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**SURVEY OF PORTABLE ANALYZERS FOR THE
MEASUREMENT OF GASEOUS FUGITIVE EMISSIONS**

Final Report

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ABSTRACT

Title III of the 1990 Clean Air Act Amendments lists 189 regulated chemicals and the Toxic Waste Release Inventory lists 309 chemicals for which emission values must be reported in the case of accidental or intentional releases. The proposed lowering of the reportable fugitive emission leak level from 10,000 to 500 ppm has caused renewed focus on portable analyzers.

Portable analyzers such as the Foxboro OVA, the Bacharach TLV, the HNu photoionization analyzers, and many others have been used to screen fugitive emissions of various organic compounds. A survey of manufacturers and published literature revealed that the leak detection field is an active one. Many new manufacturers have entered the field, while existing manufacturers have developed new products and improved old ones. As instrumentation and techniques improve, there is the possibility of testing for emissions in areas that have previously been inaccessible because of lack of equipment (technology) or motivation.

This study was undertaken to identify commercially available portable analyzers, the properties of each, recommended areas of application, and approximate cost. Also, nine portable analyzer users were selected to determine which equipment is being used in industry, the types of analyses being performed, compounds for which the equipment is being used, and problems encountered with both the equipment and the method.

SECTION 1 INTRODUCTION

1.1 Background

A "portable leak detection instrument" is an analyzer that is internally powered (battery and fuel) and is light and compact enough to be carried on site by one person and maneuvered around pipes and valves.

Portable leak detection instruments have been marketed for many years. Historically, they have been used to isolate localized hazardous conditions, but recently they have been pressed into service as a means of measuring gaseous fugitive emissions and detecting specific leaks in process lines and equipment. The number of available portable detectors has increased dramatically along with the number of companies using these instruments to refine their emissions estimates.

The procedure for monitoring gaseous fugitive emissions is documented by Environmental Protection Agency Method 21 (Appendix A). Method 21 documents procedures to screen pipe fittings, valves, pumps, open ended lines, and bulk storage tanks for volatile organic compound (VOC) gaseous fugitive emissions. The method also details the specifications that an instrument must meet in order to be used for leak detection. Method 21 applies to the 1990 Clean Air Act Amendment Title III list of 189 regulated chemicals and the Toxic Waste Release Inventory list of 309 chemicals with emission values that must be reported whenever an accidental or intentional release occurs.

The EPA is presently negotiating with affected industries to reduce the fugitive emission leak definition from 10,000 parts per million (ppm) to 500 ppm. In anticipation of a change, and in light of industry's heightened awareness of environmental issues, EPA determined a need to perform a survey of available portable detection devices for

monitoring fugitive emissions. There is also a need to address fugitive emissions of inorganics such as HCN, H₂S, HCl, and Cl₂, and develop appropriate test methodologies. Response factors for simple and complex mixtures (such as fuel oils and gasoline) also need to be developed. Field techniques are needed to explore variability in measurements due to wind problems in placing the probe near the equipment in order to obtain an accurate measurement.

The EPA, through its Atmospheric Research and Exposure Assessment Laboratory in Research Triangle Park, NC, contracted with Radian Corporation, Research Triangle Park, NC, to survey the portable analyzer supplier and user communities. The information gathered in the survey will be used to apprise the supplier and user communities of available analyzers and their application to gaseous fugitive emission monitoring. This report presents the results of the survey.

The remainder of this section discusses the objectives of the project, briefly summarizes Method 21, and details the criteria by which the instruments were judged. Section 2 classifies the instruments by detector type and describes individual instruments. In section 3, user-related problems and applications are discussed, including calibration procedures and response factors for mixtures. Section 4 contains the conclusions of this survey and recommendations for further study.

1.2 Objectives

The purpose of this report is to:

- Provide an update on currently available portable fugitive emission analyzers;
- Explore the problems involved with operating these analyzers in the field;
- Explore how industry is using these analyzers;

- Document the field calibration procedures and the quality assurance steps being taken to assure collection of quality data;
- Investigate the procedures used for reporting leak rates of process lines containing mixtures of chemicals with positive detector responses;
- Make recommendations on areas of gaseous fugitive emission detection and reporting that need further exploration.

1.3 EPA Reference Method 21

EPA Method 21, The Determination of Volatile Organic Compound Leaks, is used to measure releases of gaseous fugitive emissions of VOC's under Section 313 of Title III of the Superfund Amendments and Reauthorization Act (SARA). Method 21 is also used to develop fugitive emission inventories and to ensure permit compliance. The generation of unit-specific emission estimates is dictated by an EPA protocol document¹ and a similar Chemical Manufacturers' Association (CMA) guidance document. Using previously determined default equipment leak emission factors, plant-wide estimates can be made. Presently, facilities desire a more accurate emission estimate. Using Method 21 and EPA's protocols, emission estimates can be refined to a value closer to the actual emissions.

The instrument specifications and performance criteria for Method 21 are:

- The instrument must respond to the compound of interest;
- The linear response range and measurable range of the instrument and the calibration gas must encompass the concentration which defines a leak;
- The instrument must have a scale defined to $\pm 5\%$ of the concentration which defines a leak;
- The instrument must have a pump capable of drawing sample at a rate of 0.10 to 3.0 liters per minute;
- The instrument must be intrinsically safe in at least Class I, Division 1, and Class II, Division 1, as defined by National Fire Prevention Associations National Electric Code;

- The instrument must have a sample probe with an outer diameter ≤ 0.25 ";
- The instrument response factor for the compound of interest shall be less than 10;
- The response time shall be less than 30 seconds;
- The calibration precision must be $\leq 10\%$ of the calibration gas concentration.

These criteria are applied to all analyzers. Currently, the leak definition concentration is 10,000 ppm; therefore, instruments should have a linear response from 0 to 10,000 ppm. Previous reports² have shown that this linear response is not always obtained. Also, the scale must be readable at 9500 ppm for the current leak rate. Definition at 475 ppm will be required if the leak rate is reduced to the proposed 500 ppm level.

Instrument safety for Class I, Division 1, and Class II, Division 1, is defined by the National Electric Code:

- Class I: Areas where volatile flammable liquids and flammable gases are used;
- Division 1: Class I areas where hazardous concentrations are likely to occur in normal operations;
- Class II: Areas where combustible dust may be present;
- Division 1: Class II areas where combustible dust is likely to be present in explosive or ignitable concentrations during normal operations.

Instruments that are certified as "Factory Mutual Research Corporation Approved" (FMA) meet the National Electric Code standards above. Some instruments have British Approval Service for Electrical Equipment in Flammable Atmosphere (BASEEFA) approval referring to United Kingdom standards parallel to the National Electric Code.

Some instruments' detectors give response factors over 10 for some compounds². Analyzers with alternate detectors that give suitable responses for the compound of interest can usually be found.

The response time refers to the time period beginning when the calibration gas is introduced to the instrument and ending when 90% of the final stable reading is attained.

The calibration criteria refer to making three readings of the calibration gas by alternating zero gas with calibration gas. The average algebraic difference between the meter and the known value is calculated. The average difference divided by the known value multiplied by 100 gives the calibration precision as a percentage.

1.4 Instrument Requirements for the Survey

The instruments represented in this survey were chosen using Method 21 specifications as a guide, but each instrument does not necessarily meet all of the criteria. Equipment identified for possible use as a Method 21 instrument if modified by the manufacturer was included. Such equipment includes: instruments with a range less than 10,000 ppm; instruments with a scale not readable to $\pm 5\%$ of the leak definition; and instruments without full FMA or BASEEFA safety approval.

SECTION 2

THE ANALYZERS

The applicability of an instrument to gaseous fugitive emission analysis depends on the type of compound being analyzed and the response of the instrument detector to that compound or class of compounds. For example, flame ionization detectors (FID) respond well to methane but photoionization detectors (PID) show little response; the opposite is true when analyzing methanol. The instruments are discussed according to detector. Manufacturers' full addresses and phone numbers are listed in Appendix B.

2.1 Flame Ionization Detectors

The FID is a destructive detector that is highly sensitive to a wide variety of organics. Compounds are ionized in a hydrogen or a hydrogen blend flame, and the positively charged ions are then attracted to a negatively charged collector, producing a current. The current flow generated is proportional to the concentration of ions present.

FIDs are highly desirable for use in portable instruments because of their inherently stable baseline qualities. FIDs respond well to organics with hydrocarbon character but show little or no response to halogens, sulfur, CO, NO_x, NH₃, and water. Tables 2-1 and 2-2 list the FID analyzers by manufacturer and characteristics.

2.1.1 Foxboro

The Foxboro Company (Foxboro, Massachusetts) manufactures three portable instruments using FID: The Century OVA 88, 108, and 128. All three use ambient air with 100% hydrogen as FID fuel; response time is 2 seconds.

The 108 and 128 are FMA certified intrinsically safe (Class I, Division 1, groups A-D) and differ from each other only in their scales. The 108 uses a logarithmic

Table 2-1

Flame Ionization Analyzers

Manufacturer	Model	Method 21 Criteria							Comments
		Meets Leak Definition		5% Definition at Leak Level	Intrinsically Safe	Response Time (sec)	0.25" o.d. Probe	Sample Flow (lpm)	
		500 ppm	10,000 ppm						
The Foxboro Company	OVA 88	NO	YES	YES	NO	2	YES	2.0	
	OVA 108	NO	YES	YES	YES	2	YES	2.0	
	OVA 128	YES	NO	YES*	YES	2	YES	2.0	6
Heath Consultants, Inc.	DP-III	YES	YES	YES	NO*	3	YES	2.0	2
	DP-II	YES	NO	NO	NO*	3	YES	2.5	3
	PF-II	YES	NO	YES*	NO*	2	YES	0.7	4,6
MSA/Baseline Industries, Inc.	GasCorder	NO	NO*	NO*	NO*	3	YES	0.5	5
	FID								
Sensidyne, Inc.	Portable FID	YES	YES	YES	NO*	3	YES	1.25	1
Thermo Environmental Instruments, Inc.	710	YES	NO	NO	NO	5	YES	1.5	
	712	YES	YES	YES	NO	5	YES	1.5	

*See Comments

Comments

1. Working on making intrinsically safe instrument.
2. Plans are underway to make DP III intrinsically safe.
3. Plans are underway to make DP II intrinsically safe.
4. Currently being modified to be intrinsically safe.
5. Will reach market 9/91, and will be redesigned to meet Class I, Division 1 & 2 standards by approximately 12/92.
6. Five percent definition at 500 ppm leak level.

