## Table of Contents

1.0 PURPOSE AND SCOPE ................................................................................................................. 3  
  1.1 Purpose .................................................................................................................................. 3  
  1.2 Scope .................................................................................................................................... 3  

2.0 INFORMATION .............................................................................................................................. 3  
  2.1 Terms and Definitions ............................................................................................................... 3  
  2.2 General Information ................................................................................................................ 4  

3.0 PRECAUTIONS AND LIMITATIONS ....................................................................................... 5  
  3.1 Personnel Safety ..................................................................................................................... 5  
  3.2 Equipment Safety ................................................................................................................... 5  
  3.3 Radiation and Contamination Control .................................................................................... 5  

4.0 PREREQUISITES .......................................................................................................................... 7  
  4.1 Special Tools, Equipment, and Supplies .................................................................................. 7  
  4.2 Performance Documents ......................................................................................................... 7  
  4.3 Field Preparation .................................................................................................................... 7  

---

**CHANGE HISTORY (≤ LAST 5 REV-MODS)**

<table>
<thead>
<tr>
<th>Rev-Mod</th>
<th>Release Date</th>
<th>Justification</th>
<th>Summary of Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-4</td>
<td>03/20/2018</td>
<td>IH Request</td>
<td>Modified Step 5.1.15 to direct IHTs to span instrument once every seven days as opposed to once per work shift. Also, added more chemical constituents’ sensors to the “Zeroing” activity level on page 11 of this procedure.</td>
</tr>
<tr>
<td>B-3</td>
<td>02/13/2018</td>
<td>IH Request</td>
<td>Minor changes inserted into procedure to reflect the in-field changes currently practiced by IHTs within the field in addition to spanning practices. Modified Records Section.</td>
</tr>
<tr>
<td>B-2</td>
<td>08/29/2017</td>
<td>IH Request</td>
<td>Modified “Radiological and Contamination Control” section of procedure in addition to modifying “CAUTION” statement. Provided additional information and more detail to the Operation of the Multi-Rae PRO in addition to alleviating grammatical errors.</td>
</tr>
<tr>
<td>B-1</td>
<td>10/12/2016</td>
<td>Inconsequential change request from Records Management</td>
<td>Update record section.</td>
</tr>
<tr>
<td>B-0</td>
<td>09/26/2016</td>
<td>Periodic Review</td>
<td>Added additional information to increase rigor of Industrial Hygiene Program.</td>
</tr>
</tbody>
</table>
5.0 PROCEDURE ........................................................................................................................................ 8
  5.1 Operation of Monitor in Search Mode .............................................................................................. 8
  5.2 Data Logging ..................................................................................................................................... 21
  5.3 Downloading Data ............................................................................................................................. 23
  5.4 Records ........................................................................................................................................... 25

Table 1 - Alarm Signal Summary ................................................................................................................. 26

Table 2 – Message Indications ..................................................................................................................... 27

Table 3 - Tubing Type, Length, and Inner Diameter .................................................................................... 28

Attachment 1 - Main Operations Menu ........................................................................................................ 29

Attachment 2 – Changing the Monitor Setup ............................................................................................ 30

Attachment 3 – Relative Humidity in Excess of Operating Range .............................................................. 31

Figure 1 - MultiRAE PRO ............................................................................................................................ 32

Figure 2 - MultiRAE PRO Datalog Screen .................................................................................................. 33

Figure 3 - Monitoring Screen in “Search” Mode ......................................................................................... 34
1.0 PURPOSE AND SCOPE

1.1 Purpose

The purpose of this procedure is to ensure the proper operation and use of the MultiRAE PRO volatile organic compound (VOC) and multi-gas monitor (model PGM-6248) in support of field monitoring performed in accordance with TF-OPS-IHT-007 and applicable industrial hygiene sampling plan.

1.2 Scope

The scope includes basic operation: zeroing, span testing, function checking, using the monitor in the “Search” mode, data logging, and downloading the information.

The monitor uses a photoionization detector (PID) to make direct measurements of airborne volatile organic compounds (and some inorganic compounds) at parts per billion (ppb) levels. It also uses combustible and electrochemical sensors to measure flammable and toxic gases and vapors. The monitor takes real-time measurements, logs data, and activates an alarm when measurements exceed preset limits. The MultiRAE PRO is equipped with a 10.6 eV lamp.

If this instrument is set up with other sensor configurations, the single sensor procedures for the zero, span and function testing shall apply to those sensors unless otherwise modified by this procedure.

2.0 INFORMATION

2.1 Terms and Definitions

- Zeroing tube - Contains activated charcoal and used as a substitute for zero air
- Zeroing charcoal filter – The manufacturer’s “Active Carbon Filter” contains activated charcoal and used as a substitute for zero air
2.2 General Information

The MultiRAE PRO should be operated within the following parameters:

- **Concentration range:** PID - 10 ppb to 2000 ppm, NH₃ - 0 to 100 ppm, CO - 0 to 500 ppm, LEL - 0 to 100%, O₂ - 0 to 30%, H₂S - 0 to 100 ppm, NO₂ - 0 to 20 ppm, NO - 0 to 250 ppm, SO₂ - 0 to 20 ppm
- **Temperature range:** -4 to 122 °F
- **Operating time:** > 12 hours
- **Charge time:** < 6 hours
- **Accuracy:** PID, H₂S, LEL, CO - ± 10%, O₂ - ± 8%, NH₃, NO₂, NO, SO₂ - ±15%
- **Pump speeds:** 200 to 500 milliliters (ml) per minute
- **Relative humidity:** 0 to 95% (non-condensing), refer to Attachment 3, “Relative Humidity in Excess of Operating Range”
- **Response time (T90):** PID - 15 seconds (sec), NH₃ - 60 sec, CO - 40 sec, O₂ - 15 sec, LEL - 15 sec, SO₂ - 75 sec, H₂S - 30 sec, NO₂ - 25 sec, NO - 20 sec
- **Startup:** ≈ 33 seconds (“Fast Startup” mode), without “Fast Startup” -up time is about 2 minutes
- **Intrinsically safe:** Class 1, Division 1, Groups A, B, C, D, T4; Class 2, Division 1, Groups E, F, G
- **Backlight –** press any button to activate.
- **Minimum 10% O₂ required for valid LEL reading.”**
3.0 PRECAUTIONS AND LIMITATIONS

