

State of California

DIVISION OF OCCUPATIONAL SAFETY AND HEALTH



Memorandum

Date: January 28, 2014

To: Regional Managers and District Managers

From: Cora Gherga
Deputy Chief for Enforcement

Re: OSHA Instruction CPL 03-00-017 & Inspection Procedures for Isocyanates

This instruction describes policies and procedures for complying with OSHA Instruction CPL 03-00-017, June 20, 2013, involving the implementation of a National Emphasis Program (NEP) to identify and reduce or eliminate the incidence of adverse health effects associated with occupational exposure to isocyanates. Per the NEP, as a State Plan, we are obligated to conduct 3 inspections per year.

Isocyanates are widely used in the manufacture of flexible and rigid foams, fibers, coatings such as paints and varnishes, and elastomers, and are increasingly used in the automobile industry, auto body repair, and building insulation materials. In addition, spray-on polyurethane products containing isocyanates have been developed for a wide range of retail, commercial, and industrial uses to protect cement, wood, fiberglass, steel, and aluminum, including protective coatings for truck beds, trailers, boats, foundations, and decks.

Appendix A contains lists of industries where isocyanate exposures are known or likely to occur. The lists are not exhaustive. DOSH may include an industry sector/code not listed within its jurisdiction. If a district office knows of industries not included in Appendix A that have demonstrated a pattern of isocyanate exposures, based on sources such as worker complaints, referrals from the local health department, or previous OSHA inspection history, it should notify the NEP Coordinator for possible inclusion in the Appendix.

When a district office receives a complaint or accident that involves exposures to isocyanates, the District Manager should assign the case to a CSHO that has been trained to evaluate the employer's controls (engineering controls, administrative and work practice controls, and personal protective equipment (PPE)) where potential exposures to isocyanates are present. The district office should also notify the Regional Senior(s) and NEP Coordinator, Grace Delizo, who will be available to assist with evaluating engineering and other controls. Calico will be available to assist with sampling media/kits and shipment of samples (via Golden State Overnight) to the lab.

Inspection Procedures

A. Opening Conference

1. During the opening conference, the CSHO will confirm that the employer's SIC/NAICS code is included under this program and review the employer's chemical inventory list

and Safety Data Sheets (SDSs) (formerly called Material Safety Data Sheets (MSDSs)) to confirm that the employer is using isocyanates. If a CSHO can verify that isocyanates are not in use at a listed establishment, the inspection should be discontinued. If an establishment is not one of the listed establishments but the CSHO has verified that the facility is using isocyanates, an inspection shall be initiated following this instruction.

2. CSHOs should explain the goals of this NEP to the employer: To minimize and/or eliminate worker exposure to isocyanates shown to potentially cause work-related asthma, sensitization (respiratory, skin) and other occupational health effects (potential human carcinogen; irritant to the mucous membranes of the eyes, nose and throat, and gastrointestinal and respiratory tracts; bronchitis with bronchospasm; hypersensitivity pneumonitis (inflammation in the lungs caused by exposure to an allergen); and deaths due to both asthma and hypersensitivity pneumonitis.
3. CSHOs should request information on any hazard analyses performed at the facility for the following:

- a. Personal Protective Equipment (PPE)

The CSHO shall evaluate whether the employer has ensured the use of appropriate PPE during operations using isocyanates and the CSHO shall evaluate the effectiveness of the PPE being used in the establishment. If the employer has failed to ensure the use of required PPE, or has selected PPE which is ineffective against isocyanates, a citation of the appropriate PPE standard shall be issued.

The use of appropriate personal protective clothing (e.g., coveralls, foot coverings) shall be evaluated. Employers shall require the use of personal protective clothing that is adequate to prevent contamination of an employee's personal clothing and skin.

The use of appropriate eye and/or face protection shall be evaluated. Employers shall require the use of eye and/or face protection that is adequate to protect the employee's eyes and/or face from exposure to isocyanates.

The use of appropriate, chemical-resistant gloves (e.g., butyl, nitrile) shall be evaluated. Employers shall select and require the use of gloves that are adequate to protect the employees from dermal exposure to isocyanates (e.g., by checking the manufacturer's information about the glove type or the Safety Data Sheet.)

- b. Respiratory Protection

The use of appropriate respiratory protection shall be evaluated. The hazard evaluation requirement is performance-oriented, and a variety of estimation techniques may be used to characterize worker exposures, depending upon the nature of the chemical products, processes, operating environment, and other factors.

- c. Hazard Communication Program

A determination of whether the employer's hazard communication program complies with 8 CCR 5194 must include consideration of the training the employer provides to employees regarding the hazards associated with isocyanates.

Employers who choose not to rely on the evaluation of a hazardous chemical performed by a chemical manufacturer or importer must conduct their own evaluation and consider the available scientific evidence concerning that chemical. Otherwise, employers can rely on information from the Safety Data Sheet (SDS).

B. Walkaround and Records Review

1. SDS. Assure SDSs are complete, adequate and available.
2. Injury/Illness Records.

CSHOs should review the employer's injury and illness records to determine if injuries and illnesses related to isocyanate exposures have been recorded, including any work-related cases of asthma. The CSHO shall attempt to interview enough employees exposed to isocyanates to determine if there are unrecorded injury and illness cases. The non-mandatory health surveillance form (Appendix C) may be used when interviewing workers.

The Medical Unit may be contacted if there are questions regarding documentation of cases of occupational illness, including evaluation of the health surveillance forms, review of medical records, interviews with healthcare providers, and analysis of the scientific literature. Additional information on occupational medicine resources are found in Appendix H.

3. Medical Records Request

Based on information obtained from illness/injury records and interviews, CSHOs may need to review additional worker medical information. When accessing worker medical information, CSHOs should obtain specific written consent from a worker and should ensure that the Division or Division worker is listed on the consent form as the designated representative to receive the information.

4. Production Process Evaluation

CSHOs should request and review the employer's production and processing records.

- a. Document the types and quantities of chemicals used, what processes are involved, and the frequency of use.
- b. Evaluate and document the extent of engineering controls, the work practices implemented, and any protective equipment used during these operations.
- c. Evaluate workers' respirator usage, if any, and request a copy of the employer's respiratory protection program.
- d. Evaluate records of personal and area monitoring conducted by the employer.
- e. Evaluate the employer's housekeeping practices (frequency & methods) to determine whether they may have contributed to employee illnesses associated with isocyanates (e.g., sensitization). Check for accumulation of isocyanates on surfaces and equipment in the work/process area, outside of the work/process area, and in eating and break areas, as well as cleaning schedules and/or a pattern of housekeeping hazards. Citations shall be issued where poor housekeeping practices are documented (e.g., visible foam/coating on machinery, tools, floor or equipment near the operation) that present a risk to workers of dermal contact with isocyanates.

- f. Evaluate flammable and combustible hazards where the chemical components of an isocyanate process or operation contain flammable or combustible materials.

5. Exposure Monitoring

- a. **Air Sampling.** Personal air samples shall be collected during inspections conducted under this NEP. The CSHO shall be prepared to take samples on the opening day of the inspection. If the process that uses isocyanates is not in operation the day of the inspection, the CSHO shall return at a later date to perform sampling. Where the employer has recent and accurate sampling exposure data (e.g., taken by Cal/OSHA Consultation, third party consultant, insurance company), the CSHO shall consult with the District Manager to determine if further sampling is required. When operations using isocyanates are infrequent or unplanned, the CSHO shall consult with the District Manager to determine if sampling is necessary.

