
*Industrial Hygiene –
“I am not an expert,
but these are good
things to know.”*

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About Me

- B.S. Safety Sciences, Indiana University of Pennsylvania (2014)
- M.S. Occupational and Environmental Health-Industrial Hygiene, University of Iowa (2017)
- 1 summer internship with DuPont in Edgemoor, DE
- 2 summer internships with Northrop Grumman in Maryland
- 3 years with Northrop Grumman as an EHS Engineer in Sunnyvale, CA
- 1+ year with Northrop Grumman as an EHS Engineer in Annapolis, MD



Who is on the call?



Industrial Hygienist



Environmental Engineer



Safety Professional



Fire Protection/Life Safety Specialist



Other

What is Industrial Hygiene?

→ Industrial Hygiene is the “science and art devoted to the anticipation, recognition, evaluation, and control of those environmental factors or stresses arising in or from the workplace, which may cause sickness, impaired health and well-being, or significant discomfort among workers or among the citizens of the community. (OSHA)”



Environmental Stressors

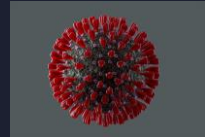
Physical:

- Noise
- Vibrations
- Posture, repetitive motion
- Radiation
- Temperature
- Light



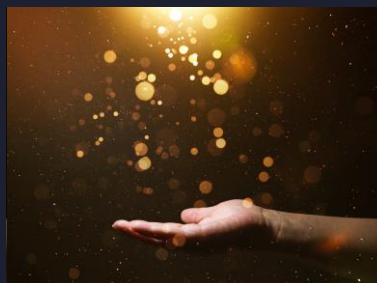
Chemical &/or Biological:

- Respiratory Hazards
- Dust, fumes, vapors, mists, fibers
- Viruses, bacteria
- Mold



Exposure Methods

- Inhalation
- Ingestion
- Dermal
- Injection



Controls



Engineering

Ventilation,
barriers



Administrative

Work
instructions,
shift/job
rotations,
signage



Personal Protective
Equipment

Gloves,
respirators,
Tyvek suits,
glasses/goggles

IH Resources

- AIHA (American Industrial Hygiene Association)
- NIOSH (National Institute of Occupational Safety and Health)
- ABIH (American Board of Industrial Hygienists)
- OSHA (Occupational Safety and Health Administration)
- ACGIH (American Conference of Governmental Industrial Hygienists)

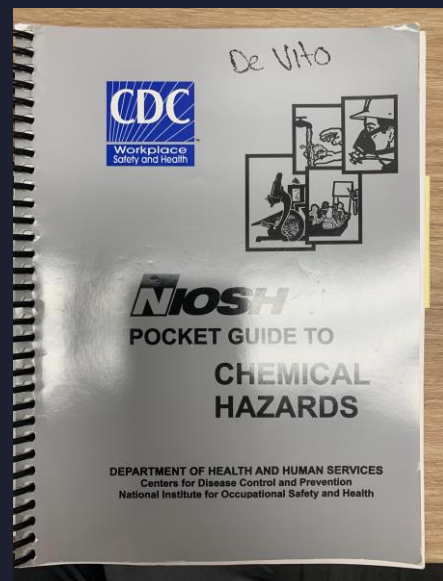
OSHA

- Regulatory agency, established 1970 under OSH Act
 - Federal OSHA
 - State OSHA
- Permissible Exposure Limits
 - [OSHA Z Table](#)
- Substance Specific Standards
 - Noise, lead, asbestos, beryllium, silica, hexavalent chromium, bloodborne pathogens, & many more



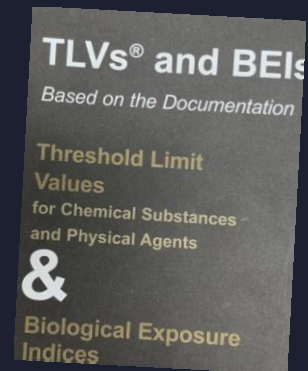
NIOSH

- Research institution under the CDC that provides research and guidance to OSHA and IH community on workplace safety and health concerns
- [Pocket Guide to Chemical Hazards](#)
- Recommended Exposure Limits (RELs) for chemicals
- [National Manual of Analytical Methods \(NMAM\)](#)
 - Sampling and analytical methods



ACGIH

- “professional association of industrial hygienists and practitioners of related professions”
- **Threshold Limit Values (TLVs)**
 - **Chemical substances and physical agents**
- **Biological Exposure Indices (BEIs)**
 - **Biological agents**
- **More stringent and more updated than OSHA**
- **Publishes new TLV & BEI booklet every year**



Exposure Limits

- 8 hour Time Weighted Average (TWA)
 - Employee exposure (limit) for a typical 8 hour work day
 - Useful for processes that occur for most of shift or intermittently during the shift
- Short Term Exposure Limit (STEL)
 - 15 minute short term exposure
 - Useful for brief exposure periods
- Ceiling (C)
 - Maximum exposure during work shift
 - Useful for processes that occur most of shift or one time process with highly hazardous substances

Respiratory Protection

Air Contaminants

- Air contaminants include particulates/dust, fumes, mists, and vapors.
- Come in variety of shapes and sizes
- Measured via sampling pumps worn on operators for personal exposure or place in an area for general exposure.

