

# Photoionization and Flame Ionization Detection Techniques

Photoionization and flame ionization are common detection techniques used for gas chromatographic (GC) systems in laboratory environments. Studies on using these two techniques for CWA detection have also been conducted. These techniques have very good sensitivity and large linear response dynamic range. They can sense a group of chemicals that can be ionized, and results are the sum of total detectable chemicals in the sample. Because of their nondiscriminative natures, these techniques are nonspecific for CWA and TIC detection. Although these methods can detect some organic CWAs and TICs with sufficient high volatility in the laboratory where the existence of the compounds is known, their nondiscriminative detection characteristics have prevented their usefulness in detecting highly toxic compounds under field conditions. Their main application as a field detector is for identifying volatile organic chemicals (VOCs). A separation method, such as the addition of a GC column ahead of the detection, is necessary to provide these technologies for potential identification of individual substance contained in a sample based on the elution times.

Both techniques measure the current generated by the ionized species sensed by the ion collector. The photoionization technique ionizes molecules using a high-energy photon source, such as ultraviolet (UV) radiation, while flame ionization technique burns organic molecules in a hydrogen flame, similar to the flame photometric detection (FPD) technique described earlier, that ionizes the decomposed fragments. The ions generated are detected similarly for both photoionization detectors (PIDs) and flame ionization detectors (FIDs). By applying an electrical field gradient across the ionization region to drive the ions to the electrodes, the ions release their charges to produce signals that can be processed.

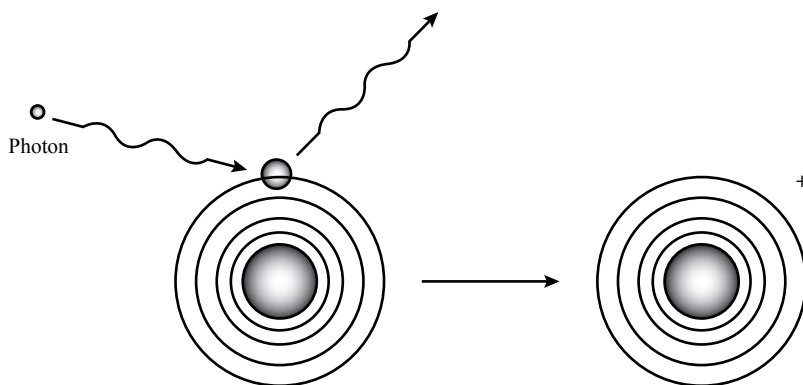
The main differences between these two techniques are their ionization source and mechanism. The photoionization technique is a nondestructive method of detection, while flame ionization method destroys the sampled material.

## 11.1 PHOTOIONIZATION TECHNIQUE

PID detects volatile organic substances in very low concentrations (parts per billion to parts per million) with a large linear dynamic range of up to six orders of magnitude. Since the first photoionization detector that was manufactured in 1974, the technique has been used in numerous applications to detect and analyze organic airborne substances. This technology uses a high-energy UV radiation source to ionize molecules. The ionized molecules are driven to the ion detector by an electric field gradient. The detector analyzes the electric current generated by ions, which is proportional to compound concentration. Photoionization is an important detection technique used in GC systems for the analysis of organic substances in various samples. Aromatic hydrocarbons or heteroatom-containing compounds (like organosulfur or organophosphorus species) are routinely analyzed with photoionization detectors in the laboratory. PID can also detect certain inorganic compounds that other types of detectors may not. This is because these inorganic species have ionization potentials (IPs) that are within reach of commercially available UV lamps (8.3 to 11.7 eV). PID is nonselective in the sense that any molecules with lower ionization potential can be ionized by an ionization source having higher energy. A UV source can improve selectivity in that the compounds with higher ionization potentials would not be ionized or detected when a lower energy source is used.

### 11.1.1 Photoionization

As discussed in [Chapter 7](#), when electrons absorb external energy from the hydrogen flame, an atom or a cluster are excited and jump to a higher energy level. The photometric method detects the radiation released by the atom or cluster when it returns to its lower energy level. When the external energy — provided by a UV source in a PID — absorbed by an atom or molecule is sufficient, photons in the radiation can knock off electrons and thus ionize the molecule as illustrated in [Figure 11.1](#). Because ionization is induced by high-energy photons, the process is called photoionization. Photoionization can be expressed as



**Figure 11.1** Photoionization.



where R represents the species to be ionized, and  $h\nu$  represents the energy of a photon required to ionize species R.

For ionization to occur, the energy ( $h\nu$ ) applied must be greater than the energy needed to remove electrons from the species (IP, or ionization energy [IE]). IE is defined as the energy needed to remove an electron from its atomic orbit and place it at an infinite distance. This energy is expressed in units of electron volts (eV). For most compounds, more than one electron can be removed. Removal of second or third electrons, however, requires much higher energy levels than that required for removing the first electron.

