

**OREGON OCCUPATIONAL SAFETY AND HEALTH DIVISION  
DEPARTMENT OF CONSUMER AND BUSINESS SERVICES**

---

**PROGRAM DIRECTIVE**

Program Directive: A-256

Issued: May 1, 2006

Revised: January 20, 2017

**SUBJECT:** Local Emphasis Program (LEP) on Occupational Exposures to Isocyanates

**AFFECTED CODES  
& DIRECTIVES:**

- OAR 437-001-0057(9)
- Program Directive A-243 “Spray Finishing: Assessing Fire Safety & Industrial Hygiene Issues for Diisocyanates”
- Hazard Communication OAR 437-002-1910.1200
- Personal Protective Equipment OAR 437-002-0134
- Personal Protective Equipment OAR 437-003-0134
- Respiratory Protection OAR 437-002-1910.134
- Air Contaminants OAR 437-002-0382
- Ventilation OAR 437-002-1910.94, OAR 437-002-0081
- Spray Finishing OAR 437-002-0107
- Sanitation OAR 437-002-1910.141, OAR 437-002-0141
- Medical Services and First Aid OAR 437-002-0161

**REFERENCES:**

- NIOSH ALERT 1996 DHHS (-NIOSH) Publication No. 96-111  
“Preventing Asthma and Death from Isocyanate Exposure”
- Oregon OSHA Hazard Alert, “Diisocyanate Exposures in Spray-on (Truck) Bed Liners, issued March 27, 2006
- Field Inspection Reference Manual
- Oregon OSHA Technical Manual

**PURPOSE:** This directive describes policies and procedures for implementing a local emphasis program to identify, reduce or eliminate the workplace incidence of adverse health hazards associated occupational exposure to isocyanates and to establish neutral administrative standards to select employers in those industries for health inspections.

**SCOPE:** This emphasis program includes inspections conducted in industries identified in Appendix A or at any work site where the division determines that there is a potential worker exposure to isocyanates.

**BACKGROUND:** Oregon OSHA started a local emphasis program PD A-256 issued May 1, 2006 that primarily was directed to spray on bed liners and undercoating applications in the automotive industry. This directive was revised Sept. 27, 2007 to focus on a broader scope of isocyanates use in industry or work sites where there is potential worker exposure to isocyanates.

**Employee exposure to isocyanates can result in both acute and chronic long-term serious health effects.** Organic isocyanates are chemicals which contain one or more isocyanate groups (-NCO) attached to an organic group. The general term “isocyanates” refers to all chemicals with two or more isocyanate groups such as diisocyanates or polyisocyanates. They are known to be an inhalation and skin hazard among occupationally exposed workers. They are powerful irritants to the mucous membranes, gastrointestinal and respiratory tract. Irritation may be severe enough to produce bronchitis with bronchospasm. They are also allergic sensitizers and are known to cause respiratory sensitization, an allergic, asthma-type reaction. Once sensitization has occurred, future exposures can produce allergic reactions often with debilitating effects. Sensitization can occur from isocyanates being absorbed through skin contact. Dermal sensitization may result in rash, itching, hives, and swelling of the extremities. Because they are not water-soluble, they cannot be easily washed off skin or clothing. Chronic exposure can result in decreased lung function, eventually leading to the sensitization of the respiratory system and the development of occupational asthma.

Isocyanates are used in a variety of manufacturing operations including 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.

The National Institute for Occupational Safety and Health (NIOSH) states that “Preventing exposure to isocyanates is a critical step in eliminating the health hazard. Engineering controls such as closed systems and ventilation should be the principal method for minimizing exposure in the workplace. Other controls, such as worker isolation and personal protective clothing and equipment may also be necessary. Early recognition of sensitization and prompt and strict elimination of exposures is essential to reduce the risk of long-term or permanent respiratory problems for workers who have become sensitized.”

The goal of this instruction is to reduce employee exposure to isocyanates shown to cause work-related asthma, sensitization (respiratory, skin) and

other occupational health issues. This goal will be accomplished by a combined effort of inspection targeting, outreach to employers, and compliance assistance. By performing activities (enforcement and outreach) related to this topic, Oregon OSHA will also raise the awareness of the occurrences and the severity of occupational health hazards related to or associated with isocyanates in all industry sectors.

**ACTION:** Inspection scheduling under this directive will incorporate these criteria:

An inspection may be scheduled from information such as recognized health hazards known to be associated with certain processes and are reasonably thought to exist at a place of employment (OAR 437-001-0057(7)). The Division will identify places of employment in Appendix A for inspections that are on the A and B tier of the health scheduling lists.

