



Advanced Air Monitoring

Instrumentation, Telemetry, Data Visualization, and Response
Strategies



Welcome to the Continuing Challenge Advanced Air Monitoring Course

Today's Instructors include:

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Today's discussions to include:

- Introduction to common and emerging instrumentation
- Telemetry systems and data acquisition tools
- Plume modeling and remote meteorological tools
- Deployment strategies for response and removal activities with case studies
- Instrumentation choice and positioning rationale
- Closing Discussions

Every year, EPA receives around 19,000 notifications via the National Response Center, managed by USCG, related to spills, explosions, and fires in the environment.

These incidents range in size and can threaten human health, the environment, the economic viability of a community, and the availability of critical infrastructure, such as drinking water systems.

It is critical to stay current with the most innovative and cutting edge monitoring technologies to provide the most accurate and immediate real-time data to make timely informed decisions during an emergency.



Modern air monitoring technology is allowing us the ability to demonstrate real-time data for an array of specialized CBRN instrumentation both remotely and in-situ using advanced telemetry and data visualization tools.

Air monitoring incorporates the use of direct-reading instruments to produce real-time data. Air sampling uses instruments such as sampling pumps designed to draw air through a specific media to collect a sample. This sample is then sent to a laboratory for analysis. For the purposes of this module, we will only be discussing air monitoring.



Standard entry monitoring equipment includes: multi-gas indicators that have multiple sensors that are interchangeable and in standard entry situations instruments generally provide concentrations of oxygen, hydrogen sulfide, lower explosive limit, carbon dioxide, and volatile organic compounds; a toxic gas meter that generally tests for volatile organic compounds if the multi-gas indicator does not already do so; a radiation meter; and potentially compound specific meters if you have previous knowledge indicating one may be necessary such as a benzene monitor for a gas production facility.



Additional Air monitoring instrumentation may include particulate monitors and specialized chemical specific instrumentation.



RAE Systems Technologies

RAE Systems by Honeywell has been developing air monitoring technology since it was founded in 1991. The company holds over 40 chemical sensor patents in the detection-sensor field, which include patents for photoionization, wireless, and radiation technologies.

EPA currently maintains a suite of AreaRAE Pro and MultiRAE Pro instruments and maintains licensing for Honeywell's proprietary SafetySuite telemetry Software program.

Benefits to utilizing RAE Systems instrumentation include:

- Widespread distribution of RAE systems products
- Simplified data sharing and cross-connectivity with users from different agencies
- Industry reputation for safety and reliability

- Built-in meteorological sensor data capabilities (AreaRAE Pro)
- Ease of use; standard interface

Limitations include:

- Maintaining instrument licensing is costly
- Proprietary telemetry system is not designed to interface with other data viewing or visualization technologies
- Technology relies mainly on radio frequency and line-of-site instead of Wifi based or bluetooth technologies



AreaRAE Pro

- Monitors up to seven threats, including Gamma radiation , VOCs, combustibles, Toxics and Oxygen
- PPB performance level on VOCs measurement
- Dedicated gamma sensor slot

- Local weather station
- SafetySuite Software and Multi-Agency collaboration
- VIPER capable
- Wireless technology sends real-time data to command station up to two miles (3km) away
- Secondary radio module (Mesh) act as an communication Hub for other wireless devices
- Sensors include: VOC, LEL, CO2, NH3, CO, Cl2, ETO, H2, HCL, HCN, HF, H2S, O2, SO2, NO, NO2, PH3, Gamma



MultiRAE

Handheld Monitor that is capable of monitoring both chemical threats and gamma radiation and is the only multi-threat monitor with parts per billion for VOCs

- More than 25 different chemical sensors
- Man down alarm

- Simple maintenance with replaceable sensors, pump, and battery
- Common operating system across all RAE Systems instruments

Chlorine (Cl₂)

Sensor Type:	Electrochemical
Range:	0 to 50 ppm
Resolution:	0.1 ppm
Stabilization/Equilibration:	No bias/10 min. after installation
Operating Temperature Range:	-4° F to 122° F (-20° C to 50° C)
Temperature Effect:	No effect on sensitivity or zero
Pressure Range:	Atmospheric ±10%
Operating Humidity:	5 to 95% RH non-condensing
Drift:	< 10% signal/6 months
Shelf Life:	6 months in sealed container
Storage Temperature:	32° F to 68° F (0° C to 20° C)
Operating Life:	2 years in air
Warranty:	1 year from date of shipment
Calibration Gas:	10 ppm Cl ₂ , balance N ₂
Part Number(s):	032-0121-000, 008-1116-001, 003-0978-000
Supported Instruments:	AreaRAE, MeshGuard, MultiRAE Family, MultiRAE-IR, MultiRAE Plus, QRAE Plus, ToxiRAE II, ToxiRAE Pro, VRAE, AreaRAE Plus, AreaRAE Pro