3.1 Personnel Safety

3.1.1 Work under this procedure falls within the General Hazards Analysis (GHA).

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

3.2 Equipment Safety

CAUTION - Over-tightening the probe to find a flow fault may cause damage to the instrument. The instrument must be green tagged if the leak test problem is not readily corrected by a small amount of rotational pressure to the probe.

3.3 Radiation and Contamination Control

3.3.1 Planned work in radiological areas must be approved by Radiological Control personnel per the Radiological Risk Screening procedure TFC-ESHQ-RP-RWP-C-01.

3.3.1.1 When performed without a formal work package or approved procedure (i.e., Level 3 or 4 work), this procedure is limited to radiological areas and work activities permitted by a low risk Radiological Work Permit (RWP).

3.3.2 Filtration requirements for air monitoring equipment.

- A radiological particulate pre-filter (1~3 micron pore size, 25 mm diameter) when monitoring in a Contamination Area (CA), High Contamination Area (HCA), or Airborne Radioactivity Area (ARA), if instrument is capable. Not required, but encouraged in posted Radiological Buffer Areas (RBA).

- The “Bacterial Air Vent” filter ahead of the radiological filter when monitoring from unfiltered tank systems. This is a sealed filter that cannot be opened for radiological survey purposes, in this case, dispose of as low level radioactive material waste if needed.

- The use of parallel, sacrificial sorbent tubes or sample media, or multiple filters may be necessary depending on intended use and equipment parameters. A specific radiological Release Survey Plan (RSP) would need to address this allowance.
3.3 Radiation and Contamination Control (Cont.)

3.3.3 Before conducting monitoring, contact the responsible Radiological Control personnel for the facility or area to determine any specific survey or monitoring requirements.
- Pre, during, and post contamination survey requirements.
- Any applicable RSP’s for your specific equipment or task.
- Alternative survey or monitoring needs to support the radiological release survey process.

3.3.4 Comply with the requirements set forth by the RWP, HPT coverage, Release Survey Plan (RSP), and any other applicable procedures as determined above.

3.3.5 When exiting radiological areas where no HPT coverage was provided, inform the radiological control personnel of the use/history for the equipment being presented (e.g., only sampled air in the Contamination Area, No known history of contamination based on use, etc.) to aid them in properly evaluating the radiological release criteria needed.
4.0 PREREQUISITES

4.1 Special Tools, Equipment, and Supplies

The following supplies may be needed to perform this procedure:
- Zeroing tube/Charcoal filter
- Isobutylene, ammonia (NH₃) and Tri-Gas function test gas
- Additional sensors and gases may include nitric oxide (NO), nitrogen dioxide (NO₂), sulfur dioxide (SO₂), and hydrogen sulfide (H₂S).

4.2 Performance Documents

The following documents may be needed to perform this procedure:
- Site form A-6003-860, “IH DRI MONITORING FIELD LOG” or approved equivalent
- Site form A-6003-861, “IH DRI FUNCTIONAL TEST DATA” or approved equivalent

4.3 Field Preparation

Special Instruction

Function and span tests for NO, NO₂, SO₂, H₂S gases should be performed in a hood or well-ventilated area.

4.3.1 ENSURE a review of the following has been completed:
- Table(s)- 1, 2
- Attachment (s)- 1, 2, 3
- Figure (s)- 1, 2, 3

4.3.2 ENSURE a review of the applicable industrial hygiene sampling plan has been completed.

4.3.3 IF using tubing, ENSURE the appropriate diameter, type, and maximum length is used, as per Table 3 or IH direction.

4.3.4 WHEN monitoring for organic compounds,

    OR

    WHEN performing remote-monitoring, USE Teflon™-coated Tygon® tubing because some gases/vapors can be absorbed by uncoated plastic tubing and result in less accurate readings.
5.0 **PROCEDURE**

5.1 **Operation of Monitor in Search Mode**

**NOTE** - When battery is fully charged, LED lights glow green on the portable or desktop charging cradle. Three solid bars are displayed in the battery icon and “Fully Charged!”

- Steps in this section can be performed in any logical order. Sections may be performed sequentially, concurrently or any logical order.

5.1.1 **UNTIL** meter releases, **TILT** meter forward to remove from charging cradle, or unclip the travel charger from the base of the instrument.

5.1.2 **CHECK** maintenance calibration date on the sticker is current for the MultiRAE PRO monitor.

5.1.3 **IF** calibration is past due, **RETURN** instrument to equipment custodian with a completed green tag, “IH INSTRUMENT SERVICE TAG” (BT-6004-019), indicating “Scheduled Maintenance Calibration” is due.

5.1.4 **CHECK** the instrument sensor selection. The normal instrument setup is with LEL, oxygen, carbon monoxide, ammonia and VOC sensors. Other specialized sensor configurations may be used and will be covered by attached instructions if different zero, span and function methods are required.