**SCHEDULING LISTS:** Inspection Scheduling Lists

1. Inspections will be focused on General Industry where workers are potentially exposed to isocyanates with processes that are known to occur.
2. Establishments with fewer than ten employees will be included.
3. Establishments that have received a comprehensive health inspection in the last three years will be deleted from the inspection list.
4. Exposures to isocyanates are found in many industries, but are not necessarily found in all establishments within those industries. Appendix A, Table 1, contains a list of relevant industries (by NAICS code) where worker exposure to isocyanates may be found. The inclusion of a listed industry does not indicate that workers will have occupational exposure to isocyanates.

**PROCEDURES:** Inspection Procedures

All inspections will be followed in accordance with the FIRM.

Inspections under this emphasis program will focus on:

1. All aspects of isocyanates-related work or exposure, including a review of written programs:
  - a. Hazard Communication OAR 437-002-1910.1200
  - b. Personal Protective Equipment OAR 437-002-0134
  - c. Respiratory Protection OAR 437-002-1910.134; e.g., establishment of a written program to include: an evaluation of the

respiratory hazards, respirator selection, change-out schedules where canisters/cartridges are in use, medical evaluation, fit testing, maintenance and care of respirators, training, program evaluation, recordkeeping, etc.

2. Air sampling of active work processes to document exposure to air contaminants per the Air Contaminants Rules OAR 437-002-0382.
3. Engineering control methods, e.g., ventilation methods, spray booths, spray areas, etc. Ventilation OAR 437-002-1910.94, OAR 437-002-0081 and Spray Finishing OAR 437-002-0107.
4. Housekeeping and personal hygiene practices, e.g., no eating etc. in spray areas, wash facilities to remove potential chemical exposure from the skin from routine work practices per the Sanitation OAR 437-002-1910.141 and related sanitation rules.
5. Medical Services and First Aid, e.g., emergency medical plan, emergency eyewash and shower per Medical Services and First Aid OAR 437-002-0161
6. Construction-related inspections. If during the course of any construction inspection a compliance officer encounters a company that falls within the NAICS codes listed in Appendix A, the inspection will include a focus on any activity that potentially exposes workers to isocyanates.
7. Compliance officers will follow existing policies and procedures when citing standards used to address hazards. Please see the following appendices for more information:

Appendix A – Industries where isocyanate exposure may occur (NAICS list)

Appendix B – Synonyms

Appendix C – Health Surveillance Form (non-mandatory)

Appendix D – Hazard Letter Example

Appendix E – Publications and Resources

Appendix F – Violation Language

Appendix G – Guidance on PPE and Respiratory Protection

Appendix H – Guidance on Medical Surveillance

- a. Cases of occupational illness due to exposure may be discovered during a review of the employer's injury and illness logs. In order to review the employee medical records, that are not specifically required by an Oregon OSHA standard (e.g., the results of medical examinations, laboratory tests, medical opinions, diagnoses, first

aid records, reports from physicians or other health care providers), they must be obtained and kept in accordance with 1910.1020 *Access to Employee Exposure and Medical Records*. Refer to PD A-266, *OR-OSHA Access to Employee Medical Records* for information and guidance.

- b. Case information may also be obtained during worker interviews. Appendix C contains a health surveillance form which may be used when interviewing workers.
- c. Exposure Monitoring and compliance officer protection. Inspections will include an evaluation of the employer's controls (engineering, administrative, and PPE) where exposure to isocyanates may occur. The compliance officer should be prepared to take samples on the day of inspection. The compliance officer must also assess their own personal protective measures and wear the appropriate personal protective equipment for all field activities when taking screening, area, bulk, wipe and personal samples (air, skin). Appropriate PPE includes eye protection, protective gloves (e.g., nitrile or butyl rubber), and, at a minimum, an air-purifying respirator with organic vapor cartridges and N95 pre-filters for short-term or limited (potential) exposure scenarios. The respirator must be protective for all contaminants in the chemical systems being evaluated. Personal safety is of utmost importance and any exposure to isocyanates must be carefully evaluated with all protective measures fully in place.
- d. Exposure Assessments. Personal air samples should be collected during inspections. If the process that uses isocyanates is not in operation the day of the inspection, the compliance officer may return at a later date to perform sampling. Where the compliance officer has determined that the employer has recent and accurate sampling exposure data (e.g., taken by state consultative service, third party consultant, insurance company), the compliance officer will consult with their manager to determine if sampling is required. When operations using isocyanates are infrequent or unplanned, the compliance officer will consult with their manager to determine if sampling should still occur.
- e. 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. While Oregon OSHA does not currently have any standards setting limits for surface contamination with, or dermal exposure to, isocyanates, if wipe sampling reveals surface contamination or dermal exposure, citations may be issued under the applicable housekeeping standards or PPE standards.

f. Surface Sampling.