Table 2-2

Flame Ionization Analyzers

Manufacturer	Model	Calibration Gas	Maximum Range (ppm)	Battery/Fuel Life (hrs)	Dimensions (in) and Weight (lbs)	Temperature Celsius	Price** (\$)	Comments
The Foxboro Company	OVA 88	Methane	0-100,000	8	9x12x4, 11	10 to 40	4400	1
	OVA 108	Methane	0-10,000	8	9x12x4, 12	10 to 40	6600	2
	OVA 128	Methane	0-1000	8	9x12x4, 12	10 to 40	6600	3
Heath Consultants, Inc.	DP-III	Methane	0-10,000	8	3.5x7x10, 7	-20 to 48	3200	7
	DP-II	Methane	0-1000	8	11x7x9, 9	-20 to 48	4000	8
	PF-II	Methane	0-5000	10	3x10x9, 6.3	-20 to 48	2500	9
MSA/Baseline Industries, Inc.	GasCorder FID	Methane	0-10,000*	8	17x11.2x8, 18.5	5 to 35	6800	10
Sensidyne, Inc.	Portable FID	Methane	0-10,000	15	14.5x4.6x9.3, 6.5	-5 to 40	4800	6
Thermo Environmental Instruments, Inc.	710	Methane	0-2000	8	10x4x8.5 Case	0 to 40	5800	4
	712	Methane	0-20,000	8	6.5x6.1x4 Gun	0 to 40	5800	5
					14 total			

*See Comments

**Approximate Base Unit Price 8/91

Comments

1. The OVA 88 is primarily for natural gas leak detection. Logarithmic analog scale.
2. Generally accepted as the industry standard. Logarithmic analog scale.
3. GC option (\$1200) for qualitative analysis. Three scales 0-10,-100,-1000. Linear analog scale.
4. Three scales 0-200,-2000,-20000. Digital readout.
5. Three scales 0-2000,-20,000,-200,000. Digital readout.
6. Two scales 0-1000, 0-10,000. Analog scale.
7. Five scales maxima of 10, 50, 100, 1000, and 10,000.
8. Five scales, maxima of 10, 50, 100, 500, and 1000.
9. Three scales 0-50, 0-500, 0-5000. Analog scale.
10. Dedicated air and hydrogen cylinders. Data logging capabilities.

1-10,000 ppm meter with a low resolution of 0.5 ppm. The 128 uses a linear scale that reads 0 - 10, 0 - 100, or 0 - 1000 ppm, depending on the range selected. Resolution on the 128 is 0.2 ppm on the 0 - 10 scale. The scale on the 88 model is logarithmic, and reads 1 - 100,000 ppm, with a resolution of 0.5 ppm on the low end of the scale. The 88 is not certified for Class I use.

The OVA unit consists of an instrument pack and sample probe. The instrument pack contains a sample pump, the FID assembly, an electronics module, a rechargeable battery pack, and a small hydrogen fuel cylinder. The operational controls are all located on the inside face plate of the pack. The sample probe carries the meter readout in a pistol grip probe head. The sample probe is tethered to the body of the instrument pack by a 3/16" Teflon® line and signal wires. Sample flow rate is 1.5 - 2.5 Lpm, with continuous analysis. The 108 and 128 have a gas chromatograph option consisting of a GC column and injection port for quantitative and qualitative analysis. A strip chart recorder is available for the GC option. A dilution probe is also an option for all three models.

2.1.2 Heath

Heath Consultants, Inc. (Stoughton, Massachusetts) manufactures three portable FID instruments that could be used for gaseous fugitive emissions testing: the Detecto-Pak II (DP II), the Detecto Pak III (DP III), and the Porta-FID(PF II).

The DP III has the widest range of the three Heath analyzers, at 0-10,000 ppm. The DP III uses a linear analog meter with two scales, 0 - 50 and 0 - 100, and five scale settings (maxima of 10, 50, 100, 1000, and 10,000 ppm) to achieve a precision readout. The FID fuel is 40% hydrogen/60% nitrogen and is supplied from 8.8-liter lecture bottles. The basic unit contains three lecture bottles that can be switched out for continuous operation. The fuel cylinder is housed in an instrument pack worn with a shoulder strap. The analog display is mounted on top of the instrument pack, which also

includes the sampling pump, FID assembly, the electronics, and the Ni-Cad battery. The sample line is made of Tygon® tubing and runs from a telescoping probe to the instrument pack. Sample draw is approximately 2 Lpm. The Detecto-Pak III has no data logging capabilities but can be linked to a strip chart recorder. The DP III is available with either a 110 volt or a 220 volt charger.

The DP II, the forerunner to the DP III, uses 40% hydrogen/60% nitrogen-fueled FID for detection up to 1000 ppm. As with the DP III, the DP II has five scales (maximum ranges of 10, 50, 100, 500, 1000), and a linear analog meter. The DP II comes with two 38-liter fuel cylinders for easy refill and continuous operation. The instrument pack, containing the sample pump, FID assembly, gel-cell battery, readout, and electronics module, is designed to be worn over both shoulders in front of the body. The fuel cylinder is worn on a belt attachment and is attached to the instrument via a flexible coiled line and a quick-connect fitting. The telescoping sample probe is connected to the instrument via a shielded Tygon® tube. Pump sampling rate is 2.5 Lpm. The battery charger is available in 220- or 110-volt models. A chart recorder is available through Heath, as is a calibration kit.

The PF II is a hand-held FID with three ranges (0 - 50, 0 - 500, 0 - 5000 ppm) and a linear analog meter. Two 8.8-liter fuel cylinders are included for operation up to 10 hours. FID fuel is 40% hydrogen/60% nitrogen. The PF-II instrument body weighs as little as 3.8 lbs when the fuel cylinder is worn on a belt attachment. When the fuel cylinder is attached to the instrument, the weight is 6.3 lbs, including sample pump, FID assembly, Ni-Cad battery readout, and electronics module. Sampling rate is 700 mL/min through a detachable telescoping probe. Pushbutton controls are all designed for single-hand operation.

2.1.3 MSA/Baseline

Baseline Industries, Inc. (Lyons, Colorado), an MSA subsidiary, produces an FID instrument for fugitive emissions called the GasCorder (also available in a PID model, see Section 2.2.5). The GasCorder FID has a 0-10,000 ppm range. Concentration, date, time, and an historical data graph are displayed on an LCD screen, along with support gas consumption, battery life, and disk capacity. A 3.5 inch, high-density disk drive is standard on the GasCorder. Data can be logged with event and location markers, or sampled at set intervals and averaged over a user-selected time period. Information from the disk can be recalled on the instrument screen, downloaded to a computer, or fed to a printer via an RS-232 port. Sample flow is 500 mL/minute. Support gases for the GasCorder (both air and hydrogen) are supplied by two internal cylinders (105 L @ 1800 psig). The GasCorder is the only portable analyzer to use dedicated, rather than ambient, air to supply its detector flame.

2.1.4 Sensidyne

Sensidyne Inc. (Clearwater, Florida) builds a portable FID instrument for gaseous fugitive emissions monitoring. The Sensidyne FID has two ranges, 0 - 1000 and 0 - 10,000 ppm, controlled by a range switch mounted on the instrument body. The scale is a semi-logarithmic analog meter mounted on top of the instrument. The FID is fueled by 100% hydrogen from a detachable cylinder (30 L @ 180 psig) located in a cage beneath the instrument. The cylinder is large enough to operate the instrument for two days (29+ hours) without a refill. The shoulder-carried instrument pack contains the display, FID fuel cylinder, FID assembly, sample pump, electronics, and rechargeable lead-acid batteries. The hand-held probe is attached to the instrument by a screw on Swagelok®-type fitting. The sample pump draws at 1.25 Lpm with an instrument response time of 3 seconds. The instrument is equipped with a probe for ground level sampling but a straight probe for pinpointing leaks around pipes is optional. Additional

hydrogen cylinders and a calibration kit are also available. The Sensidyne FID claims to be unaffected by humidity and can be operated at -5°C to 40°C.

2.1.5 Thermo Environmental

Thermo Environmental Instruments, Inc. (Franklin, Massachusetts) makes two flame ionization-based instruments applicable to gaseous fugitive emissions testing. The two models, the 710 and the 712, differ only in scale. The 710 reads 0 - 20, 0 - 200, and 0 - 2000 ppm, while the 712 reads 0 - 200, 0 - 2000, and 0 - 20,000 ppm. The minimum detectable limit for both is 0.1 ppm methane. The instruments contain a sidepack and probe/sample gun. The sample gun contains the FID and a digital, liquid crystal display (LCD). The sample gun is linked to the sidepack by an umbilical cord. The sidepack contains the rechargeable batteries, the hydrogen fuel cylinder, the electronic control circuits, and a pump that draws sample at approximately 1.5 Lpm. Response time is 5 seconds. Total hydrocarbon concentration is normally read, unless a charcoal filter and internal suppression circuit are used to give a non-methane hydrocarbon reading.

2.2 Photoionization Detectors

The PID is a nondestructive detector that utilizes ultraviolet light to ionize a sample. The positive ions migrate toward a negatively charged collector generating a current proportional to the concentration of ions. The extent of ionization or types of species ionized can be changed by substituting UV lamps of different energies. The higher the energy of the lamp, the larger the number of compounds that can be ionized. PIDs do not respond to methane, so benzene or isobutylene is often used as a calibration gas. Tables 2-3 and 2-4 list PID analyzers by manufacturer and characteristics.

2.2.1 HNu

HNu Systems Incorporated (Newton Highlands, Massachusetts) manufactures portable analyzers with PIDs. The original HNu analyzer is the PI-101 for work in Class I, Division 2 areas. The PI-101 has a linear analog display with three ranges (0-20, 0 - 200, and 0 - 2,000 ppm) and a resolution of 0.2 ppm at the 0 - 20 range. The range switch also has a standby and battery check setting. The probe assembly draws the sample via a small fan through a four inch stainless steel tube/filter at a rate of 150 - 200 mL/min. The display, calibration span, zero adjust and battery are located on the main instrument pack. The probe is attached via a 12 pin umbilical with locknut. Different energy level lamps (10.2 eV standard, 9.5 eV, 11.7 eV) are available for greater selectivity.

