Direct reading monitors for public health exposures

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Air Monitoring vs Air Sampling

Air Monitoring

Direct read – real time data

Good to determine responder PPE

Limited chemical specific monitors

Generally higher detection limits

May not be low enough to determine public health actions

Newer instruments can log or record data over time.

Air Sampling

Usually involves sending to laboratory for analysis.

Lower detection limits – often needed for public health exposure limits

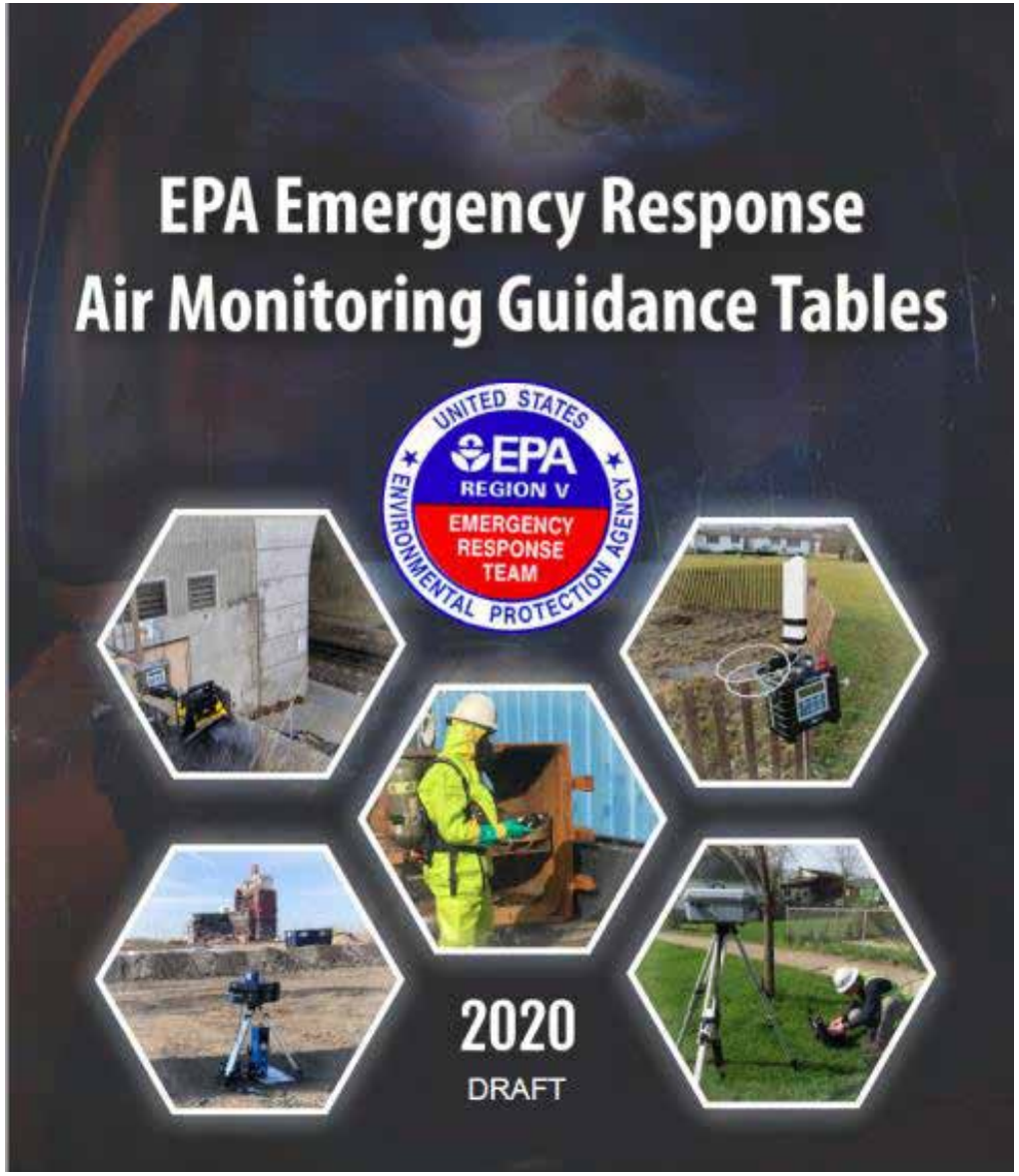
Greater accuracy

May require longer sampling times to reach public health requirements

Gives a more accurate assessment of exposure over time

Where to Look for Guidance on Monitoring

Located on RRT5.org

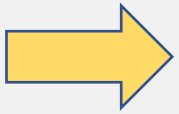


Example Guidance Table 10 – (Oil Spill, chemical Release, or Fire)

	Instrument Guidance						Regulatory Guidance							Reference		
							Occupational Action Levels		AEGL-1			PAC-1	ERPG-1	Air Sampling		
Target Compound[1]	Instrument	Detection Level	Intrinsically Safe (Y/N)	IP	LAMP, CF (ISO)	Conversion	TWA	IDLH	1-hr	4-hr	8-hr	15-min TWA	1-hr	Media	Method	Flow Rate/ Total Volume
VOCs and Gases																