Cross-Sensitivity Data, Cl ₂ Sensor		
Gas	Concentration	Response
Br ₂	1 ppm	1 ppm
ClO ₂	1 ppm	3.5 ppm
CO	300 ppm	0 ppm
CO ₂	10 %	0 ppm
Ethanol	6.60%	0 ppm
H ₂	1,000 ppm	0 ppm
H ₂ S	20 ppm	-6 ppm ¹
HCl	20 ppm	0 ppm
HCN	10 ppm	0 ppm
Hydrocarbons	% range	0 ppm
N ₂	100%	0 ppm
NH ₃	65 ppm	0 ppm
NO	35 ppm	0 ppm
NO ₂	10 ppm	12 ppm
SO ₂	5 ppm	0 ppm

¹ - **CAUTION!** Negative cross-sensitivities may cause the sensor to produce low readings than the true concentration of gas in ambient air.

Limitations

- Sensitive to extreme temperatures and high humidity
- Sensor cross-sensitivities and correction factors
- Sensor soak times can be different for certain sensors

Honeywell Technical note 114:

https://sps.honeywell.com/content/dam/his-sandbox/products/gas-and-flame-detection/documents/Technical-Note-114_updated_03-26-2018.pdf

Chemical	Ionization Energy (eV)	Lamp 1 (9.8 eV)	Lamp 2 (10.6 eV)	Lamp 3 (11.7 eV)
Benzene	9.25	0.55	0.47	0.60
Ammonia	10.16	No Response	10.90	5.70
Methylene Chloride	11.32	No Response	No Response	0.89
Methane	12.61	No Response	No Response	No Response
Isobutylene (Cal Gas)	9.24	1.00	1.00	1.00

Utilizing Technical Notes

- Difficulty detecting chemicals with high ionization rates (i.e. > 10.6 eV)
- 3 different lamps for modified ranges

Honeywell Technical Note 106B:

<https://r9data.response.epa.gov/r9responseguide/doc/FileStructure/Common/OtherReferenceDocuments/sps-his-tn-106b-multirae-series.pdf>



TVA 2020

The TVA 2020 functions as both a flame-ionization detector (FID) and PID. It can be used to detect organic and inorganic vapors in air. As a FID the TVA is highly sensitive to hydrocarbons. As a PID, the unit is very sensitive and can detect inorganic compounds the FID cannot. The Dual PID/FID detector allows the user more options to determine compound present in unknown environment.

- Leak Detection and Repair (LDAR) and EPA Method 21
- Compounds with high ionization energies (i.e. Methane)
- Non-specific detection of VOCs
- FID uses a hydrogen cylinder to function

PID/FID Response factors:

<https://r9data.response.epa.gov/r9responseguide/MainPage/OtherReferenceDocuments.html>



SPM Flex

The SPM Flex is a portable, single point Chemcassette® tape-based monitor that detects more exotic gases including isocyanates, hydrides, mineral acids, oxidizers and amines.

Features include:

- Internal Datalogging
- VIPER capability for remote visualization
- IP65 waterproof rating
- Wide array of chemicals

Limitations:

- Tapes are climate dependent
- Tapes Expire quickly and, once opened, have a limited use window
- No training cassette available

- must be refrigerated or kept frozen
- Complicated technical specification sheet

Technical Specifications: https://prod-edam.honeywell.com/content/dam/honeywell-edam/sps/his/en-us/products/gas-and-flame-detection/documents/spm_flex_gases.pdf?download=false



Installing a SPM Flex Tape



Draeger X-PID 9500

The selective PID gas measurement device is ideal for users who frequently test for hazardous toxic substances. Benzene, butadiene and other volatile organic compounds (VOCs) are carcinogenic in the small concentrations. The gas measurement device allows for short test times and lab-quality results.

