

# Mercury Response



What have we learned?



# Instructors

- EPA Region 10
  - NR Spill Line
    - 1-800-424-8802
    - Region 10
      - 206-553-1263
  - Greg Weigel, OSC
    - 208-378-5773
  - Bob Whittier, OSC
    - 907-271-3247
- START/Ecology & Environment, Inc:
  - Eric Lindeman
  - (206) 624-9537



# Objectives



- Mercury – physical properties
- Uses
- Health effects
- Interaction with other materials
- Response tactics

# Objectives

- The Spill: Where it goes when it's free
- The Sequence of a Response
- The Hunt: Ways to find the mercury
- The Removal: How to clean the mercury
- The Call: When to call it clean
  - Why should first responders care?

# Where does Mercury come from?

- Mineral – Cinnabar
  - Mercuric sulfide ( $\text{HgS}$ ) – red
- Latinized Greek - Hydrargyria
- History –
  - Chinese - medicines (prolongs life, heal fractures, maintain good health)
  - Greeks - ointments
  - Egyptians and Romans – cosmetics
  - Lewis and Clark Expedition – Syphilis
    - Mercury (II) Chloride (s)

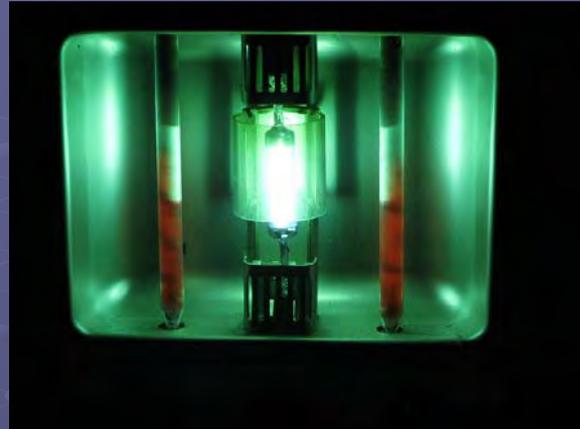


# Collecting elemental mercury from gas condensation in Sierra Nevada range, CA.



# Not So Ancient History

- Switches
- Lamps
- Lab equipment
- Thermometers
- Barometers
- Manometers
- Sphygmomanometers
- Float valves
- Thermostats
- Computers
- Batteries
- Vaccines



Examples of some products that contain mercury.



# It was just sitting there and ...

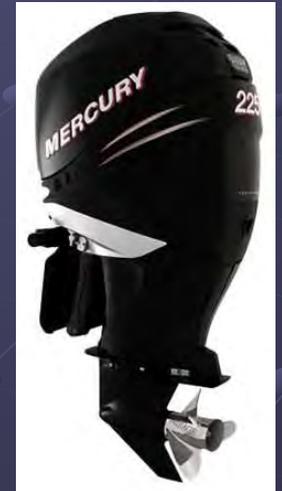
- Gold and silver mining
- Metal recycling
- Storage





# Don't Get Confused!

- Other types of mercury
  - Inorganic salts
    - Mixes with sulfur, chloride or oxygen
  - Organic compounds
    - Methylmercury
    - Phenylmercury
    - Thimerosal (sodium ethylmercurithiosalicylate)
- We are **ONLY** discussing **ELEMENTAL MERCURY**