### 11.1.2 Ionization Source

To ionize a molecule by the photoionization process, the energy of a photon must be greater than the ionization potential of that molecule. A higher-energy electromagnetic radiation than the infrared radiation, such as the ultraviolet radiation, can be used as one of the ionization energy sources. Johann Ritter (1776–1810) discovered UV in 1801, which in turn was inspired by the discovery of IR by William Herschel in 1800. Ritter used silver chloride in his experiment and found that the compound turned black much more efficiently when exposed to light just beyond the violet end of the spectrum than when exposed to red light (IR). Ritter called the invisible light he discovered “chemical rays,” which is the ultraviolet light or radiation known today. The energy level of UV light ranges from 3 to  $10^3$  eV. Refer to [Table 7.1](#) for the position of UV radiation relative to other types of radiation in the electromagnetic spectrum.

UV radiation can be generated by different means. For a photoionization detector, a UV lamp is used to provide continuous UV irradiation. Most UV lamps used in photoionization detectors have energy levels between 8.3 eV with wavelengths of 150 nm to 11.7 eV with wavelengths of 106 nm. The energy level increases with shorter wavelength sources. Most photoionization detectors use only one UV lamp at a time. The lamps, with varying eV values, can be exchanged based on application needs.

Air is comprised of  $N_2$  (78%) and  $O_2$  (21%), with relatively small amounts of other substances, including argon, water, and  $CO_2$ . IE values for these gases are greater than 12 eV. The IE of the major component of the air, nitrogen, is 15.58 eV. The IE of oxygen is 12.075 eV. Water and  $CO_2$  have the IE values of 12.59 eV and 13.79 eV, respectively. Therefore, UV sources used in common photoionization detectors cannot ionize them. This eliminates them as potential interfering compounds for photoionization detection and analysis. However, water vapor in the atmosphere has been found to cause significant effects on PID detection instruments. This effect is, perhaps, the result of factors other than the ionization effect because the ionization potential of water is higher than for the UV lamp.

### 11.1.3 Ion Detection

Sample molecules are ionized by UV radiation in the sample chamber. A pair of collection electrodes is used to apply electric potential to force the formed ions to move toward the electrodes. When the ions contact the electrodes, they become neutralized by releasing their charge and generate an electric current that can be detected by an electronic device. The electric current generated by the ions is proportional to the amount of ionized substances that enter the detector. Therefore, the concentration of molecules in the sample could be determined by measuring the current.