Benzene	UltraRAE PGM-7360 (benzene specific mode)**	0.05-200 ppm	Y	9.24 eV	9.8 lamp, 0.55	1 ppm = 3.19 mg/m^3	PEL = 1 ppm, ST 5 pm REL = 0.1 ppm, ST 1 ppm TLV = 0.5 ppm, ST 2.5 ppm	500 ppm	52 ppm	18 ppm	9 ppm	52 ppm	50 ppm	Sorbent Tube, Anasorb CSC, 226-01/Summa Canister/Tedlar bag	NIOSH 1501 TO-15 TO-3	≤0.2 L/min; 5-30 L ≤200 mL/min
	Dräger Tube	0.25-2 ppm, 2-10 ppm	Y		NA											
	Dräger Chip	0.2-10 ppm	Y													
	MultiRAE/AreaRAE PID**	0-2000 ppm	Y		10.6 lamp, 0.47											
	TVA 2020***	0.5-2,000 ppm (PID) 1-10,000 ppm (FID)	Y		10.6 lamp 0.294 (10 ppm) - 0.282 (1000 ppm)											

BTEX Exposure Limits

- C –ceiling – cannot exceed; ST-STEL-15 minute exposure
- ACUTE – 1 – 14 days of exposure; CHRONIC – 365 days or longer
  - Is this the only time someone would be exposed to BTEX?



Chemical	OSHA PEL	Cal/OSHA PEL	NIOSH REL	ACGIH TLV	AEGL -1 8 hr	ATSDR MRL ACUTE	ATSDR MRL CHRONIC
Benzene	1 ppm (ST) 5 ppm	1 ppm (ST) 5 ppm	0.1 ppm (ST) 1 ppm	0.5 ppm (ST)2.5 ppm (1996)	9 ppm	0.009 ppm	0.003 ppm
Toluene (Z37.12-1967)	200 ppm (C) 300 ppm	10 ppm (ST)150ppm (C) 500 ppm	100 ppm (ST)150ppm	20 ppm (2006)	67 ppm	2 ppm	1 ppm
Ethylbenzene	100 ppm	5 ppm (ST)30 ppm	100 ppm (ST)125ppm	20 ppm (2021)	33 ppm	5 ppm	0.06 ppm
Xylenes	100 ppm	100 ppm (ST)150ppm (C)300ppm	100 ppm (ST) 150 ppm	20 ppm (2021)	130 ppm	2 ppm	0.05 ppm

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When you measure total VOCs with a 4- gas

- What is the benzene concentration?
- We need chemical specific monitors which read low levels