Ventilation

- Engineering Control: Purpose is to remove particulates, fumes, and vapors directly at the source of generation.
- Systems need to be checked annually to ensure they are meeting design criteria
- ACGIH Industrial Ventilation Manual of Recommended Practice has VS plates with design information for many systems

Ventilation

- Types:
 - Portable smog hogs/fume extractors
 - Manufacturer specifies filter PM
 - VS plate has recommended distance from contaminant source
 - Welding fumes
 - Must be HEPA filters
 - Odor control & organic vapors
 - Contains a carbon/charcoal filter
 - Fixed ventilation
 - VS plate has recommended velocity and flow rates for face velocity or duct velocity
 - Fume hoods
 - Grinders and table saws for metal dust or wood dust



Respiratory Protection Annual Requirements

- Medical Clearance
 - Ensure lungs can handle extra resistance from breathing through a respirator
- Training
 - Education on contaminants, controls, PPE, etc.
- Fit-Testing
 - Required for tight-fitting respirators (respirators with a seal around the face, nose, mouth areas)
 - NOT required for PAPRs or Supplied Air Hoods (loose fitting respirators)
 - Employee must be clean shaven

Respirators



- Half mask respirator
 - Requires annual medical physical and fit test
 - Different cartridge/filters depending on exposure hazard
 - Use combination P100/Organic Vapor/Acid Gas cartridges to protect against particulate, organic vapor, and acid gas and eliminate need to switch.

Respirators



- Full face respirators
 - Requires annual medical physical and fit test
 - Twice as protective as half mask, and also provides eye protection
 - Different cartridges/filters depending on exposure hazard
 - Use combination P100/Organic Vapor/Acid Gas cartridges to protect against particulate, organic vapor, and acid gas and eliminate need to switch.

Respirators



- PAPR
 - Requires annual medical physical
 - More comfortable since it blows air through the helmet
 - Can provide protection up to 1000x the exposure limit if the full shroud is used.
 - Different types depending on process (welding, grinding, ammonia, intrinsically safe)

Respirators



- N95:
 - Can be used on voluntary basis to for extra protection against particulates during low hazard operations or can be mandatory such as for wildfires, hospitals, etc.,
 - Fit test not required for voluntary use but it is required for mandatory use
 - OSHA Appendix D required to be reviewed with employee if for voluntary use
 - Cannot be used in applications where there is oil involved
 - Utilize P95 or P100 for oil

Noise and Hearing Protection

Noise and the Hearing Conservation Program

- Sound Level Meter
 - Area noise measurements/spot readings/equipment specific noise measurements
 - If spot measurements indicate noise levels >85 dBA = hearing protection required area
- Noise Dosimeter
 - Personal noise exposure over work shift (provides 8 hour time weighted average for employee)
 - Stationary area noise exposure over time period
 - If dosimetry results indicate an exposure >85 dBA = enrollment in Hearing Conservation Program per OSHA



Audiograms

- Baseline + Annual, >85 dBA or Semi-annual for high noise areas, >100 dBA
- Evaluation of Audiogram Results and Employee Notification
 - Service provider will evaluate test results and notify employee
 - If any shifts, then audiogram re-test is required within 30 days
- Temporary Threshold Shift
 - Normal shift in hearing that results from noise exposure over course of a day
- Standard Threshold Shift
 - Relative to the baseline audiogram for that employee, of an average of 10 decibels (dB) or more at 2000, 3000, and 4000 hertz (Hz) in one or both ears per 29 CFR 1910.25.
- If the hearing shift is **confirmed and determined to be work related**, hearing loss is considered an OSHA recordable injury
 - Occupational audiologist determines based on noise data, employee activities, age, etc.
 - Employees must be notified of confirmed hearing shift
 - Employee notification form must be documented within 15 days of confirmed hearing shift result

Hearing Protection

→ Hearing protection options include:

- Ear Plugs
- Ear Muffs
- Custom molded ear plugs



→ Noise Reduction Rating (NRR)

- How effective the hearing protection is at reducing noise levels
- $(\text{Measured Sound Level}) - (\text{NRR} - 7) = \text{Protected Sound Level}$
- If wearing double hearing protection, an additional 5 dBA of protection is provided.



→ A Fit Test can be conducted to ensure the ear plugs chosen fit the employee and provide the best protection.