Compliance officers 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. There are several options for assessing surface contamination. If the compliance officer chooses to conduct surface sampling consult with the Oregon OSHA lab on the appropriate media and technique, perform the sampling and document the results.

g. Dermal Sampling.

Compliance officers should determine if dermal exposure measurements are needed in checking for compliance with Division 2/I or Division 3/E, PPE. If dermal exposure is observed consult the Oregon OSHA lab on appropriate sampling media and techniques, and the compliance officer should perform this sampling and document the results. For more information on “Occupational Skin Exposure,” refer to the Oregon OSHA Technical Manual, Section 2, Chapter 2.

When the compliance officer observes contaminated surfaces and equipment, dermal sampling should be conducted. Consult the Oregon OSHA lab on appropriate sampling media and techniques.

h. PPE Sampling. Gloves are one of the most basic forms of PPE but their resistance to penetration by isocyanates may not be known. Consult the Oregon OSHA lab on appropriate sampling media and techniques to detect permeation of isocyanates through gloves. Other PPE should also be wipe sampled for contamination such as the inside of respirators.

i. Methodology. Consult the Oregon OSHA lab on appropriate sampling media and techniques. Surface, dermal, or permeation sampling media are available from the Oregon OSHA lab. Compliance officers should consult with the lab if they choose to conduct surface sampling.

- j. Documentation. The compliance officer must document the results of any surface, dermal, or PPE wipe sampling in the case file. In addition, when a wipe sample is collected the compliance officer should add the code “IWIPE” on the OSHA-1 (see the section on OSHA-1 coding)

**CITATION GUIDELINES:**

If overexposures to isocyanates are identified, this condition can be cited as a violation of OAR 437-002-0382(5). Administrative or engineering controls must be determined and implemented whenever feasible to achieve compliance with those air contaminant standards.

Citations for overexposure (inhalation) to an isocyanate will be cited as serious, regardless of PPE use (including respirators), following the citation policy found in the FIRM. Where an overexposure to an Oregon OSHA permissible exposure limit (PEL), Table Z-2, exists and feasible engineering and/or administrative controls were not utilized or were ineffective, a serious citation will be issued and grouped with the overexposure.

Where an exposure to an isocyanate does not exceed an existing Oregon OSHA PEL, and is less than an established occupational exposure limit (OEL), but cases of occupational illness (e.g., work-related asthma) have been documented, a hazard letter (HL) should be issued to the employer. The HL must recommend specific actions that could assist in the reduction of cases of occupational illness and include a notification that a follow-up inspection may be conducted. A sample hazard alert letter is included in Appendix D.

There are several factors to consider in evaluating worker exposure to isocyanates. Work practices, confined spaces, ventilation and airflow characteristics, frequency and duration of exposure, surface contamination, personal protective equipment and respiratory protection should be evaluated. Where overexposure(s) to isocyanate-based chemicals are identified through air monitoring, cite OAR 437-002-0382(5). Where overexposure to isocyanate-based chemicals are identified in spray finishing operations, OAR 437-002-0382(5) establishes that administrative or engineering controls are required to mitigate the identified overexposures.

Successful management of worker exposures to isocyanates typically include effective hazard communication information and training; use of gloves and other PPE to control skin contact; respiratory protection; effective ventilation control methods; work practices designed to reduce or eliminate exposure and control strategies for any other site-specific conditions which can influence a worker’s exposure potential

The following table summarizes possible enforcement actions when dealing with isocyanate exposures. The compliance officer must be able to establish that a hazardous exposure condition exists when considering whether to issue a Division 1 (general duty) violation. Any Division 1 citations for exposure to an isocyanate must be reviewed by the Statewide Health Enforcement Manager. See Appendix F for further guidance when issuing Division 1 violations. If no Division 1 citation is issued, a hazard letter will be issued providing specific actions that would assist in reduction of exposure to help prevent cases of occupational illnesses.

	Issue Citation	Documented Illness Cases*	Consider Division 1	Issue Hazard Letter
>PEL	X			
<PEL/<OEL		X		X
No PEL/ >OEL		X	X	If no Division 1 citation
< PEL/ >OEL		X	X	If no Division 1 citation

\*Documented in conjunction with relevant factors for successful management of worker exposures, as discussed above. Examples of serious health effects include occupational dermatitis (i.e., not irritation), skin sensitization, gastrointestinal tract issues and work-related asthma; such cases are required to be listed on the OSHA 300 Log.