# NIOSH Pocket Guide

<b>Mercury compounds [except (organo) alkyls] (as Hg)</b>		<b>CAS</b> 7439-97-6 (metal)	
<b>Hg (metal)</b>		<b>RTECS</b> <a href="#">OV4550000</a> (metal)	
<b>Synonyms &amp; Trade Names</b> Mercury metal: Colloidal mercury, Metallic mercury, Quicksilver Synonyms of "other" Hg compounds vary depending upon the specific compound.		<b>DOT ID &amp; Guide</b> 2809 <a href="#">172</a> (metal)	
<b>Exposure Limits</b>	<b>NIOSH REL:</b> Hg Vapor: TWA 0.05 mg/m <sup>3</sup> [skin] Other: C 0.1 mg/m <sup>3</sup> [skin]		
	<b>OSHA PEL</b> †: C 0.1 mg/m <sup>3</sup>		
<b>IDLH</b> 10 mg/m <sup>3</sup> (as Hg) See: <a href="#">7439976</a>		<b>Conversion</b>	
<b>Physical Description</b> Metal: Silver-white, heavy, odorless liquid. [Note: "Other" Hg compounds include all inorganic & aryl Hg compounds except (organo) alkyls.]			
MW: 200.6	BP: 674°F	FRZ: -38°F	Sol: Insoluble
VP: 0.0012 mmHg	IP: ?		Sp.Gr: 13.6 (metal)
FLP: NA	UEL: NA	LEL: NA	
Metal: Noncombustible Liquid			

# Critical Conversions

- $\text{ppm} = (\text{mg}/\text{m}^3)(24.45) / \text{MW}$ 
  - MW for Hg = 200.6
- $\text{mg}/\text{m}^3 = (\text{ppm})(\text{MW}) / 24.45$

1 g =  
1,000 mg  
1,000,000  $\mu\text{g}$   
1,000,000,000 ng



# Routes of Exposure

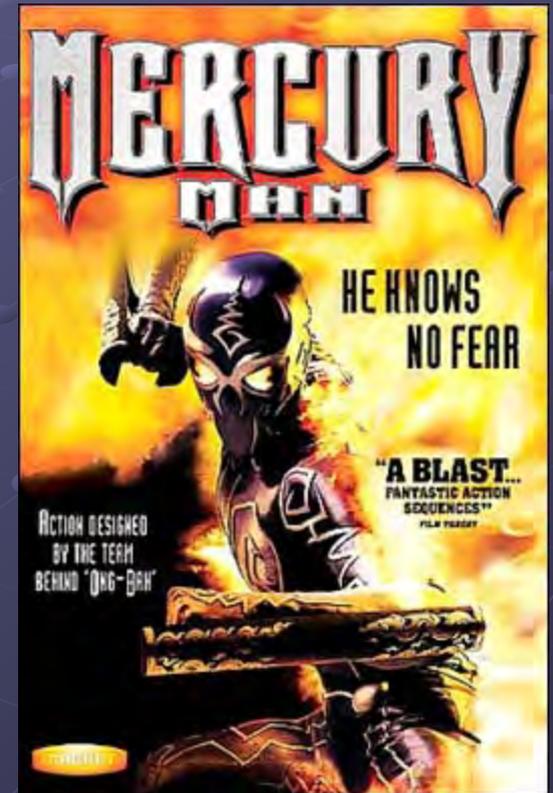
- Nonpolar, monatomic (one atom), Lipid-soluble
- Inhalation
  - Most common route
  - 90% of Hg inhaled is absorbed into bloodstream
- Ingestion
  - Less than 0.1% will be absorbed into bloodstream
  - (Note: 85% of metabolized mercury comes from fish)
- Skin/eye absorption
  - Very low, little risk of toxicity



EPA Region 10

# Mercury–Clinical Description (CDC)

- Target organs
  - Eyes, skin, respiratory system, CNS, kidneys
- Acute exposure –
  - Lung damage, nausea, vomiting, diarrhea, increases in blood pressure or heart rate, skin rashes, and eye irritation