Appendix B provides information to the CSHO on sampling protocol, how to order sampling media, and sample shipping instructions. CSHOs should contact LA Testing for any questions regarding sampling for isocyanates. Air samples collected during this NEP will be extracted in the field by CSHOs as described in Appendix B.

Note: See Appendix B for a listing of OSHA sampling and analytical methods. Individual methods can also be found using the "Analytical Methods" link (<http://www.osha.gov/dts/sltc/methods/index.html>) on the OSHA public web site.

- b. **Wipe Sampling.** Occupational exposure to isocyanates is a recognized cause of immune sensitization and asthma. Scientific research indicates that dermal exposure to isocyanates is at least as likely as inhalation exposure to induce isocyanate-related asthma. Experiments with laboratory animals have shown that dermal exposure alone to some isocyanates can be sufficient to induce respiratory sensitization. However, OSHA does not currently have any standards setting limits for surface contamination with, or dermal exposure to, isocyanates. Accordingly, if wipe sampling reveals surface contamination or dermal exposure, citations may be issued under the applicable housekeeping standards and/or PPE standards.
 - 1) **Surface sampling.** CSHOs should check for surface contamination (e.g., visible foam/coating) on surfaces, tools and equipment near the operation using isocyanates as well as in places where contamination may not be expected such as drinking fountains, telephones, locker rooms, and lunchrooms, to identify potential sources of dermal exposure and evaluate housekeeping and PPE deficiencies. Direct-reading colorimetric wipes can be used to sample surfaces for potential contamination.
 - 2) **Dermal Sampling.** When the CSHO observes contaminated surfaces and equipment, dermal sampling should be conducted. Direct-reading colorimetric wipes can be used to sample dermal exposures.
 - 3) **PPE Sampling.** Gloves are one of the most basic forms of PPE but their resistance to penetration by isocyanates may not be known. Direct-reading colorimetric media can be used to detect permeation of isocyanates through gloves and other PPE such as coveralls.
 - 4) **Methodology.** There are two types of direct-reading colorimetric wipe kits

available for performing surface, dermal or PPE wipe sampling. One is for aliphatic isocyanates (e.g., Hexamethylene diisocyanate or HDI) and the other is for aromatic isocyanates (e.g., Methylene bisphenyl isocyanate or MDI). The CSHO shall document the results of any surface, dermal or PPE wipe sampling in the case file. In addition, when a wipe sample is collected the CSHO should add the code "IWIFE" on the IMIS/OIS form under the Additional Information section. Calico Lab can be consulted if the CSHO chooses to conduct surface, dermal, or PPE wipe sampling. Both types of surface, dermal or permeation test kits are available from Calico.

For general information on wipe sampling, refer to the OSHA Technical Manual, Section II, Chapter 2, subsection V available at http://www.osha.gov/dts/osta/otm/otm_ii/otm_ii_2.html

6. CSHO Protection

CSHOs must don the appropriate PPE, such as gloves (e.g., butyl, nitrile), goggles, and protective clothing when a potential for eye or dermal exposure to isocyanates exists (e.g., exposure to contaminated equipment, chemical containers, etc.).

CSHOs must follow the DOSH Respiratory Protection Program (have a current medical evaluation and fit test) and wear appropriate respiratory protection when a potential for airborne isocyanate exposure exists. Refer to Appendix G, General Guidance for Employers on Personal Protective Equipment (including Respiratory Protection) for Worker Exposures to Isocyanates. In addition, CSHOs will take a comprehensive medical exam at least annually and wear tight-fitting PAPRs where there is a possibility of isocyanate exposures near the permissible exposure limit.

CSHOs should review CPL 03-00-017 for further guidance and discuss the need for further PPE with their District Manager.

C. Citation Guidelines

Where inhalation exposure to an isocyanate exceeds the Cal/OSHA PEL set forth at 8 CCR 5155, Table AC-1, without regard to the use of respiratory protection, citations shall generally be issued as serious, following the citation policy in DOSH P&P C-1B. Where an overexposure exists and feasible engineering and/or administrative controls were not utilized or were ineffective, an additional serious citation shall generally be issued under 8 CCR 5141.

Where workers are exposed to a particular isocyanate having an established OEL, but no OSHA PEL, a citation for exposure in excess of the OEL may be considered under 8 CCR 5141 and/or a Special Order. Follow DOSH P&P C-3 to issue a Special Order.

Where there is not enough evidence to issue a Special Order and/or a decision is made not to issue a citation, an Information Memorandum shall then be considered to recommend specific actions that would reduce worker exposures to isocyanates. Sample language is included in Appendix D. Follow DOSH P&P C-5 to issue an Information Memorandum.

If a worker is exposed to concentrations of a particular isocyanate below the PEL, but in excess of an established occupational exposure limit, consider special order and/or 5141 citation.

To illustrate:

Exposure	Issue Citations for 5155 and 5141	Consider Special Order and/or 5141 Citation	Consider Information Memorandum
> PEL	✓		
No PEL, but > OEL,		✓	If Special Order not issued or elements not met
< PEL, but > OEL,		✓	If Special Order 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 Special Order not issued or elements not met

Serious health effects are isocyanate-related illness cases recorded on the OSHA-300 log such as occupational dermatitis (i.e., not irritation), skin sensitization, gastrointestinal tract issues and work-related asthma.

Reference applicable orders for citing:

1. improper personal hygiene practices for ingestion or absorption hazards;
2. dermal exposures occurring as a result of not using or misusing PPE or using ineffective PPE; and
3. surface contamination as sanitation/housekeeping violations.

IMIS Coding Instructions

All enforcement activities (inspections, complaints, and referrals) and compliance assistance interventions conducted under this NEP must be coded with the NEP code, "ISOCYAN8," entered in the appropriate IMIS/OIS field on the form.

Whenever a consultation request/visit is made in response to this NEP, the NEP code "ISOCYAN8" must be recorded in the appropriate field on the Consultation request/visit forms.

The instruction below is for recording programmed and unprogrammed inspections conducted under this NEP.

Programmed inspections

The OSHA-1 Form shall be marked as “programmed planned” in item 24, and in item 21, Inspection Category shall be recorded as “H”. In addition to appropriate entries at 25a,b c and f, at item 25d the NEP code "ISOCYAN8" shall be selected.

Unprogrammed inspections

The OSHA-1 Form shall be marked as “unprogrammed” in item 24, and in item 21, Inspection Category shall be recorded as “H”. In addition, at item 25d the NEP code "ISOCYAN8" shall be selected.

If during any inspection it is determined the establishment is using isocyanates, the NEP code for “ISOCYAN8” shall be recorded in item 25d of the OSHA-1 Form.

This new " ISOCYAN8" code applies to the following enforcement forms:

OSHA-1 (see above), OSHA-7 (item 50), OSHA-36 (item 36) and OSHA-90 (item 30).

Should you have any questions regarding IMIS coding, please feel free to contact your IMIS Coordinator.

Follow-up Inspections.

To determine whether the employer has eliminated hazards or reduced exposures below the PEL (or OEL), follow-up inspections shall be conducted, based on available resources. Where exposures could not feasibly be reduced below the PEL (or OEL), engineering controls and administrative and work practice controls must still have been implemented to reduce exposures to the extent feasible, and workers provided with adequate respiratory protection and other appropriate PPE where necessary.

A follow-up inspection is not required when the District Office has specific knowledge and documentation indicating that the employer is no longer using isocyanates or there are no workers exposed to isocyanates.