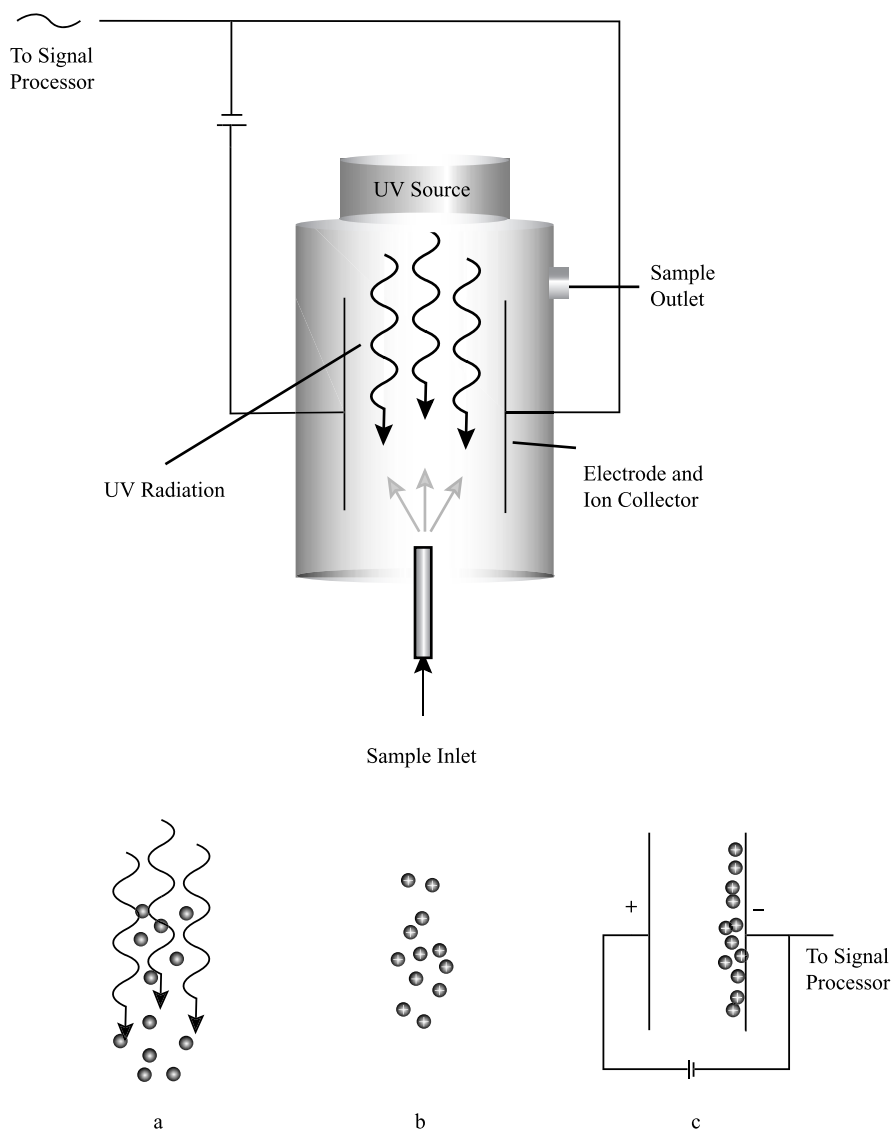
### 11.1.4 Instrumentation

Figure 11.2 is a diagram of a typical photoionization detector. In principle, a PID includes a sample inlet, ionization source, ion collector, and sample outlet. Vapor samples are introduced through the sample inlet system, which includes a GC column for general GC applications. In the field, the sample vapor is generally drawn into the detector without gas chromatographic capability. The use of a GC column increases detector selectivity, but also slows down response time. The analysis is performed continually while the sample is drawn through the detector. When the sample enters the ionization area where the electric field is applied, molecules in the sample are ionized if their IP values are lower than the UV-source energy level. The ions generated are driven to the electrodes where the ions release their charges to produce the electrical signal read by the detector. After the ions release their charges, the particles revert to their original state and exit the detector. Therefore, the photoionization method is nondestructive; the exhausted sample can be further analyzed using other methods as necessary.

### 11.1.5 Technique Specification

Theoretically, any substances that can be ionized by the selected UV source can be detected. In the past, this detection technology was used to detect various organic substances, but it is also effective in detecting inorganic substances (e.g.,  $\text{H}_2\text{S}$ ,  $\text{NH}_3$ , etc.). PID is quite sensitive, as its limit of detection reaches low parts-per-million levels and into parts-per-billion levels. Response dynamic range can be up to six orders of magnitude.

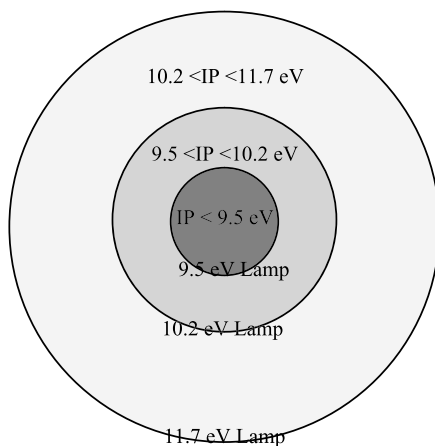
A disadvantage of the PID technique is that when a separation technology is not used (e.g., GC), the signal is generated by all ionizable chemicals in a sample rather than by a single targeted compound. All chemical components in the vapor that can be ionized contribute to the signal. Thus, the response may not represent the targeted compound unless it is the only compound that could be ionized. For example, when an 11.7-eV UV lamp is used, all chemicals with an ionization potential lower than 11.7 eV will contribute to the signal, and the result is the sum of all ionized components. Similarly, all chemicals with an IE lower than 9.5 eV will contribute to the signal when a 9.5-eV lamp is used (Figure 11.3). In brief, photoionization detectors are not selective.



**Figure 11.2** Schematic diagram of PID.

Another characteristic feature of PID is that for organic matter that can be ionized, its response is roughly proportional to the number of carbon atoms in the molecules. At the same mole concentration, the signal generated by molecules containing six carbon atoms will be roughly double that generated by molecules containing three carbon atoms. For this reason, PID is also called the “carbon counter” method.

Although photoionization is not selective, by using a lower-energy UV source, fewer chemicals will be detected since those chemicals with a higher IP will not be



**Figure 11.3** Ionization energy and energy UV lamp.

ionized. Interference is therefore reduced, but not eliminated. To positively identify a chemical using the photoionization detector, a chemical separation method such as a GC column must be used before the sample enters the detector.