# Mercury–Clinical Description (CDC)

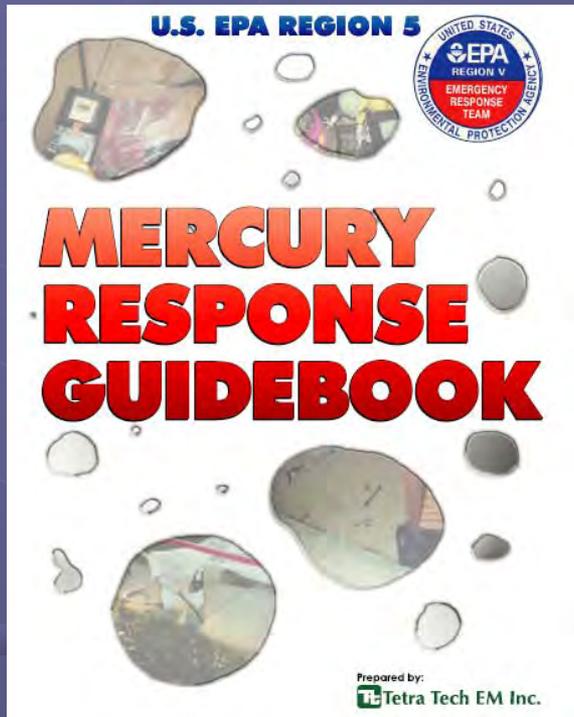
## Chronic Exposure

- Neurologic, dermatologic and renal manifestations.
- Neuropsychiatric disturbances (e.g., memory loss, irritability, or depression)
- Pneumonitis; tremor, insomnia, irritability, indecision, headache, lassitude (weakness, exhaustion); stomatitis, salivation; gastrointestinal disturbance, anorexia, weight loss; proteinuria

# Mercury – So what is the big deal?

- Mercury metabolized
  - Mercury is methylated (MeHg) where mercury readily crosses the blood-brain barrier causing the most damage to the nerves.
- Half life in blood – 7 to 10 days
- Minamata, Japan (1956) started mercury awareness, changed to methylmercury (took 5 yrs to ID problem)
- 1972, Iraq – fungicide MeHg used on grain (100s dead)

# References



- NIOSH Pocket Guide
- USEPA Region 5 Mercury Response Guidebook
- Metallic Mercury Emergency Spill Response Field Guide (ERT Edison, NJ)
- ATSDR Suggested Action Levels
- EPA Website for small residential spill  
<http://www.epa.gov/hg/spills/>



# Mercury

Contact Us Search:  All EPA  This Area  Go

You are here: [EPA Home](#) » [Mercury](#) » Mercury Releases and Spills

## Mercury Releases and Spills

You can prevent potential mercury exposure to you and your environment by:

- storing and handling responsibly products that contain mercury;
- following our tips when cleaning up mercury spills; and
- recycling or otherwise properly disposing of products that contain mercury.

### Cleaning Up Spills

- [What never to do after a mercury spill](#)
- [What to do if a thermometer breaks](#)
- **Other mercury spills**
  - [More than the amount in a thermometer, but less than one pound, which is about two tablespoons](#)
  - [More than two tablespoons \(one pound\)](#)

### Storing, Transporting and Disposing of Mercury

- [What to do if you have mercury in your home](#)
- [Packaging mercury for storage and transportation](#)
- [Recycling and disposal Options](#)

### Hazardous Waste Site Cleanup

- [Cleaning up Superfund and other hazardous waste sites where mercury is present](#)
- [Mercury Response Guidebook \(for emergency responders\)](#)

## Cleaning Up Spills

### What Never to Do After a Mercury Spill

- **Never** use a vacuum cleaner to clean up mercury. The vacuum will put mercury into the air and increase exposure.
- **Never** use a broom to clean up mercury. It will break the mercury into smaller droplets and spread them.
- **Never** pour mercury down a drain. It may lodge in the plumbing and cause future problems during plumbing repairs. If discharged, it can cause pollution of the septic tank or sewage treatment plant.
- **Never** wash clothing or other items that have come in direct contact with mercury in a washing machine, because mercury may contaminate the machine and/or pollute sewage. Clothing that has come into direct contact with mercury should be discarded. By "direct contact," we mean that mercury was (or has been) spilled directly on the clothing, for example, if you break a mercury thermometer and some of elemental mercury beads came in contact with your clothing.
- **Never** walk around if your shoes might be contaminated with mercury. Contaminated clothing can also spread mercury around.

