Using the UltraRAE Firmware 2.35
Training Agenda

• UltraRAE features
• Setting up the UltraRAE
• Turning on the UltraRAE
• Idle Operation
• RAE-Sep Tubes
• Prepping for a measurement
• Taking a measurement
• Alarm modes
• Datalogging
• Programming Mode
  – Calibration
  – Bar Code Reader
UltraRAE Features

Combination photo ionization detector (PID) with vapor specific filter tubes

- 0 – 2000 ppm VOCs
- 0 – 200 ppm Benzene
- 0 – 200 ppm Halocarbons
- 0 – 200 ppm Butadiene

PROTECTION THROUGH DETECTION
UltraRAE Features

UltraRAE Measures trace benzene in a complex fuel mixture
UltraRAE Features

- Bar-coded RAE-SEP™ tubes absorb interfering vapors and let the desired vapor through
- Measure total VOCs continuously or Benzene intermittently (1 minute sampling time)
- 400 cc/min pump draw makes remote sampling easy
- Sample draw at least 50 feet
- Pump stall feature: when moisture is detected or when pump is blocked the pump will shut off, protecting the UltraRAE from potential damage
- Runs 10 hours with pump
UltraRAE Features

• Temperature range of 32°F to 113°F (0°C to 40°C) – Must Adjust Sample time
• Rechargeable, snap-in, field-replaceable NiMH battery pack or alkaline
• RFI protection against radio interference
• Intrinsically safe: Class I, Division I, Groups A, B, C, D
Setting up the UltraRAE

- Regulator & Calibration Equipment
- Charger
- Calibration Gas
- Alkaline battery pack
- RAE Sep Tubes
- PID Cleaning Equipment & Charcoal Filters
- PROTECTION THROUGH DETECTION
Setting up the UltraRAE

Unpack the charger
Setting up the UltraRAE

Plug the charger into the wall and then into the UltraRAE

Charge the UltraRAE overnight
Setting up the UltraRAE

To install alkaline batteries, pull off the rubber boot and open the battery compartment.
Setting up the UltraRAE

Remove the battery
Setting up the UltraRAE

Unpack the alkaline battery pack and install the batteries
Setting up the UltraRAE

- Line up the battery pack
- Drop the battery pack in
- This shim fits snuggly above the battery pack
UltraRAE: Physical Description

- Probe
- Tube Tip Breaker & Reservoir
- Buzzer
- Data Port
- Tube Holder and Bar Code Reader
- Gas Exit Port
- Charger Port
UltraRAE: Physical Description

- Tip-Breaking Hole
- Tube Holder Base
- Probe
User Interface

• Three buttons on a sealed membrane faceplate
  - Y/+ (alarm): clears and tests alarms
  - N/- (light): turns on manual backlight for 60 seconds
  - MODE (on)
Turning On the UltraRAE

- Unplug UltraRAE 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 display will read **Ready**...
Calibrate the Monitor

- You must calibrate the UltraRAE before using it
Calibrate Monitor

- Each compound/tube type must be zeroed and calibrated independently
  - For example, for Benzene, a separate zero and Benzene span must be done
- Calibrating VOC with isobutylene DOES NOT calibrate the benzene or other channel
- MUST calibrate with the gas of interest
- No Correction Factors can be used
- Can use the same tube to zero and span
Calibrate Monitor

• To calibrate the monitor you will need:
  – Fresh air
  – Calibration gas corresponding to the tube type
  – Tedlar bag, open cup or demand flow regulator

• UltraRAE must use either a Tedlar bag, open cup, or demand flow regulator to calibrate

• Never calibrate with the cylinder with a fixed-flow regulator directly connected to the inlet of the instrument

• Never calibrate with a surrogate gas
Calibrate the Monitor

• Unpack the Tedlar bag, regulator and calibration gas
Calibrate the Monitor

• Unpack the charcoal filters
Calibrate the Monitor

• Unpack the charcoal filters and assemble parts as shown

Charcoal filter with VOC zeroing tube (for zeroing VOC Mode)

Effluent Scrubber with RAE Sep Tube
(To capture Benzene exiting unit while calibrating)
Calibrate the Monitor

• Before hooking up the Effluent Scrubber cut a 1.5-inch piece of tubing from the scrubber tubing.
Span Calibration

- Put this section of tubing on the inlet of the Tedlar bag
Span Calibration

- Fill Tedlar bag with span gas. **CAUTION**: Gas flow is 3 LPM – **DO NOT** connect directly to UltraRAE

Open stopper (push in)

Open gas valve 1/2 turn
Span Calibration

- Close the Tedlar bag by pulling the stopper out
Calibrate the Monitor

- To avoid breathing benzene while calibrating, attach the Effluent Scrubber before span calibration
  - Screw the effluent hose barb to the outlet port on the side of the unit
  - Attach the Charcoal Effluent Scrubber to the hose barb
Calibrate the Monitor

- Take out a RAE-Sep Tube
- Break both ends open using the tip breaker
Calibrate the Monitor

- Remove the probe
- Insert the tube with arrow pointing towards unit
- Give ¼ twist to seat the tube tightly
- Screw the probe back on
Programming Mode

• The UltraRAE must be in Programming Mode to calibrate

• Hold the MODE and N/- keys for 5 seconds to get into Programming Mode

• If UltraRAE asks a question:
  – Answer Y/+ or N/-
  – To accept or move on to the next option use the MODE key
  – Repeatedly pushing the MODE key will always eventually return the UltraRAE to the main display
Calibrate Monitor?