HNu also offers an IS-101 model (intrinsically safe). In addition to having the features of the PI-101, the IS-101 is certified for operation in Class I, Division 1 areas.

The HNu (hazardous waste) has all the features of the PI-101. Additional features include a positive displacement pump for drawing sample (200-275 ccm), a probe mounted LED concentration readout, and a in-line filter and improved seals for working in high humidity conditions.

The most recent addition to HNu's line of analyzers is the DL-101. It is Class I, Division 2 design and has an LCD display that shows mode, time, site number, concentration, and low battery. Data logging of up to 256 points with downloading to printer or PC via an RS-232 port is standard. Twelve precalibrated applications can be stored in memory and individual calibration curves can be stored for different energy lamps (10.2 eV standard, 11.7 eV, and 9.5 eV optional). The pistol grip probe houses the PID assembly, a positive displacement pump for drawing sample, and the probe/filter tube assembly. The probe is linked to the instrument pack by a three foot

Table 2-3

Photoionization Analyzers

Manufacturer	Model	Method 21 Criteria							
		Meets Leak Definition		5% Definition at Leak Level	Intrinsically Safe	Response Time (sec)	0.25" s.d. Probe	Sample Flow (ppm)	Comments
		500 ppm	10,000 ppm						
HNu Systems, Inc.	IS-101	YES	NO	NO	YES	3	YES	0.17	
	DL-101-2	YES	NO	NO	NO*	3	YES	0.25	1
	DL-101-4	YES	NO	YES*	NO*	3	YES	0.25	2,6
MSA/Baseline	GasCorder	YES	NO*	YES*	NO*	3	YES	0.5	5,6
	PID	YES							
MSA International	Photon	YES	NO	YES*	NO*	3	YES	0.5	3,6
Sentex Sensing Technology, Inc.	Scentogun	YES	NO	YES*	NO	2	YES*	0.1	4,6
Thermo Environmental Instruments, Inc.	580-S	YES	NO	YES*	YES	2	YES	0.4	6
	580-B	NO	NO	NO	NO	2	YES	0.4	

*See Comments

Comments

1. Class I, Division 2 certified.
2. Class I, Division 2 certified.
3. Class I, Division 2 certified.
4. Meets Method 21 probe size criteria only when used with optional extension.
5. Will be redesigned approximately 12 - 18 months after it reaches the market (9/91) to meet Class I, Division 1 & 2 requirements.
6. Five percent definition at 500 ppm leak level.

Table 2-4

Photoionization Analyzers

Manufacturer	Model	Calibration Gas	Maximum Range (ppm)	Battery/Fuel Life (hrs)	Dimensions (in) and Weight (lb)	Temperature Range	Price** (\$)	Comments
HNu Systems, Inc.	IS-101	Benzene, Isobutylene	0-2000	8	8x5x9, 10	-15 to 40	5000	1
	DL-101-2	Benzene	0-2000	8	8x3x6, readout 4 8x3, probe 3	40 Max	4900	2
	DL-101-4	Benzene	0-2000	8	8x3x6, readout 4	40 Max	5500	3
MSA/Baseline	GasCorder PID	Benzene	0-2000*	8	17x8x8, 10	5 to 35	5000	7
MSA International	Photon	Isobutylene	0-2000	8	16.9x3.8x5.8, 7	0 to 40	5000	5
Sentex Sensing Technology, Inc.	Scentogun	Benzene	0-2000	6	9x6x4, 4	None Supplied	3750	6
Thermo Environmental Instruments, Inc.	580-S	Benzene	0-2000	8	6.75x5.75x10, 7.5	5 to 40	5300	4
	580-B	Benzene	0-2000	8	6.8x5.8x10, 6	5 to 40	4400	4

*See Comments

** Approximate Base Unit Price 8/91

Comments

1. Basic instrument is PI-101. The HW-101 (Hazardous Waste) is Class I, Division 2 certified. Analog readout, 3 scales. 9.5, 10.2, 11.7 eV lamps.
2. DL-101-2 has two modes of operation, datalogging capabilities, digital readout, 9.5, 10.2, 11.7 eV lamps
3. DL-101-4 has four modes of operation, datalogging capabilities, digital readout, 9.5, 10.2, 11.7 eV lamps.
4. Digital display, datalogging capabilities, optional bar code reader interface.
5. Digital display, datalogging capabilities, 10.6 eV lamp.
6. Digital display, 10.6, 11.5 eV lamps.
7. Dilution system available. 8.4, 9.6, 10.2, 10.6, 11.8 eV lamps. Data logging capabilities.

cable. The instrument pack contains the battery, readout, and a 21 button control panel. The DL-101 has a 0-2000 ppm range with a resolution of 0.1 ppm. Sample is drawn at 250 mL/minute. The instrument pack contains the battery, display, 21-button control panel, and electronics assembly.

The DL-101 is available in two different models: the DL-101-2 and the DL-101-4. The DL-101-2 offers survey and hazardous waste modes. The DL-101-4 offers all four modes:

- Survey, for immediate results on start-up;
- Hazardous waste, for analysis after calibration, data logging, date, site and time;
- Industrial hygiene, providing time weighted averages, time, site and concentration information; and
- Leak detection, for time interval monitoring providing time, average concentration and site information.

2.2.2 MSA/Baseline

Baseline Industries' (Lyons, Colorado) PID instrument incorporates many of the features found in their GasCorder FID (see section 2.1.5). The 0-2000 ppm range is displayed on a graphical LCD screen showing date, time, real time concentration, historical data graph, detector status, and battery life. The data logging uses a 3.5", 1.4 megabyte, high-density disk drive to store individual points, sampling points at set intervals, and data averages for set time periods. The internal pump samples at 500 mL/min through a quick-disconnect sample inlet line. The PID GasCorder comes standard with a 10.2 eV lamp, but lamp energies of 8.4, 9.6, 10.6, and 11.8 eV are available.

2.2.3 Mine Safety Appliance

Mine Safety Appliance International (MSA, Pittsburgh, Pennsylvania) manufactures a hand-held PID called the Photon Gas Detector. The Photon Gas Detector has a digital LCD display with a resolution of 0.1 ppm, and is approved for use in Class I, Division 2, areas. The PID comes with a 10.6 eV lamp. The instrument is operated using a 12-button keypad. Functions include maximum concentration recall, numeric or bar graph display, and backlit display. The Photon Gas Detector has three calibration memories, and can be calibrated with two user specified gases in addition to the reference gas, isobutylene. Sample enters through a short (approximately 4-inch) stainless steel tube and filter assembly. The pump draws at a rate of 500 mL/min; response time is three seconds. Included in the instrument kit is a 100 ppm isobutylene calibration cylinder with regulator and tubing.

2.2.4 Sentex

Sentex Sensing Technology (Ridgefield, New Jersey) makes a PID-based instrument called the Scentogun. The Scentogun has three ranges (0-20, 0-200, 0-2000 ppm) with a 0.1 ppm low scale resolution. The digital LCD display is located on the pistol-like probe body; readings are obtained at 1- or 5-second time intervals. A 10.6 eV lamp comes standard with the Scentogun. Calibration is performed using benzene or isobutylene; response time is two seconds. The Scentogun has data logging capabilities and can store 200 points (consisting of date, time, concentration, and location) for downloading to a printer or computer via an RS-232 port. The instrument itself consists of a probe/gun with the display, pump, and PID assembly. The probe attaches to a belt-worn battery pack. The sample pump draws at approximately 100 mL/min through a probe extension with a 1/8" diameter. Total weight is 4 pounds.

2.2.5 Thermo Environmental

Thermo Environmental Instrument Co. (Franklin, Massachusetts) has two PID-equipped instruments available to the portable analyzer market: the 580-B and the 580-S. Both are hand-held, with 0 - 200 and 200 - 2000 ppm digital LCD readouts. Response time is two seconds. The exhaust port is designed so that a Tedlar® sample bag can be attached. The 580 series is operated by a seven-button keypad (including maximum signal hold) located beneath the display. Automatic data logging provides storage of up to 700 points by date, time, location, and alarm status. An RS-232 port allows downloading of data points to a printer or an IBM PC or compatible computer. The RS-232 port can also be used to directly interface a bar code reader with the 580 instruments. The PC communications software is an optional accessory. Other accessories include dilution probe, calibration kit, and water trap.

2.2.6 Spectronics

Spectronics Corporation (Westbury, New York) uses UV-based technology to pinpoint refrigeration, water/coolant stream, and oil and diesel/gasoline leaks. Additives that are fluorescent in UV light are put in the equipment loop to be tested. The equipment in that loop is then exposed to a UV lamp to pinpoint the leaks. The location of leaks can be pinpointed, but no quantification can be made.

2.3 Infrared

An infrared detector is a non-destructive method that uses infrared (IR) light to elevate gas molecules to a higher energy state. Infrared technology is different from flame ionization and photoionization. Because individual compounds have specific light absorption characteristics, IR can be used as a selective detector when the light is set for the corresponding absorbance wavelength of the target molecule. Interference from other infrared-excitabile molecules in the sample atmosphere can result in false positives

when molecules with similar absorbance characteristics as the target molecule are present.

Several companies will offer nondispersive IR analyzers in the near future, but presently only Foxboro offers a IR instrument suitable for Method 21 use. The instrument, the MIRAN 1BX, is rated for hazardous atmospheres. The MIRAN contains approximately 115 chemicals in its preprogrammed library, with room for 10 to 15 user-calibrated listings. The MIRAN consists of a large instrument case containing the detector cell, pump, batteries, and electronics. The weight is heavy for a portable instrument -- approximately 28 pounds. Sample is drawn through a sample wand, umbilical, and filter assembly. The sample wand has a large cylindrical filter on the end that makes it difficult to screen pipes and valves.

The MIRAN's readout is a two-line alphanumeric LCD display that is operated by a 28-button keypad. The display uses logical prompts to guide the user through the instrument options. Generic screening as a primary function is not consistent with the MIRAN's design and a knowledge of the compounds expected to be present is required. The MIRAN is listed in Tables 2-5 and 2-6.

