Isocyanates: OSHA's NEP

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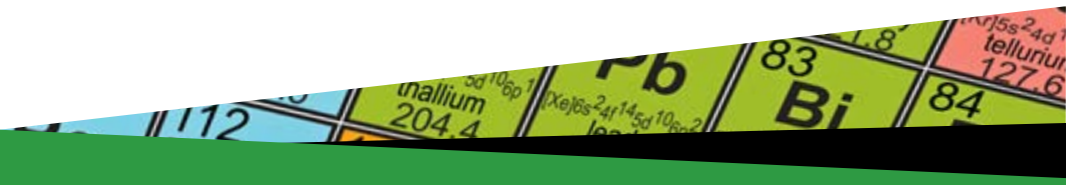
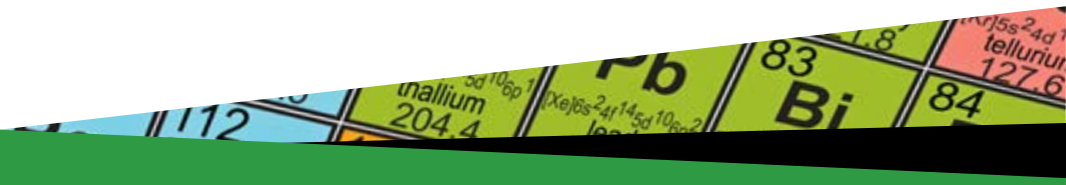
Objectives

- This presentation will enable attendees to:
  - ✓ Know signs/symptoms with routes of exposure to isocyanates
  - ✓ Understand OSHA site selection
  - ✓ Understand OSHA inspection procedures including various exposure assessments
  - ✓ Understand OSHA enforcement



Background on Isocyanates

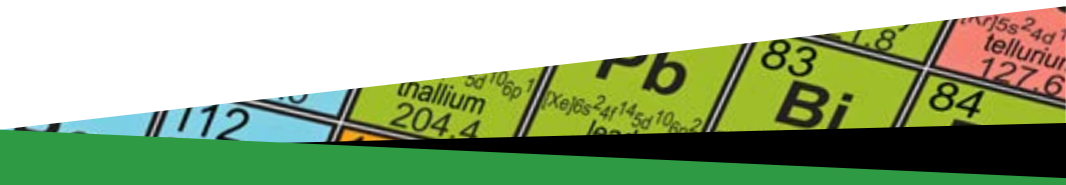
- Isocyanates are reactive chemicals that contain the isocyanate group (-NCO)
- They react with alcohols to produce polyurethane polymers
- Isocyanates are the essential raw materials for polyurethane plastics



Background on Bhopal, India

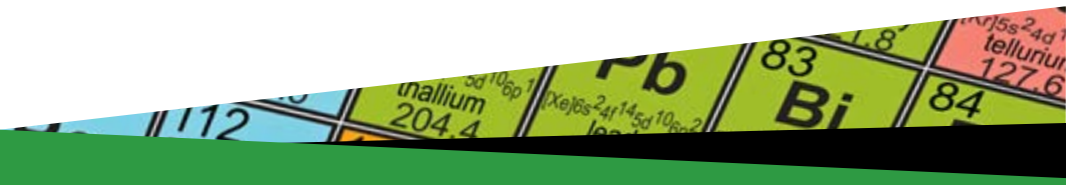
- In 1984, in Bhopal, India, an accidental Union Carbide gas leak of methyl isocyanate resulted in the deaths of more than 2,000 people and adverse health effects in greater than 170,000 survivors.

- Pulmonary edema was the cause of death in most cases, with many deaths resulting from secondary respiratory infections such as bronchitis and bronchial pneumonia.