Appendix A

Industries Where Isocyanate Exposures are Known or Likely to Occur⁵

- Automotive – paints, glues, insulation, sealants and fiber bonding, truck bed lining
- Casting – foundry cores
- Building and construction – sealants, glues, insulation material, fillers
- Electricity and electronics – cable insulation, PUR coated circuit boards
- Mechanical engineering – insulation material
- Paints – lacquers
- Plastics – soft and hard plastics, plastic foam and cellular plastic
- Printing – inks and lacquers
- Timber and furniture – adhesives, lacquers, upholstery stuffing and fabric
- Textile – synthetic textile fibers
- Medical care – PUR casts
- Mining – sealants and insulating materials
- Food industry – packaging materials and lacquers

The tables below provide a construction list as well as primary and secondary lists for general industry and maritime by SIC and NAICS codes. The construction list identifies sectors where construction workers are most likely to have exposures to isocyanates. The primary list includes general industry and maritime industries where exposures to isocyanates are known to occur, exposures have been demonstrated to be above the PEL, and workers have exhibited illnesses associated with exposure to isocyanates. The secondary list for general industry/maritime includes settings where exposures to isocyanates are known to occur, however not all establishments in these listed industries have necessarily documented worker overexposures to isocyanates.

Note: The following are not exhaustive lists. An area office may include an industry sector/code not listed if it falls within their area office's jurisdiction.

Construction

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

⁵ International Consensus Report on: Isocyanates – Risk assessment and management, 2001, pgs. 11-12, <http://www.arbeidstilsynet.no/binfil/download2.php?tid=77871>

1799	Special Trade Contractors, NEC	238150	Glass and Glazing Contractors
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General Industry/Maritime (Primary)

SIC	SIC Title	NAICS 2007	NAICS Title
2299	Textile goods, Not Elsewhere Classified	313230	Nonwoven Fabric Mills
2599	Furniture and Fixtures, Not Elsewhere Classified	339950	Sign Manufacturing
2851	Paints, Varnishes, Lacquers, Enamels, and Allied Products	325510	Paint and Coating Manufacturing
3089	Plastics Products, NEC	337215	Showcase, Partition, Shelving, and Locker Manufacturing
3281	Cut Stone and Stone Products	327991	Cut Stone and Stone Product Manufacturing
3442	Millwork/Metal Window and Door Manufacturing	332321	Wood or Metal framed windows and Doors, Manufacturing
3499	Fabricated Metal Products, Not Elsewhere Classified	332999	All Other Miscellaneous Fabricated Metal Product Manufacturing
3721	Aircraft and Parts	336411	Aircraft Manufacturing
3732	Boat Building and Repairing (boat building)	336612	Boat Building
3792	Travel Trailers and Campers	336214	Travel Trailer and Camper Manufacturing
7532*	Top, Body, and Upholstery Repair Shops and Paint Shops	811121*	Automotive Body, Paint, and Interior Repair and Maintenance

* = No target list currently available from DEA/OSA. Area Offices may generate their own list for these SIC/NAICS industries which fall under their jurisdiction.

General Industry/Maritime (Secondary)

SIC	SIC Title	NAICS 2007	NAICS Title
2296	Tire Cord and Fabrics	314992	Tire Cord and Tire Fabric Mills
2396	Misc. Fabricated Textile Products	336360	Motor Vehicle Seating and Interior Trim Manufacturing
2396	Automotive Trimmings, Apparel Findings, and Related Products (textile motor vehicle trimming)	336360	Motor Vehicle Seating and Interior Trim Manufacturing

2431	Millwork	321911	Wood Window and Door Manufacturing
2435	Hardwood Veneer and Plywood	321211	Hardwood Veneer and Plywood Manufacturing
2436	Softwood Veneer and Plywood	321212	Softwood Veneer and Plywood Manufacturing
2493	Reconstituted Wood Products	321219	Reconstituted Wood Product Manufacturing
2531	Public Building and Related Furniture	336360	Motor Vehicle Seating and Interior Trim Manufacturing
2591	Drapery Hardware and Window Blinds and Shades	337920	Blind and Shade Manufacturing
2759	Commercial Printing, NEC	323112	Commercial Flexographic Printing
3052	Rubber and Baskets Hose and Belting	326220	Rubber and Plastics Hoses and Belting Manufacturing
3061	Molded, Extruded and Lathe-Cut Mechanical Rubber Goods	326291	Rubber Product Manufacturing for Mechanical Use
3069	Fabricated Rubber Products, NEC (except rubberized fabric and rubber resilient floor covering)	326299	All Other Rubber Product Manufacturing
3083	Laminated Plastics Plate, Sheet, and Profile Shapes	326130	Laminated Plastics Plate, Sheet (except Packaging), and Shape Manufacturing
3086	Plastics Foam Products (urethane and other foam products)	326150	Urethane and other Foam Product (except Polystyrene) Manufacturing
3088	Plastics Plumbing Features	326191	Plastics Plumbing Fixture Manufacturing
3321	Gray and Ductile Iron Foundries	331511	Iron Foundries
3366	Copper Foundries	331525	Copper Foundries (except Die-Casting)
3479	Coating, Engraving, and Allied Services, NEC	332812	Metal Coating, Engraving (except Jewelry and Silverware), and Allied Services to Manufacturers
3491	Industrial Valves	332911	Industrial Valve Manufacturing
3519	Internal Combustion Engines, NEC	333618	Other Engine Equipment Manufacturing
3585	Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment	333415	Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing

3632	Household Refrigerators and Home and Farm Freezers	335222	Household Refrigerator and Home Freezer Manufacturing
3677	Electronic Coils, Transformers, Other Conductors	334416	Electronic Coil, Transformer, and Other Inductor Manufacturing
3714	Motor Vehicle Parts and Accessories	336322	Other Motor Vehicle Electrical and Electronic Equipment Manufacturing
3842	Orthopedic, Prosthetic, and Surgical Appliances and Supplies	339999	All Other Miscellaneous Manufacturing
3851	Ophthalmic Goods	339115	Ophthalmic Goods Manufacturing
3911	Jewelry, Silverware, and Plated Ware	339911	Jewelry (except Costume) Manufacturing
3999	Manufacturing Industries, NEC	326199	All Other Plastics Product Manufacturing
4449	Water Transportation of Freight, NEC	483211	Inland Water Freight Transportation
4789	Transportation Services, NEC	488999	All Other Support Activities for Transportation
4911	Electric Services	221119	Other Electric Power Generation
4932	Gas, and Other Utility Services Combined	221210	Natural Gas Distribution
7538*	General Automotive Repair Shops	811111*	General Automotive Repair
7539*	Automotive Repair Shops, NEC	811118*	Other Automotive Mechanical and Electrical Repair and Maintenance
7549*	Automotive Services, Except Repair and Carwashes	488410*	Motor Vehicle Towing
		811122	Automotive Glass Replacement Shops
		811191	Automotive Oil Change and Lubrication Shops
		811198	All Other Automotive Repair and Maintenance

* = No target list currently available from DEA/OSA. Area Offices may generate their own list for these SIC/NAICS industries which fall under their jurisdiction.