[An occupational exposure limit (OEL) is a non-regulatory established airborne exposure limit. An OEL includes NIOSH Recommended Exposure Limits (RELs) and ACGIH Threshold Limit Values (TLVs)]

#### Personal Protective Equipment (PPE):

##### 1. PPE Assessment.

At the opening conference, the compliance officer will review the employer's hazard assessment in determining compliance with the appropriate PPE regulations, including conducting a PPE assessment and inclusion of employee training.

##### 2. PPE Evaluation.

An evaluation of the effectiveness of the PPE being used in the establishment will be performed. If the employer has selected PPE which is found to be ineffective against isocyanates, a citation of the appropriate PPE standard will be issued.

- a. The use of appropriate protective clothing (e.g., coveralls, foot coverings) will be evaluated. Employers will require their use to prevent contamination of an employee's personal clothing



and skin. Observed violations of OAR 437-002-0134 will be cited.

- b. The use of appropriate eye and/or face protection will be evaluated. Employers will require the use of eye and/or face protection that is adequate to protect the employees' eyes and/or face from exposure to isocyanates. Observed violations of OAR 437-002-0134(8) will be cited.
- c. Detailed inspection and citation guidance related to respiratory protection (1910.134) is contained in Program Directive A-233 Respiratory Protection: General Guidelines.

With regard to isocyanates, Oregon OSHA's longstanding policy has limited respirator selection only to SARs (supplied air respirators) when overexposure is documented. The rationale includes the significant hazards associated with isocyanates, e.g., corrosive and irritant properties; exposure potential through inhalation and skin absorption, which can lead to respiratory sensitization; increased risk of overexposure associated with oligomers, especially when the vapor and aerosol phases are present; limitations of air-purifying respirators such as improper fit and leakage around sealing surfaces or wrong choice of cartridges and pre-filters; and mixtures of chemicals that produce additive or synergistic health effects. Oregon OSHA strongly urges the use of supplied-air respirators as the most protective class of respiratory protection for worker safety.

At least one manufacturer has produced a NIOSH-certified organic vapor cartridge with an ESLI (end of service life indicator) for toluene isocyanate (TDI). This ESLI cannot be used for any other isocyanate. Federal OSHA issued a Letter of Interpretation dated July, 18, 2000, outlining when APRs (air purifying respirator) are acceptable for use with chemicals having poor warning properties. APRs are permitted for use with isocyanates when certain requirements are met: an exposure assessment has been completed that accurately describes and documents employee exposure, change schedules are in place and followed such that cartridges or canisters are replaced prior to chemical breakthrough, and data used to develop change schedules are adequately documented in the written respiratory protection program. Employers and workers should follow manufacturers' recommendations for respirator selection and change schedules. Since many of the variables affecting respirator selection and use are user-specific and site-dependent, the information derived through the exposure assessment bear directly on the successful development and implementation of an effective change schedule. The reader is directed to 1910.134 for other requirements addressing respirator

selection, medical evaluation, fit testing, care and maintenance, training, record-keeping and program evaluation.

Based on 1910.134(d)(1)(iii), an employer must identify and evaluate the respiratory hazard(s) present in the workplace. The evaluation must include a reasonable estimate of employee exposures to those respiratory hazards. The contaminant's chemical state and physical form must also be identified. For example, in spray finishing operations, isocyanates can be present in both a vapor phase and a particulate phase. From 1996 through 2000, Oregon OSHA has identified through air sampling for the biuret and isocyanurate forms of hexamethylene isocyanate that approximately 35-39 percent of those samples (319 total) were above the 8-hour time-weighted average PELs. The majority of these samples came from evaluation of spray finishing operations in auto body/automotive refinishing. Isocyanates have ceiling limits which must never be exceeded (an exposure limit for which worker exposures must never exceed the concentration established for each chemical).

Work practices that involve close-in work with spray finishing equipment may produce exposure above acceptable limits even though engineering controls such as ventilation achieve or exceed minimum linear flow and/or volumetric flow rate recommendations. In such a case, supplied air respiratory protective devices are the preferred protection.

When APRs are used to control worker overexposure to isocyanates, the compliance officer will thoroughly review the employer's respiratory protection program to assure that an exposure assessment has been completed and documented, and that change schedules are established and followed. Where an exposure assessment and/or change schedule has not been completed or is inadequate, supplied-air respirators must be used as an interim control if operations continue. Reference 1910.134(d)(1)(iii) and (d)(3)(iii).