Exposure

- Annals of Occupational Hygiene, June, 2006: Exposure due to thermal degradation of polyurethane car paint. Exposures approached but did not exceed the ACGIH/NIOSH limits. (Canadian Research Project)
- Journal of Occupational Hygiene, Nov., 2013: 6 of 27 cases of occupationally induced asthma from secondary exposures such as clean up after spray applications in Washington State study 1999-2010.
- Journal of Occupational and Environmental Hygiene, Sept., 2004: Conn. Auto body shops 66.5µg NCO primer, 134.4µg for sealer, 358.5µg for clearcoat.
- Annals of Occupational Hygiene, 2004, Downdraft spray booths produce lower exposure than cross draft or semi-downdraft booths. High volume, low pressure paint spray guns decrease exposure.

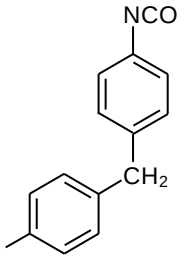


Used in the Formation of Many Polyurethane Products

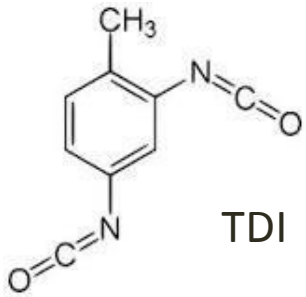
- Paint
- Blown foam insulation
- Polyurethane foam
- Insulation materials
- Surface coatings
- Car seats
- Furniture
- Foam mattresses
- Under-carpet padding
- Packaging materials
- Laminated fabrics
- Adhesives

Common Uses

- Methyl isocyanate – MIC (pesticides)
- Methylene Bis (phenyl isocyanate) – MDI (polyurethane foam)
- Toluene diisocyanate – TDI (flexible foam, coatings, adhesives, binders, sealants)
- Hexamethylene diisocyanate – HDI (paints and coatings)
- Naphthalene diisocyanate – NDI (elastomers used in industry such as auto, machinery, and industrial applications)



MDI



TDI

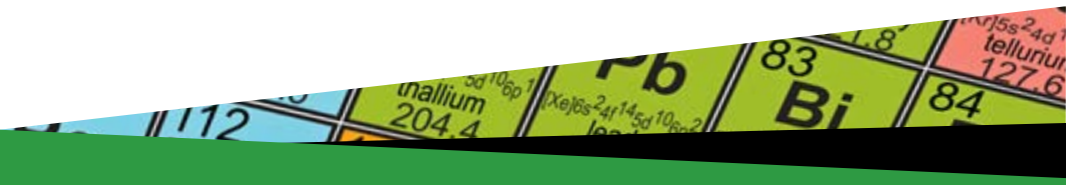
Common Uses

- Methylene bis-cyclohexylisocyanate (HMDI)
- Isophorone diisocyanate (IPDI)

- HDMI and IPDI are used in enamel coatings resistant to abrasion and UV light such as for aircraft

- HDI biuret (polyurethane paints)

- HDI isocyanurate (contact lenses, dental materials, other chemicals, polyurethanes, medical absorbents)



Spray Application Exposure

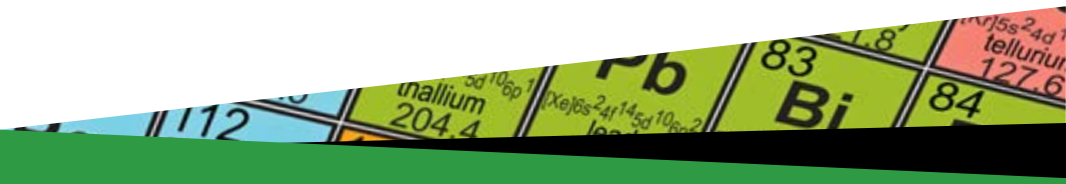
- Vapor, mist, particulates (isocyanates, amines) can migrate to other rooms or floors

Trimming Foam Exposure

- Cutting, scraping foam that is not fully cured generates dust that may contain isocyanates