- The calibration menu is as follows:
  - Fresh air calib?
  - Span calib?
  - Modify span value?
Fresh Air Calibration

- You must be in a location with clean ambient air
- Otherwise hook the charcoal filter to the tip of the probe (more important for VOC than benzene)
Fresh Air Calibration

- Press MODE until Calibrate Monitor? appears
- Press Y/+ Display reads Fresh air calib? Press Y/+ 
- Confirm or correct the tube type and press Y/+ 
- Wait until display reads 0.0…Done!
- The next sub menu will display and read Span calib?
Span Calibration

- Connect the Tedlar bag to the inlet port of the UltraRAE and open the stopper.
Span Calibration

- Press Y/+  
- Confirm or correct the tube type and press Y/+  
- **Span gas = xx ppm?**  
- Confirm that your span gas is of the right concentration by comparing the displayed value to the value on the cylinder
Span Calibration

• Wait for the monitor to count down to zero
• Disconnect the Tedlar bag
• Press \[Y/+\] to calibrate to another tube type
• Press \[N/-\] or \[MODE\] to abort more calibrations and move on to the next menu item
Programming Mode

• You can also use the Programming Mode to:
  – Change the alarm limits
  – Change the site ID
  – Change user ID
  – Change lamp type
  – Change real time clock and more
Programming Menus

• Calibrate monitor?
• Change alarm limits?
• View or change datalog?
• Change monitor setup?
• Change sensor configuration?
Turning on the Bar Code Reader

- Press **MODE** until the display reads Monitor Setup?

- The monitor setup menu is as follows:
  - Change Site ID?
  - Change User ID?
  - Change User Mode?
  - Change Date?
  - Change Time?
  - Change Backlight?
  - Change DAC/Alarm output?
  - Change DAC range?
  - Change Bar Code Reader?
Turning on the Bar Code Reader

- Press \textbf{N/-} until the display reads \textbf{Change Bar Code Reader?}
- Press \textbf{Y/+}
- The display shows the current reader status.
- Press \textbf{N/-} to toggle between \textbf{On?} and \textbf{Off?}
- Toggle to desired status and press \textbf{MODE}
- Press \textbf{Y/+} to \textbf{Save?}
- When the bar code reader is on, the UltraRAE automatically identifies the tube type and applies the calibration and measurement time for the tube identified
Adjusting the Bar Code Reader

- Adjusting the Bar Code Reader may be necessary when:
  - A new type of tube is used
  - It gets dirty or misaligned with use
  - A new batch of tubes is used
Adjusting the Bar Code Reader

- Start the unit by pressing the \textit{Y/+} and \textit{MODE} keys simultaneously to enter Diagnostic Mode.
- The display shows raw sensor readings.
- Press \textit{MODE} until CCD = [value] is displayed.
- With no tube CCD should read 64. If not, the bar code reader is damaged or misaligned.
- Insert a VOC tube; CCD should read 59-61. If not, use the \textit{N/-} key to adjust down or \textit{Y/+} key to go up.
- Insert a benzene tube; CCD should read 47-52. If not, use the \textit{N/-} key to adjust down or \textit{Y/+} key to go up.
- See TN-134 for more details.
Idle Operation of the UltraRAE

Now the sensor and pump are turned off (idle) and you can cycle through the idle operation menu:

As you press

The display will read:

- Last = [tube type], [reading in ppm]
- Change current tube type?
- [Battery voltage]
- [Date], [time], [temperature]
- PC Comm?
- Ready…
Idle Operation of the UltraRAE

- Use the idle operation of the instrument to:
  - Prep the instrument for taking a measurement
  - Change current tube type
  - Check Battery voltage
  - Ready the instrument to communicate with the PC
UltraRAE 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 most chemicals
  - Clean with anhydrous methanol if it gets dirty
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.
- This filter can reduce the UltraRAE’s response to low vapor-pressure/high boiling compounds. When sampling for these chemicals it is recommended to periodically remove this filter to note a significant change in readings.
Preparing for a Measurement

• To take an accurate measurement
  – Read and understand the Data Sheet
  – Calibrate the instrument
  – Set the instrument to the correct type of gas (and tube)
  – Use the correct type of RAE-Sep tube
  – Set the Measure Wait Time to match the ambient temperature
  – The UltraRAE comes from the factory with the tube barcode reader turned OFF (This may change)
Preparing for a Measurement