## 11.2 FLAME IONIZATION TECHNOLOGY

Flame ionization, a common detection and analysis technology for volatile organic chemicals, is similar to photoionization. FID uses a hydrogen flame rather than UV radiation as the means to produce ions from decomposed organic fragments in a vapor sample. This technique also has a very good limit of detection (parts-per-billion to low parts-per-million level) for VOCs with a large linear dynamic response range up to seven orders of magnitude. It is a nonselective method that responds to any molecule containing carbon–hydrogen bonds without the ability to identify the various compounds. Consequently, FID cannot effectively detect inorganic compounds such as  $\text{H}_2\text{S}$  and  $\text{NH}_3$ . Because of its nonselective nature, it is more useful as a type of GC detector than as a field detection device for toxic compounds. FID has been incorporated in handheld field instruments for VOC detection when precise identification is not a requirement.

FID is similar to the flame photometric technique except in the ways that signals are harvested. For the flame photometric technique, the hydrogen flame temperature is between  $2000^\circ\text{C}$  and  $2500^\circ\text{C}$ . At this temperature, all organic substances decompose and form ions containing carbon-hydrogen. The actual formation of ions in the hydrogen–air flame is a rather complex process. Basically, the organic molecules undergo a series of reactions including thermal fragmentation, chemi-ionization, and ionic molecule and free radical reactions to produce the charged species. The quantity of ions produced is proportional to the number of reduced carbon atoms present in the flame and hence the number of molecules. The FID responds to the number of carbon atoms entering the detector per unit

of time, which is similar to photoionization detectors. For this reason, FID is also referred to as a “carbon counter” detector.

All organic matter decomposes when burned in a hydrogen flame, and ions are generated for many organic molecules. The FID sums all chemicals contained in the sample that generated the ions in the hydrogen flame. Flame ionization detectors are insensitive toward noncombustible gases such as  $\text{H}_2\text{O}$ ,  $\text{CO}_2$ ,  $\text{SO}_2$ , and  $\text{NO}_x$ . Therefore, these substances do not interfere with detection. Consequently, FID is quite often is coupled with a photoionization device to identify VOCs.

The diagram in [Figure 11.4](#) shows the operational principle of FIDs. FIDs, constructed similarly to FPDs, are comprised of a sample inlet, hydrogen fuel inlet, combustion chamber, and electrodes that provide the electric field and act as an ion collector. The decomposed sample is vented through a chimney exhaust. The major difference between an FID and a FPD is the method used to process the detection signal. Instead of measuring light emission from excited ions, the FID measures electric current generated by the ions.

Samples can be introduced into an FID either directly or through a GC column. Hydrogen, air, and sample vapor are mixed in the combustion chamber and burned. Because of the high temperature of the hydrogen-rich flame, organic substances in the vapor are decomposed to hydrocarbon fragments and ionized. The ions move along the electrical field toward the electrodes where current is produced when the ions hit them. This signal is then sent to the electronic signal processor.

There are a few disadvantages in using photoionization and/or flame ionization instruments for field CWA and TIC detection. Both PIDs and FIDs are not “selective”: they respond to all chemicals that can generate ions via the UV source (in PID) or hydrogen–air flame (FID). Therefore, no specific identification and corresponding concentration can be determined based solely on PID or FID detection responses. Separation of sample compounds is necessary for both technologies to identify target chemicals or determine respective concentrations. Another concern about the FID is the use of hydrogen gas as fuel. As discussed in [Chapter 7](#), a hydrogen cartridge is an alternative to a compressed gas cylinder. Nevertheless, the use of hydrogen still creates logistic issues.

### 11.3 COMPARISON OF PHOTOIONIZATION, FLAME IONIZATION, AND FLAME PHOTOMETRIC TECHNIQUES

PIDs and FIDs have similar detection capability for VOCs in that the ionization process and signal collection of both are nonselective. Although very useful as VOC detectors, they are quite limited when used as field detectors for CWAs. Detection of CWAs can occur only through the use of response factors equivalent to respective calibration gas. Methane gas and isobutylene are used by FID and PID, respectively, as the reference calibration gas. Response factors correlate detector responses calibrated against the reference gases to a known concentration of a given compound. The usefulness of response factors, unfortunately, is valid only if the sample contained the targeted chemical without any other influences (i.e. in a known situation). They are not viable CWA or TIC detectors because they do not provide specific

