleaning during continuous operation
  - Pump runs then turns off, the lamp remains on to clean the sensor and lamp surface
  - When concentration exceeds 2 ppm the pump runs continuously until the concentration drops
  - Set to 30-100%. Time on in a 10 second interval. If set to 30% then on 3 seconds off 7 seconds. If set to 50% then on 5 off 5 seconds.
  - Will reduce loss of span sensitivity to <5% running 24/7 for over 90 days in backgrounds of <10 ppm (Refer to TN-165)

Change Monitor Setup?

- Change Unit? *(ppm or mg/m3)*
- Change Pump Speed? (ppbRAE only)
- Change Dilution Ratio? (M2K only)
- Change Output? *(DAC or Alarm)*
- Change DAC range? *(20, 200, 2000, 10k ppm)*
- Set Temperature Unit? (^{o}C or ^{o}F)

Choose (Y) to accept or (N) to move on, MODE to escape

Power Off

- Hold Mode Key for full 5 seconds
- Audible alarm will beep and display will read “Power-down in ...5 seconds”
- Leave MiniRAE 2000 on charger when not in use

Deep Discharge?

- Plug 12 VDC charger into charge port
- The screen will display “Deep Discharge?” for 10 sec.
  - ***Pushing “N/-” will initiate charging***
  - ***Don’t push anything and the unit will switch to charge in 10 sec.***
  - ***Full charge can take up to 8 hours***
  - ***Deep Discharge is not necessary for Nickel Metal Hydride batteries in MiniRAE 2000 or ppbRAE***

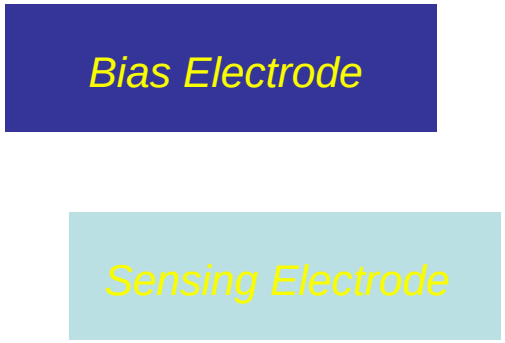
Patented RAE Systems Breakthrough!

- Lamp runs for 4 hours during charging
- Generates small amounts of ozone which helps to scrub sensor and lamp clean
- With probe removed user will see the sensor glow purple during charging
- Does not decrease lamp life
- Drastically increases PID stability and reduces requirement for cleaning (Refer to TN-165)

Maintenance

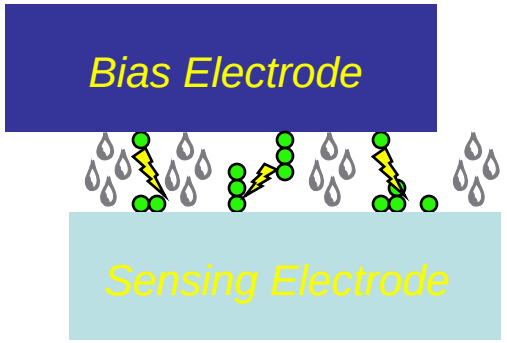
- Clean PID Lamp & Sensor
  - When display creeps upwards after good zero
  - When PID responds to moisture
  - When movement of PID results in response on display

Clean Sensor



No dirt build-up to foster a decrease in airspace resistance

Dirty Sensor



Dirt build-up absorbs water and breaks down airspace resistance leading to sensor "leakage" or moisture response

Maintenance

- Humidity Check
  - Cup hand over inlet or breathe into inlet for 10-20 seconds
  - Do not block flow
  - If M2K reads >2 ppm or ppbRAE reads >500 ppb, then the sensor needs cleaning

Maintenance

- How to Clean PID Sensor
  - Always clean sample probe and replace or clean filters FIRST! If PID holds a stable zero after this step then further cleaning may not be necessary
  - Use anhydrous methanol (Lamp cleaning solution)
  - Clean lamp face with lens tissue
  - Clean sensor by immersion in cleaning solution
  - Ultrasonic Cleaner (Jewelry cleaner) for 15 min. cleans much better than just dipping in
- Drying the PID Sensor
  - Let air dry overnight
  - Warm air (not hot) will speed drying

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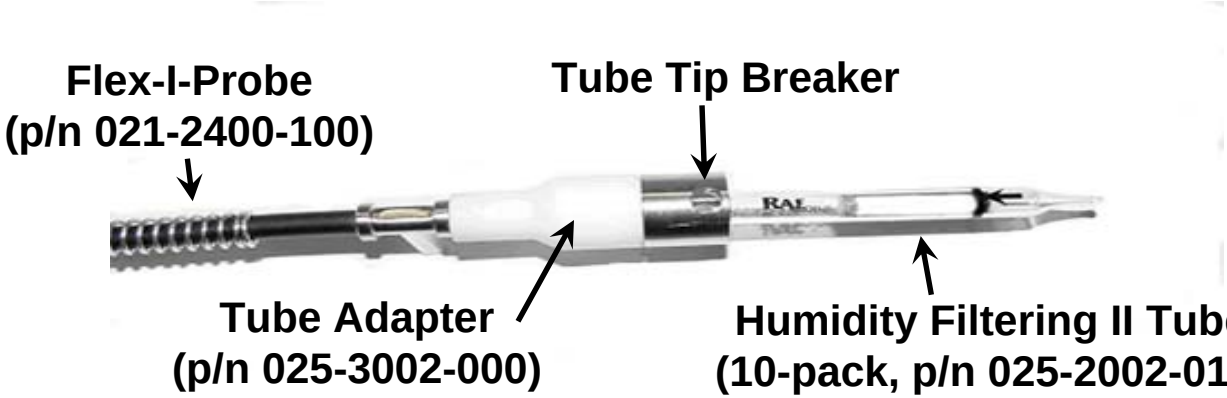
Humidity Filtering II Tubes



- Temporary relief for a dirty sensor
- Dries sample gas for about ½ hour
- Measure VOCs; multiple sample use OK
- Useful for gasoline and chlorinated solvents
- **CAUTION:** May cause low response for some compounds or at low temperature or concentration

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Configuration from Computer Datalogging

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Questions?

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