2.4 Solid State and Electrochemical Instruments

A large number of the portable analyzers currently on the market use solid state sensing devices, the most common being a tin oxide device that converts changes in current to concentration as a sample gas flows over the sensor. A gold film detector is also being used. The gold film senses changes in resistance as mercury or hydrogen sulfide molecules are deposited on it. Electrochemical cells are being employed as gas sensors in many compound-specific instruments. Tables 2-5 and 2-6 list solid state and electrochemical-type analyzers by manufacturer and characteristics.

Table 2-5

Infrared, Electrochemical, and Solid State Analyzers

Manufacturer	Model	Method 21 Criteria							
		Meets Leak Definition		5% Definition at Leak Definition	Intrinsically Safe	Response Time (sec)	0.25" s.d. Probe	Sample Flow (lpm)	Comments
AIM USA	1300	YES	YES	YES	YES	1	YES*	1.5	5
	3300	YES	YES	YES	YES	1	YES*	1.5	5
Arizona Instrument	Jerome 431X	NO	NO	NO	NO	13	YES	0.750	3
	Jerome 631X	NO	NO	NO	NO	6	YES	0.150	4
Bacharach, Inc.	TLV sniffer	YES	YES	YES	YES	<30	YES	1.75	
	MV-2	NO	NO	NO	NO	5	YES	N/A	2
CEA Instruments, Inc.	Gasceker GS4	YES	YES	NO	YES*	<10	YES	0.3	6
The Foxboro Company	MIRAN 1Bx	YES	NO	YES*	YES	compound dependent	NO	30	1
Gas Tech, Inc.	1238	YES	NO	YES*	YES*	<10	YES	0.47	7
	4320	YES	NO	YES*	YES*	<10	YES	1.0	7
	GP-116	NO	YES	YES	NO*	5	YES	2.0	8
McNeil International	Gasurveyor 4	YES	NO	YES*	YES	5	YES	0.5	

*See Comments

Comments

1. Internal library of approximately 115 compounds.
2. No sample flow given.
3. Scale reads in milligrams per cubic meter.
4. Four scales 1-1000 ppb, 0.1-1.0 ppm, 1-10 ppm, and 10-50 ppm. Response time varies by scale and mode setting (survey mode times given).
5. Meets Method 21 criteria only when used with optional sample pump attachment.
6. BASEEFA certification is pending.
7. Intrinsically safe Class I, Division 1, Groups C and D.
8. Submitted for UL safety approval.
9. Leak definition at 500 ppm.

Table 2-6

Infrared, Electrochemical, and Solid State Analyzers

Manufacturer	Model	Calibration Gas	Maximum Range (ppm)	Barriers/Pool Life (hrs)	Dimensions (in) and Weight (lbs)	Temperature Range	Price** (\$)	Comments
AIM USA	1300	Methane	0-50,000	7.5	18x2 dia, 4.5	0 to 50	1200	5
	1300	Benzene	0-50,000	7.5	18x2 dia, 4.5	0 to 50	2200	5
Arizona Instrument	Jerome 431X	N/A	0-.999 (mg/m3)	6	6x13x4, 7	0 to 40	5900	4
	Jerome 631X	N/A	0-50	6	6x13x4, 7	0 to 40	9900	4
Bacharach, Inc.	TLV sniffer	Hexane	0-10,000*	8	9x3.75x6.6, 5	10 to 49	1840	2
	MV-2	N/A	0-1.0 (mg/m3)	4	11.4x4.8x4.4, 6	N/A	3300	3
CEA Instruments, Inc.	Gaseker GS4	Methane	0-10,000	10	3x6x6, .3	-10 to 50	1200	6
The Foxboro Co.	MIRAN 1Bx	*	*	4	27x9x11, 28	5 to 40	17,100	1
Gas Tech, Inc.	1238	Hexane	0-1000	8	12x3.8x5.5, 8	-12 to 49	1300	7
	4320	Hexane	0-2000	8	12x3.8x5.5, 8	-12 to 49	2600	8
	4320	Hexane	0-2000	8	12x3.8x5.5, 8	-10 to 40	<5000	9
McNeil International	Gasurveyor 4	*	0-1000	15	7x3.8x4.1, 3.5	-20 to 50	1900	10

*See Comments

**Approximate Base Unit Price \$/91

Comments

1. Infrared. Internal library of approximately 115 compounds. Calibration ranges from 0-10 ppm to 0-2000 ppm. Digital readout. Infrared instrument.
2. Range can be expanded to 0-100,000 ppm with 10:1 dilution probe option.
3. Mercury vapor detector only. Digital readout.
4. Digital readout, data logging capabilities, software optional.
5. Digital readout with data logging capabilities. PC software optional.
6. Logarithmic LED scale, not defined enough at 95% for Method 21.
7. analog meter, also reads 0-100% LEL combustibles.
8. Analog meter, also reads 0-100% LEL combustibles, 0-25% oxygen, 0-100 ppm H₂S, and 0-300 ppm CO₂.
9. Digital readout, data logging system with integral bar code pen. 25,000 and 50,000 ppm ranges available.
10. Electronically calibrated.

2.4.1 AIM USA

AIM USA (Houston, Texas) makes an instrument that can be used for Method 21 testing when used with the optional sample pump. Models 1300 and 3300 have digital displays with readouts to 50,000 ppm. The instruments use tin oxide semiconductor sensors sensitive to alkane groups. The instrument consists of a flashlight-like body containing the battery, detector assembly, LCD readout, and operating keypad. The optional pump (a requirement for Method 21) attaches to the instrument head and is powered by the rechargeable battery. A sample line meeting Method 21 criteria is attached to the inlet of the pump. The AIM instruments have data-logging capabilities and, with optional software, can be downloaded to an IBM PC or compatible computer.

2.4.2 AZI

Arizona Instruments Corporation (Tempe, Arizona) manufactures one portable analyzer for mercury vapor and one model for analyzing H₂S.

The Jerome 431 mercury vapor analyzer uses a gold film sensor to detect mercury in air to 0.999 mg/m³. The sensor is selective for mercury, and is not susceptible to interferences from hydrocarbons, particulates, and magnetic fields. Sampling is accomplished by the pump drawing a precise volume of air (at 750 mL/min) over the gold sensor. The mercury is absorbed and integrated, registering as a proportional change in electrical resistance. The concentration is displayed on the digital LCD display until the next sample is started. Sensitivity is 0.003 mg/m³ with a response time of 13 seconds.

The Jerome 631-X H₂S analyzer also uses a gold film sensor for detection. The 631-X has four ranges measuring up to 50 ppm. Sample flow is 150 mL/min, and response times vary by range. The four-range 631-X, when used in sample mode, has response times of 30 seconds for 1 - 100 ppb, 25 seconds for 0.10 - 1.00 ppm, 16 seconds

for 1.0 - 10.0 ppm, and 13 seconds for 10 - 50 ppm. In the survey mode, all response times are reduced by ten seconds. The analyzer has a sensitivity of 3 ppb and employs an LCD digital display.

2.4.3 Bacharach

Bacharach, Inc. (Pittsburgh, Pennsylvania) manufactures several lines of portable analyzers using solid state technology. Many of the instruments are designed for exposure monitoring and confined entry purposes, but the TLV Sniffer is an intrinsically safe instrument directly applicable to Method 21 gaseous fugitive emissions.

The TLV detector is based on the heat of combustion for combustible gases. Sample gas is passed over two resistive elements -- one coated with a platinum catalyst, the other inert -- that act as arms of a Wheatstone Bridge. An unbalanced current of the bridge produces a signal proportional to the gas concentration. The TLV has three ranges, 0-100, 0-1000, and 0-10,000 ppm calibrated to hexane. Resolution is 2 ppm on the low scale. A sample pump within the instrument pack draws sample at 1750 mL/min for a response time of less than 30 seconds. In addition to the pump, the instrument pack contains the battery pack, analog display, detector module, and electronics board. There is also a connection for hooking up a recorder. The probe is a short aluminum tube with a filter assembly which connects to the instrument pack with a quick-connect fitting. A 1:10 dilution probe and a calibration kit are available. The TLV can also be run using ordinary size D flashlight batteries or rechargeable Ni-Cad batteries. Finally, the TLV is available with special scales and ranges for gases other than hexane, as follows:

- 0-100, 0-1000, 0-10,000 ppm methane or hydrogen;
- 0-500, 0-5000, 0-50,000 ppm methane or hydrogen;
- 0-200, 0-2000, 0-20,000 ppm acetylene; and
- 0-300, 0-3000, 0-30,000 ppm vinyl chloride monomer.

Bacharach also produces a portable instrument for mercury vapor detection. The MV-2 is an analog display instrument calibrated in mg/m³. The detector is a UV photometer with a sensitivity of 0.01 mg/m³. Sample is drawn by a fan, which is powered by a rechargeable Ni-Cad battery. The UV light is absorbed by some halogenated hydrocarbons and benzene ring compounds, but the slight interference this may cause does not normally present a problem.

2.4.4 CEA Instruments

CEA Instruments, Inc. (Emerson, New Jersey) produces several lines of portable analyzers. The Gaseeker GS4 is the most applicable to gaseous fugitive monitoring. The Gaseeker GS4 uses a logarithmic LED bar graph display to indicate concentration of flammable gas (calibrated to methane) up to 10,000 ppm, with a low end of 1.0 ppm. The tin oxide sensor is located in the instrument pack along with the pump, readout, and electronics. A sample probe or hose can be attached to the inlet on the instrument body. Sample flow is approximately 300 mL/minute

CEA also produces two gas-specific lines of instruments, the 7-series and the TG-KA series. Both lines read ppm on a digital readout. The high scale is 20 ppm on most of these instrument, so Method 21 use is limited. The gases detected by one or both lines are:

- Ammonia
- Diborane
- HF
- Phosphine
- Arsine
- H₂S
- Hydrogen
- Silane
- Bromine
- HCl
- Ozone
- Chlorine
- HCN
- Phosgene

2.4.5 Gas Tech

Gas Tech, Inc. (Newark, California) manufactures three instruments suitable for Method 21 testing of hydrocarbons, as well as several single-gas analyzers for inorganics.

