


| EHSS Standard Operating Procedure | | | |
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|  | Subject: Multi-Gas Monitor Calibration Procedure - RAE Systems QRAE II | Sections: All EHSS | Distribution: All EHSS Personnel |
| | EHSS SOP #010 -2019 | | |
| Issuing Authority: Rebecca Ponza, Director of EHSS Signature: <i>Rebecca J. Ponza</i> | | Effective: March 13, 2019 | Supersedes: N/A |

RAE Systems QRAE II Calibration Verification Procedure

| INDEX | PAGE |
|---|------|
| Applicability, Purpose, Role of EHSS, Definitions, Items Needed | 1 |
| Procedures | 2-3 |
| Figure 1 | 4 |
| Diagram 1 | 5 |
| Calibration Form | 6 |

- I. Applicability:** This Standard Operating Procedure is applicable to all Syracuse University Environmental Health and Safety Services Personnel.
- II. Purpose:** To provide a detailed set of calibration instructions for EHSS staff members responsible for calibration of the RAE Systems QRAE II multi-gas monitor.
- III. Frequency** The role of EHSS is to maintain QRAE II functionality by performing bimonthly calibration verifications.
- IV. Definitions:** Multi-gas Monitor:
- Provides continuous exposure monitoring of hydrogen sulfide (H₂S), carbon monoxide (CO), combustible gases - lower explosive limit (LEL), and oxygen (O₂) for personnel in potentially hazardous environments.
- Calibration:
- The process of configuring an instrument to provide a result for a known sample (calibration gas) within an acceptable range (+/- 5%).
- Bump Test (as Found Reading):
- A qualitative function check in which a known concentration of challenge gas is used to verify sensor performance. A bump test does not calibrate sensors. It is recommended that the QRAE II performance be verified before each use (if possible) by conducting a bump test. If readings fall outside of an acceptable range (+/- 5%) for the challenge gas, the unit must be calibrated.
- V. Items Needed** All items located in Lyman Hall room 034 B & C
- ✓ RAE Systems - QRAE II multi-gas monitor
 - ✓ Calibration Gases
 - Multi-gas calibration mixture - RAE Systems recommends:

1. H₂S - 10 parts per million (ppm)
2. CO - 50 ppm
3. Combustible gases LEL - 50% LEL Methane
4. O₂ - 18% balanced with nitrogen

Multi-gas calibration cylinder is stored in protective case on shelving under fume hood in 034C (Figure 1). Check to make sure gas has not expired.

- ✓ Regulators - Regulator (0.5 l/m - marked on side) is stored with multi-gas cylinder in protective case on shelving under fume hood in 034C (Figure 1).
- ✓ Calibration Binder - Located in shelving above instruments. Will need a new In-House Equipment Calibration Form” for each instrument calibration test. Calibration form is attached.
- ✓ Tubing - Located with multi-gas cylinder in protective case on shelving under fume hood in 034C. Used to connect multi-gas cylinder to the gas inlet on the front of the QRAE II pump. Please refer to attached Diagram 1 showing the location of the pump inlet. The QRAE II pump must be calibrated using a fixed-flow regulator with a flow rate between 0.5 and 1.0 liters per minute.
- ✓ Fume Hood - Hydrogen sulfide is poisonous, corrosive and flammable and must be used in a fume hood.

VI. Procedures

QRAE II Monitor Start-Up

1. Start by filling out information or checking appropriate box on a new calibration form. New forms are located in the calibration binder sleeve or attached:
 - a) Date
 - b) Person Calibrating
 - c) Calibration Location
 - d) Instrument Manufacturer: RAE Systems
 - e) Instrument Name - QRAE II
 - f) Model # - PGM - 2400
 - g) Serial # - 181-150097
 - h) Calibration Gases - Multi-gas mixture
2. Turn on QRAE II (startup) by pressing and holding the mode key for 2 seconds. When display powers on, release the mode key. Please refer to attached diagram showing monitor key locations.
3. The QRAE II is now operating and performing self-tests/programs. After completing tests the instrument will operate in normal operating mode and display readings on the display screen for: CO, H₂S, O₂, and LEL.

As-Found Readings For Ambient Air and Calibration Gas (Bump Tests)

4. Once initial startup readings stabilize, record the Ambient Air As-Found readings on calibration form under As-Found/Ambient Air for: CO, H₂S, O₂, and LEL.
5. Attach regulator to multi-gas calibration cylinder. Connect QRAE II gas inlet to the multi-gas calibration cylinder regulator using the provided tubing. Remember to open valve on regulator just prior to connecting tubing to the gas inlet. Wait until readings on the monitor display stabilize and record Calibration Gas As-Found readings on calibration form under As-Found/Calibration Gas for: CO, H₂S, O₂, and LEL. Disconnect tubing from gas inlet and turn off gas at regulator.