Appendix B

**ISOCYANATE SAMPLING, FIELD EXTRACTION,
and SAMPLE SHIPMENT PROCEDURES**

The CSHO should contact the LA Testing laboratory directly for questions regarding a sampling and/or analytical method.
(Ref: OSHA [Chemical Sampling Information](#))

Isocyanate CAS no. OSHA IMIS no.	Synonyms	Vapor Pressure	Cal/OSHA PEL		Occupational Exposure Limits (OEL)				OSHA Method no.	Sampling Medium	Flow Rate (L/min)	Sample Volume (L)
					NIOSH REL ¹		ACGIH TLV ^{®2}					
					ppm	mg/m ³	ppm	mg/m ³				
Methyl isocyanate 624-83-9 1773	MIC; Isocyanatomethane	348 mmHg @ 68 °F	0.02 T Skin	0.05 T	0.02 T	0.05 T	0.02 T		Method 54 FV	XAD-7 tube 1-2PP	0.05	15
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	0.005 T	0.051 T	0.005 T 0.02 C	0.050 T 0.2 C	0.005 T		Method 47 FV	GFF 1-2PP	1.0	15
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	0.005 T 0.02 C 0.02 STEL	0.04 T 0.15 STEL		4	0.005 ⁵ T 0.02 STEL		Method 42 FV	GFF 1-2PP	1.0	15 to 240
Hexamethylene diisocyanate 822-06-0 1377	HDI; HMDI; 1,6-Diisocyanatohexane	0.5 mmHg @ 77 °F	0.005 T	0.034 T	0.005 T 0.02 C ⁶	0.035 T 0.14 C ⁶	0.005 T		Method 42 FV	GFF 1-2PP	1.0	15
1,6-Hexamethylene diisocyanate biuret 4035-89-6 D668	1,6-Hexamethylene diisocyanate Biuret; HDI Biuret; HDIB	0.000075 mmHg @ 77 °F							PV2030 PV	GFF 1-2PP	1.0	15

Isocyanate CAS no. OSHA IMIS no.	Synonyms	Vapor Pressure	Cal/OSHA PEL		Occupational Exposure Limits				OSHA Metho d no.	Sampling Medium	Flow Rate (L/min)	Sample Volume (L)
			ppm	mg/m ³	NIOSH REL ¹		ACGIH TLV ⁰⁸					
					ppm	mg/m ³	ppm	mg/m ³				
1,6-Hexamethylene diisocyanate homopolymer 28182-81-2 H130	Hexamethylene Diisocyanate Homopolymer; HDIH; Desmodur N3300; 1,6-Diisocyanato-Hexane Homopolymer; Poly (hexamethylene diisocyanate)	5.2x10 ⁻⁹ mmHg @ 77 °F							PV2125 PV	GFF 1-2PP	1.0	15
Isophorene diisocyanate 4098-71-9 1539	IPDI; Isocyanic acid, methylene(3,5,5-trimethyl-3,1-cyclohexylene) ester; 3-Isocyanatomethyl-3,5,5-trimethylcyclohexyl-isocyanate; Isophorone diamine diisocyanate	0.0003 mmHg @ 68 °F	0.005 T 0.02 STEL Skin	0.045 T	0.005 T 0.02 ST	0.045 T 0.18 ST	0.005 T		PV2034 PV	GFF 1-2PP	1.0	15 To 60
Methylene-bis(4-cyclohexylisocyanate) 5124-30-1 2651	Hydrogenated MDI; Dicyclohexylmethane-4,4'-diisocyanate; HMDI; Desmodur W	5.2x10 ⁻⁹ mmHg @ 77 °F	0.005 T	0.054 T	0.01 C ⁶	0.11 C ⁶	0.005 T		PV2092 PV	GFF 1-2PP	1.0	15
1,5-Napthalene Diisocyanate 25551-28-4 3173-72-6	1,5-Naphthylene Ester Isocyanic Acid, Napthalene Diisocyanate NDI	0.003 mmHg @ 75°F	0.01 C	0.085 C	0.005 T 0.02 C ⁶	0.04 T 0.17 C ⁶			PV2046 PV	GFF 1-2PP	1.0	60
Toluene-2,6-diisocyanate ³ 91-08-7 T177	2,6-diisocyanato-1-methylbenzene; 2,6-TDI	0.01 mmHg @ 77 °F					0.005 ⁵ T 0.02 STEL		Method 42 FV	GFF 1-2PP	1.0	15 to 240

CAS = Chemical Abstract System

IMIS = Integrated Management Information System

C = 15-minute ceiling; T = 8-hour time-weighted average; ST = short-term exposure limit; STEL = short-term exposure limit

FV = fully validated method, PV is partially validated method

GFF = glass fiber filter

1-2PP = 1-(2-pyridyl)piperazine

¹REL = NIOSH recommended exposure limit

²American Conference of Governmental Industrial Hygienists Threshold Limit Value 2010

³Toluene-2,6-diisocyanate is usually not found in a pure state and often occurs in a mixture of 80% toluene-2,4-diisocyanate and 20% toluene-2,6-diisocyanate

⁴NIOSH has designated toluene-2,4-diisocyanate as an occupational carcinogen with no safe exposure level

⁵ACGIH TLV for toluene diisocyanate is for toluene-2,4- or 2,6-diisocyanate, or a mixture of the two: Notice of Intended Change 0.001 ppm TWA, 0.003 ppm STEL Inhalable fraction and vapor.

⁶NIOSH Ceiling REL is a 10-min average

ISOCYANATE SAMPLING, FIELD EXTRACTION, and SAMPLE SHIPMENT PROCEDURES

Introduction

Chemicals containing the isocyanate functional group (-NCO) can contain more than one isocyanate group, for example toluene diisocyanate has two isocyanate groups, but as a class of chemicals they are often collectively referred to as isocyanates.

Except for methyl isocyanate which is extremely volatile and is sampled using coated adsorbent tubes, OSHA monitors workplace exposure to isocyanates using glass fiber filters that are impregnated with 1 milligram of 1-(2-pyridyl)piperazine (1-2PP). 1-2PP reacts with isocyanates to form a stable chemical derivative. These samples are normally extracted and analyzed by chemists at the laboratory. CSHOs will now be instructed in how to perform field extraction of isocyanate samples when using filter sampling procedures. Methyl isocyanate samples do not have the same derivatization issues inherent in filter samples and they do not require field extraction.

This isocyanate sampling, field extraction, and sample shipment protocol is now standard operating procedure to be followed for this NEP. All offices must follow this procedure.

Purpose of Field Extraction

The purpose of field extraction is to enhance the recovery of highly reactive isocyanates that are collected on the air sampler but for various reasons do not come into contact with the derivatization reagent coated on the filter. Such isocyanates may become unavailable for reaction with the 1-2PP reagent because of unwanted chemical side-reactions that occur during or after sampling. One way to bring collected isocyanates and the reagent into contact is to extract the samples immediately after sampling. Field extraction is of benefit only if it is performed immediately after sampling.

Apparatus

Personal sampling pump. A personal sampling pump that can be calibrated to within $\pm 5\%$ at the recommended flow rate with the sampling device in line.

Coated glass fiber filters. Glass fiber filters (GFF) coated with 1.0 mg 1-(2-pyridyl) piperazine (1-2PP). Coated GFFs can be obtained from LA Testing. Store the coated filters in a refrigerator until use. Avoid exposure of the coated filters to sunlight or heat. Discard the coated filters if they are not used within a month after receipt. CSHOs can also obtain the coated adsorbent tubes used for methyl isocyanate.

Field extraction solution. The field extraction vials each contain 3-mL of a solution composed of

90% v/v acetonitrile and 10% v/v dimethyl sulfoxide. **CAUTION.** These are both extremely toxic and flammable solvents (see SDS). CSHOs can obtain glass vials containing the correct volume of field extraction solution from LA Testing in the same way that the coated filters were obtained. It is important to keep the packaging material in which the vials containing the extraction solution was shipped from LA Testing for use to pack and return the vials to LA Testing for analysis.