Hydrocarbon analyzers -- Models 1238 and 4320 in the GasTechtor series -- are both intrinsically safe, and the 1238 is UL® classified. Both have catalytic bead detectors. Ranges on the 1238 are 0-500 and 0-1000 ppm; the 4320 has one range of 0-2000 ppm. The scales are definable to 10 ppm on both instruments, although the 4320 uses a digital readout while the 1238 employs an analog display. Both units use sample pumps with a flow rate of approximately 1 L/min housed in a carrying case with the detector, display, batteries and electronics assembly.

The third Gas Tech instrument is designed specifically for Method 21 testing. The GP-116, introduced in October, 1991, has a catalytic combustion sensor and a 12,500 ppm range. The resolution is 100 ppm. The analyzer is powered by four size C batteries which are contained in the instrument body with the pump, detector, and 5-button keypad. A four-line LCD display gives the concentration, maximum concentration, identifying code, and high/low alarm setting. The GP-116 is designed to be used with bar code tags and is equipped with a contact type bar code pen that interfaces directly with the instrument. The optional PC-compatible software generates the data gathering plan for downloading to the instrument.

2.4.6 McNeill

McNeill International (Willoughby, Ohio) makes a line of portable analyzers called the Gasurveyors. The Model 4 has a 0-1000 ppm LCD scale that reads in digital and analog modes. The Model 4 is an intrinsically safe instrument that uses Pellistor sensors (Wheatstone Bridge Principle) for gas detection. The Model 4 Gasurveyor has an internal pump that provides a sample draw of approximately 500 mL/min. Response time is 5 seconds. The pump, detector, display, electronics, and controls are all located in the instrument pack. Sample enters the side of the instrument through a Tygon®-like tube. Calibration is accomplished using a clip-on, solid-state electronic calibrator. A data logging system is available.

2.4.7 Compur Monitors

Compur Monitors (Houston, Texas) makes electrochemical-sensor-based instruments for monitoring specific compounds. The ranges of these instruments are too small for fugitive emissions work (less than 300 ppm) and the instruments are primarily designed for personal monitoring and confined space entry.

2.5 Other Detector Systems

2.5.1 Thermal Conductivity Detectors

A thermal conductivity detector (TCD) uses a hot filament to detect a sample gas. When a sample passes over the filament, the thermal conductivity of the gas stream changes, allowing the filament to cool or heat and changing the resistance of the filament. The electrical resistance is constant as long as the make-up of the gas flow (carrier) over it remains constant. A change in resistance produces a change in the signal.

Matheson Gas Products (Montgomeryville, Pennsylvania) and Gow Mac, Inc. (Bound Brook, New Jersey) make TCD leak detectors that can be used in plant applications. The TCDs used in these two instruments give positive and negative signals since ambient air is the carrier. The use of ambient air means that the instrument is ideal for detecting CO₂, argon, helium, Freon® and other gasses with thermal conductivities that differ greatly from air. The TCD instruments are not designed for detection of flammable gasses.

2.5.2 Ion Mobility Spectrometers

Ion mobility spectrometry (IMS), an uncommon detection method, shows promise as a more universal detection method than either flame ionization or photoionization.

Graseby Ionics Analytical Division of Watford, England, is currently producing a compact instrument, designated the AVM (advanced vapor monitoring), using IMS technology. The AVM weighs 5.7 lbs and measures approximately 15" x 6"x 3" (l x h x w). Operating temperature range is 0-40 °C, at 10-90% relative humidity. The AVM is powered by a rechargeable 6 V Ni-Cad battery with an operating window of 5 hours. The AVM also contains optional data logging capabilities with PC/AT downloading for spectral analysis using a Graseby Ionics advanced signal processing board. The AVM/IMS system has sensitivity in the ppb range. It also contains a ⁶³Ni radioactive source. According to correspondence dated July, 1991, Graseby will be opening a U.S. facility in Orlando, Florida, in the fall of 1991.

2.5.3 Fiber Optic Chemical Sensor

A new instrument using a fiber optic chemical sensor (FOCS) is about to be introduced to the portable analyzer market by Fiber Chem, Inc. (Las Vegas, Nevada). The FOCS consists of a fiber optic waveguide containing a hydrocarbon specific coating on the side of a bare core. The intensity of reflected light from the fiber tube to the detector is dependent on the hydrocarbon concentration. A change in the refractive index on the fiber optic tube "leaks light out." Less light is returned to the detector, producing a linear response proportional to the concentration. The sensor has a 50-150,000 ppm range with a resolution of 10 ppm.

2.5.4 UE Systems, Inc.

UE Systems, Inc. (Elmsford, New York) manufactures an ultrasonic instrument for locating leaks called the Ultraprobe 2000. The Ultraprobe is based on the principle that forcing a fluid through a small opening creates turbulence on the downstream side known as "white noise." The white noise produced by a leak is ultrasonic noise, which is easily picked up by the Ultraprobe sensor gun. The ultrasonic waves are heterodyned to produce an audible sound that is heard through earphones.

The ultrasound system can not give concentration information, but an operator can, with experience, locate and somewhat quantify a leak in plant equipment. Loud ambient noise does not effect the Ultraprobe. Because of the short wavelengths of high frequency soundwaves, equipment emitting competing ultrasonic sounds can often have the signal blocked by something as simple as a clipboard.

2.5.5 Miscellaneous

One of the logistical problems associated with fugitive emission monitoring is the identification of individual valves and flanges. Even a small chemical plant can have thousands of components that are eligible for Method 21 screening. The number of hours required to identify, tag, and log all the applicable components is enormous. A possible solution to this dilemma is to identify the components with a bar code. During screening, the operator simply scans the bar code label with a portable reader and enters the concentration information on the reader keypad. The information can then be readily downloaded or printed, simplifying both reporting and preventive maintenance procedures.

SECTION 3

PORTABLE ANALYZER USERS

To evaluate the current use of portable analyzers in industry, eight companies (petroleum, chemical, contractor/consultant, listed in Appendix C) were contacted regarding their instrument use. Questions were asked regarding:

- Types of instrument used;
- Frequency of use;
- Problems encountered with instruments;
- Calibration procedures; and
- The procedures for handling mixtures of chemicals.

The responses had a major impact on the conclusions and recommendations of this report.

3.1 Instruments in Use

The Foxboro OVAs, Models 108 and 128, were easily the predominant analyzers in use by the companies surveyed. The Bacharach TLV Sniffer and the HNu PI-101 were the next most common instruments. Finally, the Foxboro MIRAN and Thermo Environmental 712 were each used by one company.

3.2 Frequency of Use

All eight companies used the OVA as their primary portable analyzer for emissions inventories and leak detection preventive maintenance. The frequency of use ranged from daily to two weeks per year, with weekly use being most common. The

TLV Sniffer was used by four companies for less than 20% of emissions measurements. The PI-101 was used by two companies for an average of three weeks per year.

3.3 Instrument Problems

The OVA (the most frequently used instrument) had the highest number of responses regarding problems. Some problems were also encountered with the TLV, HNu, MIRAN, and 712 although low frequency of use for these four instruments precluded a large number of responses. Also, some respondents reported no problems at all.

Most of the problems were minor and were common to all of the respondents. The most frequently reported problems are discussed below, by instrument type.

3.3.1 OVA

The Foxboro OVA 108 and 128 were cited as being adversely affected by high humidity resulting in an approximate 20% sensitivity reduction to organics. Pump failures and repairs to the pre-amplifier were also reported as a result of moisture. In cold weather, OVAs were reported as having flame-out or ignition problems, as well as reduced sensitivity. Another common problem encountered with the 108 and 128 occurred with the dilution probe. Problems associated with calibrating and calibration drift were common. Often the dilution assembly was only reliable for 2 hours after calibration.

The miscellaneous complaints leveled against the OVA included one response that it was "always in the shop for repairs." Filter clogging was a problem, but was solved using glass wool in the probe tip. Breaking of the probe-to-pack wires was cited as a shortcoming. Finally, one respondent stated a reduced response to acetaldehyde. The OVA response factor for this compound, as determined by Radian for U.S. EPA

Emission Measurement Branch², is 8.77, and a "reduced response" would be expected. There was one response indicating that "standard zero air" was unsuitable for zeroing the 128 on the x1 scale. Ultra-high pure (UHP) zero air was needed to render the lower 20% of the scale readable.

Aside from the dilution probe problems mentioned above, there were no responses indicating drift problems. All companies reported calibrating their OVA's "by the manufacturer's guidelines" for the initial daily calibration and then according to Method 21, as required. The calibration gas used most often was methane, but no problems were reported when using butadiene, ethylene oxide, or hexane. One company reported calibrating after every flame-out. Generally, however, one low calibration (100-500 ppm) and one high calibration (8000-10,000 ppm) were used at the beginning of the day for all calibrations. Linearity was reported as good with such a two point calibration, but historical data demonstrate that linearity can be a problem. Some companies reported a single calibration point of 10,000 ppm for leak detection surveys, but a high-low calibration for reporting/certification programs.

3.3.2 TLV

The TLV Sniffer, like the OVA, showed a problem in high humidity conditions. Temperature extremes were also indicated as being a problem -- both heat and cold caused fluctuations in performance.

Additionally, the TLV response time was cited as being barely within the 30 second Method 21 time limit, thus making the instrument slow and difficult to use in screening programs. The design of the zero adjust knob was also the subject of a complaint: its location made it easy to bump, and thereby skew the low calibration. Two respondents noted a general problem with the low calibration, saying it was difficult to keep constant. One even went so far as to recommend against using the TLV if the leak definition concentration is lowered to 500 ppm.

Calibration of the TLV for Method 21 testing was done using high-low gases at 10,000 and 500 ppm. One company had used the TLV for ammonia detection and reported that it had determined a 4.8 response factor. The same company was one of the respondents that stated difficulty with low calibration of the TLV.

3.3.3 PI-101

The HNu PI-101 photoionization instrument, though used by only two companies, received the same complaint from both, that the bulbs burned out too quickly. No environmental problems with temperature or humidity were reported.

Calibration of the PI-101 was performed with benzene or isobutylene because of the lack of a PID response to methane. The problem of the PI-101 maximum scale reading at 2000 was approached the same way by both users: instruments were calibrated at 20% of full scale, with a maximum scale reading of 2000 equal to a real concentration of 10,000 ppm.

