

# INSTALLATION AND MAINTENANCE OF A RAEGUARD PID

## INTRODUCTION

The RAE Systems RAEGuard 2 PID is a fixed photoionization detector (PID) that measures a broad range of volatile organic compounds (VOCs). The RAEGuard 2 PID monitor operates in flow-through



mode. Because it is in an explosion-proof stainless-steel enclosure, it can be used in most environments, including hazardous environment applications for measuring highly toxic gases. Therefore, correct installation and

maintenance is required to ensure effectiveness as a monitoring tool.

This technical note describes guidelines for installation, commissioning, testing, calibration and maintenance of the RAEGuard 2 PID (photoionization detector) monitor and the factors that need to be considered.

## INSTALLATION

This instrument can be installed as a separate unit, set of the units, or part of a system (for example, a multi-point VOC measuring system; please refer to RAE Systems Application Note AP-237 for more information).

### Preface

It is vital that you understand the gas and conditions you want to measure. Many factors can impact the performance of an active sampling system, including dust, water condensation, gas condensation, and pressure in a duct.

### Dust

Unless the particle size is less than 1  $\mu\text{m}$ , the only impact on the performance is the filter replacement interval. Use RAE Systems' fine filter (P/N 033-3034-000).

## Water condensation

The RAEGuard 2 PID system is able to operate at 0 to 95% relative humidity, non-condensing, without distortion of the actual VOC concentration reading. Nevertheless, water vapors are very often present in VOC samples, especially in duct sampling. The sample temperature very often is high enough, and is higher than at the measurement point. On the way from the sampling point to the instrument, sampling gas is cooling. As temperature decreases, relative humidity (RH<sup>1</sup>) of the water vapors in the VOC samples increases and may reach 100% or the dew point<sup>2</sup>. If the temperature at the measuring point is lower than at dew point, water vapor may condense in the tubing, the PID lamp, and the PID electrodes. The amount of condensed water may be significant. This condensation affects the accuracy of the instrument's measurement.

### For example:

If the sampling temperature is 122° F (50° C) and RH=40%, and at the measurement point the temperature is 77° F (25° C), about 10 g of water may condense from 1m<sup>3</sup> of the sampling air. At constant gas monitoring, with the instrument pump duty cycle (default of 50%) and gas flow (~ 500 cc/min), provided by the instrument pump, it takes two to three days to collect this amount of water in the instrument system.

Presence of water must be considered at the lowest ambient temperature and the highest relative humidity percentage at the highest temperature in the sample line. This calculation must be performed when of sampling from ducts. Additional sampling equipment may be required. RAE Systems recommends using a water-collecting filter (P/N of the filter housing is 490-0163-000 and P/N of the filter replacement is 490-0164-000).



**Figure 1. Water-collecting filter.**

**Note:** Filter housing and filter replacement elements are currently available only in North America. Contact RAE Systems for more information.

The filter is installed in between the sample source and the instrument, in the place where the temperature doesn't exceed the instrument's temperature.

### Target and background gases condensation

Many very toxic gases have a very low vapor pressure. Therefore, gas may become a liquid or a crystal even at very low concentrations of it in the air, if the temperature at the measurement point is lower than at the sampling temperature. This factor must be considered before selecting an active sampling system for measuring them. The following example illustrates the fundamentals of the vapor pressure issue:

#### Phenol

RAE Systems portable and fixed PIDs are used in phenol factories all over the world. Phenol can crystallize from the gas phase to the solid one when its vapor pressure in the gas state is higher than that of the sublimation vapor of the solid phenol. This process depends greatly on the temperature variations, since vapor pressures depend on them.

Maximum Phenol concentrations as gas in air at different temperatures (approximate numbers) are as follows:

- At 122° F (50° C): The maximum concentration of phenol is around 3600 ppm.
- At 77° F (25° C): The maximum concentration of phenol is around 440 ppm.

Sampling phenol gas from a duct at 122° F (50° C) with a concentration of 440 ppm and higher into an environment with an ambient temperature of 77° F (25° C) and below results in a crystallization of the phenol. This is seen as slow recovery time as the gas evaporates again in the tube. If the monitor is overexposed, it may be necessary to clean the sample train to speed the recovery time.

#### Pressure

Until pressure variation is within a specified range of 90 to 110 kPa, a monitoring instrument gives a correct reading. Make sure that pressure in the sampling duct doesn't exceed these values. Slightly exceeding them is acceptable, but the reading may be distorted. That distortion doesn't relate to the PID itself, which is rather stable in terms of pressure variation, but it does relate to sampling gas density variation.

### Outdoor Installation

When installing a RAEGuard 2 PID outdoors, make sure a rain shield protects the monitor. It is necessary to prevent water from being sucked into the sample train. If the monitor is used in duct sampling applications, the risk of condensation is high.

**Note:** Consult RAE Systems before installation.

### COMMISSIONING A RAEGUARD 2 PID

Ensure the power is correctly connected and meets the nominal requirements. Double-check for correct wiring. Be sure that instrument is grounded correctly, too. Refer to the RAEGuard 2 PID User's Guide<sup>3</sup> for information on wiring and testing.

Assemble a tubing system for gas delivery from the sampling area to the instrument. The recommended tubing should be either stainless steel or Teflon. This type of tubing provides the minimum gas absorbing to the walls and reduces instrument reading distortion. Attach the tubing to the outlet to return the gas back to the gas stream or out of the zone of the personal working area in order to prevent possible contamination with toxic gases. There are no requirements for this portion of the tubing.

When all the necessary parts of the system are connected and the whole system is installed, perform a check for leaks. Disconnect the tubing from the sampling duct and block the tube inlet, or simply block the tube inlet from the sampling area if there is no connection for the short period of time (usually for the several seconds). If there is no leak in the system, the pump stops working. Make sure that you are observing that the pump stops due to your action rather than due to the pump duty cycle. Resume pump work according to the User's Guide<sup>3</sup>. If there is a leak, perform failure analysis (FA), fix system and make a final leak check using the procedure described above.

### SERVICE AND CALIBRATION INTERVAL

RAE Systems recommends sensor module calibration if it does not pass a bump (calibration check) test, but no less than every six months, and filter replacement every six months. Note that these intervals are application dependent and directly relate to the gas exposure. Therefore, intervals should be adjusted accordingly. For the calibration procedure, follow the recommendations in the User's Guide.

**Note:** A two-hour warm-up time is recommended before making critical measurements.

RAE Systems recommended guidelines based on correct use of filters:

1. Monthly bump (calibration check) tests. If the system fails to pass, a full calibration must be done.
2. 6-month filter replacement interval, unless a filter break-through is observed, requiring immediate replacement.
3. 12-month sensor and lamp cleaning or replacement interval.

**REFERENCES:**

1. <http://hyperphysics.phy-astr.gsu.edu/hbase/kinetic/relhum.html>
2. [http://en.wikipedia.org/wiki/Dew\\_point](http://en.wikipedia.org/wiki/Dew_point)
3. <http://www.raesystems.com>