**NOTE** - The default setup is for all installed sensors to be turned on. All sensors shall be ready for use unless specialized work plan instructions are provided by the IH sample plan.

- The “calibration” gas cylinder icon may appear in the shaded sensor identification bar of the main sampling screen when zeroing and spanning is required. The “✓” icon appears on the top of the screen left of “Search” when spanning is not required.

5.1.5 **PRESS AND HOLD** [MODE] button until the following conditions are met:

- Beep sound
- Display appears
- LED alarm lights turn on.

5.1.6 **CONFIRM** the following “Self Test”:

- Display shows the model number, sensors installed, etc.
- Cycles through start-up menu until “Ready…Start Sampling?” is displayed.
5.1 Operation of Monitor in Search Mode (Cont.)

5.1.7 PRESS [Y+] button to warm up the meter with pump running for a minimum of 30 minutes after the PID detector has been initialized.

NOTE - A fully charged battery pack should show a solid battery icon in the upper right hand corner and “Search” operation mode should be displayed at the top. If the “Hygiene mode” is used, nothing will appear in the top center of the screen.

5.1.8 ENSURE battery is fully charged.

5.1.8.1 CONFIRM the following:
- Battery pack shows a full battery icon in upper right hand corner.

5.1.9 IF battery needs charging, PERFORM the following using the cradle or travel charger:

5.1.9.1 UNTIL “Unit Off” is displayed, PRESS and HOLD [MODE] button (≈ 5 seconds).

5.1.9.2 WHEN using the desktop cradle charger, PLACE alignment pins on charging cradle into bottom of instrument.

5.1.9.3 PRESS DOWN gently until locked into place.

5.1.9.4 ENSURE AC adapter is plugged into the wall outlet.

5.1.9.5 CONNECT AC adapter into side of charging cradle.

5.1.9.6 CONFIRM the display indicates the following:
- LED’s on cradle glow red
- “Li-Ion Charging” is displayed

5.1.9.7 WHEN using the travel charger, use the indicator light to determine the front of the travel charger.

5.1.9.8 PRESS the unit onto the base of the instrument with the indicator light facing the same direction as the instrument screen until both charger clips securely engage.

5.1.9.9 FOLLOW step 5.1.9.4 to 5.1.9.6 to deliver power to the travel charger.

5.1.9.10 WHEN fully charged, GO TO Step 5.1.5.
5.1 Operation of Monitor in Search Mode (Cont.)

NOTE - “Search” mode allows the user to manually start and stop the monitoring operation. In the “Hygiene” mode, the sample pump will run continuously and the instrument must be turned off to go out of sample mode.

5.1.10 IF monitor is set up in “Search” operation mode, PRESS [Y/+] button at the “Ready…Start Sampling?” prompt to start instrument with the pump running.

Perform a Leak Check

5.1.11 HOLD finger over filter housing inlet for three to five seconds AND CONFIRM the following indicating a successful leak test:

- Monitor’s visual, audible, and vibration alarms activated (if enabled) sound
- An “x” appears in the center of the “pump” icon (at the top right hand of the display).

5.1.12 REMOVE finger from filter housing inlet AND PRESS [Y/+] button to deactivate any alarm and to continue pumping.

5.1.13 IF monitor does not leak check successfully, PERFORM the following:

5.1.13.1 CHECK filter housing.

5.1.13.2 CHECK AND TIGHTEN connections.

5.1.13.3 IF O-ring is damaged, REPLACE the O-ring at the bottom of the in-line filter housing.

CAUTION

Over tightening the probe may cause damage to the instrument. The instrument must be green tagged if the leak test problem is not readily corrected by a small amount of rotational pressure to the probe.

5.1.13.4 CHECK the tightness of the probe-to-instrument base.

5.1.13.5 GO TO Step 5.1.11 AND REPEAT leak check steps.
5.1 Operation of Monitor in Search Mode (Cont.)

5.1.14 IF monitor fails the leak test, RETURN instrument to equipment custodian with a completed green tag, i.e. “IH INSTRUMENT SERVICE TAG” (BT-6004-019).

Zeroing the NH₃, LEL, CO, NO, NO₂, SO₂, and H₂S Sensors (if required)

NOTE - Sensors have warmed up if a numerical reading is next to its name in the display. If it is not warmed up, three dashes “---” are seen next to the sensor that is not ready.

- Installed sensors should be zeroed and spanned at least once every seven (7) days, or more frequently as needed.

5.1.15 ENTER the programming mode screen by PRESSING AND HOLDING the [MODE] and [N/-] buttons together for about five seconds.

5.1.16 PRESS the [Y/+] button to “Select” the “Calibration” submenu.

5.1.17 ENSURE “Fresh Air” display is HIGHLIGHTED.

5.1.17.1 PRESS [Y/+] button to select it.

5.1.17.2 PRESS [Y/+] button to “Start”

NOTE - “Calibrating” and a 60 second countdown appears. The sensors that zero successfully show “Pass” and their current reading which should be “0” for all sensors except the O₂ sensor which will read approximately “20.9%.”

5.1.18 IF a sensor fails to zero, TROUBLESHOOT AND GO TO Step 5.1.15 AND REPEAT the zeroing sequence.
5.1 Operation of Monitor in Search Mode (Cont.)

5.1.19 IF sensor fails the zero test, RETURN meter to equipment custodian with a completed green tag “IH INSTRUMENT SERVICE TAG” (BT-6004-019) indicating it “Will Not Zero.”

NOTE - The VOC sensor completes an initial room air zero but is zeroed again with the “Active Carbon Filter”, or equivalent to achieve the lower detection limit in the Single Sensor Zero actions.