3.3.4 MIRAN and 712

The rarely-used MIRAN and 712 FID each received one comment. The MIRAN was deemed difficult to use because of interferences at the wavelength being used. The 712 received a complaint of being "maintenance intensive," a tendency to break down after a single use. The electronics of the 712 were susceptible to field upset. The calibration gas was methane, with no range problems encountered (the 712 has a 20,000 ppm maximum). The MIRAN has a set calibration library but, as noted in section 2.3, can be calibrated for specific compounds.

3.4 Mixtures of Chemicals

The calculation of response factors for mixtures of chemicals is not a well-documented area. When asked how they dealt with chemical mixtures in process lines, companies answered several different ways. The responses generally fell into three categories: (1) the response factor (Rf) of the mixture was calculated using the Rfs of the individual component and the mole fractions present, (2) the reading was recorded "as methane" or, (3) a single component Rf was used to determine quantities.

Method 21 does not describe a specific method for computing the response factor for a mixture of chemicals. About half of the respondents used the method below or a slight variation in dealing with mixtures. A response factor for a mixture was calculated as:

$$Rf_{\text{mix}} = (\text{Mole Fraction Gas 1} * Rf \text{ Gas 1}) + (\text{Mole Fraction Gas 2} * Rf \text{ Gas 2}) + \dots + (\text{Mole Fraction Gas } i * Rf \text{ Gas } i)$$

One variation of the above equation used an average of the Rfs multiplied by the weight percent of the chemical of interest to determine the Rf of the mixture. Another variation used the mole fraction of the chemical of interest multiplied by the Rf of the chemical of interest multiplied by the instrument response to obtain an emission concentration, as follows:

$$\text{Concentration} = \text{Instrument Reading} * Rf_x * \text{Mole Fraction}_x$$

Several companies reported using a notation of "as methane" when they recorded values. One company responded that the raw value was used to determine leaks for the "leak-no leak" method¹ of reporting, which classifies a component as either leaking or not leaking if it is under or over 10,000 ppm, respectively.

The method of using one Rf to determine total concentration was reported by two respondents. One used the highest Rf in the mixture, and one used the Rf of the predominant compound in the mixture. Neither used any mole fraction or weight percent of the chemical of interest in its calculation.

One contractor reported using the Rf and percentage stream codes provided by its client for application against the instrument responses.

3.5 Calculation of Response Factors for Mixtures

In the absence of specific instructions for calculation of a response factor for mixtures in Method 21, members of the user community are using a variety of procedures (Section 3.4) to determine some response factor for a mixture. A small study of binary mixtures with individual component response factors as well as mixture compositions encompassing a wide range indicated that the response factor of the mixtures was not a simple algebraic average of component response factors.² Individual response factors must be weighted appropriately to reflect the composition of the mixture. An appropriate weighting scheme which has been suggested is shown below.

$$\frac{1}{RF_{\text{mix}}} = \frac{VF_A}{RF_A} + \frac{VF_B}{RF_B} + \dots + \frac{VF_i}{RF_i}$$

where

VF_A = volume fraction of component A

RF_A = response factor for component A.

The expression has a [VF/RF] term for every component of the mixture.

For example, what is the response factor of a mixture which has equal volumes of two components with response factors of 2 and 10, respectively, where the true total volume concentration is 500 ppm?

The observed response of 250 ppm of the mixture with a response factor of 2 is $250 \text{ ppm}/2$, or 125 ppm.

The observed response of 250 ppm of the mixture with a response factor of 10 is $250 \text{ ppm}/10$ or 25 ppm.

The total observed response of this mixture should be $125 \text{ ppm} + 25 \text{ ppm}$, or 150 ppm. The response factor for the mixture is therefore [actual value/observed value] = $500/150$, or 3.33. The algebraic mean of the two response factors would be $6 (10+2/2)$, nearly twice the actual value.

Mathematically, the response factor for the mixture is calculated as:

$$\frac{1}{\text{RF}_{\text{mix}}} = 0.50/2 + 0.50/10 = 0.25 + 0.05 = 0.30$$

$$\text{RF}_{\text{mix}} = 3.33$$

SECTION 4

CONCLUSIONS AND RECOMMENDATIONS

The number of portable analyzers available for fugitive emissions monitoring has grown significantly in the past 5 years. Lowering of the concentration which defines a leak from 10,000 ppm to 500 ppm will expand the number of usable instruments even more, by approximately three-fold. The combination of a lower concentration to define a leak and the increased scrutiny of environmental air quality regulations has and will continue to force companies to refine their emissions estimates. Portable instrument use will necessarily continue to rise in answer to these demands.

Section 4.1 summarizes the positive and negative instrument characteristics found in the survey. Section 4.2 contains the recommendations for areas that need further research. Section 4.3 includes recommendations concerning expanded EPA involvement.

4.1 Instrument Characteristics

The majority of instruments covered in this report, including all of the most recent models, use digital LCD readouts. The distinct numbers and increased readability of the LCD display contribute to more precise readings and ease of use. By employing solid state circuitry, instruments lend themselves to data logging and PC/printer downloading, a property that is highly desirable when screening thousands of components.

Limited range prevented many instruments from being strictly included as viable Method 21 instruments, but the pending decrease in leak definition concentration would automatically bring them within range. The next most common barrier is the intrinsically safe design criterion. Rebuilding instruments to meet the Class I, Division 1, standards of the National Electric Code is being pursued by the manufacturers of several analyzers.

4.2 Research Areas

4.2.1 Response Factors

Response factors are a frequently researched area of portable instrument use. Even more information is needed for all instruments in order to develop consistency in reporting and instrument selection.

The most pressing area of concern for Rfs is quantifying emissions from mixtures. Instrument users noted a large inconsistency in reporting chemical mixtures resulting from confusion as to the correct Rf to use in such situations. Respondents used either no Rf, only one Rf, or a weighted Rf for reporting purposes. Laboratory research is needed on actual emission concentrations from pipes containing multiple chemicals, using pipes and valves with controlled leak rates. An important part of these investigations would be mathematical modeling. Test streams of three-, four-, and five-chemical mixtures are suspected of behaving differently from two-component mixtures.

The response factors for inorganics are especially lacking in documentation. Inorganics, therefore, merit attention both as singular emissions and in mixtures.

4.2.2 Instruments

Side-by-side comparisons can be made in a controlled environment to determine instrument performance characteristics and similarity of instruments using the same type of detector. Equally important as a follow-up is a field test of similar instruments (using the same detector) to determine comparability. The same laboratory/field comparisons should be made using instruments with differing detectors to determine comparability between instruments. Finally, instrument linearity over wide concentration ranges needs to be documented to determine whether a single Rf is sufficient for a single chemical, or whether multiple or weighted Rfs should be developed.

4.2.3 New Sensors

Detectors that are more universal are needed for comprehensive fugitive emission inventories. Instruments using new sensor technology should be tested against proven analyzers to determine comparability and applicability. Linear response over a concentration range is also a significant concern to be addressed by new analyzers.

4.3 Other Areas of Interest

Under current regulations any individual with an approved portable analyzer (i.e., an analyzer that meets Method 21 guidelines) can test for gaseous fugitive emissions. As emissions estimates become more refined and more stringent permitting requirements are imposed, the qualifications and ability of an individual to correctly measure emissions from equipment will become an issue.

To ensure competence, certification of individual testers, much like visible emission certification (smoke school), may be a course of action. Independent testing of individual contractors' instruments by a third party is also a possibility. More feasible, would be the development of a "standard leak." A component could be assembled with a permeation tube inside a heated vessel to provide the pollutant.

Compliance audits are required to aid in the evaluation of tester competence. EPA Method 5 stack tests are sometimes subject to EPA audit while testing is in progress. The same effort could be made with fugitive emission testing in large chemical plants. Performance audit screenings by EPA members following testers could be used for measurement comparisons. Auditors would also observe the physical screening of components and calibrations throughout the day.

A compilation of the EPA protocols and the industry guidelines into one volume would serve to standardize the fugitive emission arena.

SECTION 5
REFERENCES

1. "Protocols for Generating Unit-Specific Emission Estimates for Equipment Leaks of VOC and VHAP." EPA Report Number 450/3-88-010. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC. October, 1988.

2. "Method 21 Evaluation for the HON (90-ME-07)". EPA 450/4-92-012. EPA Contract Number 68D90054. Prepared by J.T. Bursey, J.A. Sokash, Radian Corporation, Research Triangle Park, NC.

APPENDIX A

METHOD 21

METHOD 21-DETERMINATION OF VOLATILE ORGANIC COMPOUNDS LEAKS

1. Applicability and Principle.

1.1 Applicability. This method applies to the determination of volatile organic compound (VOC) leaks from process equipment. These sources include, but are not limited to, valves, flanges and other connections, pumps and compressors, pressure relief devices, process drains, open-ended valves, pump and compressor seal system degassing vents, accumulator vessel vents, agitator seals, and access door seals.

1.2 Principle. A portable instrument is used to detect VOC leaks from individual sources. The instrument detector type is not specified, but it must meet the specifications and performance criteria contained in Section 3. A leak definition concentration based on a reference compound is specified in each applicable regulation. This procedure is intended to locate and classify leaks only, and is not to be used as a direct measure of mass emission rates from individual sources.

2. Definitions.

2.1 Leak Definition Concentration. The local VOC concentration at the surface of a leak source that indicates that a VOC emission (leak) is present. The leak definition is an instrument meter reading based on a reference compound.

2.2 Reference Compound. The VOC species selected as an instrument calibration basis for specification of the leak definition concentration. (For example: if a leak definition concentration is 10,000 ppmv as methane, then any source emission that results in a local concentration that yields a meter reading of 10,000 on an instrument calibrated with methane would be classified as a leak. In this example, the leak definition is 10,000 ppmv, and the reference compound is methane.)

2.3 Calibration Gas. The VOC compound used to adjust the instrument meter reading to a known value. The calibration gas is usually the reference compound at a concentration approximately equal to the leak definition concentration.

2.4 No Detectable Emission. Any VOC concentration at a potential leak source (adjusted for local VOC ambient concentration) that is less than a value corresponding to the instrument readability specification of section 3.1.1 (c) indicates that a leak is not present.