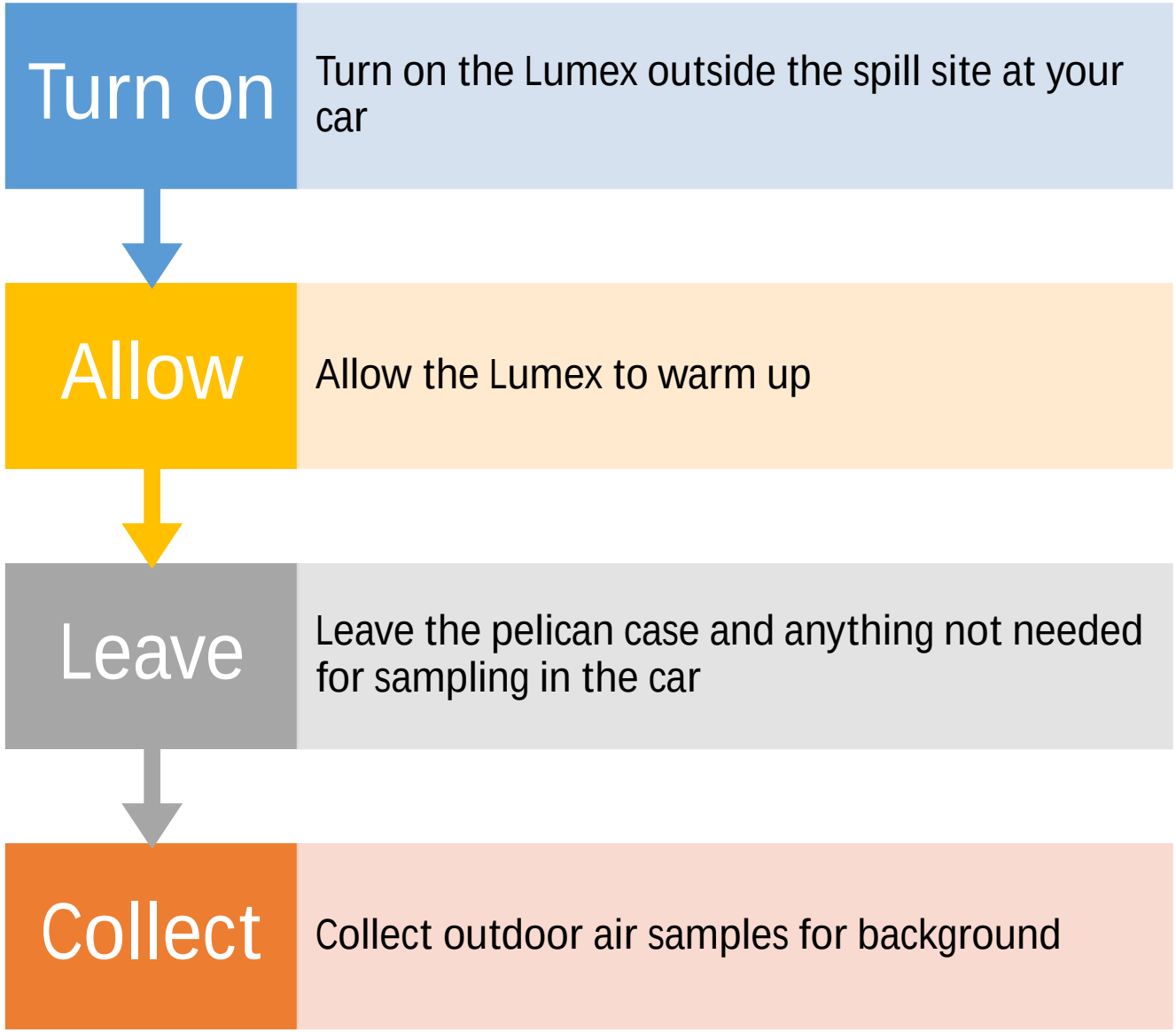
Cases where we have used chemical specific monitors

- Mercury spills
- Sulfur compounds in farm irrigation water
- Sulfur compounds from food processing
- Petroleum spills
- Smoke from structure fires

Example Using a Mercury Vapor Analyzer

- Lumex
- Detection limit: 0.5 ng/m3
  - Varies by model
- Real time monitoring

Begin Screening



Avoid contaminating the Lumex while screening

- Start the Lumex at your car.
- Leave case for the Lumex in your car
- Once on your shoulder do not set it down
- Do not touch the nozzle directly to surfaces

What to look for during the screening?