Vial rack (tray) to hold extraction solvent vials, sized for 15-mm vials. Vial racks are used to secure the field extraction vials because they may help prevent spilling of the solvent.

Backup (support) pads. 37-mm cellulose.

Polystyrene cassettes. Three piece, 37-mm standard with top, bottom, and ring pieces and end plugs.

Isocyanate sampler. Except for methyl isocyanate, OSHA's methods for isocyanates specify sampling using the filter cassette sampler shown in Figure 1. Assemble the three-piece polystyrene cassette containing a coated glass fiber filter and a backup pad as shown in Figure 1. Use disposable gloves and metal forceps to handle the filters. There is no need to change gloves for each sampler to be assembled. Do not assemble more cassette samplers than expected to be used in a single sampling site visit. Do not expose the assembled isocyanate samplers to high temperatures or direct sunlight.

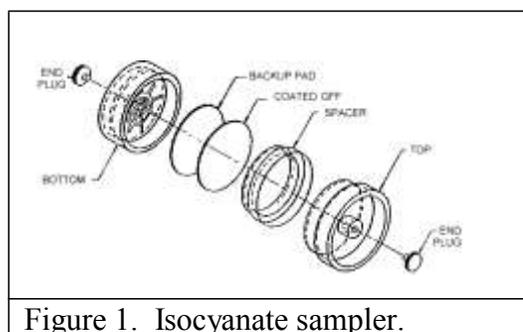


Figure 1. Isocyanate sampler.

Disposable gloves. Disposable nitrile gloves such as Ansell "Touch N Tuff," no. 92-600, are convenient and have good touch sensation properties. **CAUTION.** The Ansell "Touch N Tuff" gloves are rated by the manufacturer as having excellent resistance to dimethyl sulfoxide, but only fair resistance to acetonitrile. Immediately change the gloves if you spill solvent on them. Equivalent gloves from another manufacturer can also be used.

Metal Forceps. Clean the forceps with isopropyl alcohol and wipe them dry before each use. Isopropyl alcohol is adequate for cleaning purposes.

A six-pack cooler together with frozen ice packs (e.g., Blue-Ice type or equivalent) is a convenient and effective way to transport sampling and extraction media to and from the CSHO's office in a vehicle. This is a precaution intended to prevent degradation of the sampling media.

LA Testing has available an Isocyanates Sampling Kit that has the equipment necessary to extract air samples in the field. These supplies can be ordered together as a kit, or each item can be ordered separately through LA Testing.

Sampling Procedure

Sample open-face by removing the top piece and the end plug from the cassette sampler immediately before sampling.

Attach the cassette to the calibrated sampling pump with flexible tubing and position it in the workers breathing zone so that it is in an approximately vertical position with the open-face pointing down during sampling. Position the sampling pump, cassette and tubing so it does not impede work performance or worker safety.

Do not allow air being sampled to pass through any hose or tubing before entering the cassette.

Sample for the appropriate time using the flow rate shown in Table 2 of Appendix B.

Field Extraction Procedure

Wear disposable gloves for the following procedure and do not spill any of the solvent because this will affect sample results. Extract each sample separately and wear new gloves for each sample. **CAUTION.** The extraction solution is extremely toxic and flammable (see SDS). Immediately after sampling and in a clean location remove the coated filter from the cassette using clean forceps and place it in the glass vial containing the field extraction solution. If you spill any solvent on your gloves, replace them with new gloves immediately. Place the filter flat against the inside surface of the vial. Do not fold or crumple the filter. Immediately tightly seal the vial with the lined cap. Check to be certain that the cap on the vial is firmly tightened and does not leak. Vigorously shake the vial to wet the filter. Properly identify the sample and wrap each sample with a Form 1HS. Note any solvent spills on the Form OSHA-91A. Discard the backup pad and the polystyrene cassette in the regular trash.

Submit at least one blank sample with each set of samples. Extract and handle the blank sampler in the same manner as the other samples except draw no air through it. Do not leave the cassette top off the blank sample while air samples are being collected. Briefly remove the top cassette piece from the blank sample and then immediately replace it and extract the sample.

Record sample air volume (in liters of air) for each sample, along with any potential interference such as anhydrides, amines, alcohols, and carboxylic acids on the Form OSHA-91A.

Waste from the field extraction procedure except for the extraction solvent can be disposed of as regular trash. The CSHO's office may want to keep unused coated filters if they will be sampling again within the next month otherwise they can be disposed of as regular trash. The extraction solvent should either be returned to LA Testing for disposal or disposed of locally if the office has access to a hazardous waste handler (e.g., perhaps a local laboratory could dispose of the waste).

Shipping Procedure

Ship any bulk samples separate from the air samples.

Use the packaging material and packaging instructions that was supplied by Calico Lab to pack and return the sample extraction vials to LA Testing for analysis.

Submit the extracted samples to LA Testing for analysis as soon as possible after sampling. As a precaution, store the samples in a refrigerator for up to 1 week if delay is unavoidable. The samples do not require refrigerated shipment. Be certain to follow all applicable hazardous materials shipping restrictions and requirements. Persons shipping hazardous goods must use Golden State Overnight, our authorized contract carrier that has been approved by U.S. Department of Transportation (DOT).

CSHOs should check with their district manager or Calico to obtain the required DOT Hazardous Goods training.

Resources

OSHA's sampling and analytical methods for isocyanates can be accessed and downloaded from OSHA's public website www.osha.gov. They are located under Chemical Sampling Information.

Appendix C

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

a. If YES, what has changed and when? _____

7. Do you use any of the following personal protective equipment while working or while in the work area?

a. Respirator ___YES ___NO TYPE _____

b. Gloves ___YES ___NO TYPE _____

c. Protective Clothing ___YES ___NO TYPE _____

d. Eye Protection ___YES ___NO TYPE _____

e. Other Protective Equipment (If worker answers YES, please list below):

Please ask the worker the following questions in regard to past and current medical conditions: (For YES responses, note the month and date of first diagnosis).

8. Has a doctor ever told you that you have asthma? ___YES ___NO

If YES, when did the doctor tell you this? _____

9. Has a doctor ever told you that you have any of the following work-related conditions?

a. Work-related asthma - ___YES ___NO

If YES, when did the doctor tell you this? _____

b. Allergies from exposures at work - ___YES ___NO

If YES, when did the doctor tell you this? _____

c. Bronchitis from exposures at work - ___YES ___NO

If YES, when did the doctor tell you this? _____

d. Skin rash from exposures at work - ___YES ___NO

If YES, when did the doctor tell you this? _____

e. Hypersensitivity pneumonitis - ___YES ___NO

If YES, when did the doctor tell you this? _____

(If the worker has been diagnosed with any work-related condition or has symptoms that may be associated with isocyanate exposure, consider asking the worker to sign a medical release to

obtain a copy of the worker's personal medical records or obtain a medical access order (MAO) for the worker's employer medical records).

