Addressing MiniRAE 2000 and ppbRAE Moisture Sensitivity

The sensors in the MiniRAE 2000 and ppbRAE photoionization detectors (PIDs) were designed to have little or no response to moisture. However, when the sensor is dirty, bent out of shape or corroded, the MiniRAE 2000 and ppbRAE may show a strong response to humidity above about 85%RH.

Quick Humidity Response Tests

Try exhaling gently into a MiniRAE 2000 for 10 to 15 seconds or cupping your hand over the inlet probe. Moisture from your hand provides a fairly continuous high humidity stream. Be sure not to block the flow.

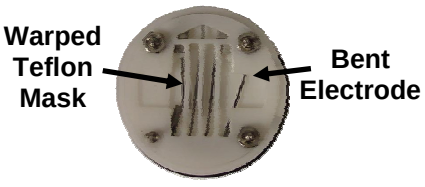
The instrument should show little or no response from these tests. If the MiniRAE 2000 shows >5 ppm isobutylene units or the ppbRAE shows >500 ppb increase in reading, then something is wrong. The design instruments make it quick and easy to remove and clean the sensor to address this problem. Try focusing on the following areas:

1. Inspect the sensor for damage or corrosion.
2. Clean the sensor housing.
3. Clean the sensor using an ultrasonic bath.

Inspect the Sensor for Damage or Corrosion

If the sensor appears corroded, it should be replaced. If the sensor is damaged or even slightly bent, it can show increased response to moisture. The bias and sensing electrodes are two sets of "fingers" in the MiniRAE 2000 sensor. These fingers should be straight and parallel. The bias electrode is easy to see when the bottom of the sensor is inspected. However, the sensing electrode should be blocked from sight (and the UV light from the PID lamp) by a Teflon mask. If the sensing electrode can be seen because the fingers are bent or the Teflon mask is warped, the sensor needs replacement. A warped Teflon mask can be a sign that the sensor has been exposed to too much heat. If the sensing electrode is exposed to UV light from the lamp, it gives an undesired positive response to the light. If the fingers look aligned but are not in the same plane (some fingers are bent towards or away from the lamp), then the sensor should be replaced. The fingers should be close to, but not touching, the Teflon mask. In some cases it is possible to carefully bend the electrodes back into the correct position if the damage is very minor.

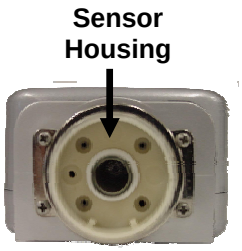
Good Sensor (partly disassembled)



Damaged Sensor

Clean the Sensor Housing

If the PID sensor is not damaged, thoroughly wipe clean the sensor housing area using a cotton swab dipped in lamp-cleaning methanol. Let the sensor housing area dry completely. Reassemble the PID, and perform a humidity response test. If it shows no response, calibrate the meter and return it to service.



Dirty Sensor Causes Current Leakage

A dirty sensor is the number-one reason for humidity response. The sensor has two electrodes, a bias electrode and a sensing electrode. One has a more positive charge than the other. As the UV light breaks down chemicals into positive ions and negative electrons, they migrate to the oppositely charged electrodes. With clean, dry air and sensor components, no current can leak across the air space between the two electrodes.

However, even microscopic dirt accumulations on the electrodes and Teflon parts can promote leakage, especially when the relative humidity is >85%. This is because water absorbs more readily onto dust particles than onto a clean Teflon or glass surface. The sensor may appear to be visually clean, but

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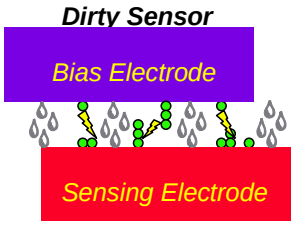
No dirt build-up to foster a decrease in airspace resistance



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

actually is dirty enough to cause leakage. This current leakage is interpreted by the PID as a drifting reading of typically over 10 to hundreds of ppm with no VOC present (over 1 ppm for a ppbRAE).

At very high levels of leakage, the MiniRAE 2000 displays a "Clear Sensor, Quit?" message on the screen. Pressing the "Y" key tells the MiniRAE 2000 to continue. The "Clear Sensor, Quit?" message can also be displayed if the MiniRAE 2000 pump has been shut off with a high level of sample left in the meter.

Prevention is the Best Cure

Preventing dirt and dust from entering the PID sensor is the best cure for moisture response. Make sure that all of the filters in the instrument are clean and effective. In dirty environments, it may be necessary to add an external filter (such as a water trap filter disk). However, under normal circumstances there should be no response to humidity with just the standard sintered metal filter installed. A Humidity Filtering Type II Tube can be used to dry the sample stream and measure VOCs at high humidity for about a half hour (see TN-178). Many compounds can be measured this way, especially those commonly encountered in soil remediation such as gasoline and trichloroethylene. Some caution needs to be taken because some very heavy compounds can be lost on the tube. A C-Filter can also be installed in the probe to prevent dirt build up and to remove enough moisture from the air stream to delay a leak current. However, a C-Filter should be used with extreme caution and replaced on a daily or weekly basis, as it can absorb some chemicals being measured and actually release absorbed water if it has been saturated.

Cleaning the PID Sensor

Cleaning the lamp and sensor surfaces using the lamp cleaning kit with cotton swabs is not good enough to remove humidity response. An ultrasonic cleaning bath MUST be used. Ultrasonic cleaners are available from laboratory suppliers, or a jewelry cleaner from a department store can be used. To clean the sensor, remove it from the meter and immerse it in lamp-cleaning solution (anhydrous methanol) in a small beaker or baby food jar. Fill the ultrasonic cleaning bath with water. Place the beaker containing the sensor into the water bath of the ultrasonic cleaner. The ultrasonic waves pass through the water and container and assist in cleaning the sensor. The lamp-cleaning solution in the jar can be reused a few times until it becomes dirty. Let the

sensor dry at least a few hours, and preferably overnight (warm but not hot air will speed the drying process).

Caution! Do not overheat the sensor and never disassemble the sensor!

It is very important to blow or shake out any residual lamp cleaning solution from the sensor before letting it air dry. Otherwise, some of the dirt that was just extracted into the cleaning solvent could be deposited

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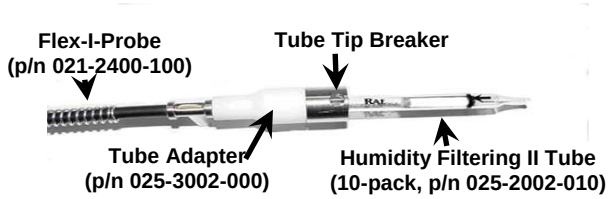
back onto the sensor components as they dry. Reinstall the clean, dry sensor into the MiniRAE 2000. Exhale into the meter and check the response. If it shows no response to the moisture in your breath, calibrate the instrument and return it to service.

If moisture problems still persist, contact the RAE Systems Service Department at 888-723-4800.

Using Humidity Filtering II tubes

Humidity Filtering Tubes (Type II) can be used to dry the sample gas and measure many VOCs for about 15 minutes to 1 hour. Their use prevents moisture effects, even on a dirty sensor. The tubes (p/n 025-2002-010) are inserted into an adapter (p/n 025-3002-000) attached to a Flex-I-Probe (p/n 021-2400-000). Many compounds such as trichloroethylene and gasoline pass through the tube easily. Some heavy vapors like diesel fuel or polar compounds like acetone and alcohols require extended sampling times. See Technical Note TN-178 for more details and cautions on use. (Note that Type I Humidity Filtering tubes cannot be used during measurements.)



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