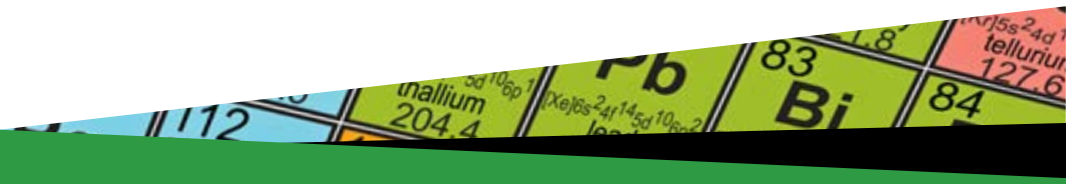
Other Considerations

- **Long term stability of polyurethane foam:**
  - Fully cured polyurethane foam is not considered a problem unless disturbed
  - Heating, welding, or grinding generates free isocyanates and other hazards
  - Fires and thermal degradation can generate and release hydrogen cyanide, carbon monoxide, amines, and isocyanates



Health Effects from Workplace Exposure

- Occupational asthma
  - At least 15% adult onset asthma work related (American Thoracic Society, 2003).
- Dermatitis
  - Studies indicate that dermal exposure is a significant cause of respiratory sensitization.
- Irritation of mucus membranes
- Hypersensitivity pneumonitis
- Chest tightness
- Human Carcinogenic Potential (e.g., TDI – "reasonably anticipated" by NTP, IARC Group 2B-possible human carcinogen)



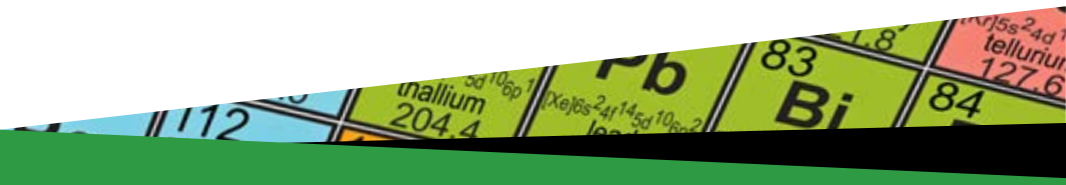
Exposure Limits

- OSHA Permissible Exposure Limits – MIC, MDI, TDI
- Other Occupational Exposure Limits -NIOSH, ACGIH

Isocyanate CAS no. OSHA IMIS no.	Synonyms	Vapor Pressure	OSHA PEL		Occupational Exposure Limits (OEL)			
					NIOSH REL[1]		ACGIH TLV®[2]	
			ppm	mg/m³	ppm	mg/m³	ppm	mg/m³
Methyl isocyanate 624-83-9 1773	MIC; Isocyanatomethane	348 mmHg @ 68 °F	0.02 T	0.05 T	0.02 T	0.05 T	0.02 T	
Methylene bisphenyl isocyanate 101-68-8 1073	4,4-Diphenylmethane diisocyanate; MDI; 4,4-Diisocyanadiphenyl-methane; Methylene bis(4-phenylisocyanate); Methylene Bis(Phenyl Isocyanate)	0.000005 mmHg @ 77 °F	0.02 C	0.2 C	0.005 T 0.02 C	0.050 T 0.2 C	0.005 T	
Toluene-2,4-diisocyanate (TDI) 584-84-9 2470	2,4-Diisocyanato-1-methylbenzene; TDI; 2,4-TDI; 2,4-Toluene diisocyanate	0.01 mmHg @ 77 °F	0.02 C	0.14 C		[4]	0.005[5] T 0.02 STEL	

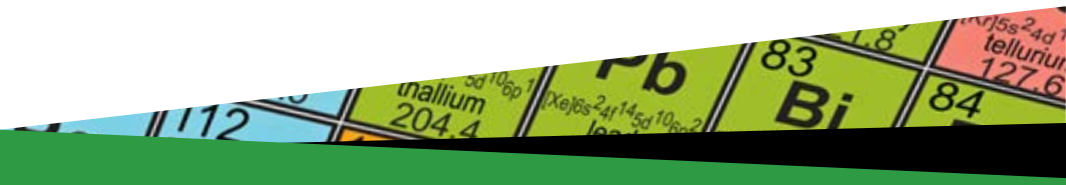
Background on OSHA's NEP

- OSHA develops National Emphasis Programs to focus inspections and outreach efforts on specific hazards in a workplace
- Approved – June 20, 2013.
- Developed to focus OSHA resources on the workplace serious health effects associated with occupational exposure to isocyanates
- Combines enforcement and outreach efforts to raise awareness to employers, workers, and safety and health professionals