- Zeroing the PID sensor is required prior to each day’s use.
- The zeroing charcoal filter that comes with the MultiRAE PRO has a maximum zeroing capacity of 20 times.

Zeroing the PID (VOC) Sensor

5.1.20 USING one of the following to ZERO the PID sensor:
- zeroing tube
- zeroing charcoal filter (“Active Carbon Filter”)

NOTE - The zeroing charcoal filter that comes with the MultiRAE PRO has a maximum zeroing capacity of 20 times.

5.1.21 PRESS [N/-] button, until “Single Sensor Zero” is highlighted THEN

PRESS [Y/+] button.

5.1.22 PRESS the [N/-] button repeatedly until the VOC sensor is highlighted.

5.1.23 ATTACH MultiRAE PRO inlet to either of the following:
- zeroing tube (arrow pointed to the pump inlet)
- zeroing charcoal filter (cap off and arrow pointed toward pump inlet)

5.1.24 PRESS [Y/+] button twice.

NOTE - “Zeroing” appears in the display along with the 60 second countdown. If zeroing is successful, “Zero Calibration Passed” will be displayed and “0 ppb” concentration will be shown.

5.1.25 WHEN “Zero Calibration Passed” appears, REMOVE zeroing test equipment.

5.1.26 IF using a charcoal zeroing filter, CHECK one of the square boxes to indicate its use.
5.1 Operation of Monitor in Search Mode (Cont.)

Confirming and Changing Span Gas Values

NOTE - Only the PID sensor must be zeroed, spanned, and function tested prior to each day’s use to ensure optimum stability.

5.1.27 PRESS [MODE] button once, to go back to the “Calibration” menu.

5.1.28 PRESS the [N/-] button repeatedly until “Change Span Value” is highlighted.

5.1.29 PRESS [Y/+] button to “Select” this command.

5.1.30 ENSURE “LEL” is highlighted.

5.1.31 PRESS [Y/+] button AND

CONFIRM concentration matches span gas.

5.1.32 IF correct, PRESS [MODE] button to advance to next sensor.

5.1.33 IF incorrect, MATCH the span gas concentration by pressing the following:
- [N/-] button to change the digit location
- [Y/+] button to change digit value.

5.1.34 WHEN done, SELECT [MODE] button THEN

PRESS [Y/+] button to “Save”, or [N/-] button to “Undo.”

5.1.35 UNTIL sensors’ span values match their corresponding gas cylinder concentration,

REPEAT Steps 5.1.31 through 5.1.33 for all applicable sensors.

5.1.36 WHEN span values are correct, PRESS [MODE] button.
5.1 Operation of Monitor in Search Mode (Cont.)

**Span Testing**

5.1.37 PRESS [N/-] button until “Single Sensor Span” is highlighted.

5.1.38 CONNECT isobutylene gas cylinder tubing to inlet of the MultiRAE PRO.

**NOTE** - Flow sensitive regulators on the calibration gas cylinders may start the flow of gas automatically.

5.1.38.1 PRESS [Y/+] button to select “Single Sensor Span.”

5.1.38.2 PRESS the [N/-] button to highlight the “VOC” sensor.

5.1.38.3 PRESS the [Y/+] button to select.

5.1.38.4 PRESS [Y/+] button to “Start.”

5.1.38.5 ALLOW the full 60 second span time to elapse.

5.1.39 IF successful, CONFIRM “Span Calibration Passed” is displayed under the VOC sensor along with the span value **AND**

GO TO Step 5.1.43.

5.1.40 IF “Span Calibration Failed” is displayed, **ENSURE** isobutylene gas is applied to the inlet of the MultiRAE PRO.

5.1.41 **TROUBLE SHOOT AND**

GO TO Step 5.1.38.1 and repeat the span sequence.

5.1.42 IF unsuccessful, RETURN meter to equipment custodian with a completed green tag “IH INSTRUMENT SERVICE TAG” (BT-6004-019) indicating it “Calibration Failure.”

5.1.43 **DISCONNECT** isobutylene gas cylinder.
5.1 Operation of Monitor in Search Mode (Cont.)

5.1.44 CONNECT ammonia gas cylinder tubing to inlet of the MultiRAE PRO.

NOTE - Flow sensitive regulators on the calibration gas cylinders may start the flow of gas automatically.

5.1.44.1 PRESS [N/-] button until “NH3” is highlighted.

5.1.44.2 PRESS [Y/+] button to select this sensor.

5.1.44.3 ALLOW the full 180 second span time to elapse.

5.1.45 IF successful, CONFIRM “Span Calibration Passed” is displayed under the ammonia sensor along with the span value AND

GO TO Step 5.1.49.

5.1.46 IF “Span Calibration Failed” is displayed, ENSURE ammonia is applied to inlet of the MultiRAE PRO.

5.1.47 TROUBLE SHOOT AND

GO TO Step 5.1.44.

5.1.48 IF unsuccessful, RETURN meter to equipment custodian with a completed green tag, “IH INSTRUMENT SERVICE TAG” (BT-6004-019) indicating “Calibration Failure.”

5.1.49 DISCONNECT ammonia gas cylinder.
5.1 Operation of Monitor in Search Mode (Cont.)

5.1.50 PRESS the “MODE” key AND

PRESS [N/-] to highlight “Multi Sensor Span” from the main calibration menu.

5.1.51 CONNECT tri-gas cylinder tubing to inlet of the MultiRAE PRO.

NOTE - Flow sensitive regulators on the calibration gas cylinders may start the flow of gas automatically.

