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AIR SAMPLING FOR THE NON-INDUSTRIAL HYGIENIST

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Objectives

- Basic concepts and terminology of air sampling
- Units of concentration
- Exposure limits for air contaminants
- Methods of sampling strategy
- Appropriate use of and types of IH sampling equipment
- Hands on demonstrations



Basic Air Sampling

What is industrial hygiene?



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Chemical

Gases
Vapors
Fumes
Dusts
Fibers
Mists



Physical

Temperature
Noise
Repetitive Motion &
Awkward Postures
Ionizing & Non-
Ionizing Radiation



Biological

Fungi (Mold)
Bloodborne Pathogens
Bacteria
Poisonous Plants
Poisonous & Infectious
Animals

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Chemical Hazards

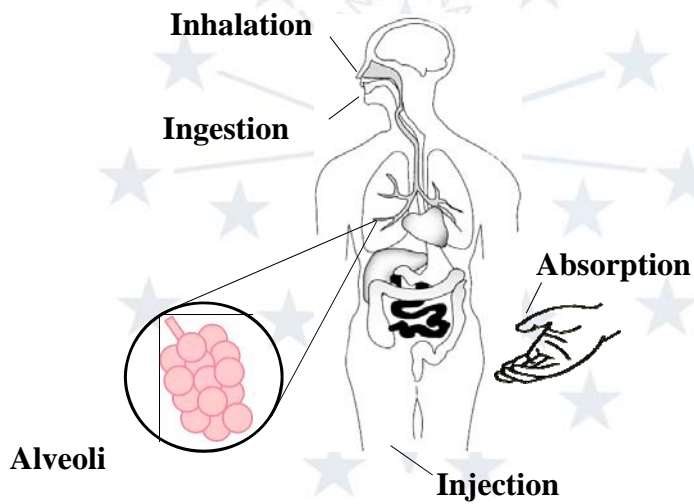
- **gases** (Carbon Monoxide, Carbon Dioxide, Acetylene, Oxygen)
- **vapors** (Acetone, Toluene, MEK)
- **fumes** (Asphalt, diesel, welding)
- **dusts** (Wood, limestone)
- **fibers** (Asbestos)
- **mists** (Oil Mist)



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Routes of Entry



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Chemical Health Effects

- Acute
- Chronic
- Local
- Systemic

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Units of Concentration

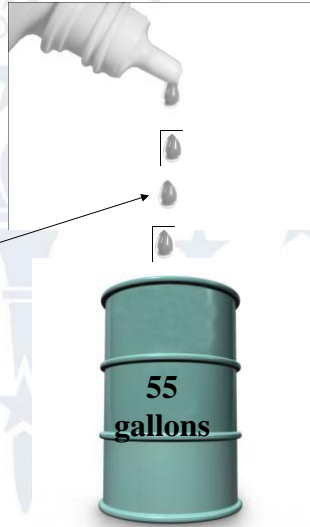
- PPM – Parts Per Million
- MG/M³ – Milligrams per cubic meter
- UG/M³ – Micrograms per cubic meter
- F/CC – Fibers per cubic centimeter

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Part Per Million (ppm)

Four (4) eye drops in a 55 gallon drum is equivalent to 1 part per million (1 ppm).



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Milligrams per Cubic Meter of Air (mg/m^3)



*Example:
[One (1) packet of artificial
sweetener is 1 gram]*

*One (1) packet of artificial
sweetener in the volume of the
Empire State Building is
equivalent to 1 microgram
per cubic meter of air
($1 \mu\text{g}/\text{m}^3$).*



Approximate Volume = $1,000,000 \text{ m}^3$

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Micrograms per Cubic Meter of Air ($\mu\text{g}/\text{m}^3$)



$$\text{X } 1 = (1 \mu\text{g}/\text{m}^3)$$

$$\begin{aligned} \text{X } 50 \text{ (artificial sweetener packets)} \\ = 50 \mu\text{g}/\text{m}^3 \\ \text{(OSHA PEL for Lead).} \end{aligned}$$



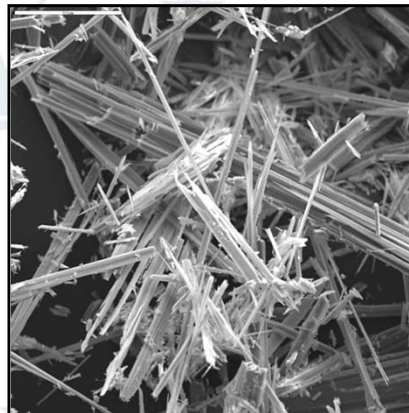
Empire State Building

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Fibers per Cubic Centimeter (f/cc)

Fiber – Means a particulate form of asbestos, 5 micrometer (μm) or longer, with a length-to-width ratio of at least 3 to 1.



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OSHA PEL for Asbestos



0.1 f/cc is equivalent to the number of fibers on the tip of a pencil mixed in with the volume of ten refrigerators.