[Revised by 55 FR 25604, June 22, 1990]

2.5 Response Factor. The ratio of the known concentration of a VOC compound to the observed meter reading when measured using an instrument calibrated with the reference compound specified in the application regulation.

2.6 Calibration Precision. The degree of agreement between measurements of the same known value expressed as the relative percentage of the average difference between the meter readings and the known concentration to the known concentration.

2.7 Response Time. The time interval from a step change in VOC concentration at the input of the sampling system to the time at which 90 percent of the corresponding final value is reached as displayed on the instrument readout meter.

3. Apparatus.

3.1 Monitoring Instrument.

3.1.1 Specifications.

a. The VOC instrument detector shall respond to the compounds being processed. Detector types which may meet this requirement include, but are not limited to, catalytic oxidation, flame ionization, infra red absorption, and photoionization.

[b. - e. revised and f. added by 55 FR25604, June 22, 1990]

b. Both the linear response range and the measurable range of the instrument for each of the VOC to be measured, and for the VOC calibration gas that is used for calibration, shall encompass the leak definition concentration specified in the regulation. A dilution probe assembly may be used to bring the VOC concentration within both ranges: however, the specifications for instrument response time and sample probe diameter shall still be met.

c. The scale of the instrument meter shall be readable to ± 2.5 percent of the specified leak definition concentration when performing a no detectable emission survey.

d. The instrument shall be equipped with an electrically driven pump to insure that a sample is provided to the detector at a constant flow rate. The nominal sample flow rate, as measured at the sample probe tip, shall be 0.10 to 3.0 liters per minute when the probe is fitted with a glass wool plug or filter that may be used to prevent plugging of the instrument.

e. The instrument shall be intrinsically safe as defined by the applicable U.S.A. standards (e.g., National Electric Code by the National Fire Prevention

Association) for operation in any explosive atmospheres that may be encountered in its use. The instrument shall, at a minimum, be intrinsically safe for Class 1, Division 1 conditions, and Class 2, Division 1 conditions, as defined by the example Code. The instrument shall not be operated with any safety device, such as an exhaust flame arrestor, removed.

f. The instrument shall be equipped with a probe or probe extension for sampling not to exceed 1/4 in. in outside diameter, with a single end opening for admission of sample.

3.1.2 Performance Criteria.

[(a) and (b) revised by 55 FR 25604, June 22, 1990]

a. The instrument response factors for each of the VOC to be measured shall be less than 10. When no instrument is available that meets this specification when calibrated with the reference VOC specified in the applicable regulation, the available instrument may be calibrated with one of the VOC to be measured, or any other VOC, so long as the instrument then has a response factor of less than 10 for each of the VOC to be measured.

b. The instrument response time shall be equal to or less than 30 seconds. The instrument pump, dilution probe (if any), sample probe, and probe filter, that will be used during testing, shall all be in place during the response time determination.

c. The calibration precision must be equal to or less than 10 percent of the calibration gas value.

d. The evaluation procedure for each parameter is given in Section 4.4.

3.1.3. Performance Evaluation Requirements.

- a. A response factor must be determined for each compound that is to be measured, either by testing or from reference sources. The response factor tests are required before placing the analyzer into service, but do not have to be repeated as subsequent intervals.
- b. The calibration precision test must be completed prior to placing the analyzer into service, and at subsequent 3-month intervals or at the next use whichever is later.
- c. The response time test is required prior to placing the instrument into service. If a modification to the sample pumping system or flow configuration is made that would change the response time, a new test is required prior to further use.

3.2 Calibration Gases. The monitoring instrument is calibrated in terms of parts per million by volume (ppmv) of the reference compound specified in the applicable regulation. The calibration gases required for monitoring and instrument performance evaluation are a zero gas (air, less than 10 ppmv VOC) and a calibration gas in air mixture approximately equal to the leak definition specified in the regulation. If cylinder calibration gas mixtures are used, they must be analyzed and certified by the manufacturer to be within a 2 percent accuracy and a shelf life must be specified. Cylinder standards must be either reanalyzed or replaced at the end of the specified shelf life. Alternately, calibration gases may be prepared by the user according to any accepted gaseous standards preparation procedure that will yield a mixture accurate to within ± 2 percent. Prepared standards must be replaced each day of use unless it can be demonstrated that degradation does not occur during storage.

Calibrations may be performed using a compound other than the reference compound if a conversion factor is determined for that alternative compound so that the

resulting meter readings during source surveys can be converted to reference compound results.

4. Procedures.

4.1 Pretest Preparations. Perform the instrument evaluation procedures given in Section 4.4 if the evaluation requirements of Section 3.1.3 have not been met.

4.2 Calibration Procedures. Assemble and start up the VOC analyzer according to the manufacturer's instructions. After the appropriate warmup period and zero internal calibration procedure, introduce the calibration gas into the instrument sample probe. Adjust the instrument meter readout to correspond to the calibration gas value.

NOTE- If the meter readout cannot be adjusted to the proper value, a malfunction of the analyzer is indicated and corrective actions are necessary before use.

4.3 Individual Source Surveys.

4.3.1 Type I - Leak Definition Based on Concentration. Place the probe inlet at the surface of the component interface where leakage could occur. Move the probe along the interface periphery while observing the instrument readout. If an increased meter reading is observed, slowly sample the interface where leakage is indicated until the maximum meter reading is obtained. Leave the probe inlet at this maximum reading location for approximately two times the instrument response time. If the maximum observed meter reading is greater than the leak definition in the applicable regulation, record and report the results as specified in the regulation reporting requirements. Examples of the application of this general technique to specific equipment types are:

a. **Valves** - The most common source of leaks from valves is at the seal between the stem and housing. Place the probe at the interface where the stem exits the packing gland and sample the stem circumference. Also, place the probe at the interface of the packing gland take-up flange seat and sample the periphery. In addition, survey valve housings of multipart assembly at the surface of all interfaces where a leak could occur.

b. **Flanges and Other Connections** - For welded flanges, place the probe at the outer edge of the flange-gasket interface and sample the circumference of the flange. Sample other types of nonpermanent joints (such as threaded connections) with a similar traverse.

c. **Pumps and Compressors** - Conduct a circumferential traverse at the outer surface of the pump or compressor shaft and seal interface. If the source is a rotating shaft, position the probe inlet within 1 cm of the shaft-seal interface for the survey. If the housing configuration prevents a complete traverse of the shaft periphery, sample all accessible portions. Sample all other joints on the pump or compressor housing where leakage could occur.

d. **Pressure Relief Devices** - The configuration of most pressure relief devices prevents sampling at the sealing seat interface. For those devices equipped with an enclosed extension, or horn, place the probe inlet at approximately the center of the exhaust area to the atmosphere.

e. **Process Drains** - For open drains, place the probe inlet at approximately the center of the area open to the atmosphere. For covered drains, place the probe at the surface of the cover interface and conduct a peripheral traverse.

f. **Open - Ended Lines or Valves** - Place the probe inlet at approximately the center of the opening to the atmosphere.

g. Seal System Degassing Vents and Accumulator Vents - Place the probe inlet at approximately the center of the opening to the atmosphere.

h. Access Door Seals - Place the probe inlet at the surface of the door seal interface and conduct a peripheral traverse.

4.3.2 Type II - "No Detectable Emission". Determine the local ambient concentration around the source by moving the probe inlet randomly upwind and downwind at a distance of one to two meters from the source. If an interference exists with this determination due to a nearby emission or leak, the local ambient concentration may be determined at distances closer to the source, but in no case shall the distance be less than 25 centimeters. Then move the probe inlet to the surface of the source and determine the concentration described in 4.3.1. The difference between these concentrations determines whether there are no detectable emissions. Record and report the results as specified by the regulation.

For those cases where the regulation requires a specific device installation, or that specified vents be ducted or piped to a control device, the existence of these conditions shall be visually confirmed. When the regulation also requires that no detectable emissions exist, visual observations and sampling surveys are required. Examples of this technique are:

a. Pump or Compressor Seals - If applicable, determine the type of shaft seal. Perform a survey of the local area ambient VOC concentration and determine if detectable emissions exist as described above.

b. Seal System Degassing Vents, Accumulator Vessel Vents, Pressure Relief Devices - If applicable, observe whether or not the applicable ducting or piping exists. Also, determine if any sources exist in the ducting or piping where emissions could occur prior to the control device. If the required ducting or piping exists and there

are no sources where the emissions could be vented to the atmosphere prior to the control device, then it is presumed that no detectable emissions are present. If there are sources in the ducting or piping where emissions could be vented or sources where leaks could occur, the sampling surveys described in this paragraph shall be used to determine if detectable emissions exist.

4.3.3 Alternative Screening Procedure. A screening procedure based on the formation of bubbles in a soap solution that is sprayed on a potential leak source may be used for those sources that do not have continuously moving parts, that do not have surface temperatures greater than the boiling point or less than the freezing point of the soap solution, that do not have open areas to the atmosphere that the soap solution cannot bridge, or that do not exhibit evidence of liquid leakage. Sources that have these conditions present must be surveyed using the instrument techniques of 4.3.1 or 4.3.2.

Spray a soap solution over all potential leak sources. The soap solution may be a commercially available leak detection solution or may be prepared using concentrated detergent and water. A pressure sprayer or a squeeze bottle may be used to dispense the solution. Observe the potential leak sites to determine if any bubbles are formed. If no bubbles are observed, the source is presumed to have no detectable emissions or leaks as applicable. If any bubbles are observed, the instrument techniques of 4.3.1 or 4.3.2 shall be used to determine if a leak exists, or if the source has detectable emissions, as applicable.

4.4 Instrument Evaluation Procedures. At the beginning of the instrument performance evaluation test, assemble and start up the instrument according to the manufacturer's instrument for recommended warmup period and preliminary adjustments.

4.4.1 Response Factor. Calibrate the instrument with the reference compound as specified in the applicable regulation. For each organic species that is to be measured during individual source surveys, obtain or prepare a known standard in air at a concentration of approximately 80 percent of the applicable leak definition unless limited by volatility or explosivity. In these cases, prepare a standard at 90 percent of the saturation concentration, or 70 percent of the lower explosive limit, respectively. Introduce this mixture to the analyzer and record the observed meter reading. Introduce zero air until a stable reading is obtained. Make a total of three measurements by alternating between the known mixture and zero air. Calculate the response factor for each repetition and the average response factor.