10. Please ask the worker the following questions regarding symptoms. (If worker answers **NO**, go to the next symptom. If the answer is **YES**, ask the questions across the row):

Symptom*	YES	NO	If yes, approximately what date did you first notice symptoms?	Do your symptoms occur at work?	Do your symptoms improve when you are away from work such as while on vacation or on the weekends? <i>(Describe):</i>	Do you think your symptoms are brought on by any particular work activity, chemical exposure, or work area? <i>(Describe):</i>
Cough						
Wheezing						
Watery or itchy eyes						
Nose stuffiness or itching						
Skin rash or itching						
Shortness of breath						
Chest tightness						
Fever or chills						

*Not related to a cold or infection

11. Have you missed any days from work because of respiratory symptoms? ___**YES** ___**NO**

12. Have you been restricted or transferred from one job assignment to another because of respiratory symptoms? ___**YES** ___**NO**

13. Have you informed anyone in management or supervision of symptoms related to isocyanate exposure? ___**YES** ___**NO**

Other Comments:

Appendix D

Sample Isocyanates Information Memorandum

Note: This Info Memo must be adapted to the specific circumstances noted in each inspection. The Info Memo below is an example of the type that may be appropriate in some circumstances. If the employer has implemented, or is in the process of implementing efforts to address problem conditions, those efforts should be recognized and encouraged, if appropriate.

Italicized comments are for OSHA compliance use only and should not be included in the Info Memo.

An inspection of your workplace and evaluation of your OSHA recordkeeping logs at (*location*) on (*date*) disclosed the following condition(s), which are consistent with employee exposure to (*list isocyanate*), a known occupational health hazard; (*list conditions*).

(Include a general description of the risk factors for each task/job associated with respiratory sensitization/asthma, such as lack of ventilation, lack of PPE, inappropriate PPE, etc.)

Even though sampling did not show exposures above an OSHA permissible exposure limit, in the interest of workplace safety and health, I recommend that you voluntarily take the necessary steps to materially reduce or eliminate your employees' exposure to the conditions listed above.

While the risk of health hazards associated with exposure to isocyanates can be reduced or eliminated by implementing a single means of abatement, in most cases a variety of abatement methods will provide a more effective method of addressing these hazards. These include workplace analysis of jobs and tasks to assess hazards associated with those jobs and tasks and the steps to abate them; product substitutions; engineering, administrative and work practice controls; accurate injury and illness recordkeeping; medical surveillance; medical management of occupational illnesses and injuries; education and training of employees; and management oversight. When respiratory sensitization, asthma or other hazards associated with isocyanate exposure are addressed on an incremental basis to determine the effectiveness of a specific control strategy, it is important to evaluate the effectiveness of the results in a timely manner. If the initial control strategy fails to eliminate or substantially reduce employee exposures, additional control measures should be implemented.

We have examined available information on the hazards associated with these jobs/tasks, and your efforts to address these hazards. The evaluation suggests that the following additional methods of abatement should be implemented.

1. Engineering Controls

If substitution is not possible, engineering controls are the first line of defense in employee protection. Therefore, employers should provide appropriate engineering controls and should

train their employees in their use and in proper work practices to ensure that employee occupational exposure to isocyanates are maintained below levels hazardous to employees. The following engineering controls are recommended:

- *(list possible engineering controls: local exhaust ventilation, automated process, isolating the process, etc.)*

2. Administrative and Work Practices Controls

The following work practices should be used to ensure that occupational exposure to an isocyanate(s) during *(list operation(s))* is (are) reduced:

- *(List possible controls such as: limiting the time employees are exposed);*
- *(Job rotation);*
- *(Monitor employee exposures on a regular basis);*
- *(Limit the number of employees who have access to areas where the operation occurs);*
- *(Provide separate lockers for work clothes and street clothes);*
- *(Do not eat, drink, apply cosmetics or use tobacco products in work area(s));*
- *(Do not leave the workplace wearing protective work clothing or equipment or take it home to launder);*
- *(Wash face, hands, and forearms before eating, drinking, smoking, or applying cosmetics);*
- *(Shower at end of work shift);*
- *(Immediately and thoroughly wash off skin with soap and flowing water if dermal contact occurs);*
- *(Wear appropriate personal protective equipment);*
- *(A medical surveillance program as described in Appendix I);*
- *(Etc.)*

3. Personal Protective Equipment

To be effective, personal protective equipment must be individually selected; properly fitted and periodically refitted; conscientiously and properly worn; regularly maintained; and replaced as necessary. In addition, employers must:

- Perform a workplace hazard assessment in accordance with Title 8 sections 3203 and 3380 to determine if hazards are present, or are likely to be present which necessitate the use of personal protective equipment (PPE);
- Provide and ensure the use of the appropriate gloves (e.g., butyl, nitrile), goggles, and protective clothing when a potential for eye or dermal exposure exists (e.g., exposure to contaminated equipment, chemical containers, etc.);
- Train employees on the limitations and use of PPE required during *(list operations)*;

- Establish, implement, and maintain a written respiratory protection program in accordance with Title 8 section 5144(c) whenever the employer requires the use of respiratory protection;
- Provide and ensure that employees use appropriate respiratory protection;
- *(Etc.)*.

4. Training and Information

Employers must comply with the OSHA Hazard Communication standard, Title 8 section 5194. In particular, employers must ensure that employees exposed to isocyanates are trained in and have access to the following information:

- The specific nature of the operations in their workplace where exposure may occur;
- Safety Data Sheets (SDSs) for chemicals containing isocyanates;
- The signs and symptoms of isocyanate exposure;
- The importance of avoiding dermal contact when working with isocyanates;
- The engineering controls the employer is using to reduce employee exposures to isocyanates;
- Specific work practices that should be used to reduce exposure to isocyanates;
- The use of appropriate protective equipment, including respirators and skin protection and the limitations of that equipment; and
- Methods that may be used to detect the presence of the isocyanates in the workplace, such as workplace monitoring.

In addition, the results of any air or wipe sampling the employer or others have conducted for levels of isocyanates should be shared with employees and/or their representative.

(Using the above components, together with information gathered during the inspection, describe the specific conditions or weaknesses and suggest methods of abatement.)

You may voluntarily provide this District Office with progress reports on your efforts to address these conditions. Cal/OSHA may return to your worksite to further examine the conditions noted above.

Appendix E

Publications and Resources

OSHA publications are available online at <http://www.osha.gov/pls/publications/publication.html>. If you are unable to access the online publications and would like to place an order, please contact the OSHA Publications Office at 1-800-321-OSHA (6742).

OSHA Online Resources:

[*Safety and Health Topics Page on Isocyanates*](#)
[*Safety and Health Topics Page on Occupational Asthma*](#)
[*Safety and Health Topics Page on Hazard Communication*](#)
[*Safety and Health Topics Page on Personal Protective Equipment*](#)
[*Safety and Health Topics Page on Respiratory Protection*](#)
[*Safety and Health Topics Page on Spray Operations*](#)
[*Safety and Health Topics Page on Ventilation*](#)

Additional Safety and Health Topics Pages can be found online at [OSHA Safety and Health Topics](#).

OSHA Publications:

- [Chemical Hazard Communication](#) (No. 3084)
- [Hazard Communication Guidelines for Compliance](#) (No. 3111)
- [Job Hazard Analysis Guide](#) (No. 3071)
- [Personal Protective Equipment](#) (No. 3151)
- [Small Business Handbook](#) (No. 2209)
- [Small Entity Compliance Guide for Respiratory Protection Standard](#) (CFR 1910.134), (No. 9071)

[OSHA/NIOSH Spirometry InfoSheet](#) - <http://www.osha.gov/Publications/osha3415.pdf>

[OSHA/NIOSH Spirometry Worker Info](#) - <http://www.osha.gov/Publications/osha3418.pdf>

OSHA Small Business Assistance:

Small business owners who are concerned about the cost of professional help can contact the OSHA Consultation Project Office in their state for free consultation service. Priority is given to businesses with fewer than 250 employees at a worksite, with further consideration given to the severity of the worksite problem. The OSHA Consultation Program can help employers evaluate and prevent hazardous conditions in their workplace that can cause injuries and illnesses, including the hazards associated with exposures to isocyanates. For more compliance assistance information, please visit OSHA's Small Business web page at <http://www.osha.gov/dccsp/smallbusiness/index.html>.