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### What to Do if a Mercury Thermometer Breaks

**NOTE:** these instructions also apply to spills from other sources, if the amount spilled is less than or similar to the amount in a thermometer (see [specific information about how to clean up broken fluorescent bulbs](#))

- Have everyone else leave the area; don't let anyone walk through the mercury on their way out. Make sure all pets are removed from the area. Open all windows and doors to the outside; shut all doors to other parts of the house.
- DO NOT allow children to help you clean up the spill.
- Mercury can be cleaned up easily from the following surfaces: wood, linoleum, tile and any similarly smooth surfaces.
- If a spill occurs on carpet, curtains, upholstery or other absorbent surfaces, these contaminated items should be thrown away in accordance with the disposal means outlined below. Only cut and remove the affected portion of the contaminated carpet for disposal.



- Mercury Home
- Basic Information
- Where You Live
- Frequent Questions
- Releases and Spills
- Fish Consumption Advisories
- EPA's Roadmap for Mercury
- Power Plant Emissions
- Human Health
  - Human Exposure
  - Health Effects
  - Links & Resources
- Environmental Effects
- Consumer & Commercial Products
- Data & Publications
- Grants & Funding
- International Actions
- Laws & Regulations
- Science & Technology
- En español
- Site Map
- Related Links

# So What Is Too High

- Exposure limits
  - OSHA PEL – Ceiling  $0.1 \text{ mg/m}^3$   
( $100 \text{ } \mu\text{g/m}^3$  or  $10,000 \text{ ng/m}^3$ )
  - NIOSH REL -  $0.05 \text{ mg/m}^3$  (8-hour TWA)
  - ACGIH TVL –  $0.025 \text{ mg/m}^3$
  - Skin notation
    - Corrosive

# ATSDR Recommended Limits

## ● Residential

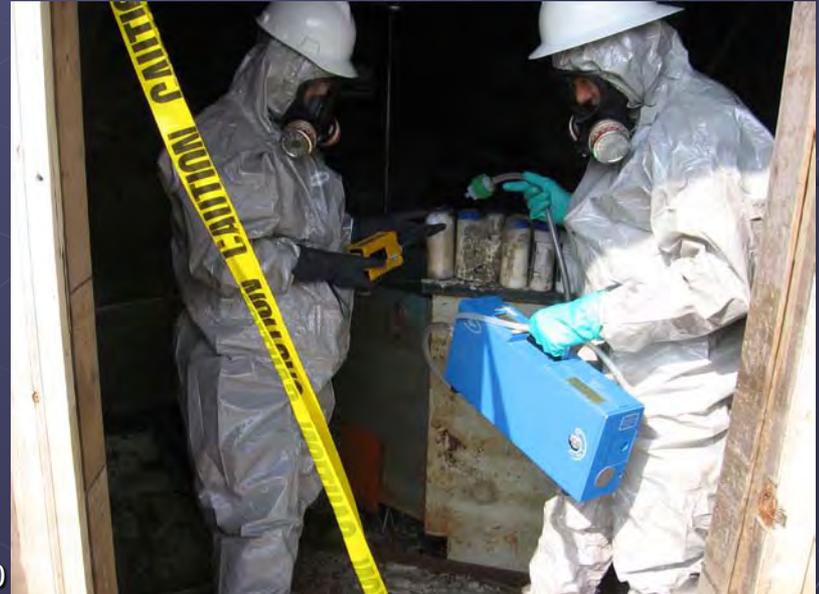
- $<1.0 \mu\text{g}/\text{m}^3$  – Acceptable occupancy level
- $>10.0 \mu\text{g}/\text{m}^3$  – Isolate residents from exposure
- $<10.0 \mu\text{g}/\text{m}^3$  – Allowable personal effects



# ATSDR Recommended Limits

## ● Occupational and Commercial Settings

- $<3.0 \mu\text{g}/\text{m}^3$  – Re-occupancy after spill
- $<25.0 \mu\text{g}/\text{m}^3$  – Occupational setting
- $>25.0 \mu\text{g}/\text{m}^3$  – PPE upgrade
- $>10,000 \mu\text{g}/\text{m}^3$  – IDLH \*