OSHA's NEP Procedures

- NEP applies to General Industry, Maritime, and Construction
- NEP applies to ALL isocyanates
- Master targeting list for General Industry and Maritime
- Area Offices are required to make three (3) inspections per year
- NEP covers a three year period



Site Selection: GI / Maritime

- **Appendix A –**
  - **Primary** targeting list compiled using NIOSH HHE evaluations, inspection sampling data (SLTC) – known overexposures, and available workers' compensation data

SIC	SIC Title	NAICS	NAICS Title
2599	Furniture and Fixtures	339950	Sign Manufacturing
3442	Millwork/Metal Window and Door Manufacturing	332321	Wood or Metal Framed Windows and Door Mfg
3792	Travel Trailers and Campers	336214	Travel Trailer and Camper Mfg

  - **Secondary** targeting list similar for settings known to use isocyanates but no documented overexposures

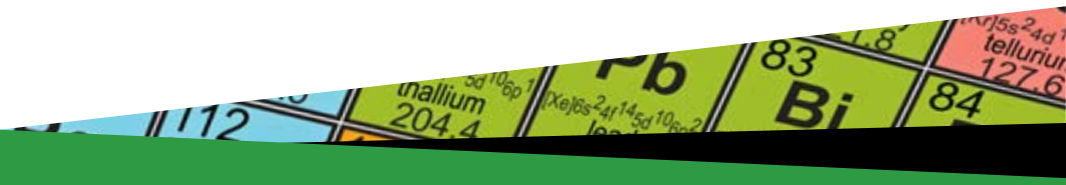
Site Selection: Construction

- Inspections are made whenever a complaint/referral is received; or a CSHO observes an activity where potential isocyanate exposures are suspected
- Where potential exposure exists:
  - Document the status and condition of the work operation

SIC	SIC TITLE	NAICS 2007	NAICS TITLE
1721	Painting and Paper Hanging	238230	Painting and Wall Covering Contractors
1742	Plastering, Drywall, Acoustical, and Insulation Work	238310	Drywall and Insulation Contractors
1752	Floor Laying and Other Floor Work, NEC	238330	Flooring Contractors
1793	Glass and Glazing Work	238150	Glass and Glazing Contractors
1799	Special Trade Contractors, NEC	238150	Glass and Glazing Contractors

Site Selection

- An area office has a broad flexible approach to the targeting list, similar to other NEPs
- NEP maintains flexibility for an area office to use their judgment in adding sites based on local knowledge where exposure would be anticipated
- Example: SIC/NAICS 7500 – "Auto repair"
- If the establishment is not one of the listed establishments but the CSHO has verified that the facility is using Isocyanates, an inspection following the NEP should be initiated



Inspection Procedures

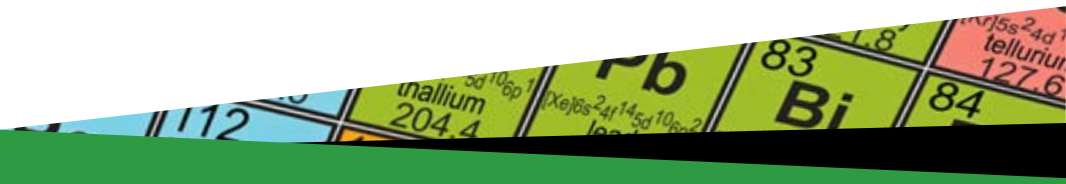
- Hazard Communication
  - Check employer's chemical inventory list and SDSs to confirm that the employer is using Isocyanates
    - Inspection may be discontinued if CSHO can verify no chemicals containing isocyanates used in a process/activity
    - May need to make site walk-around and/or interview workers
  - Check for adequate training on hazards associated with isocyanates