National Institute for Occupational Safety and Health (NIOSH) Resources:

NIOSH [Safety and Health Topics Page on Isocyanates](#)

NIOSH [Safety and Health Topics Page on Asthma and Allergies](#)

NIOSH Preventing Asthma & Death from MDI Exposure During Spray-on Truck Bed Liner and Related Applications, (Sept. 2006), DHHS Pub. No. 2006-149

Other Resources:

Heederik, Derrick, Henneberger, Paul A. and Relich, Carrie A. (2012). “Primary prevention: exposure reduction, skin exposure and respiratory protection.” *European Respiratory Review* 21(124), 112-114. Available at: <http://err.ersjournals.com/content/21/124/112.full.pdf>

De Vries, Thomas, Bello, Dhimiter, Stowe, Meredith H., Harari, Homero, Slade, Martin D., and Redlich, Carrie A. (2012). “Transferability of Aliphatic Isocyanates from Recently Applied Paints to the Skin of Auto Body Shop Workers.” *Journal of Occupational and Environmental Hygiene*, 9, 699-711. Available at: <http://www.ncbi.nlm.nih.gov/pubmed/23067057>

Arrandale, V.H., Liss, G.M., Tarlo, S.M., Pratt, M.D., Sasseville, D., Kudla, I., Holness, D.L. (2012). “Occupational Contact Allergens: Are They Also Associated With Occupational Asthma?” *American Journal of Industrial Medicine*, 353-60. Available at: www.ncbi.nlm.nih.gov/pubmed/22238032

Bello, Dhimiter, Herrick, Christina A., Smith, Thomas J., Woskie, Susan R., Streicher, Robert P., Cullen, Mark R., Liu, Youcheng, Redlich, Carrie A. (2007). “Skin Exposure to Isocyanates: Reason for Concern.” *Environmental Health Perspectives*, 115(3), 328-335. Available at: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1849909/>

Appendix F

Sample Special Order Language

Where exposures to isocyanates exist and the conditions meet the elements of a Special Order per P&P C-3, a Special Order may be issued. Below is an example of language to use.

The employer did not furnish a place of employment that was free from recognized hazards that were causing or were likely to cause death or serious physical harm to employees in that employees were exposed to (*chemical name*), which was causing or likely to cause respiratory illness such as asthma or skin sensitization:

- a. On or about (*date*), (*list employee titles, or names*) working in the (*name area(s)*) was/were exposed to (*name chemical*). Exposures occurred via (*list routes of entry: inhalation, ingestion, dermal absorption, etc.*) at concentrations of (*list exposure levels, surface/dermal contamination levels*).

The employer could feasibly adopt measures that would be effective in reducing or eliminating employee exposure to (*name chemical*) and the associated risk of developing (*asthma or other effects of exposure/disease*). Examples of such measures may include:

- 1) Engineering controls including (*if applicable, list relevant engineering controls, such as local exhaust ventilation, substitution, etc.*).
- 2) Administrative and work practice controls, including (*if applicable, list relevant administrative and work practice controls, such as rotation, cleaning working surfaces, maintenance of engineering controls, medical monitoring, etc.*).
- 3) Personal Protective Equipment, including (*if applicable, list relevant PPE*).

Appendix G

General Guidance for Employers on Personal Protective Equipment (including Respiratory Protection) for Worker Exposures to Isocyanates

The following information is adapted for this NEP based on information obtained from the Region 2 Isocyanate Local Emphasis Program.

Employers are required to make a hazard assessment of their workplace to determine what kinds of personal protective equipment (PPE) their employees need for protection against isocyanates. The types of PPE selected will be influenced by a number of factors, such as the specific job functions of the worker and the chemical resistance of the PPE. An effective PPE program greatly increases the effectiveness of protective gear.

Specific Job Functions

The nature of the job being performed will greatly influence the selection and features of protective clothing. For example, workers that are analyzing foam samples in a laboratory may require light-duty gloves (at least 5 mil in thickness) that are flexible and preserve manual dexterity. The potential for worker exposure is limited to a localized area and may only require gloves and either a lab apron or lab coat, in addition to eye protection. In contrast, a maintenance project, such as repairing a pump line, may require workers to wear thicker gloves that are rugged and durable, as well as hooded chemically-resistant overalls and boots.

General Principles of Personal Protective Equipment Selection

- The item must be suitable for the job the worker is to perform.
- The item must offer a protection time that exceeds potential exposure times.
- The item must be replaced before protection time is exceeded.
- Disposable items are preferable to reusable ones, because of contamination/decontamination issues.

Chemical Resistance of Glove or Clothing

To be effective, the protective clothing must resist permeation and penetration by the chemical or chemicals being handled. Use of disposable gloves and clothing is preferred because proper decontamination of reusable items is often difficult. The employer should request documentation from the manufacturer or distributor specifying if the protective equipment meets the appropriate test standard(s) for the type(s) of chemical(s) used in the workplace. For example, some isocyanates may be part of a solvent mixture, so the gloves must protect against the solvent also.

The protection time of PPE is an important selection consideration. Protection time is the time required for a chemical to permeate or make its way through the chemical protective glove or clothing material, and is the material's maximum use time. Keep in mind that isocyanates are often found as a mixture with other chemicals, especially solvents. Gloves and clothing may be affected by solvents, which can reduce the time it takes for solvents and isocyanates to permeate the glove material. PPE manufacturers are able to provide protection times for their equipment.

It is important for the wearer to understand the need to change gloves and clothing often enough to avoid exceeding manufacturers' stated protection times and to prevent skin contact with isocyanates. The manual dexterity requirements of some jobs require the use of thin, form-fitting gloves. These may offer limited amounts of protection time, so use of such gloves is acceptable only if the gloves are changed with sufficient frequency. For example, if a job requires the use of thin, flexible gloves with a 30-minute protection time for isocyanates, then the wearer should change gloves within 30 minutes from initial contact with the isocyanate-containing compound.

Eye and/or Face Protection

Based on the operation, either safety goggles or a face shield may be required when working with isocyanates.

Respiratory Protection - General

An effective written respiratory protection program must be developed and implemented in accordance with Title 8 section 5144. Key provisions include assignment of a program administrator, fit testing, medical evaluations, proper use of respirators, training and information (including the need for a user seal check each time the respirator is donned), maintenance and care of respirators, program evaluation and recordkeeping.

Respirator Evaluation and Selection

The employer is required to select the appropriate respirator for each situation in which employees are exposed to isocyanates above the PEL or at any level that poses a recognized hazard of death or serious injury or illness to workers. Some factors that must be included in the evaluation by the employer are as follows.