Do not enter - if measurement inside door is greater than 10,000 ng/m³

What are the levels throughout the site?

What are the spikes?

Is the mercury vapor isolated to one area?

Investigation log

Contact Information		
Name:		Date: / /
Address:		City:
County:	Zip:	Phone: ( )
Reported by:		
Instrument Information		
Lumex model (Reg. or Light):	%R:	Temperature:
Incident Information		
Spill location setting:		Incident date: / /
Estimated amount spilled:		
Mercury source:	Brand name:	
Model:	Serial #:	
Number of people present when spill occurred:		
# Pregnant:	# Children:	Children's ages:
Measures taken:		

Spill area map:

Investigators:

Units are in (circle one) | ng/m3 ug/m3			
Location	**Reading**	**Location**	**Reading**

First entry

- Collect samples as you open the door. Use these to determine next steps

*When deciding upon actions. consider whether the mercury is confined to an area that can be sealed off from the rest of the building

Indoor Concentrations		Suggested Action*	Discussion
ng/m³	µg/m³		
<1,000	<1	Occupants can remain in building	The level below which occupants may choose to stay in the building for the duration of the cleanup.
Between 1,000 and 10,000	Between 1 and 10	Evacuate sensitive populations.	Values in this range may require a site-specific plan to minimize exposure for sensitive populations. Keep windows open for adequate fresh air exchanges.
>10,000	>10	Isolate residents from the exposure or evacuate occupants. Do not characterize further.	This situation should be handled by professionals.
>50,000	>50	Evacuate occupants. Do not characterize further.	The Lumex tends to be less accurate in the higher range. Actual concentrations may be much higher and more acutely hazardous. This situation should be handled by professionals.

Breathing zone

- Children's breathing zone: Floor to ~3 feet
- Adult breathing zone: 4-5 feet
- Collecting samples in these regions is representative of what someone would be breathing

Floor / spill zone

- Screening the floor helps located mercury missed during clean-up
- Focus on cracks, molding, floor seams, areas where a bead of mercury could hide

Screening levels for objects

- Making decisions on disposing of an item.
- If the item is not important to the owner, it is often easiest to dispose of it.
- Place items in plastic bags and screen headspace

Indoor Concentration		Suggested Action	Discussion
ng/m^3	$\mu g/m^3$		
<1,000	**<1**	Items **may be acceptable** to keep.	No hotspots at carpet surface. Porous materials (throw rugs, upholstered furniture, linens, clothing) may be aired out in the sun – DO NOT LAUNDER. Hard surfaces can be cleaned, then aired out in the sun. Consider re-screening items before returning to use.
Between 1,000 and 10,000	**Between 1 and 10**	Items **may not be acceptable** to keep.	Remove and dispose of affected carpeting and padding. Err on the side of caution and dispose of other affected materials. (Antiques and heirlooms may be exceptions.) Or, air out items for weeks in a warm, non-living space and consider re-screening before returning to use.
>10,000	**>10**	Items **should not be kept**.	

Post clean-up levels

- Used for re-occupancy and to measure effectiveness of cleanup
- Screen indoor air
- NIOSH 6009 provides a laboratory quality result for legal purposes

Indoor Concentration**		Suggested Action	Discussion
ng/m^3	$\mu g/m^3$		
<1,000	**<1**	Clean-up is **sufficient for re-occupancy of residential structure.**	Value assumes pregnant women and/or children under the age of 6 years live in the affected dwelling.
<3,000	**<3**	Clean-up **may be sufficient for re-occupancy of non-residential structure.** Use professional judgment for areas having sensitive populations (e.g., schools, daycares, clinics). NIOSH 6009 testing may be recommended.	Clearance number is not applicable to occupational settings where mercury is normally handled.