5.1.51.1 PRESS [Y/+] button to select “Multi Sensor Span” for the “LEL, CO and OXY” sensors.

5.1.51.2 PRESS [Y/+] button to “Start” if the countdown window does not appear after a few seconds.

5.1.51.3 ALLOW the full 60 second span time to elapse.

5.1.52 IF calibration is successful, CONFIRM “Pass” is displayed under:

- “LEL”, ”CO”, and “OXY” sensors
- Span values,

AND

GO TO Step 5.1.56.

5.1.53 IF “Fail” is displayed, ENSURE the tri-gas is applied to inlet of the MultiRAE PRO. PRESS “No” to the “Calibrate” NH₃ sensor command.

5.1.54 PRESS [N/-] key to highlight “Multi Sensor Span.”

5.1.54.1 TROUBLESHOOT AND REPEAT steps 5.1.51 through 5.1.52.

5.1.55 IF unsuccessful, RETURN meter to equipment custodian with a completed green tag “IH INSTRUMENT SERVICE TAG” (BT-6004-019) indicating “Calibration Failure.”

5.1.56 DISCONNECT the tri-gas cylinder.
5.1 Operation of Monitor in Search Mode (Cont.)

NOTE - Ammonia and VOC sensors have already been completed in the previous single sensor sequences.

5.1.57 PRESS [N/-] key twice to bypass the multi-calibration for NH3 and VOC and return to the main calibration menu

5.1.58 PRESS [MODE] button twice to return to the “Ready Start Sampling?” screen

Function Check the Sensors

5.1.59 PRESS the [Y/+] button from the “Ready… Start Sampling?” screen.

5.1.60 CHECK the readings are as follows, before function testing begins.
   • <300 ppb VOC
   • 0 ppm CO
   • 0 ppm NH3
   • ≈ 20.9% OXY
   • 0% LEL.

5.1.61 ATTACH appropriate gas cylinder tubing to the inlet of the MultiRAE PRO

5.1.62 WAIT for the sensors to respond fully to the known gas concentration before recording the reading.

5.1.63 CONFIRM readings are within the tolerance values listed.

5.1.64 IF concentrations are within tolerance, RECORD readings in the Site Wide Industrial Hygiene Database (SWIHD).

5.1.65 DISCONNECT tubing.

5.1.65.1 REPEAT steps 5.1.61 through 5.1.64 for all installed sensors.

5.1.65.2 ENSURE sensors return to the normal background concentration before proceeding with each sensor.
5.1 Operation of Monitor in Search Mode (Cont.)

5.1.66 IF not within the acceptable range for each sensor, REPEAT steps 5.1.59 through 5.1.65 again

OR

5.1.66.1 TROUBLESHOOT AND PERFORM zero, span test and function check as described in previous steps.

5.1.66.2 IF not within the acceptable range after the performance of an additional function check, RETURN meter to equipment custodian with a completed green tag “IH INSTRUMENT SERVICE TAG” (BT-6004-019) indicating “Function Check Failure.”

Clear Peak Readings From Memory

NOTE - MultiRAE PRO will alarm if the pump is stopped while the lamp is running.

5.1.67 PRESS [N/-] button until “Peak” appears at top of screen.

5.1.68 PRESS [Y/+] button to select “Clear.”

5.1.68.1 PRESS [Y/+] button to clear peaks at “Clear Peak and Minimum Values?” screen

5.1.69 PRESS [N/-] key until “Stop Sampling?” appears.

5.1.69.1 PRESS [Y/+] button to Stop.
5.1 Operation of Monitor in Search Mode (Cont.)

**Initiate a New Measurement Cycle**

5.1.70 **PRESS** [Y/+] button when “Ready…Start Sampling?” is displayed to initiate monitoring.

**Perform Monitoring**

5.1.71 **PERFORM** monitoring in accordance with TF-OPS-IHT-007, industrial hygiene sampling plan, work package, and/or IH direction.

5.1.72 **IF** performing source monitoring and an action level(s) is reached, **DO NOT** go immediately to alarm response contained in 5.1.74. Instead, switch to breathing zone monitoring.

5.1.73 If action level(s) are still exceeded, proceed to alarm response steps contained in 5.1.74.

5.1.74 **IF** an instrument reading exceeds action limits as contained within the IHSP or as directed by IH:

5.1.74.1 **STOP** and **PLACE** work in safe configuration.

5.1.74.2 **NOTIFY** workers to move upwind AND **CONTACT** FWS and cognizant IH.

5.1.74.3 **EVALUATE** the source of the alarm.

5.1.74.4 **FOLLOW** corrective actions given by IH or contained within Industrial Hygiene Sample Plan

5.1.74.5 **CLEAR AND RESET** alarms before allowing workers to resume work.

5.1.74.6 **IF** additional information is needed, **REFER** to instrument-specific procedures and operation manuals.

**NOTE** - MultiRAE PRO will alarm if the pump is stopped while the lamp is running.

5.1.75 **PRESS** [N/-] button to advance to the “Stop Sampling?” screen.

5.1.75.1 **PRESS** [Y/+] button to stop the measurement cycle.

5.1.76 **RECORD** all readings into the Site Wide Industrial Hygiene Database (SWIHID).
5.1 Operation of Monitor in Search Mode (Cont.)

Perform Post Monitoring Activities

5.1.77 PRESS [N/-] button to cycle through main menu to view measurement peaks, minimums, and averages.

NOTE - The STEL and TWA values will appear only when the instrument is in the “Hygiene” mode.

