1.0 Scope and Applicability

The photoionization detector (PID) is a portable instrument used to detect the real-time presence and relative concentration of certain ionizable compounds in gaseous or vapor states. This instrument is typically used for both health and safety monitoring of the work area breathing zone and for the screening of environmental samples. Other uses may include screening of soil gas probes or leak detection (e.g., tanks, vessels, process lines). Consult FSOP 1.1, Initial Site Entry and FSOP 2.1.4, Sample Headspace Screening prior to using a PID for health and safety monitoring or sample headspace screening procedures, respectively.

2.0 Health and Safety Cautions

2.1 Hazardous vapors or gases may be present in concentrations requiring use of personal protective equipment (PPE) such as respiratory protection (Table 1, FSOP 1.1, Initial Site Entry). Ambient (breathing zone) air conditions need to be monitored.

2.2 Prior to use in potentially flammable atmospheres, consult the instrument manual to determine if the PID is intrinsically safe.

2.3 PIDs only measure the relative concentration of molecules in gases or vapors that are ionizable, i.e. those with an ionization potential (IP) less than that of the instrument's ultraviolet lamp IP. (Refer to paragraph 3.3 below.) PIDs may not detect the presence of toxic or explosive gases or vapors with relatively high IPs, including carbon monoxide, chlorine, hydrogen, hydrogen cyanide, hydrogen sulfide or methane. PIDs do not detect or measure the concentration of atmospheric oxygen or the presence of explosive atmospheres. Be sure to use the correct instrument(s) for health and safety monitoring. (Refer to FSOP 1.1, Initial Site Entry.)

2.4 Many instruments are equipped with audio and visual alarms that may be set at threshold limits for the gas or condition of concern. Default alarm levels are generally set by the manufacturer, but should be set in accordance with the specified limits in the site specific health and safety plan.

3.0 Procedure Cautions

3.1 The user should be familiar with the operation of the instrument being used. Consult the instrument manual for operating and calibration instructions specific to the instrument prior to use.

3.2 PID readings are not compound specific. The instrument must be calibrated using a relatively non-toxic gas such as isobutylene and zeroed to a known clean or background air source. Readings are relative to the calibrant gas, and although the instruments display "ppm" or parts per million readings, the readings
are actually ppm-calibration gas equivalents. Response to specific gases and vapors, if known to be present, may be estimated using response factors, a compound-specific number that provides an estimate of the actual gas or vapor concentration when multiplied by the instrument response.

3.3 PIDs only detect molecules that can be ionized. PIDs are equipped with ultraviolet lamps of different ionization energies (IE), typically 9.8 electron volts (eV), 10.2 eV, 10.6 eV, and 11.7 eV. The IE of the lamp must be higher than the ionization potential (IP) of the compound(s) being screened. Consult the instrument manual or other reference for the ionization potential of the constituent(s) to be monitored to determine the proper lamp (or if a PID is appropriate for the proposed monitoring task).

3.4 PID performance may be adversely affected by temperature fluctuations, and PID readings are significantly affected by the presence of water vapor and methane due to their high IEs (> 12 eV). If using a PID in extremely wet or cold conditions, store the instrument in a relatively warm, dry location such as the front seat of a field vehicle with the heater running. A flame ionization detector may be better suited for use in these conditions and generally is preferred in situations where large temperature fluctuations, very moist or humid conditions or high methane concentrations are anticipated. Elevated methane concentrations may be encountered in subsurface areas adjacent to at solid waste landfill disposal units.

3.5 Excessively dusty environments may overwhelm a PID inlet filter and reduce performance by fouling the ionization chamber or lamp. Filters should be inspected and changed after use in excessively dusty environments, and the lamp or ionization chamber should be cleaned if the instrument begins exhibiting a weak response to calibration gas.

3.6 If used for sample headspace screening, never allow the instrument probe to draw in liquid or solid material from a sample container, which may damage the instrument.