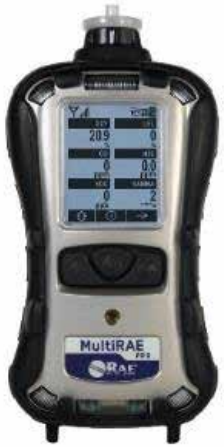
**All source mercury and contaminated items have been removed and adequate ventilation has occurred. Measurement is taken from breathing zone.

Real Time Monitoring and Air Sampling Methods for ER

Air monitoring

- Selectivity
- Resolution/Sensitivity/Range
- Calibration
- Environmental conditions
- Correction factors
- Response times
- Sensor cross-sensitivities
- Sensor poisons/overexposure
- Intrinsic safety

Monitoring instrumentation
VOC and Gas Detection



- RAE SYSTEMS
- MultiRAE Pro
- Benzene Ultra RAE
- AreaRAE Network

Monitoring instrumentation VOC and Gas Detection

MULTIRAE PRO and AREA RAE electrochemical sensors

- AMMONIA
- CHLORINE
- CHLORINE DIOXIDE
- HYDROGEN CYANIDE
- PHOSPHINE
- SULPHUR DIOXIDE
- ETHYLENE OXIDE

SINGLE SENSOR CONSIDERATIONS

- TEMPERATURE EFFECTS
- SHELF LIFE OF SENSORS
- CROSS SENSITIVITIES
- ATMOSHERIC PRESSURE

Monitoring instrumentation chemical specific instruments

SINGLE POINT MONITOR (SPM)

SPM FLEX

SPM flex – colorimetric chemical specific tape monitor

AVAILABLE TAPES

- ARSINE
- PHOSPHINE
- HYDROGEN SULFIDE
- MINERAL ACIDS
- CHLORINE
- HYDRAZINE
- HYDROGEN PEROXIDE
- FLUORINE
- AMMONIA
- NITROGEN DIOXIDE
- CHLORINE DIOXIDE
- PHOSGENE
- HYDROGEN CYANIDE
- SULPHUR DIOXIDE

TAPE CONSIDERATIONS

- LIFE SPAN/SHELF LIFE FOR CASSETTE TAPES
- TAPE STORAGE – LIGHT AND TEMPERATURE SENSITIITIES
- WIDE RANGE IN RESPONSE TIMES FOR VARIOUS TAPES
- INTERFERENCES
- CROSS SENSITIVITIES

SPM flex – colorimetric chemical specific tape monitor

- AVAILABLE TAPES
  - ARSINE
  - PHOSPHINE
  - HYDROGEN SULFIDE
  - MINERAL ACIDS
  - CHLORINE
  - HYDRAZINE
  - HYDROGEN PEROXIDE
  - FLUORINE
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Monitoring instrumentation particulates