- Review OSHA 300 Injury and Illness logs for potential occupational illnesses due to isocyanate exposure

- Check for effective respiratory protection program including fit-testing, medical evaluation, training, and respirator cleaning

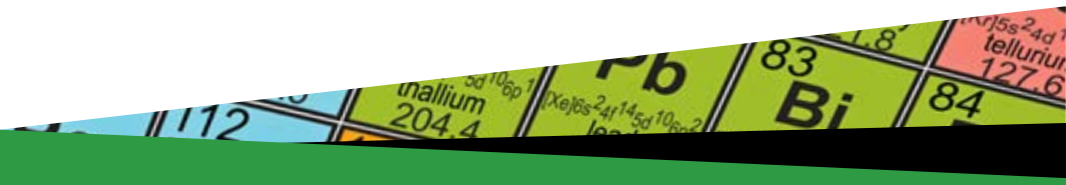
Respirator Program

- Must develop a **written program** with **worksite-specific procedures** when respirators are necessary or required by the employer
- Must update program as necessary to reflect changes in workplace conditions that affect respirator use
- Must designate a **program administrator** who is qualified by appropriate training or experience to administer or oversee the program and conduct the required program evaluations
- Must provide respirators, training, and medical evaluations at no cost to the employee



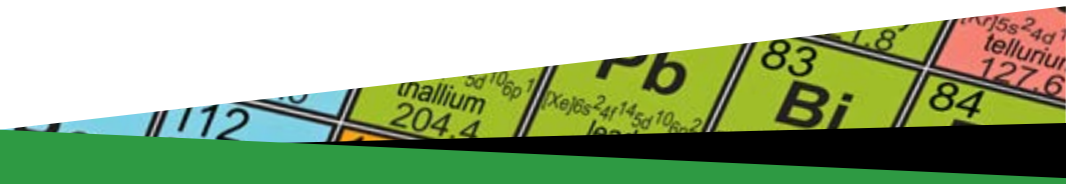
Respirator Program Elements

1. Selection
2. Medical evaluation
3. Fit testing
4. Use
5. Maintenance and care
6. Breathing air quality and use
7. Training
8. Program evaluation



Respirator Medical Evaluation

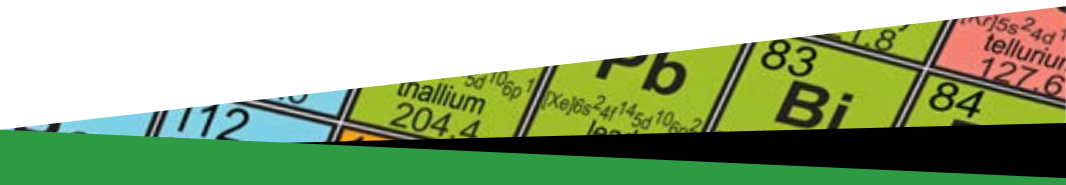
- Must provide a medical evaluation to determine employee's ability to use a respirator, **before fit testing and use**
- Must identify a PLHCP to perform medical evaluations using a medical questionnaire or an initial medical examination that obtains the same information
- Medical evaluation must obtain the information requested by the questionnaire in Sections 1 and 2, Part A of App. C
- Follow-up medical examination is required for an employee who gives a positive response to any question among questions 1 through 8 in Section 2, Part A of App. C or whose initial medical examination demonstrates the need for a follow-up medical examination



Respirator Fit Testing

- Employees using tight-fitting facepiece respirators must pass an appropriate qualitative fit test (QLFT) or quantitative fit test (QNFT):
  - prior to initial use,
  - whenever a different respirator facepiece (size, style, model or make) is used, and
  - at least annually thereafter

- Must conduct an additional fit test whenever the employee reports, or the employer or PLHCP makes visual observations of, changes in the employee's physical condition (e.g., facial scarring, dental changes, cosmetic surgery, or obvious change in body weight) that could affect respirator fit