- Make sure the instrument is set for the correct gas (and tube)
- Press the MODE key until the display reads:
  - Last = [tube type], [reading in ppm]
    - Displays the gas/tube type the UltraRAE is set-up for
    - Displays the last measurement
Preparing for a Measurement

• If the instrument is not set up for the correct gas/tube, you must change the tube type
• Press the **MODE** key until the display reads:
• Change current tube type?
  – Select from
    • Butadiene
    • VOCs
    • Benzene
    • Halocarbons
  – Select by pressing **N/-** until the desired tube type appears.
  – Press **Y/+** to select the tube type
UltraRAE Sep Tubes

• Four types of RAE Sep Tubes are available
  – Butadiene
  – VOCs
  – Benzene
  – Halocarbons

• Use a new tube for each measurement. Used tubes may cause low or high readings.
• Benzene and Butadiene require a 9.8 eV photoionization lamp
• Halocarbon requires an 11.7 eV lamp
• You MUST use the correct lamp to take an accurate, reliable measurement
Preparing for a Measurement

Check the Data Sheet for the correct Measure Wait Time and adjust in Programming Mode

For Benzene:

<table>
<thead>
<tr>
<th>Temp (°C)</th>
<th>2-10</th>
<th>10-15</th>
<th>15-30</th>
<th>30-40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temp (°F)</td>
<td>36-50</td>
<td>50-60</td>
<td>60-86</td>
<td>86-104</td>
</tr>
<tr>
<td>Measure Time (sec)</td>
<td>150</td>
<td>90</td>
<td>60</td>
<td>40</td>
</tr>
<tr>
<td>Sample Vol. (mL)</td>
<td>900</td>
<td>540</td>
<td>360</td>
<td>240</td>
</tr>
</tbody>
</table>
Inserting a Tube

• Press the MODE key until the display reads Ready…
• Break the ends off of a new tube using the tube tip breaker on the head of the instrument
• Insert the new tube with the arrow pointing into the instrument
• The display will then read Tube in... [tube type] ... Start?
Taking a Measurement

• Press \([\text{Y/+}]\) The display reads:
  – \textbf{Log on…} (if datalogging is turned on)
  – \textbf{Wait…} and counts down Measure Wait Time
    (60 sec for benzene; no count down for VOC)
• Display will alternate between \textbf{Done!} and
  the gas reading shown in ppm
• Press \([\text{Y/+}]\) display reads \textbf{Remove tube!}
• Remove tube, display reads \textbf{Ready…}
  repeat the process for a new
  measurement

\(\text{RAE SYSTEMS}\)
After a Measurement

• Be sure to **remove tube** after measurement
• Moisture gradually absorbing onto the tube can form a **corrosive liquid** that will **damage** the instrument if sucked in!!
• Do not re-use tubes because readings are not guaranteed
Alarms: Pre-set Alarm Limits

The UltraRAE has pre-set alarm limits:

<table>
<thead>
<tr>
<th>Cal Gas</th>
<th>Cal Span</th>
<th>Low Alarm</th>
<th>High Alarm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benzene</td>
<td>5.0 ppm</td>
<td>5.0 ppm</td>
<td>10.0 ppm</td>
</tr>
<tr>
<td>Butadiene</td>
<td>5.0 ppm</td>
<td>5.0 ppm</td>
<td>10.0 ppm</td>
</tr>
<tr>
<td>Halocarbon</td>
<td>10.0 ppm</td>
<td>10.0 ppm</td>
<td>25.0 ppm</td>
</tr>
<tr>
<td>VOC</td>
<td>100.0 ppm</td>
<td>50.0 ppm</td>
<td>100.0 ppm</td>
</tr>
</tbody>
</table>
Alarms: Lamp Alarm

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 UltraRAE and restart
• If after restart “Lamp” message disappears, UltraRAE is ready for use
• If after restart “Lamp” message remains, the PID needs service
Alarms: Pump Check

0.0 Pump

- Every time the UltraRAE is used it is important to check pump flow.
- With a tube in place in the tube holder, block the probe inlet, the UltraRAE 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.
UltraRAE Datalogging

- The UltraRAE is pre-set to datalogging ON if that option is included in the purchased features.
- Sample data contains:
  - Sample number, time, tube name and gas concentration.
- No TWA or STEL can be recorded because of intermittent sampling.
- The UltraRAE stores sample data in groups called “events”:
  - Stores start time, user ID, site ID, serial number, last calibration date, alarm limits.
  - A new events is created when the instrument is turned on, or a configuration parameter is changed (e.g., change tube type).
UltraRAE: 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

• 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 (an ultrasonic cleaner is required for cleaning)
UltraRAE: Maintenance

• Drying the PID Sensor
  – Let air dry overnight
  – Warm air (not hot) will speed drying