4-Gas Calibration

6. Enter “program” mode by pressing and holding both the mode and Y/+ keys simultaneously for 3 seconds. You will be prompted for a password. Press the

- mode key 4 times to enter “0000”, then the Y/+ key to select “Y”. This will pause the normal operating mode and the display will show “program mode”.
7. Press mode key to scroll through the menu.
 8. When “calibrate monitor” is displayed, press Y/+ key to select.
 9. Use mode key to scroll through menus until “multiple sensor calibration” is displayed and press Y/+ key to select.
 10. Press Y/+ key for OK and connect multi-gas calibration cylinder to the gas inlet port using the provided tubing. Remember to open valve on regulator just prior to connecting tubing to the gas inlet. Press Y/+ key to start calibration. You should see a countdown from 60 seconds. When finished the screen displays “Multiple Sensor Calibrated” message. Disconnect tubing from gas inlet and shut off gas at regulator.
 11. If a sensor fails, repeat calibration. If calibration fails again, sensor replacement may be needed. Consult manual.
 12. To return to normal operation mode, scroll through menu using mode key to “back” and use Y/+ key to select (2 times).

As-Left Readings

13. Perform As-Left Readings by reconnecting the multi-gas calibration cylinder to the inlet port using the provided tubing. Remember to open valve on regulator just prior to connecting. Write down As-Left readings on calibration form under As-Left/Calibration Gas for: CO, H₂S, O₂, and LEL. When finished, disconnect tubing from gas inlet and shut off gas at regulator.
14. If As-Left/Calibration Gas readings are outside of the acceptable range (more than +/- 5% of any of the calibration gases), a repeat calibration of the instrument must be performed.
15. Continue to let QRAE II monitor run and record As-Left /Ambient Air readings on the calibration form for: CO, H₂S, O₂, and LEL..
16. When finished, turn of monitor by pressing and holding mode button for 5 seconds.
17. Fill out a calibration sticker (binder sleeve) indicating date of calibration, who performed calibration, date next calibration is due. Remove old sticker and affix new sticker on instrument.
18. Check Date/Time by using mode key to scroll through menu. Consult manual if necessary.
19. Check multi-gas calibration cylinder levels to make sure enough calibration gas is left for future calibrations. Note any maintenance performed on form.
20. Place calibration sheet into binder. Update binder index.
21. Remove regulator from the multi-gas cylinder for storage. Place cylinder, regulator and tubing into protective case and return to storage shelving below fume hood.

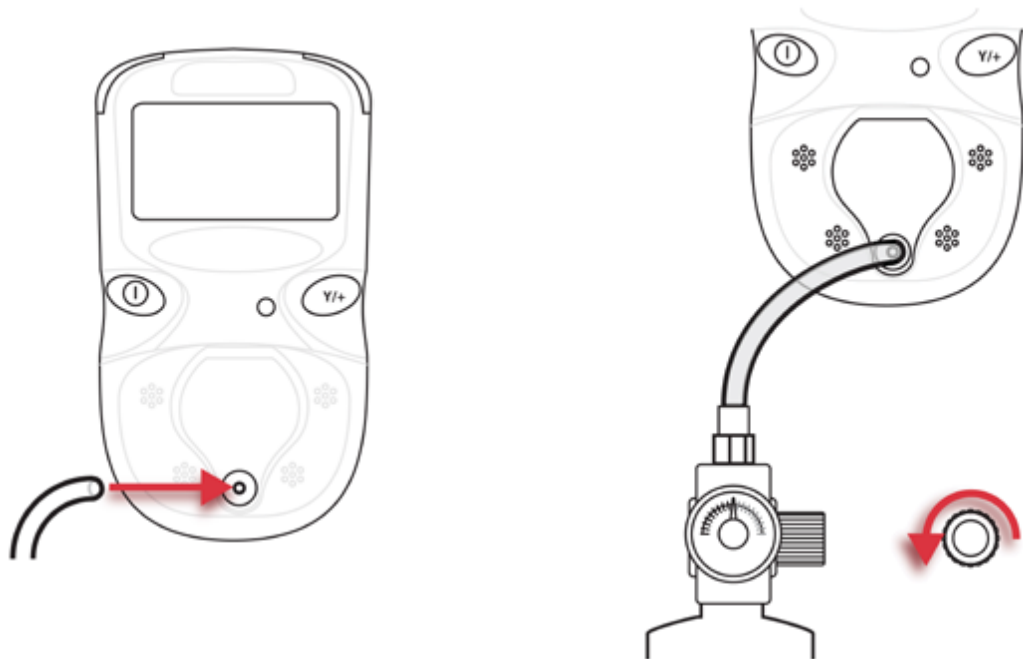
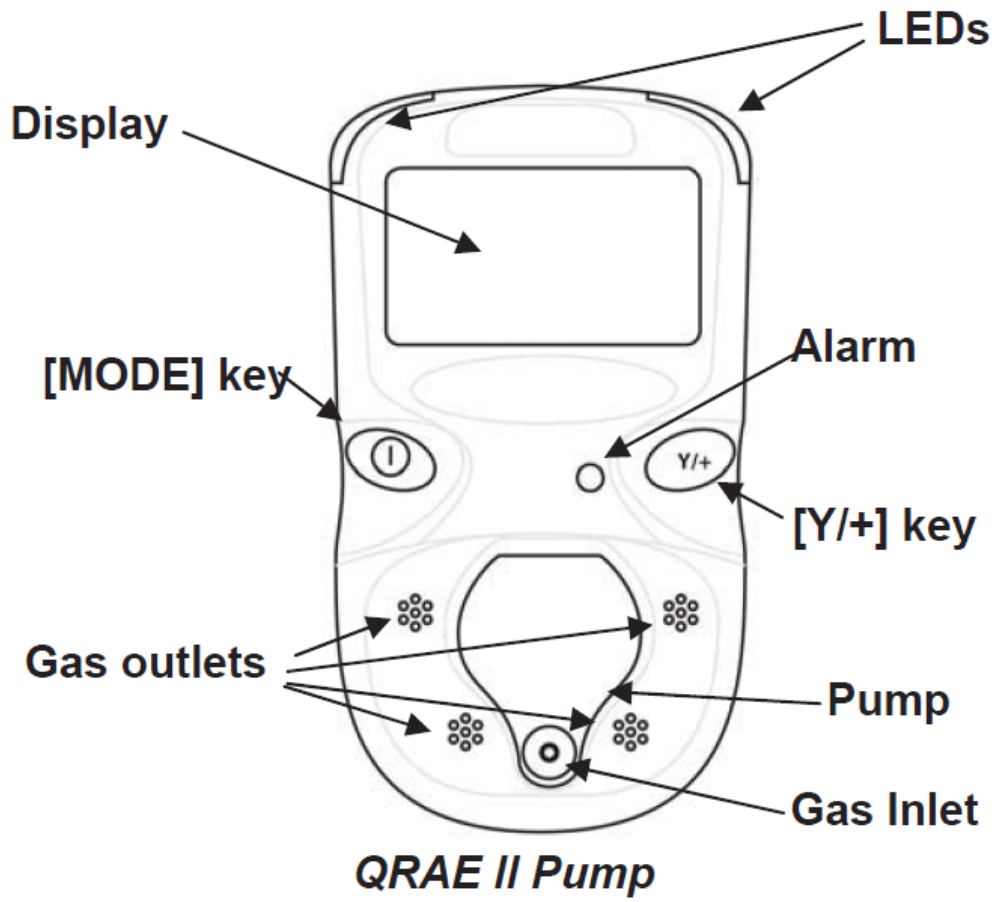
Figure 1