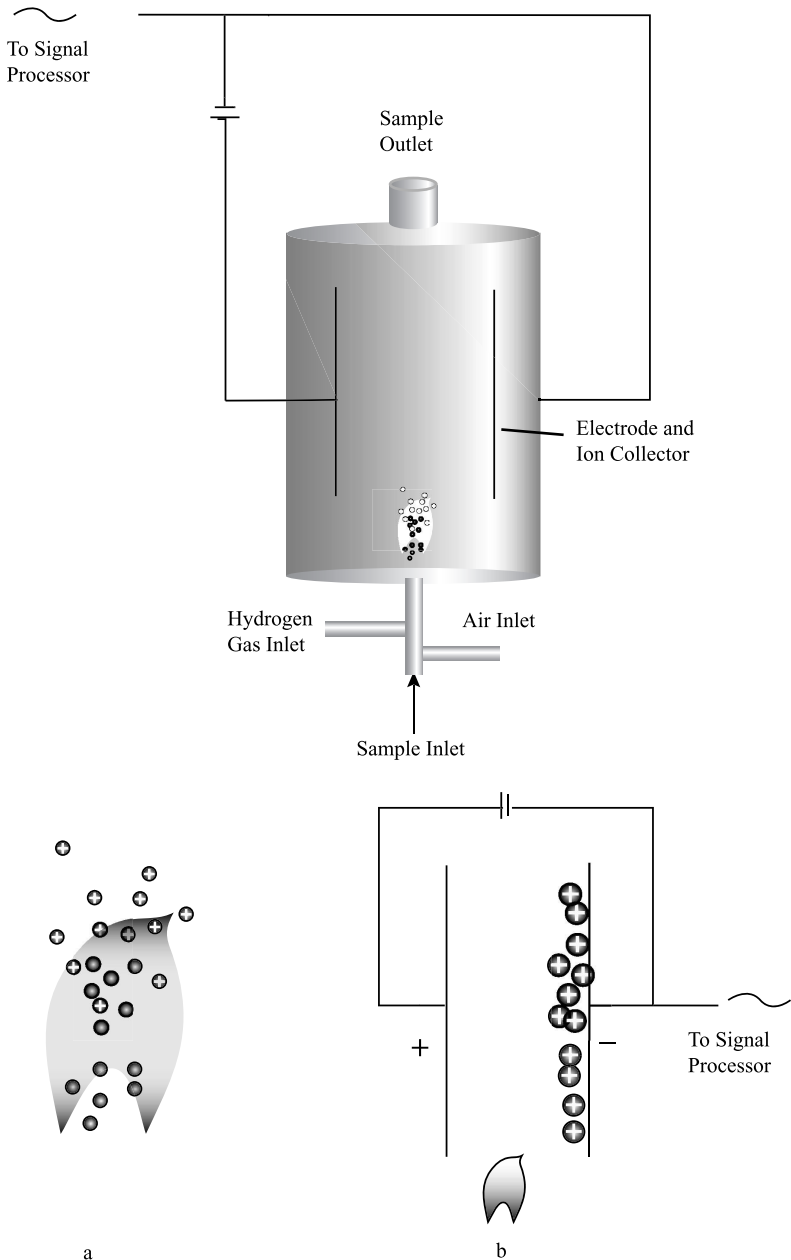


Figure 11.4 Schematic diagram of FID.

chemical concentration data. Given that the only difference between FID and FPD is the way that signals are processed, FPD has the advantage of greater selectivity. Besides the detection of phosphorous and sulfur components as used in general CWAs, FPDs can similarly detect other element emissions through the use of



different light filters. The ability to selectively detect target chemical light emission makes the FPD more selective. It detects those chemicals containing elements that emit light upon burning in the hydrogen–air flame. Theoretically, other chemicals lacking these elements will not interfere with the detection. Thus, FID and PID are excellent VOC detectors, and multiple compounds can be simultaneously and quickly detected. Their use as CWA and TIC detectors requires component separation of the sample before detection. For this reason, the PID and FID are not being aggressively pursued as CWA detection devices, although many FID and PID manufacturers would like them to be. FPD offers much more specificity in CWA and TIC detection.