- Provides a Personal Attenuation Rating for the employee to use instead of the NRR
- Allows employees to see which hearing protection is best for their ears

Other IH Topics and Hazards

Heavy Metals

- Employees who perform welding, cutting, brazing, grinding, etc tasks for the majority of their shift each day are exposed to heavy metals.
- These employees should wear FR rated clothing over their clothes--either washable by vendor or disposable.
 - Prevents take home contamination
- Employees need to wash their hands and HEPA vacuum any particulate off of them before entering break rooms, offices, etc.
- Recommendation to have tacky mats at entryway threshold to capture any particulates on the soles of shoes.

Ergonomics

Office:

- Computer, laptop, and desk set up
- Reach of phones
- Adjustable chairs
- Sit/stand desks

Industrial:

- Look at tasks that may have whole body or partial body vibration
- Repetitive motions
- Grip type
- Postures
- Weight
- Involve employee with solutions
- Washington State Tool good for evaluating tasks
- NIOSH Lifting Equation

Sampling Basics

Data Sheet

- Record serial numbers (pump, calibrator), sample ids, media type, location, employee names, and other information about the process you are sampling
- Helpful to have a map or to draw a visual of the area

Calibrator

- Ensure your flow rate is set to what it needs to be (air)
- Ensure your equipment is measuring accurately (noise and other direct read instruments)
- Calibrate before and after sampling session



Air Sampling

- Sampling train-Calibration
 - Pump>Media>Calibrator
- High, medium, or low flow pumps
 - Based on sampling method (NMAM, OSHA)



Air Sampling

- Sampling train
- Media
 - Cassettes- particulates (dust, heavy metals)
 - PPI- aerosols, oil mists, isocyanates
 - Tubes- solvents, gases
- Blanks
- Chain of Custody
- Report & Employee Notification



Noise Sampling

- Calibrate before use
- Dosimeter:
 - Use software to set up criterion, threshold, exchange rate
 - Employee wears on shoulder as close to ear as possible
- Sound Level Meter:
 - Octave band analyzer-used to determine noise pressure levels at set frequencies
 - Beneficial for determining engineering controls
 - Create a noise map and take readings every 3 feet from source
 - Beneficial for establishing hearing protection zones
 - Hold mid torso without any obstructions around you in direction of noise source



Scenario

Scenario

Paint Shop wants to bring in a new paint to use and asks you for guidance prior to purchasing.

- Environmental Hat:
 - VOCs, HAPs, & Air Permitting
 - Hazardous Waste
- Safety Hat:
 - Slip/trip/falls, hand tools, etc.
- Fire Protection Hat:
 - Flammability and storage of paint
- Quality or Supervisor Hat:
 - Quality of paint on product
 - Cost
- Industrial Hygiene Hat:
 - Constituents of paint
 - Hex chrome, lead, silica?
 - Inhalation and dermal exposure
 - Respiratory protection, gloves, Tyvek suit
 - How will it be applied?
 - Brush vs spray
 - Where will it be applied?
 - Paint booth, fume hood, in the open shop,
 - How noisy is the operation?

Steps to take

1

Ask for Safety Data Sheet

2

Look up exposure limits

3

Evaluate controls

4

Perform risk assessment

5

Develop sampling plan if needed

6

Walk the area/put eyes on it

SDS

- Section 2: Hazard information and pictograms
 - Sensitizers, allergic skin reaction, carcinogen
- Section 3: Constituents
 - Chromates, silica, lead,
 - Sample if 10% or more of composition
- Section 7: Handling and Storage
 - Any special handling methods
- Section 8: PPE
 - Call for respiratory protection, gloves, ventilation requirements etc.
- Section 9: Physical and Chemical Properties
 - VOCs- volatility (if sampling will even capture anything; do you need to alert your air permit engineer)
 - Density- sink or rise in air (important for process location)

Look up exposure limits

→ Chromium:

Occupational Exposure Limits			
Agent	ACGIH TLV ($\mu\text{g}/\text{m}^3$)	OSHA Permissible Exposure Limit [PEL] ($\mu\text{g}/\text{m}^3$)	OSHA Action Limit ($\mu\text{g}/\text{m}^3$)
Hexavalent Chromium	0.2 [Inhalable]	5.0	2.5

Evaluate Controls

- Spray painting in paint booth
- PPE- respirator, gloves, double tyvek

Walk the area

- Paint booth performing per standards?
 - Check manometer for flow
 - Look at filters
 - Review previous ventilation survey
 - How is the item set up in the booth?
- Supplied air?
 - All components of supplied air system match
 - Grade D certification
- PPE in good condition
 - No rips in gloves or Tyvek
- Other EHS Items
 - Waste bins
 - Sprinklers
 - Egress
 - Tacky mats
 - Ergonomics (spray gun weight, how will their posture be for what they are painting)

Questions?

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References

- [Industrial Hygiene.PDF \(osha.gov\)](#)
- [ACGIH](#)
- OSHA.GOV
- [U \(army.mil\)](#)