Alternatively, if response factors have been published for the compounds of interest for the instrument or detector type, the response factor determination is not required, and existing results may be referenced. Examples of published response factors for flame ionization and catalytic oxidation detectors are included in Bibliography.

[4.4.1 amended by 55 FR 47472, November 14, 1990]

4.4.2 Calibration Precision. Make a total of three measurements by alternately using zero gas and the specified calibration gas. Record the meter readings. Calculate the average algebraic difference between the meter readings and the known value. Divide this average difference by the known calibration value and multiply by 100 to express the resulting calibration precision as a percentage.

4.4.3 Response Time. Introduce zero gas into the instrument sample probe. When the meter reading has stabilized, switch quickly to the specified calibration gas. Measure the time from switching to when 90 percent of the final stable reading is attained. Perform this test sequence three times and record the results. Calculate the average response time.

5. Bibliography

[5. revised by 55 FR 47472, November 14, 1990]

1. Dubose, D.A., and G.E. Harris. Response Factors of VOC Analyzers at a Meter Reading of 10,000 ppmv for Selected Organic Compounds. U.S. Environmental Protection Agency, Research Triangle Park, NC. Publication No. EPA 600/2-81-051. September 1981.

2. Brown, G.E., et al. Response factors of VOC Analyzers Calibrated with Methane for Selected Organic Compounds. U.S. Environmental Protection Agency, Research Triangle Park, NC. Publication No. EPA 600/2-81-110, September 1981.

3. DuBose, D.A., et al. Response of Portable VOC Analyzers to Chemical Mixtures. U.S. Environmental Protection Agency, Research Triangle Park, NC. Publication No. EPA 600/2-81-110. September 1981.

APPENDIX B

MANUFACTURERS' ADDRESSES

AIM USA
12919 Southwest Freeway, Suite 146
Stafford, TX 77477
P. O. Box 770540
Houston, TX 77272-0540
(713) 240-5020

Arizona Instrument Corporation
1100 East University Drive
P. O. Box 1930
Tempe, AZ 85280
(602) 731-3400, (800) 528-7411

Bacharach, Inc.
625 Alpha Drive
Pittsburgh, PA 15238
(412) 963-2000

Baseline Industries, Inc.
Subsidiary of Mine Safety Appliance Co.
North Star Route
Box 649
Lyons, CO 80540
(303) 823-321-4665

CEA Instruments, Inc.
16 Chestnut Street
Emerson, NJ 07630
(201) 967-5660

The Foxboro Company
P. O. Box 500
600 N. Bedford Street
East Bridgewater, MA 02333
(508) 378-5556

Gas Tech, Inc.
8445 Central Avenue
Newark, CA 94560-3431
(415) 794-6200

Gow-Mac
P. O. Box 32
Bound Brook, NJ 08805
(201) 560-0600

Graseby Ionics Ltd., Analytical Division
Park Avenue, Bushey, Watford,
Herts, England WD2 2BW
(0923) 81616600

HNu Systems, Inc.
160 Charlemont Street
Newton Highlands, MA 02167-9987
(617) 964-6690

Heath Consultants Incorporated
100 Tosca Drive
P. O. Box CS-200
Stoughton, MA 02072
(617) 344-1400, (800) 432-8487

Matheson Gas Equipment Technology
166 Keystone Drive
Montgomeryville, PA 18936
(215) 641-2700

McNeill International
37914 Euclid Avenue
Willoughby, OH 44094
(216) 953-0005, (800) 626-3455

MSA International
Instrument Division
P. O. Box 426
Pittsburgh, PA 15230
(412) 967-3256, (800) 672-4678

Mobay Corporation/ Compur Monitors Group
7015 West Tidwell, Suite G106
Houston, TX 77092-2028
(713) 93901103, (800) 828-7239

Sensidyne, Inc.
16333 Bay Vista Drive
Clearwater, FL 34620
(813) 530-3602, (800) 451-9444

Sentex Sensing Technology, Inc.
553 Broad Avenue
Ridgefield, NJ 07657
(201) 945-3694

Spectronics Corporation
956 Brush Hollow Road
P. O. Box 483
Westbury, NY 11590
(516) 333-4840, (8000) 274-8888

Thermo Environmental Instruments, Inc.
8 West Forge Parkway
Franklin, MA 02038
(508) 520-0430

UE Systems
12 Main Street
Elmsford, NY 10523
(914) 592-1220, (800) 223-1325

APPENDIX C

RESPONDENTS' ADDRESSES

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11807 Port Road
Seabrook, TX 77586**

**R.G. Wood
Clear Lake, Texas Plant
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Houston, TX 77258-0190**

**Anne Coogan-Acevedo
Newark Terminal
354 Doremus Avenue
Newark, NJ 07105-4872**

Union Carbide Corporation

**Patricia George
P. O. Box 8361, Bldg. 770
Charleston, WV 25303**

**Mike Douglass
P. O. Box 50, Bldg. 731
Hahnville, LA 70057**

Mobil Chemical Corporation

**R.S. Anderson
Olefins/Aromatics Plant
P. O. Box 3868
Beaumont, TX 77704**

Texas Eastman Corporation

**Pat Pickle
P. O. Box 7444
Longview, TX 75604-7444**

International Technology

Gary Anderle
1006 North Bowen Road
Arlington, TX 76012

Enviroplan, Inc.

Estelle Simpson
3 Becker Farm Road
Roseland, NJ 07068

Darbonne Services, Inc.

Rt. 4, Box 1478
Lake Charles, LA 70611
(No name given)

C-K Associates, Inc.

Daniel Wolf/Bob Lingard
17170 Perkins Road
Baton Rouge, LA 70810

APPENDIX D
CONTACT SHEETS



CONTACT SHEET WA#9

Introduction: Identify self and Radian

Working on EPA contract -- "Survey of Portable Analyzers for Measurement of Fugitive Emissions"

Definition of Fugitive Emission testing being "in accordance with method 21"

Objective: To survey manufacturers and the user community to determine the available instruments for fugitive emissions and the applications that have been made with the present equipment.

To document problems that have been encountered with the instruments and identify possible improvements to the method.

Instruments/Manufacturers:

Name (instrument) : _____

Company (address, phone, person contacted) : _____

A. Physical

1) Dimensions : _____

2) Weight : _____

3) Certified Intrinsically Safe : _____

Class _____

Division _____

Group(s) _____

4) Operational max and min temperature and humidity : _____

5) Ability to "sniff" valves/flanges (ie...does it have a single, narrow, exclusive, entry path for the air ? unlike the miran 1b) : _____

6) Operational time limit (hrs per charge) : _____

7) Time required to fully charge : _____

B. Detectors

1) Type of detector (FID, PID, etc) : _____

2) Range of detector (in ppm) : _____

can it be modified to read ppm instead of %... _____

3) Type of display (digital, analog, logarithmic) : _____

4) Definition of scale (can it be read at 90% of cal gas [450 & 9000] for response time test, can it be read to $\pm 5\%$ of leak definition number)

at 500 ppm: _____

at 10,000 ppm : _____

5) Response time : _____

C. Miscellaneous

1) Memory/Storage of points : _____

2) Computer download of data : _____

3) Calibration

a) ease (set points, accessibility, how often) : _____

b) cal. gas (alternatives to methane) : _____

4) Rezeroing/Clear time for readings over 500 ppm : _____

CONTACT SHEET WA#9

Introduction: Identify self and Radian

Working on EPA contract -- "Survey of Portable Analyzers for Measurement of Fugitive Emissions"

Definition of Fugitive Emission testing being "in accordance with method 21"

Method 21 Criteria: Instrument must...

- 1) Respond to the compound of interest...compound being screened
- 2) Measure the concentration at leak definition criteria (presently 10,000 ppm)
- 3) Have a scale defined to $\pm 5\%$ of the leak definition
- 4) Be intrinsically safe
- 5) Have a response factor of less than 10 for the compound being measured
- 6) Have a response time of less than 30 seconds
- 7) Have a calibration precision of $\leq 10\%$ of the calibration gas.

Objective: To survey manufacturers and the user community to determine the available instruments for fugitive emissions and the applications that have been made with the present equipment.

To document problems that have been encountered with the instruments and identify possible improvements to the method.

USER COMMUNITY:

Name (contact) : _____

Company (address, phone) : _____

Types of Instruments used (in last 2 years)

OVA 108 ____ (# of times)

OVA 128 ____

Miran 1Bx ____

Thermo Environmental

580-b ____ (PID)

580-s ____ (PID)

710 ____ (FID)

712 ____ (FID)

HNu PI101 ____

Others:

(1) Baseline Industries "Gascorder" (PID or FID)

(2) MSA "Photon" (PID)

(3) Aim USA "AIM 815, 2000, 3000"

(4) CEA "Gaseker GS4"

(5) CEA "TG-KA" (halogenated)

(6) Gastech "82series, GX-86, 4320"

(7) TLV Sniffer

Problems encountered with each instrument used (even if minor):

OVA 108 _____

OVA 128 _____

Miran 1Bx _____

Thermo Environmental

580-b _____

580-s _____

710 _____

712 _____

HNu PI101 _____

Others:

(1) Baseline Industries "Gascorder" (PID or FID)

(2) MSA "Photon" (PID)

(3) Aim USA "AIM 815, 2000, 3000"

(4) CEA "Gaseeker GS4"

(5) CEA "TG-KA" (halogenated)

(6) Gastech "82series, GX-86, 4320"

(7) TLV Sniffer

Have any instruments used ever experienced trouble operating in;

heat (Y N)? cold (Y N)? humidity (Y N)?

If yes to any of the above give Instruments, Temperatures, and Humidity below...

Did any instrument ever have trouble meeting the method 21 criteria. (Mainly response times and calibration precision.)

Exactly what are the calibration procedures being used : _____

What have been the results of using alternate calibration gases (non-methane)

How are scales of less than 2000 ppm treated for leak detection purposes, if a leak is defined as 10,000 ppm ? (The HNu for instance)

How are mixtures dealt with, response factor-wise? Mixtures where more than one component that will respond to the instrument is present in the process stream being monitored.