## 11.4 APPLICATIONS

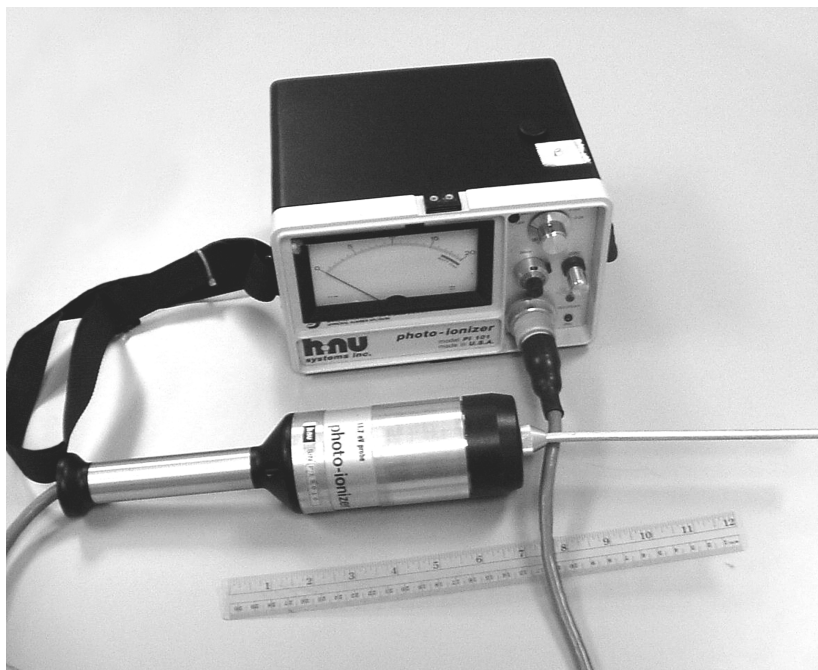
The Foxboro TVA-1000B Toxic Vapor Analyzer<sup>®</sup> is a dual PID and FID system. The two detectors can be used individually or in combination. Results are displayed in parts per million, parts per billion, or as percent concentration. The PID has a dynamic range of 0.5 to 2000 ppm of isobutylene using a 10.6-eV lamp, while the FID has a dynamic range of 1 to 10,000 ppm of methane. A pressurized hydrogen cylinder is used to provide the hydrogen for FID operation. The 85-cc cylinder of compressed hydrogen at 2200 psi lasts for approximately 8 hr of continuous operation.

This detector was evaluated under the Domestic Preparedness Program (DPP) (<http://hld.sbcom.army.mil/ip/reports.htm#detectors>) as a potential viable CWA detector. Response factors for diverse CWAs were created against known concentrations, under known environmental conditions. Evaluators concluded that this detection mechanism would be susceptible to interference. Its nondiscriminatory detection results cannot assure users whether they are caused by a CWA or other contaminants that may coexist in the air.

The DPP has also evaluated PID detectors made by RAE Corp. and Mine Safety's Passport II<sup>®</sup>, and the FID manufactured by PerkinElmer Corp. called MicroFID<sup>®</sup>. These detectors were considered too nonspecific to be considered as viable detection devices to provide adequate warning and information about the existence of CWAs or TICs. Identification of toxic substances is essential if these technologies are to be adopted. Short descriptions of available FID and PID instruments follow.

The Passport PID II Organic Vapor Monitor (Mine Safety), ppbRae<sup>®</sup> (Rae Systems), and HN $\mu$  Model PI-101 Trace Gas Analyzer<sup>®</sup> (HN $\mu$  Systems, Inc.) (Figure 11.5) are all PID detectors. They use UV lamps at 10.6 or 11.7 eV to ionize molecules and detect the presence of the photoionized species in the sample stream. They do not distinguish among individual chemicals. The concentration displayed represents the concentration of all ionized species. Moisture, oxygen, methane, and other compounds will quench the PID signal to cause underreporting of concentration readings. A daily calibration check is part of the setup routine for operation.

The Passport PID II Organic Vapor Monitor weighs 2.5 pounds with the battery attached, with dimensions of 8.125 in.  $\times$  2.875 in.  $\times$  3.75 in. It draws in 350 cc/min, and is said to be operable between 0°C to 40°C with a noncondensing of 1% to 95% relative humidity (RH).



**Figure 11.5** Photoionizer detector. Photo courtesy of K. Y. Ong.

HNu Model PI-101 Trace Gas Analyzer is a portable instrument that can detect, measure, and provide a direct reading of the concentration. The analyzer consists of a sample probe, readout assembly, and battery charger. The sample probe contains sensing and amplifying circuitry, and the readout box contains meters, controls, and power supply. The standard probe uses a 10.2-eV lamp and has a response time of less than 5 sec to reach 90% of full detection capacity. It has several sensitivity scales and a detection range from 0.1 to 2000 ppm. It is operable up to 90% RH at temperatures ranging from  $-10$  to  $40^{\circ}\text{C}$ . The detector weighs approximately 9 pounds with the probe attached, and measures 8.25 in.  $\times$  5.25 in.  $\times$  9.5 in. The test conducted at the U.S. Army Soldier Biological and Chemical Command (SBCCOM) used the 11.7-eV probe to provide maximum ionization potential for assessment of its capability to detect CWAs.

RAE Systems Inc. of Sunnyvale, California is the manufacturer of the parts-per-billion Volatile Organic Compound (VOC) Monitor (ppbRAE Model PGM-7240) (Figure 11.6). According to the manufacturer, the ppbRAE is a PID with a standard 10.6-eV or optional 9.8- or 11.7-eV UV lamp. The ppbRAE is a durable, lightweight (19.5 oz, including battery pack), handheld detector designed for continuous monitoring of dangerous environments for VOCs. Alarm levels can be preset for low, high, short-term exposure limit (STEL) and time weighted average (TWA) levels. There is an audible alarm as well as a red flashing LED, along with the direct parts-per-billion display readout. The detector also has point data logging capability for postevent downloading to a computer.