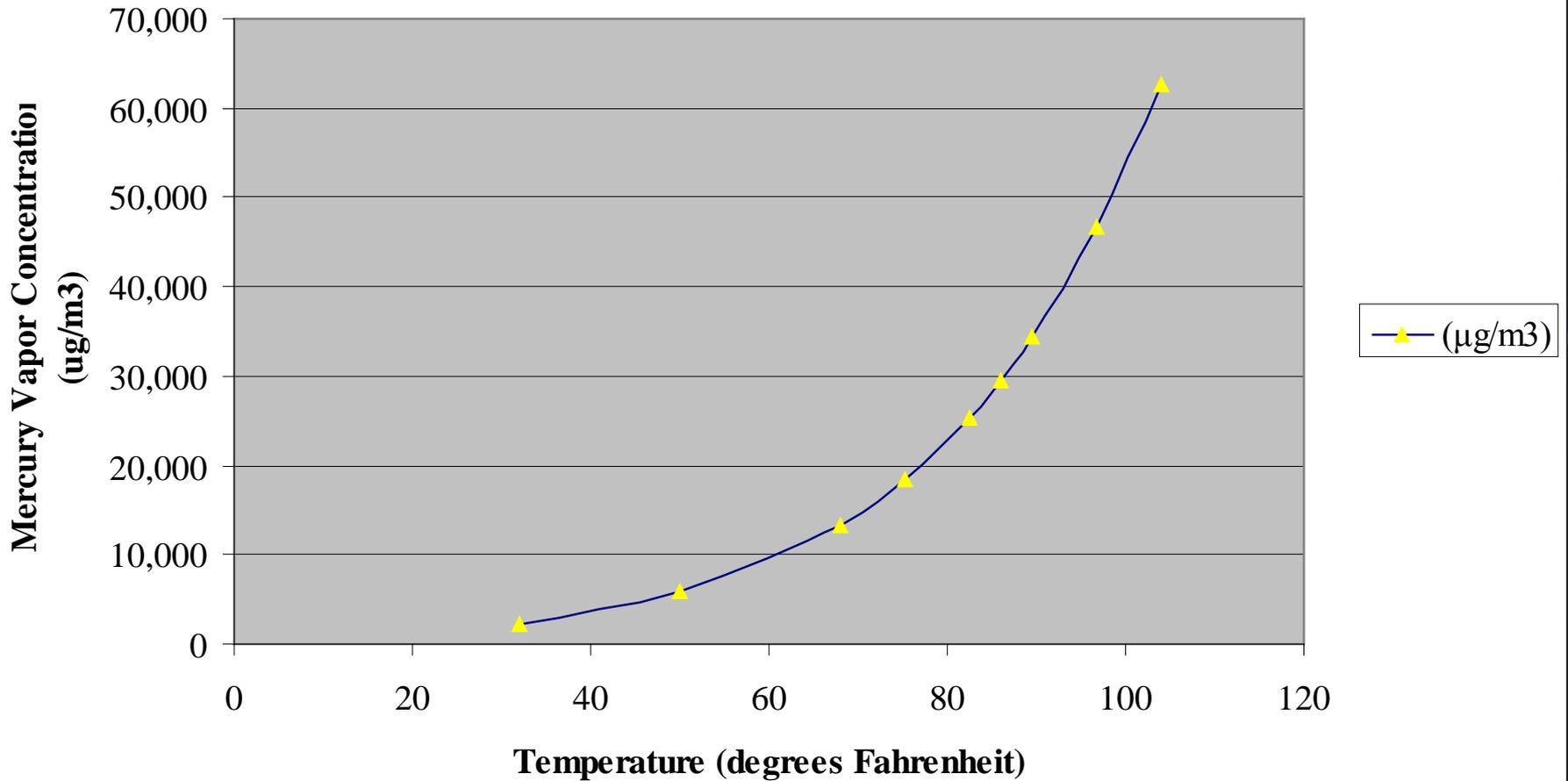


# Mercury Interaction with Other Materials

# Chemistry of Mercury

- Molecular weight – 200.6
- Vapor pressure – 0.0012 mmHg
- Forms covalent bonds
  - Weaker bonds (share electrons)
  - Not ionic bonds like other metals (take electrons)

## Mercury Vapor vs. Temperature



Data from OSHA web site Hazards of Mercury

# Chemistry of Mercury

- Like likes like

- Amalgamation with other metals

- Zinc
- Silver
- Gold
- Copper
- Uranium
- Sulfur, etc.