Average amount of air a worker breathes during an 8-hour shift (ten refrigerators)

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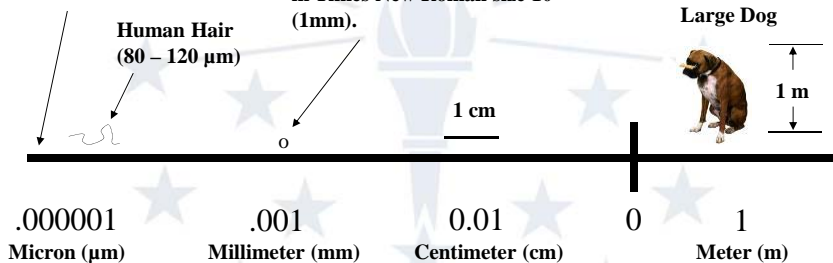
Respirable Particles

Respirable Dust, e.g.,
Lead, Silica &
Asbestos (<10 μm)

A lower case 'o' when printed
in Times New Roman size 10
(1mm).

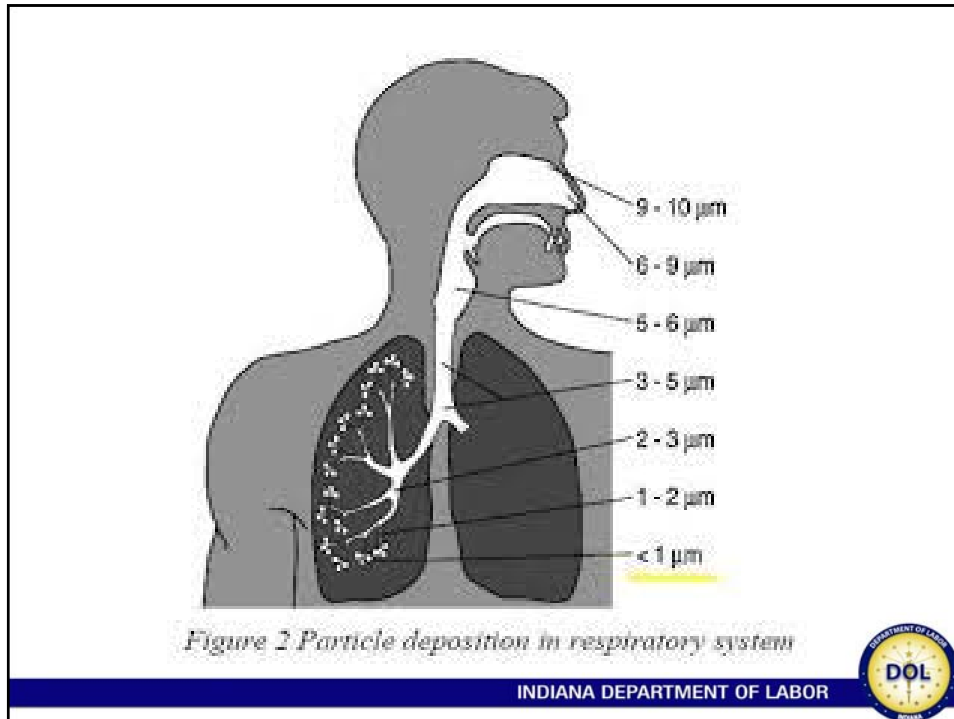
Human Hair
(80 – 120 μm)

Large Dog



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Exposure Limits – Air Contaminants

- OSHA – Occupational Safety and Health Administration - Permissible Exposure Limits (PELS)
- NIOSH – National Institute for Occupational Safety and Health – Recommended Exposure Limits (RELS)
- ACGIH – American Conference of Governmental Industrial Hygienist – Threshold Limit Values (TLVs)

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OSHA Permissible Exposure Limits

- **Time Weighted Average (TWA)**
 - Average employee exposure over an 8-hour period
- **Action Level (AL)**
 - Exposure level at which some OSHA regulations set to protect employees takes effect
- **Ceiling Limit (C)**
 - Maximum allowable level.
- **Short Term Exposure Limit (STEL)**
 - Level that must not be exceeded when averaged over a specified short period of time - usually 15 minutes

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1910.1000

Derived from
1968 ACGIH*
TLV[®] booklet



*American Conference of Governmental Industrial Hygienists

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1910.1000 Examples

Substance	8-hr TWA	Ceiling
Acetone	1000 ppm	
Carbon monoxide	50 ppm	
Hydrogen Chloride		5 ppm
Particulates not otherwise regulated (PNOR)	15 mg/M ³ , Total dust	
	5 mg/M ³ , Respirable fraction	

NOTE: The employer must ensure no employee exceeds any PEL

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1910.1000(b) - Table Z-2

Substance	8-hr TWA	Ceiling	Peak	Notes
Carbon Disulfide	20 ppm	30 ppm	100 ppm	30 min
Hydrogen sulfide		20 ppm	50 ppm	10 min
Styrene	100 ppm	200 ppm	600 ppm	5 min in any 3 hrs
Toluene	200 ppm	300 ppm	500 ppm	10 min

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1910.1000(c) - Table Z-3

adopted this table from the American Conference of Governmental Industrial Hygienist's (ACGIH) mineral limits