**Figure 11.6** ppbRAE detector. Photo courtesy of K. Y. Ong.

The ppbRAE uses a dual-channel PID and an electrode-less discharge UV lamp as the high-energy photon source. The built-in sample pump draws in the vapor sample at a nominal flow rate of 400 cc/min. The sample passes by the UV lamp where it is photoionized, enabling the ions to be detected as current is generated. The instrument uses the sensor readings to calculate the gas concentrations based on a known response factor derived from a reference calibration gas. The ppbRAE was evaluated in its “Hygiene” mode, where the monitor runs continuously and the liquid crystal display displays the instantaneous readings. Operational temperature range is  $-10^{\circ}\text{C}$  to  $40^{\circ}\text{C}$  and RH range is 0% to 95%.

These PID detectors exhibited wide ranges of response factor (RF) values between units as well as within the same unit. RFs represent the ratio between the signals obtained from exposures to the targeted substances and the calibration gases used to span the detection range with known concentration. They displayed varied and inconsistent parts-per-billion values when exposed to similar concentrations of CWA vapors. Consequently, no meaningful RF versus agent concentration relationship could be determined. Residual effects from CWA challenges and/or calibration drift were observed. The UV lamps, used to ionize the vapor samples for detection, are easily contaminated by exposure to dust, dirt, moisture, and other compounds. Frequent and thorough cleanings are required to maintain detector performance.

PerkinElmer Corp. produces the Photovac MicroFID<sup>®</sup> Handheld Flame Ionization Detector (Figure 11.7). This detector was selected for testing based on a survey of existing detection devices by Battelle Memorial Institute. The survey identified the detectors most likely to be used by local responders in the event of a terrorist incident involving CWA(s). No attempt was made to optimize chemical agent detection capability. No pretest theoretical assessment was made on the detectors except to learn operating procedures from the manufacturer’s user manual.



**Figure 11.7** MicroFID detector. Photo courtesy of K. Y. Ong.

Unpredictable CWA detection performance prevented the establishment of a reliable response curve. Test results suggested that the MicroFID in its current configuration could not be used effectively for CWA detection. Recalibration checks clearly suggested that detector sensitivity was not degraded by exposure to CWAs, as methane detection capability was nearly constant. Methane detection responses also did not appear to be affected by RH changes. However, CWA detection at varied humidity conditions showed that humidity grossly affected instrument sensitivity. Testing was discontinued after ambient-temperature agent sensitivity tests because of poor performance in CWA detection.

Based on observations from testing of various devices from different manufacturers, both PID and FID instruments would not be the detectors of choice for CWA or TIC detection without the addition of a GC type of compound separator to increase selectivity. In brief, other detection technologies are preferable. (The related DPP test report is posted at <http://hld.sbcom.army.mil/ip/reports.htm#detectors>.)

## 11.5 FACT SHEETS ON SELECTED PHOTOIONIZATION AND FLAME IONIZATION DETECTORS

### Detector Name

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Foxboro TVA 1000B PID Detector

### Manufacturer/Distributor and Contact Information

The Foxboro Company  
33 Commercial Street  
Foxboro, MA 02035  
Tel: 508-543-8750

### Technique Description

The TVA 100B PID Detector is man portable detector utilizes 10.6 eV UV source for photoionization. It co-existed with a companion FID for broader detection capability. The two complement each other.

### Chemical Detection Capability and Performance

It can detect nerve, blister, blood, and choking agents as well as many TICs that could be ionized with near real time detection. Unfortunately, the detections are non-specific. Responses cannot be attribute to a certain compound in the unknown situations, therefore, cannot be readily used for toxic environments. It can only serve as an indication that something (VOC) is in the air.

### Other Feature

Audio and visual alarm indications. Response factor can be determined for laboratory uses. Response factor varies with moisture contents in the sample, in general, due to quenching effect.

### Domestic Preparedness Test Report

Testing of Commercially Available Detectors Against Chemical Warfare Agents: Summary Report, February 1999.  
([http://hld.sbcom.army.mil/downloads/reports/detectors\\_summary.pdf](http://hld.sbcom.army.mil/downloads/reports/detectors_summary.pdf))

### Detector Name

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MiniRae Classic, ppbRae, MiniRAE 2000

### Manufacturer/Distributor and Contact Information

Rae Systems, Inc  
1339 Moffett Park Dr.  
Sunnyvale, CA 94089  
Telephone: 877-723-2878

### Technique Description

The MiniRae Classic, ppbRae, MiniRAE 2000 detector are handheld portable detector utilizes 10.6eV UV lamp for photo-ionization ionization.