# Vapor vs. Beads

- Over 2-3,000  $\mu\text{g}/\text{m}^3$ 
  - Beads present
  - Will never vaporize away



# Mercury Interactions with Building Materials

- Mercury breaks down into smaller beads
- Sealed, Non-porous surfaces - OK
  - Paints
  - Metals
  - Walls
- Porous surfaces – Bad!
  - Concrete, wood, carpet, tiles, asphalt, etc.
- More later on clean up



# Protection Recommendations

Respirators and PPE

# Disclaimer

- Who sets your respiratory protection and PPE policy?
  - NFPA
  - OSHA
  - Organization guidelines
  - Company or department policy
- Ultimately, you must follow your requirements, however . . .

# ATSDR Guidelines

- OSHA PEL – 100  $\mu\text{g}/\text{m}^3$  – Ceiling
- NIOSH REL – 50  $\mu\text{g}/\text{m}^3$  – 8-hr TWA
- ACGIH TLV – 25  $\mu\text{g}/\text{m}^3$  – 8-hr TWA
- ATSDR Recommended Upgrade
  - $>25 \mu\text{g}/\text{m}^3$  – Full face APR
  - $>10,000 \mu\text{g}/\text{m}^3$  – IDLH – SCBA
- Our practice, to wear respirators at lower levels

# Respirator Cartridges

- EPA – Scott respirators
  - Mercury (chlorine) vapor cartridges
- ESLI – End of Life Service Indicator
  - Color change
  - Breakthrough time
- P100 – HEPA
  - Particulates



# PPE for Response

- Tyvek
- Nitrile
- Booties
- Optional
  - Hardhat



# Decon

- Critical to conduct to avoid spreading contamination
- Avoid stepping in contamination
- Plastic sheeting to step on and bag waste and PPE

# Decon

- Set up as close to contaminated site as possible as not to track contamination
- Multiple decon sites may exist
- Usually dry decon with with removal of PPE and Lumex screening on shoes, hands, etc.

# Basic Decon

## ● The Set Up

- Drop sheet
- Chairs
- Poly bag
- Lumex



● Wash hands and face after decon

● Full wash as soon as practicable



# Waste Disposal

- **Is it Hazardous or Non-Hazardous?**
- **Generator Knowledge vs. Analytical Testing**

# What have we learned from our responses?

- Public Health
- Residents and relocation
- School or site closures
- Exposures (Acute and Chronic)
- Spreading of contamination
- Disposal
- Public perception and involvement
- Outside agency involvement





# The Arsenal

What to grab when the site is hot!

# Mercury Response Capabilities

- Jerome
- Lumex
- Chips and Tubes
- Innov-X XRF
- Air Sampling Sorbent Tubes

# Lake City HS Example

- Floor Sink in Janitors Closet

$$100,000 \text{ ng/m}^3 = 0.1 \text{ mg/m}^3$$

$$\text{ppm} = 0.1 \text{ mg/m}^3 \times 24.45 / 200.6$$

$$0.01219 \text{ ppm mercury vapor}$$

# Jerome 431-X Mercury Vapor Analyzer

- Capabilities:

- Detects mercury vapor at the  $\mu\text{g}/\text{m}^3$  level and greater
- $3.0 \mu\text{g}/\text{m}^3$

- Limitations:

- May not detect mercury at lower levels
- 7 pounds

- Uses:

- Mercury spills such as thermometers, hydrometers, switches, pressure gauges