1910.1000(c) - Table Z-3

Substance	PEL
Crystalline Silica (Respirable fraction)	$\frac{10\text{mg}}{\text{M}^3}$ % SiO ₂ + 2
Coal dust (< 5% SiO ₂)	2.4 mg/M ³
Nuisance dust	15 mg/M ³
Respirable dust	5 mg/M ³

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How to Find Health Hazards

- Review MSDS or SDS
- Review Processes in all Departments/Areas looking for health & physical hazards
- Review Past Air Sampling Records
- Create Spreadsheets to make it visual (Documentation)
- Prioritizing health hazards to evaluate

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Facility Health Audit

- Looking for Part A/Part B products
- Brake Cleaners/Carburetor Cleaners
- Spray Booths....Isocyanates/Formaldehyde
- Stainless Steel Welding.....Hex Chrome
- Dust Exposures...Sanding, Cutting, Welding
- Forktrucks....Carbon Monoxide

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During Walkaround

- Corrosive Materials...changing out totes... PPE - Chemical goggles / faceshield, gloves, safety shower / eyewash – tested weekly
- Lead Solder & other lead products
- Health Rating of 2 or 3 on labels (older)
- New - Hazard communication 2012 (GHS) 0 or 1 on labels will become the more hazardous chemicals

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Screen and or Sample

- Screening (shorter period of time) sec/mins
 - Hazardous chemicals - detector tube and air sampling pump, direct reading monitor
 - Noise (Sound level meter)
- Sampling (longer period of time) hours
 - Hazardous chemicals - media and air sampling pump, air sampling badges

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Types of Instruments

- Pumps - send samples to lab
- Direct reading - electronic
 - Instantaneous
- Detector tube - read stain from chemical reaction
 - Cylinder or bellows pump
 - Passive tube - usually dosimeter

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Pump Sampling

- Wide variety of media for many contaminants
- Very accurate - + or - 5 % typical
- Must wait for results

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Direct Reading Instruments

- Instant results - printout or display
- Can be expensive
- Must replace sensors
- Can be delicate
- Hybrids - chip readers. Chemical / electronic

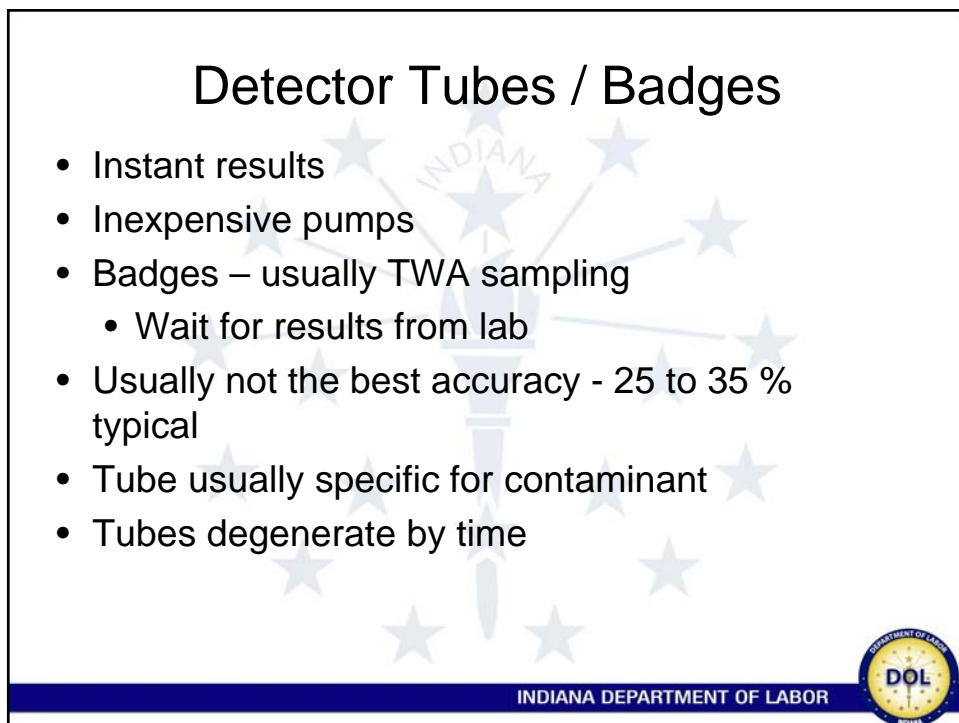
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Detector Tubes / Badges

- Instant results
- Inexpensive pumps
- Badges – usually TWA sampling
 - Wait for results from lab
- Usually not the best accuracy - 25 to 35 % typical
- Tube usually specific for contaminant
- Tubes degenerate by time





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Miscellaneous to Observe

- Calibrate before and after
- Intrinsic safety
- Suitability for method, accuracy, conditions, etc.
- Often less expensive to rent

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Sampling Guidelines

- Manufacturer
- OSHA health standard may specify
- www.osha.gov
- www.cdc.gov
- acgih_pubs@pol.com

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Summary

- Looking for health hazards
- Chemical health effects
- Routes of entry
- Units of concentration
- Exposure limits
- Screening versus sampling
- Types of sampling instruments
- Sampling guidelines

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Questions?

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