Training and Information

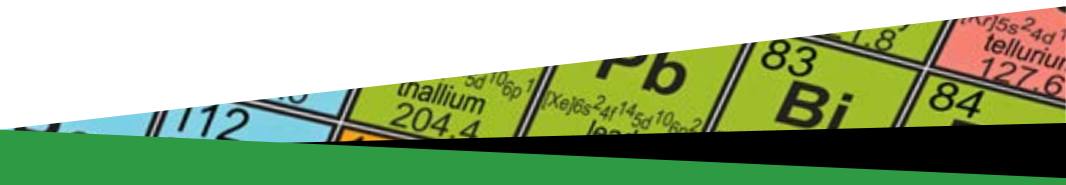
- Employees who are required to use respirators must be trained such that they can demonstrate knowledge of at least:
  - why the respirator is necessary and how improper fit, use, or maintenance can compromise its protective effect
  - limitations and capabilities of the respirator
  - effective use in emergency situations
  - how to inspect, put on and remove, use and check the seals
  - maintenance and storage
  - recognition of medical signs and symptoms that may limit or prevent effective use
  - general requirements of this standard

Training and Information (cont'd)

- Training must be provided prior to use, unless acceptable training has been provided by another employer within the past 12 months

- Retraining is required annually, and when:
  - changes in the workplace or type of respirator render previous training obsolete
  - there are inadequacies in the employee's knowledge or use
  - any other situation arises in which retraining appears necessary

- The basic advisory information in Appendix D must be provided to employees who wear respirators when use is not required by this standard or by the employer



Inspection Procedures for PPE

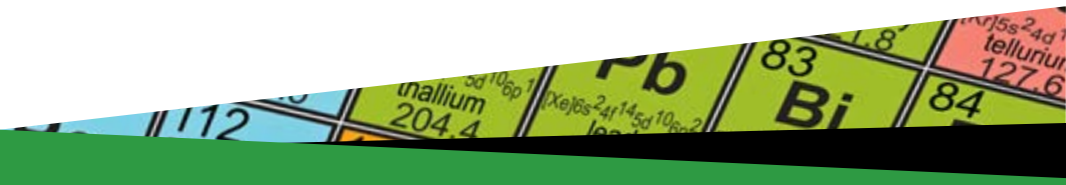
- Review employer's PPE hazard assessment
- Evaluate the effectiveness of PPE during use of isocyanates:
  - Clothing – adequate to prevent contamination of employee's personal clothing or skin
  - Eye/Face – adequate to protect eyes and face from Isocyanate contact
  - Respiratory Protection - adequate to handle poor warning
    - properties (e.g. change schedule for APRs)
  - Chemical resistant gloves
    - (e.g. butyl, nitrile vs. latex)
  - Information on PPE in Appendix G

PPE: Gloves

- Latex gloves exhibited a higher permeation rate compared with nitrile for isocyanates and both materials presented permeation

- Butyl material exhibited no permeation or breakthrough for isocyanates under the tested conditions (Annals of Occupational Hygiene, 1/20/14)

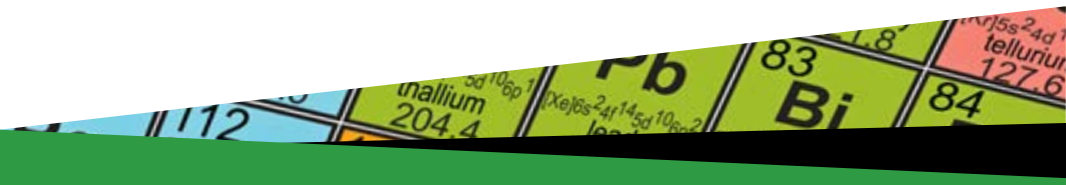
- Polyvinyl alcohol gloves also recommended



PPE Training

Employees required to use PPE must be trained to know at least the following:

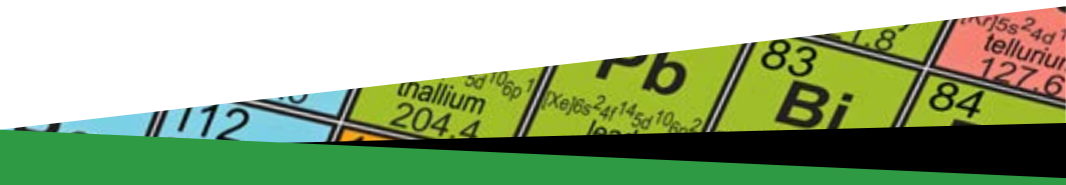
- When PPE is necessary
- What type of PPE is necessary
- How to properly put on, take off, adjust, and wear
- Limitations of the PPE
- Proper care, maintenance, useful life and disposal



Payment for PPE

When PPE is required to protect employees, it must be provided by the employer at no cost to employees, except for specific items, such as:

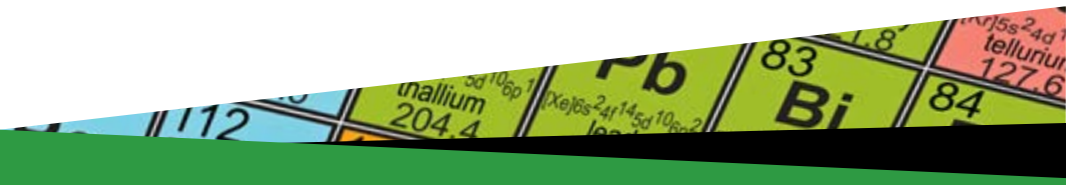
- Safety-toe footwear
- Prescription safety eyewear
- Everyday clothing and weather-related gear
- Logging boots



PPE Summary

Employers must implement a PPE program where they:

- Assess the workplace for hazards
- Use engineering and work practice controls to eliminate or reduce hazards before using PPE
- Select and provide appropriate PPE at no cost*
- Inform employees why the PPE is necessary and when it must be worn
- Train employees how to use and care for their PPE and how to recognize deterioration and failure
- Require employees to wear selected workplace PPE



OSHA Inspection Procedures Form

- Health Surveillance Form (non-mandatory)
- Available to CSHO when interviewing worker

Appendix C (non-mandatory)

Health Surveillance Form (Non-mandatory) – Isocyanate Exposure

Interviewer: _____ **Date:** _____

Worker Name: _____

1. What was the month and year that you were hired at this company? _____

2. What is your job title? _____

3. Please describe your job duties: _____

_____

4. How many hours per week do you work on average? _____

5. In what area or areas of the plant do you work? _____

6. Have there been any recent changes to your immediate work environment or processes in your worksite?

___YES___NO

OSHA Sampling Procedures

- The CSHO will be prepared to take personal air samples on the first day of the inspection
  - Follow sampling protocol which includes field extraction procedure for glass fiber filter samples
- Wipe samples may be collected to determine surface, dermal, and/or PPE contamination
  - Using direct-reading colorimetric wipes

Exposure Assessments

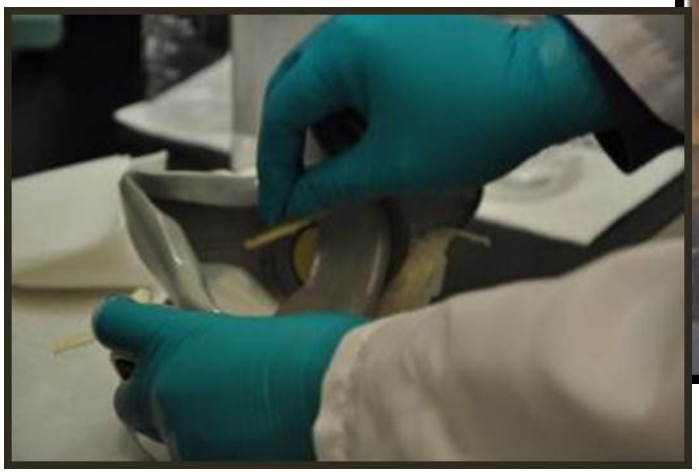
- Wipe sampling (Swype pads)
  - Surface
  - Dermal
  - PPE
- Expected and unexpected areas