3.7 PIDs should be calibrated before each use and at any time the proper performance of the instrument appears to be questionable.

3.8 Always use a regulator with an appropriate flow rate to calibrate a PID. Information on calibration and regulator flow rate should be included in the operator’s manual.

3.9 Never use a source of highly concentrated organic vapors to check whether or not a PID is responding properly (e.g., never insert a PID probe in to the fill port of a vehicle fuel tank, as doing so could damage the instrument).

3.10 Take care when using a PID to screen atmospheres with highly concentrated organic vapors (e.g., opening of a drum containing solvent- or petroleum-contaminated soil). Screening in this manner may contaminate the instrument’s lamp or filter to the point that the PID must be serviced or removed from the area.
of elevated vapor concentrations until it can equilibrate, or may otherwise
damage the instrument.

3.11 PIDs should be cleaned, inspected, and internally calibrated annually by a
service center authorized by the instrument manufacturer.

3.12 Always transport the instrument in a protective case or secure the instrument
during transport.

4.0 Personnel Qualifications

Ohio EPA personnel performing field sampling activities must meet DERR’s
qualifications for performing work at uncontrolled hazardous waste sites.

5.0 Equipment and Supplies

5.1 Calibrant gas (e.g., isobutylene)
5.2 Regulator for calibrant gas cylinder
5.3 Clean containers such as sealable plastic bags or jars with foil or film covers (if
using for headspace screening)
5.4 Field log book, field log sheets, or appropriate field form
5.5 Pens or markers
5.6 PPE appropriate for site-specific work activities
5.7 Inert tubing with “tee” connector
5.8 Instrument with operation manual
5.9 Protective case for instrument transport
5.10 Tedlar® bag
5.11 Instrument-specific calibration log book

6.0 Procedures

6.1 Consult the instrument manual for both general procedures and instrument-
specific operating functions prior to using the instrument.

6.2 Make sure instrument is fully charged before use. Bring a spare or backup
battery if necessary.

6.3 Turn the instrument on and allow it to warm up. Some instruments will give a
“ready” prompt in the instrument display when ready for use. Make sure pump is
running and lamp is on. Check for warnings on instrument display during warm
up. Check alarm levels to be sure they are consistent with site specific health and
safety plan.

6.4 Calibrate the instrument according to the manufacturer’s instructions with a
relatively non-toxic span gas (e.g., isobutylene) before use:

6.4.1 Calibrate the instrument directly from the cylinder using a flow regulator of
appropriate flow rate (equal to or slightly higher than the pump capacity)
or a pressure demand regulator. Use a piece of tubing to connect the regulator to the instrument probe. If the regulator flow rate is significantly higher than the pump flow, then install a “tee” fitting in the tubing to bleed of excess calibrant gas.

6.4.2 For an alternate calibration method, fill a clean Tedlar® bag with the calibrant gas by first connecting the cylinder to the bag with the regulator and tubing and allowing the bag to inflate after opening the valve on the bag. Next, close the valve on the bag, attach the instrument probe to the bag with a length of tubing and open the bag valve when ready to calibrate.

6.4.3 Record calibration data, including operator name, location, instrument make and model, date, time, calibration gas type, and result in the calibration notebook.

6.5 Zero the instrument with a clean air source such as a cylinder of certified clean air or to ambient (background or off-site) air, and ensure that the instrument is zeroed or recording background readings before use.

6.6 Use the instrument for health and safety monitoring or headspace screening in accordance with the site specific site specific health and safety plan and FSOP 1.1, Initial Site Entry and/or site specific work plan and FSOP 2.1.4, Sample Headspace Screening as appropriate.

6.7 Observe and record the instrument readings as appropriate.

7.0 Data and Records Management

Refer to FSOP 1.3, Field Documentation.

8.0 References

FSOP 1.1, Initial Site Entry

FSOP 1.3, Field Documentation

FSOP 2.1.4, Sample Headspace Screening