- A. The concentration of isocyanates in the air to which employees will be exposed must be considered. MDI and TDI have OSHA Ceiling Limits; Methyl Isocyanate has an 8-hour TWA PEL. See Appendix B. Other isocyanates have been evaluated by other organizations and have occupational exposure limits such as the NIOSH REL or ACGIH TLV. Section 5144(d)(3)(A) requires the employer to "provide a respirator that is adequate to protect the health of the employee and ensure compliance with all other OSHA statutory and regulatory requirements under routine and reasonably foreseeable emergency situations." Therefore, when selecting a respirator for protection against substances that have TWA PEL or Ceiling Limits, the employer must not only consider if exposure levels may be reached or exceeded during routine operations, but also if they may be exceeded during reasonably foreseeable emergency situations. The employer must then select a respirator that would provide adequate protection against these levels.
- B. Negative pressure respirators carry a greater risk of leakage than positive pressure respirators. If the face-to-facepiece seal is compromised (e.g., because of beard growth), more contaminated air is likely to leak in than would be the case with positive pressure respirators.

The protection factor of the respirator needs to be taken into account when selecting a respirator. Section 5144(d)(3)(A) discusses the protection factors of the respirators. The respirator

chosen must protect the employee from the concentration of isocyanate to which they are being exposed.

Section 5144(d)(1)(A) states, “the employer shall select and provide an appropriate respirator based on the respiratory hazard(s) to which the worker is exposed and the workplace and user factors that affect respirator performance and reliability.”

Section 5144(d)(3)(C) further states that for protection against gases and vapors at levels that are not Immediately Dangerous to Life or Health (IDLH) an air-purifying respirator may be used, provided that:

1. The respirator is equipped with an end-of-service life indicator (ESLI) certified by NIOSH for the contaminant; or
2. If there is no ESLI appropriate for conditions in the workplace, the employer implements a change schedule for canisters and cartridges that is based on information or objective data that will ensure that canisters and cartridges are changed before the end of their service life. The employer shall describe in the respirator program the information and data relied upon and the basis for the change schedule and the basis for reliance on the data.

OSHA anticipates that some employers who perform the required evaluation will determine that air-purifying respirators (APRs) are appropriate for their circumstances. Others may prefer to provide powered-air purifying respirators (PAPRs). APR and PAPR cartridges also need to be changed out. See below on change-out information. Under some circumstances, other employers may determine that Supplied-Air Respirators (SARs) may be the only appropriate type of respirator for these hazards, especially in high-exposure industries like automotive painting.

Respirator Cartridges and Change-out Schedules

Cal/OSHA’s Respiratory Protection standard, Title 8 section 5144, does not permit the use of warning properties as the sole basis for a cartridge change-out schedule. In addition, isocyanate-containing compounds do not have appropriate sensory warning properties. For atmospheres which are not IDLH, APRs are now considered acceptable as long as appropriate precautions and change-out schedules are in place. See Title 8 section 5144(d)(3)(C).

Currently, there are few respirator cartridges or canisters available on the market with ESLI, and none for isocyanates. An employer must select a cartridge or canister recommended for the chemical(s) against which the cartridge or canister is meant to protect employees. The employer must then implement a change schedule for the canister or cartridges that is based on objective information or data that will ensure that the canister and cartridges are changed before the end of their service life. The data relied upon and the information forming the basis of the determination must be included in the written respirator program. If more information becomes available, an employer would be expected to review and, if necessary, revise the change-out schedule. Further information on change out schedules may be found at http://www.osha.gov/SLTC/etools/respiratory/change_schedule.html.

The International Isocyanate Institute⁶ sponsored a study to determine the effectiveness of air-purifying respirator cartridges in removing MDI aerosols from air. They concluded that:

- Organic vapor cartridges without a particulate filter were not effective at removing MDI aerosols from air;
- Organic vapor cartridges with dust/mist (DM) or high efficiency (N100) filters effectively removed greater than 99% of MDI aerosol and vapor in all test atmospheres; and
- Formation of MDI aerosols was evident even at very low (<100ug/m³) total MDI concentrations.

Other PPE Information

Isocyanate vapors are corrosive and severely damaging to the eyes. Contact may cause permanent eye damage. If a half-mask respirator is selected, an employer would also be required under Title 8 section 3380 to ensure that the employee uses appropriate eye and face protection.

Vapors of isocyanates may cause skin irritation and sensitization. The employer is required under Title 8 sections 3203 and 3380 to assess the workplace and select appropriate personal protective equipment. Additional personal protective equipment to protect the skin of the face and neck may be required if an employer elects respirators which leave these areas exposed.

Exposure to diisocyanates can cause various respiratory ailments. If an employee using an APR reports any medical signs or symptoms which could be attributed to isocyanate exposure, the employer must take appropriate action. Section 5144(e)(7)(A) requires additional medical monitoring if an employee reports medical signs or symptoms related to the ability to use a respirator.

Employee Training on PPE

Personal protective equipment can be effective only if the equipment is selected based on its intended use; employees are trained in its use; and the equipment is properly tested, maintained, and worn.

Teaming the proper personal protective equipment with a good training program can give the worker a large measure of safety where other controls are inadequate or impossible. Train your employees to know:

- Why hand, arm, and body clothing, and respiratory protection are necessary – i.e., why isocyanates are a hazard that require skin and breathing protection;
- How the PPE will protect them;

⁶ Information on the International Isocyanate Institute, Inc. may be found at www.diisocyanates.org.

- The limitations of the protective equipment you have supplied;
- When a worker must wear the protective equipment;
- How to wear the protective gloves, sleeves, and clothing properly;
- How to ensure a comfortable and effective fit;
- How to identify signs of wear, such as cracks, scrapes or lacerations, thinning or discoloration, or break-through to the skin; and
- How to clean and disinfect reusable protective gloves, sleeves, body clothing, and respiratory protection.

Appendix H

General Guidance for Employers on Medical Surveillance Program Information for Worker Exposure to Isocyanates

A medical surveillance program for workers exposed to isocyanates should be developed, supervised and monitored by a physician who is Board Certified/Board Eligible in any of the following:

- Occupational Medicine
- Pulmonology/Pulmonary Medicine
- Internal Medicine
- Family Medicine
- Allergy and Immunology (especially if focused on asthma care)

General recommendations for an isocyanates medical surveillance program include⁷:

- Preplacement, annual and exit general medical examinations with:
 - Special emphasis on the respiratory tract
 - A medical history including an extensive work history, history of pre-existing respiratory conditions such as asthma, and a smoking history.
 - Spirometry (more information for employers and employees can be found on the [Spirometry Information sheet \(http://www.osha.gov/Publications/osh3415.html\)](http://www.osha.gov/Publications/osh3415.html) and [Spirometry Worker Information sheet \(http://www.osha.gov/Publications/osh3418.html\)](http://www.osha.gov/Publications/osh3418.html)).
- Workers with a history of respiratory conditions should be informed of the potential for increased health risks associated with exposure to isocyanates.
- Isocyanate-sensitized individuals should be assigned to work in areas where exposure to isocyanates is not expected.

Examples of medical surveillance programs:

1. Michigan State University's "Recommended Medical Screening Protocol for Workers Exposed to Occupational Allergens"
<http://www.oem.msu.edu/userfiles/file/Resources/asthmaprotocol.pdf>
2. Asthma Initiative of Michigan's Recommended Medical Screening Protocol for People Exposed to Work-Related Allergens
<http://www.getastmahelp.org/work-related-asthma-screening.aspx>

General Occupational Medicine Resources:

Association of Occupational and Environmental Clinics (AOEC) - <http://www.aoec.org/>

Workplace Health and Safety Queensland Designated Doctor Program: Isocyanate health surveillance guidelines: www.deir.qld.gov.au/workplace/resources/pdfs/ddp-isocyanateguide.pdf

⁷ These recommendations can be found at http://www.michigan.gov/documents/cis_wsh_cet5045_90179_7.doc