Cylinder protective cases on shelving under fume hood

Multi-Gas Cylinder & Regulator



DIAGRAM 1



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ENVIRONMENTAL HEALTH AND SAFETY SERVICES OFFICE

IN-HOUSE EQUIPMENT CALIBRATION FORM

Date: _____ Person Calibrating: _____

CALIBRATION LOCATION

Building: _____ Room: _____

Ambient Temperature: _____ Ambient Humidity: _____ Barometric Pressure: _____
(NWS web site for SYR)

EQUIPMENT TO BE CALIBRATED

Instrument Manufacturer: Rae Systems
Model #: PGM-2400

Instrument Name: QRAEII
Serial #: 181-150097

Calibration Gases

Item: Multi-gas mixture Conc: NA Manuf: _____ Lot/Ser#: _____ Exp.Date: _____
Item: _____ Conc: _____ Manuf: _____ Lot/Ser#: _____ Exp.Date: _____

As-Found / Calibration / As-Left Data

| Calibration Gas | Calib. Std. Value | Calibration Standard Accuracy | As-Found Reading "Ambient Air" | As-Found Reading "Calibration Gas" | As-Left Reading "Calibration Gas" | As-Left Reading "Ambient Air" | Estimated Accuracy |
|---|-------------------|-------------------------------|--------------------------------|------------------------------------|-----------------------------------|-------------------------------|--------------------|
| Carbon Monoxide (CO) | 50 ppm | ± | | | | | +/- |
| Hydrogen Sulfide (H ₂ S) | 10 ppm | ± | | | | | +/- |
| Oxygen (O ₂) | 18 % | ± | | | | | +/- |
| Lower Explosive Limit (LEL) - % Methane | 50% Methane | ± | | | | | +/- |

NOTE: As-Left/Calibration reading should be very close to span gas value (+/- 5 %). **If not, recalibrate.**

If readings continue to fall outside of the 5% accuracy after several calibrations, sensor replacement may be needed/consult manual.

DATE/TIME: Check Date/Time. _____ Date is expressed as Month/Day/Year

_____ Time is expressed as Hours/Minutes/Seconds

CALIBRATION STICKER? ____

MAINTENANCE / CLEANING PERFORMED

Action: _____

COMMENTS: _____

FOR NEXT TIME

Next Calibration Due Date: _____ How much calibration gas left? _____ PSI

Supplies to Order
Item: _____ Conc.: _____ Qty.: _____ Size: _____