5.1.78 PERFORM post function checks of the sensors by following Steps 5.1.59 through 5.1.63.

5.1.79 RECORD readings and post function check results in the Site Wide Industrial Hygiene Database (SWIHD).

5.1.80 PROVIDE completed field documentation to the Project Industrial Hygienist within 2 working days.

5.1.81 UNTIL “Unit Off” is displayed, PRESS AND HOLD [MODE] button (≥ 5 seconds).
5.2 Data Logging

NOTE - A “floppy disc” icon will appear in the upper right-hand corner of the screen when data logging is enabled.

5.2.1 PRESS AND HOLD [MODE] and [N/-] buttons for about 3 seconds from “Ready - Start Sampling?” screen to enter the program menu.

5.2.2 PRESS the [N/-] button until “Datalog” is displayed AND PRESS the [Y/+] button to select.

NOTE - Cleared data cannot be recovered once it is deleted.

5.2.3 PRESS the [Y/+] button to select “Clear Datalog” AND PRESS [Y/+] button to clear the data.

5.2.4 VERIFY “Datalog Interval” is highlighted AND PRESS [Y/+] button.

5.2.5 SET “Datalog Interval” per one of the following:
- [Y/+] button to change the digit value
- [N/-] button to advance to the next digit.

NOTE - If no changes are made, the previously set value is saved.

- The typical data log intervals are from 5 to 60 seconds. Other intervals may be specified for different projects as needed by Industrial Hygiene. Intervals can be set from 1 to 3600 seconds.

5.2.6 PRESS the [MODE] button until “Save” and “Undo” is displayed AND PRESS the [Y/+] button to save changes or [N/-] key to cancel changes.

5.2.7 PRESS the [Y/+] button to enter the “Sensor Selection” options.

5.2.8 PRESS the [N/-] button to scroll through sensors.

5.2.9 PRESS the [Y/+] button to “Toggle” the “X” to select the sensor to data log.

5.2.10 ENSURE appropriate sensors are checked. IF a sensor is not chosen to data log, PRESS the [Y/+] button to select once highlighted.

5.2.11 PRESS the [MODE] button when finished and then “Save” and “Undo” is displayed, PRESS the [Y/+] button to save changes or [N/-] button to cancel changes.
5.2 Data Logging (Cont.)

5.2.1 PRESS [Y/+] to enter “Data Selection” options.

5.2.2 ENSURE all data types are selected.

5.2.2.1 IF a selection is not required, PRESS the [Y/+] button to select once highlighted.

5.2.3 PRESS the [MODE] button until “Save” and “Undo” is displayed AND PRESS the [Y/+] button to save changes or [N/-] button to cancel changes.

NOTE - The default is for all data types to be included in data logging.

5.2.4 VERIFY “Data Log Type” type is highlighted AND PRESS [Y/+] key.

5.2.5 PRESS [N/-] button to scroll through data log type choices.

5.2.6 PRESS the [Y/+] button to SELECT “Manual.”

NOTE - The default is for “Data Log Type” to be “Manual” unless otherwise specified by Industrial Hygiene.

5.2.7 IF changes were made, PRESS [Y/+] button to “Save” or [N/-] key to cancel changes.

5.2.8 ENSURE “Memory Full Action” is highlighted AND PRESS the [Y/+] button.

5.2.9 PRESS the [N/-] button to select “Stop When Full.” AND PRESS the [Y/+] key.

5.2.10 PRESS the [Y/+] button to “Save” or [N/-] key to cancel changes.

5.2.11 PRESS the [MODE] button twice to return to “Ready... Start Sampling?” screen.

5.2.12 PRESS the [Y/+] button to start sampling.
5.3 Downloading Data

5.3.1 SET the MultiRAE PRO in the desk top charging cradle, or attach the travel charger unit.

5.3.2 ENSURE data cable from the USB port of the PC is connected to the communication port of the charging cradle or the travel charger unit.

5.3.3 PRESS the [N/-] button repeatedly until “Enter Communications Mode?” is displayed \textbf{AND}

PRESS the [Y/+] key.

\textbf{NOTE} - “Ready to Communicate With Computer” should be displayed.

5.3.4 VERIFY “PC” is highlighted \textbf{AND}

PRESS the [Y/+] button.

5.3.5 START “ProRAE Studio II” software on the PC.

5.3.6 SELECT “Administrator” at log in screen \textbf{AND}

TYPE in “rae.”

5.3.7 PRESS “OK” key.

5.3.8 SELECT the “A” magnifier lens icon at the computer toolbar to automatically detect the attached instrument.

5.3.9 \textbf{HIGHLIGHT} MultiRAE PRO that is attached to the PC \textbf{AND}

\textbf{CHOOSE} “Select.”

5.3.10 SELECT “Datalog” from menu list on left side of computer screen.

\textbf{NOTE} - Icon functions appear as the cursor is placed over the function symbols.

5.3.11 SELECT “Download All Data” icon in the toolbar under “Datalog (i.e., 3 arrows pointing down).
5.3 Downloading Data (Cont.)

5.3.12 **ENSURE** download is complete by noting events captured in the left-hand column.

5.3.13 **VIEW** data by clicking on event number by date and time.

5.3.14 **SAVE** data by clicking on the “File” menu in the upper left corner of the screen **AND**

**SELECT** “Save as.”

5.3.14.1 **CHOOSE** the drive to save the file **AND** **NAME** the file in the “File Name” box

5.3.14.2 **CHOOSE** “Open”, then “Save.”

5.3.14.3 **SELECT** “Save as.

5.3.15 When finished saving data, **SELECT** “x” in the toolbar.

5.3.16 **WHEN** prompted, “Do you want to delete all datalog?” **PRESS** “Yes.”

5.3.17 **PRESS** [Y/+] on the instrument to end the connection to the PC.