AEROSOL MONITORS

TSI DUSTTRAK

Air sampling methods – mobile lab

SUMMA CANISTERS

TEDLAR BAG W/VACUUM BOX

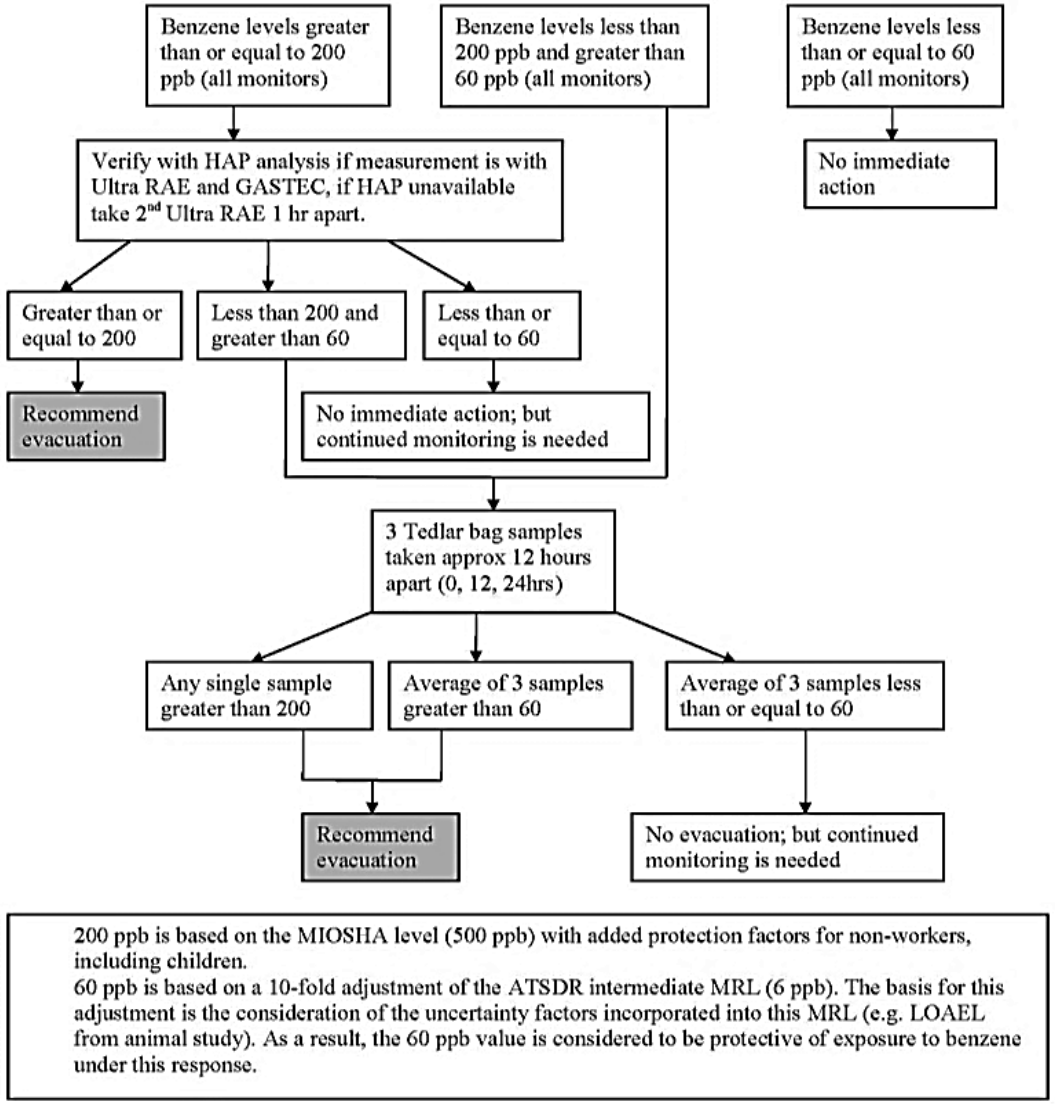
AIR SAMPLING PUMPS W/MEDIA

Air sampling EPA TAGA Mobile Lab

Air sampling hapsite

- Civil Support Teams
- Can be set up on site to analyze Tedlar bag samples
- Chemical specific results
- ppb detection limits
- Useful to supplement monitoring instruments for quick turnaround data

Monitoring combined with sampling can be used for evacuation and re-occupancy



200 ppb is based on the MIOSHA level (500 ppb) with added protection factors for non-workers, including children.
60 ppb is based on a 10-fold adjustment of the ATSDR intermediate MRL (6 ppb). The basis for this adjustment is the consideration of the uncertainty factors incorporated into this MRL (e.g. LOAEL from animal study). As a result, the 60 ppb value is considered to be protective of exposure to benzene under this response.

Questions?