### **Chemical Detection Capability and Performance**

It can detect many TICs and possible some CWAs that could be ionized with near real time detection. Unfortunately, the detections are non-specific. Responses cannot be attribute to a certain compound in the unknown situations, therefore, cannot be readily used for toxic environments. It can only serve as an indication that something (VOC) is in the air.

### **Other Feature**

It has audio and visual alarm indications and data logging features. It can be networked. Response factor can be determined for laboratory uses. Response factor varies with moisture contents in the sample, in general, due to quenching effect

### **Domestic Preparedness Test Report**

Testing of Commercially Available Detectors Against Chemical Warfare Agents: Summary Report, February 1999.  
([http://hld.sbcom.army.mil/downloads/reports/detectors\\_summary.pdf](http://hld.sbcom.army.mil/downloads/reports/detectors_summary.pdf))

### **Detector Name**

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MSA Passport II Organic Vapor Monitor

### **Manufacturer/Distributor and Contact Information**

Mine Safety Appliances  
P. O. Box 426  
Pittsburg, PA 15230  
Telephone: 800-MSA-2222

### **Technique Description**

The MSA Passport II Organic Vapor Monitor is a handheld portable detector utilizes 10.6 eV UV lamp for photo-ionization ionization.

### **Chemical Detection Capability and Performance**

It can detect many TICs and possible some CWAs that could be ionized with near real time detection. Unfortunately, the detections are non-specific. Responses cannot be attribute to a certain compound in the unknown situations, therefore, cannot be readily used for toxic environments. It can only serve as an indication that something (VOC) is in the air.

### **Other Feature**

It has audio and visual alarm indications and can be upgraded to detect new compounds through changeable data libraries. No expendables except for occasional filter changes. It meets MIL standards and currently fielded by many nations. It can be networked.

### **Domestic Preparedness Test Report**

Testing of Commercially Available Detectors Against Chemical Warfare Agents: Summary Report, February 1999.  
([http://hld.sbcom.army.mil/downloads/reports/detectors\\_summary.pdf](http://hld.sbcom.army.mil/downloads/reports/detectors_summary.pdf))

**Detector Name**

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HNu PI 101 and DL102 Organic Vapor Monitor

**Manufacturer/Distributor and Contact Information**

PID Analyzers, LLC  
25 Walpole Park South Drive  
Walpole, MA 02081  
Telephone: 800-724-5600

**Technique Description**

Both detectors are photo-ionization based using several different UV lamps of 9.5, 10.2, 10.6, and 11.7eV as interchangeable modules for different applications

**Chemical Detection Capability and Performance**

These detectors are used primarily for VOC detection and can detect many TICs and possible some CWAs that could be ionized with near real time detection. Unfortunately, the detections are non-specific. The response is fast but cannot be attribute to a certain compound in the unknown situations, therefore, cannot be readily used for toxic environments. It can only serve as an indication that something (VOC) is in the air.

**Other Feature**

The DL 102 is a more advanced model from model 101. They has built-in library of sensitivities and 7000 points data logging capability.

**Domestic Preparedness Test Report**

Testing of Commercially Available Detectors Against Chemical Warfare Agents: Summary Report, February 1999.  
([http://hld.sbcom.army.mil/downloads/reports/detectors\\_summary.pdf](http://hld.sbcom.army.mil/downloads/reports/detectors_summary.pdf))

**Detector Name**

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Perkin Elmer MicroFID Flame Ionization Detector

**Manufacturer/Distributor and Contact Information**

The Perkin Elmer Corporation  
761 Main Avenue  
Norwalk, Connecticut 06859  
Telephone: 203-761-5330

**Technique Description**

This is a handheld portable flame ionization based detector using a small compressed cylinder of hydrogen. It is aimed for detection of VOC that will burn. It does not distinguish between individual pollutants.

### **Chemical Detection Capability and Performance**

The detector is used primarily for VOC detection and can detect many TICs and possible some CWAs that could be ionized with near real time detection. Unfortunately, the detections are non-specific. Responses is fast but cannot be attribute to a certain compound in the unknown situations, therefore, cannot be readily used for toxic environments. It can only serve as an indication that something (VOC) is in the air.

### **Other Feature**

It has data logging capability. One fully charged hydrogen cylinder lasts approximately 11 hours of operation.

### **Domestic Preparedness Test Report**

Domestic Preparedness Program: Testing Of Photovac Microfid Handheld Flame Ionization Detectors Against Chemical Warfare Agents - Summary Report, October 1999  
([http://hld.sbcom.army.mil/downloads/reports/photovac\\_microfid\\_summary\\_report.pdf](http://hld.sbcom.army.mil/downloads/reports/photovac_microfid_summary_report.pdf))