5.3.18 **PRESS AND HOLD** [MODE] button until ”Unit Off” appears.

5.3.19 **UNPLUG** the USB cable from the charger.
5.4 Records

Data and attachments are entered into the Site-Wide Industrial Hygiene Database and when reviewed and completed by the Industrial Hygienist, are uploaded to IDMS via an automated interface. The record custodian identified in the Company Level Records Inventory and Disposition Schedule (RIDS) is responsible for record retention in accordance with TFC-BSM-IRM_DC-C-02.
Table 1 - Alarm Signal Summary

The instrument constantly monitors and updates the gas concentration and compares it with the programmed alarm limits (time-weighted average, short-term exposure limit, low, and high). When the concentration exceeds any of the preset limits, a loud buzzer, vibration, and a red flashing light are activated immediately (if enabled). The monitor also alarms during battery, lamp, or pump failure.

<table>
<thead>
<tr>
<th>Alarm Type</th>
<th>Buzzer &amp; LED</th>
<th>Display</th>
<th>Vibration</th>
<th>Reading</th>
<th>Backlight</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Super Alarm</td>
<td>4 beeps/sec</td>
<td>“Super Alarm” Screen</td>
<td>400ms</td>
<td>-</td>
<td>ON</td>
<td>Highest</td>
</tr>
<tr>
<td>Man Down Alarm</td>
<td>3 beeps/sec</td>
<td>“Man Down Alarm” screen</td>
<td>400ms</td>
<td>-</td>
<td>ON</td>
<td></td>
</tr>
<tr>
<td>Man Down Warning</td>
<td>2 beeps/sec</td>
<td>“Are you OK?” screen</td>
<td>400ms</td>
<td>-</td>
<td>ON</td>
<td></td>
</tr>
<tr>
<td>Fail</td>
<td>3 beeps/sec</td>
<td>“Lamp” at PID location</td>
<td>400ms</td>
<td>Blinking reading</td>
<td>ON</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>“Off” at LEL location</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pump</td>
<td>3 beeps/sec</td>
<td>Blinking pump symbol</td>
<td>400ms</td>
<td>Reading</td>
<td>ON</td>
<td></td>
</tr>
<tr>
<td>Max</td>
<td>3 beeps/sec</td>
<td>“Max” at sensor location</td>
<td>400ms</td>
<td>Blinking reading</td>
<td>ON</td>
<td></td>
</tr>
<tr>
<td>Over Range</td>
<td>3 beeps/sec</td>
<td>“Over” at sensor location</td>
<td>400ms</td>
<td>Blinking 9999</td>
<td>ON</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geiger Counter-style Alarm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G7</td>
<td>7 beeps</td>
<td>“Neg” at sensor location</td>
<td>400ms</td>
<td>0</td>
<td>ON</td>
<td></td>
</tr>
<tr>
<td>G6</td>
<td>6 beeps</td>
<td>“Stel” at sensor location</td>
<td>400ms</td>
<td>Reading</td>
<td>ON</td>
<td></td>
</tr>
<tr>
<td>G5</td>
<td>5 beeps</td>
<td>“TWA” at sensor location</td>
<td>400ms</td>
<td>Reading</td>
<td>ON</td>
<td></td>
</tr>
<tr>
<td>G4</td>
<td>4 beeps</td>
<td>“Bump” at sensor location</td>
<td>400ms</td>
<td>Reading</td>
<td>ON</td>
<td></td>
</tr>
<tr>
<td>G3</td>
<td>3 beeps</td>
<td>Blinking battery symbol</td>
<td>400ms</td>
<td>Reading</td>
<td>ON</td>
<td></td>
</tr>
<tr>
<td>G2</td>
<td>2 beeps</td>
<td>Blinking RF offline symbol</td>
<td>400ms</td>
<td>Reading</td>
<td>ON</td>
<td></td>
</tr>
<tr>
<td>G1</td>
<td>1 beep</td>
<td>“Full” bottle symbol</td>
<td>-</td>
<td>Reading</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>“Empty” bottle symbol</td>
<td>-</td>
<td>Reading</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td>1 beep/sec</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STEL</td>
<td>1 beep/sec</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TWA</td>
<td>1 beep/sec</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calibration Fail</td>
<td>1 beep/sec</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bump Fail</td>
<td>1 beep/sec</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Datalog Full</td>
<td>1 beep/sec</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calibration Required</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Battery</td>
<td>1 beep/min</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nwk Lost</td>
<td>1 beep/min</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nwk Joined</td>
<td>1 beep</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comfort Beep</td>
<td>1 beep/min</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Key:
STEL = Short-Term Exposure Limit
TWA = Time-Weighted Average
Nwk = Network
## Table 2 – Message Indications