Exposure Assessments

- Expected
  - Work benches
  - Tool handles
  - Cleaning areas
  - Beverages in the workplace

Exposure Assessments

- Unexpected
  - Drinking fountains
  - Door knobs
  - Locker rooms
  - Keyboards
  - Inside PPE



OSHA enforcement

Exposure	Issue Citation	Consider 5(a)(1) violation	Consider HAL
> PEL	✓		
No PEL, but > OEL,		✓	If 5(a)(1) not issued or elements not met
< PEL, but > OEL,		see FOM, Chapter 4, Section XIII.B.1.e	If 5(a)(1) not issued or elements not met
Reported illnesses/health effects (even if no overexposures have been documented)		✓ If serious illnesses/or health effects present and employer recognizes the hazard	If 5(a)(1) not issued or elements not met

- **5(a)(1) elements**: (1) The employer failed to keep the workplace free of a hazard to which employees of that employer were exposed; (2) The hazard was recognized; (3) The hazard was causing or was likely to cause death or serious physical harm; and (4) There was a feasible and useful method to correct the hazard.

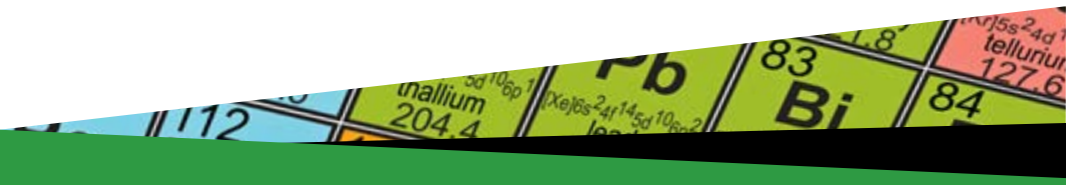
Outreach

- Letters to stakeholders
- Isocyanates Safety & Health Topics Page:

- Link: http://www.osha.gov/SLTC/isocyanates/index.html

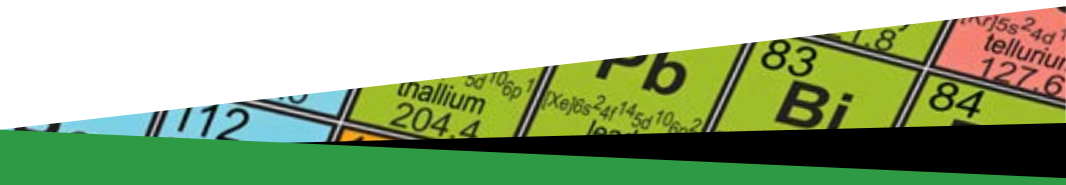
CPL 03-00-017 Appendices

- **Appendix A** - Industries Where Isocyanate Exposures are Known or Likely to Occur
- **Appendix B** - Isocyanate Sampling, Field Extraction, and Sample Shipment Procedures
- **Appendix C** – Health Surveillance Form (Non-mandatory) – Isocyanate Exposure
- **Appendix D** – Sample Isocyanates Hazard Alert Letter
- **Appendix E** – Publications and Resources
- **Appendix F** – Sample General Duty Clause Citation Language
- **Appendix G** – General Guidance for Employers on Personal Protective Equipment(including respiratory protection) for Worker Exposures to Isocyanates
- **Appendix H** – General Guidance for Employers on Medical Surveillance Program Information for Worker Exposure to Isocyanates



Summary

- Isocyanates causes many health effects including occupational asthma
- NEP applies to General Industry, Maritime, and Construction
- Targeting list built on NIOSH HHE evaluations, inspection sampling data (SLTC), and available workers' compensation data
- Exposures can occur in expected and unexpected areas
- Employer may be subject to citation if workers exposed above PEL or OEL where documented
- Various compliance assistance material available



Questions?

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