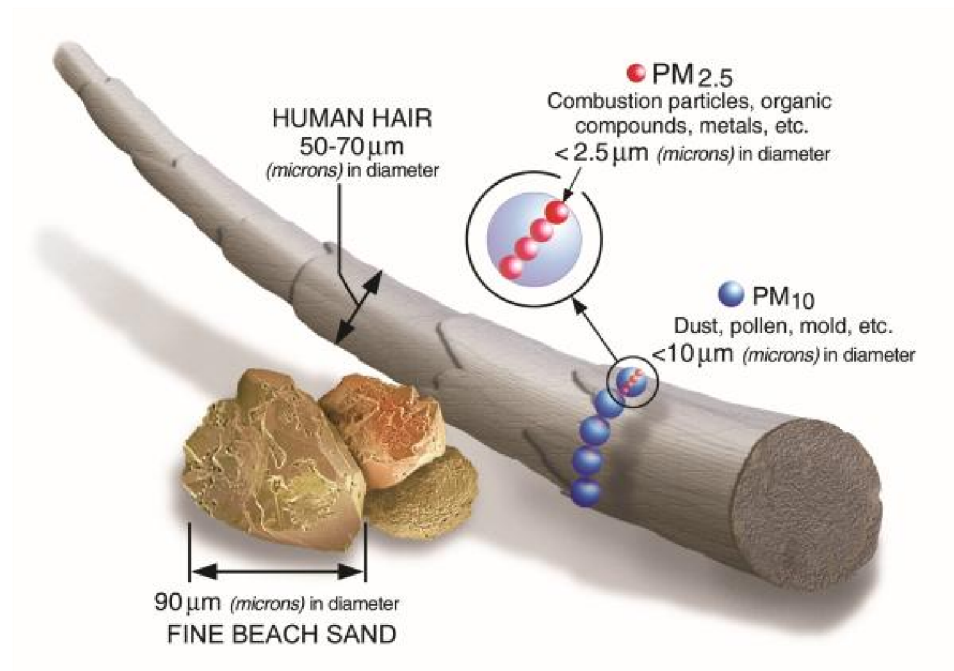
The gas measurement device is based on gas chromatography (GC) and photoionization detection (PID) technologies.

“Seeker” mode allows continuous, direct-reading measurement of the total concentration of all VOCs present. “Seeker” mode is similar to using a single-PID gas measurement device.

“Analysis” mode allows selective measurement for monitoring specific toxic compounds. Predefined target compounds can be precisely

measured in seconds. “Analysis” mode is similar to gas chromatography analyzes conducted in the laboratory.

Particulates in Air



Particulate Monitoring



Sidepak AM-520



The AM-520 is designed to take measurements from the workers breathing zone to provide both real-time aerosol mass concentration readings of dusts, fumes, mists, smoke and fog; as well as a new response concentration that can display a secondary aerosol reading for respirable silica or diesel particulate matter ($.08\mu\text{m}$) applications. The L-scattering laser photometer conducts real-time aerosol mass concentration and response concentration readings of respirable dust respirable silica and diesel particulate matter (DPM, $.08\mu\text{m}$) within a worker breathing zone.

PM10, PM4 (Respirable), PM5 (China Respirable), PM2.5, PM1 and DPM Cyclone kits.



Dusttrak Instruments

The Dusttrak is a light-scattering laser photometer that gives you real-time aerosol mass readings and collects a gravimetric sample. It uses a

sheath air system that isolates the aerosol in the optics chamber to keep the optics clean for improved reliability and low maintenance.

- Aerosols, PM1, PM2.5, respirable, PM10
- Automatic zeroing (with adaptor)
- Manual and programmable data logging functions
- Aerosol concentration range 0.001 to 400 mg/m³
- Environmental Enclosure
- Heater attachment



Limitations

- High humidity can cause errors
- Manual zeroing with handheld unit
- 6-hour RT with 4-hr recharge
- Routine maintenance of dust filter
- Survey vs. Manual Data mode
- Annual factory calibration and maintenance is required



XAM-8000

- 1- to 7 gas detection device.
- Detection of toxic and combustible gases as well as vapors and oxygen.
- Functions with hoses of up to 45 meters in length.
- Easy to switch between diffusion and pump mode.
- Two high-performance PID sensors. The PID HC covers a measurement range of 0 to 2,000 ppm (Isobutene).
- The PID LC ppb is particularly suited for a measurement range of 0 to 10 ppm (Isobutene) with a high resolution in the range below 1 ppm.
- Pre-Tube Benzene measurements



Lumex 915-M

Real time detection of mercury vapor in air and reports data at ng/m^3 .

The Lumex is a portable multifunctional atomic absorption spectrometer with Zeeman background correction, which eliminates the effect of interfering impurities. The Lumex 915 is the only instrument is approved for clearance surveys during removal actions.

- Both active and passive air monitoring
- Range $5\text{--}50,000 \text{ ng}/\text{m}^3$, active; $200,000 \text{ ng}/\text{m}^3$ passive monitoring
- Designed to determine mercury content in ambient air, water, soil, natural and stack gases, dental and medical testing and diagnostics, analysis of food and marine life.



Jerome 505, Jerome 405, Jerome 431X are Mercury vapor analyzer instruments. Jerome 505 is the only non - gold film instrument that performs real time Mercury Vapor Analyzer is a portable fluorescence spectroscopy analyzer, instrument J505 Mercury Vapor Analyzer is a portable fluorescence spectroscopy analyzer, which allows the detection cell to be simpler, smaller, lighter weight and more durable than competing spectroscopy instruments. . The Jerome 431X and 405 are and the gold film technology that requires regeneration and are not as accurate as atomic absorption technology ..

Thank You