<table>
<thead>
<tr>
<th>Message</th>
<th>Condition</th>
<th>Alarm Indications</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Gas exceeds “High Alarm” limit</td>
<td>3 beeps/flashes per second</td>
</tr>
<tr>
<td>OVR</td>
<td>Gas exceeds sensor’s measurement range</td>
<td>3 beeps/flashes per second</td>
</tr>
<tr>
<td>MAX</td>
<td>Gas exceeds electronic circuit’s maximum range</td>
<td>3 beeps/flashes per second</td>
</tr>
<tr>
<td>LOW</td>
<td>Gas exceeds “Low Alarm” limit*</td>
<td>3 beeps/flashes per second</td>
</tr>
<tr>
<td>TWA</td>
<td>Gas exceeds “TWA” limit</td>
<td>3 beeps/flashes per second</td>
</tr>
<tr>
<td>STEL</td>
<td>Gas exceeds “STEL” limit</td>
<td>3 beeps/flashes per second</td>
</tr>
<tr>
<td>Crossed pump icon flashes</td>
<td>Inlet blocked or pump failure</td>
<td>3 beeps/flashes per second</td>
</tr>
<tr>
<td>“Lamp” flashes</td>
<td>PID lamp failure</td>
<td>3 beeps/flashes per second</td>
</tr>
<tr>
<td>Empty battery icon flashes</td>
<td>Low Battery</td>
<td>3 beeps/flashes per second</td>
</tr>
<tr>
<td>CAL</td>
<td>Calibration failed, or needs calibration</td>
<td>3 beeps/flashes per second</td>
</tr>
<tr>
<td>NEG</td>
<td>True sensor reading is below zero, even though a zero reading is shown for the sensor</td>
<td>3 beeps/flashes per second</td>
</tr>
</tbody>
</table>
### Table 3 - Tubing Type, Length, and Inner Diameter

<table>
<thead>
<tr>
<th>Tubing Type</th>
<th>Nominal</th>
<th>Volume</th>
<th>Delay Time @ 300 cc/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>UltraRae/MultiRae® 300 cc/min</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Tubing Type</strong></td>
<td><strong>in OD</strong></td>
<td><strong>Nominal</strong></td>
<td><strong>cm</strong></td>
</tr>
<tr>
<td>Teflon Extension Probe</td>
<td>⅛</td>
<td>0.125</td>
<td>0.063</td>
</tr>
<tr>
<td>Teflon Mini/UltraRAE</td>
<td>⅛</td>
<td>0.157</td>
<td>0.110</td>
</tr>
<tr>
<td>Metal or Teflon</td>
<td>⅛</td>
<td>0.188</td>
<td>0.127</td>
</tr>
<tr>
<td>Metal or Teflon</td>
<td>⅛</td>
<td>0.250</td>
<td>0.190</td>
</tr>
<tr>
<td>Metal or Teflon</td>
<td>⅛</td>
<td>0.313</td>
<td>0.248</td>
</tr>
<tr>
<td>Metal or Teflon</td>
<td>⅛</td>
<td>0.375</td>
<td>0.311</td>
</tr>
<tr>
<td>Metal or Teflon</td>
<td>⅛</td>
<td>0.500</td>
<td>0.436</td>
</tr>
</tbody>
</table>

*Correct for decrease in flow rate due to pressure drop in tubing.*
Attachment 1 - Main Operations Menu

NOTE 1: The MultiRAE PRO is equipped with a 10.6 eV lamp, combustible gas and electrochemical sensors. The monitor can be programmed to respond to selected VOCs and combustible gases when necessary.

NOTE 2: Additional information, including programming and maintenance features, can be found in the “MultiRAE User’s Guide.”

After the monitor is turned on and the display reads “Ready…Start Sampling?”, the user can cycle through the main operation menu by pressing the [N/-] button repeatedly. The pump is turned off during this idle operation.

Some main operation menu options include:

- “Ready…Start Sampling?”: The monitor is ready to take a measurement. Press the [N/-] button to advance to the next menu display, or press the [Y/+] button to start a measurement.

- “Peak” and “Min” Reading: The highest and lowest instantaneous readings since the start of the measurement. If the [Y/+] button is pressed while the peak reading is displayed, the unit will confirm the clearing of the peak and minimum values. If the [Y/+] button is pressed again, the peak and minimum values will be cleared.

- "Start Datalog?” allows the user to start or stop data logging of the current measurement. A diskette icon is displayed when data logging is on.

- “VOC” & “LEL Gas Status”: Status can be changed in the “Calibration” menu i.e. the calibration and measurement gas.

- “Enter Communications Mode?” allows the user to download data from the MultiRAE PRO to a personal computer or send/receive configuration information between a personal computer and the MultiRAE PRO using the ProRAE Studio II software.
Changing the monitor’s setup can be accomplished through the meter.

1. With the instrument turned on, press both the [MODE] and [N/-] buttons to reach the setup menu.


3. The submenus for each setup menu can be accessed by pressing the [Y/] button to “Select” it.

4. Choose the command to be changed by pressing the [Y/] button, make the changes, [N/-] button to select the right option, press the [MODE] button when “Done” and [Y/] button to “Save” or [N/-] button to “Undo.”

5. Numerical settings to be changed like alarm settings, data log interval, etc. use the [N/-] button to choose the digit position and the [Y/] button to set the numerical value.

6. When finished, press the [MODE] button and then the [Y/] button to “Save” the value or [N/-] button to “Undo.”

7. To return to the main menu, press the [MODE] button repeatedly until “Ready…Start Sampling?” appears.

More detailed information regarding the submenu commands can be found in the “MultiRAE User’s Guide.”
Attachment 3 – Relative Humidity in Excess of Operating Range

The relative humidity range is specified by the instrument manual and was clarified in correspondence with the manufacturer to be usable to 100% relative humidity levels (non-condensing) if the MultiRAE PRO is allowed to warm up for 30 minutes in a room whose relative humidity is less than 95%. This enables the instrument to warm up and prevents condensation.

Condensing moisture’s effects on the photoionization detector can cause: (1) “quenching effect” – ultraviolet light is blocked by condensation from ionizing the target gas/vapor and its concentration is underestimated and (2) “current leakage effect” – associated with a dirty sensor, condensation can promote current flow and overestimate the target gas/vapor concentration.
Figure 1 - MultiRAE PRO
Figure 2 - MultiRAE PRO Datalog Screen
Figure 3 - Monitoring Screen in “Search” Mode