- d. The use of appropriate, chemical-resistant gloves (e.g., butyl, nitrile) will be evaluated. Employers will select and require the use of gloves that are adequate to protect the employees from dermal exposure to isocyanates. Compliance officers should check the manufacturer of the glove type or the safety data sheets to determine if the appropriate glove is being used. Observed violations of OAR 437-002-0134(12) will be cited.

All citations related to the employer's failure to ensure the use of appropriate PPE during operations using isocyanates will be classified in accordance with the FIRM. This includes violations of applicable PPE regulations (e.g., OAR 437-002-0134 and 1910.134).

#### Hazard Communication:

Detailed inspection and citation guidance related to chemical hazard communication (1910.1200) is contained in Program Directive A-150 Hazard Communication. Consideration should be given to the training on isocyanates that employees receive under the employer's hazard communication program.

#### Housekeeping and Hygiene Practices:

The employer's methods for ensuring adequate housekeeping will be evaluated and documented. The frequency of cleaning and the methods used should be assessed when determining if the employer's housekeeping and hygiene practices may have contributed to employee illnesses (e.g., sensitization). Compliance officers should check for accumulation of isocyanates on surfaces outside of the work/process area, in eating areas, and on workers' clothing.

Where there is worker exposure to isocyanates and poor housekeeping practices are documented, citations of the applicable sections of 1910.141, Sanitation, should be issued. Where worker exposure to an isocyanate is not documented but associated illnesses and poor housekeeping practices are documented, the compliance officer should cite the applicable PPE and/or sanitation standards.

#### Flammable and Combustible Products:

Where the chemical components of an isocyanate process contain flammable or combustible materials, compliance with 1910.106, Flammable Liquids, will be assessed. Where an employer is in violation of 1910.106 but is in full compliance with the most current version of NFPA 33 - Standard for Spray Application Using Flammable or Combustible Materials, violations of 1910.106 will not be issued. Compliance officers should note it in the inspection case file.

#### Follow-up Inspections:

Where citations or a Division 1 violation is issued for overexposures to an isocyanate, or abatement documentation provided by the employer for other serious citations is not adequate, follow-up site visits will be conducted to determine whether the employer is eliminating exposures or reducing exposures below the PEL. Where exposures could not feasibly be reduced below the PEL, engineering and administrative 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 employer no longer uses the isocyanate.

**OSHA-1 CODING:** The inspection for all enforcement activities and compliance assistance interventions conducted under this LEP must be coded as follows:

1. The Inspection Type will be **Programmed Planned**.
2. All inspections conducted under this LEP will be coded as “Health” inspections.
3. Select the LEP “Exposure to Isocyanates in Various Industries” on the emphasis tab in OTIS.

The Scope of Inspection will be **Comprehensive**.

**OUTREACH:** Outreach efforts will be made to employers, industry groups, trade associations, labor unions, and safety and health organizations that may be affected by this national emphasis program. Such programs could include letters to employers, professional associations, local safety councils, apprenticeship programs, local hospitals and occupational health clinics, and other employer organizations for workplaces that have potential worker exposures to isocyanates or provide medical assistance in treating workers’ illnesses associated with exposure to isocyanates. Speeches, training sessions, and/or news releases through the local newspapers, safety councils and/or industrial hygiene organizations can provide another avenue for dissemination of information. Alliances developed with industries, labor groups, and other organizations would also be an effective way to reach out to affected employers and workers.

**TRAINING:** Oregon OSHA will assure that health compliance officers receive training on this local emphasis program and other appropriate policies and procedures prior to conducting health inspections under this directive.

**EVALUATION:** This LEP will be evaluated using data collected from case files and follow-up site visit reports to evaluate how the Strategic Plan goals are being met and if they continue to apply. The data will be evaluated to determine the impact of Oregon OSHA inspections on the reduction of worker exposures to isocyanates at each work site.

**EFFECTIVE DATE:** This directive is in effect until canceled or superseded.

**History:** Issued 5-1-2006, Revised 9-27-2007 , 12-2-2013, and 1-20-2017

## APPENDIX A

Industries where isocyanate exposures are known or likely to occur

(List taken from International Consensus Report on isocyanates, 2001)

[www.arbeidstilsynet.no/binfil/download2.php?tid=77871](http://www.arbeidstilsynet.no/binfil/download2.php?tid=77871)

- 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 above is not an exhaustive list of where and which types of products worker exposure to isocyanates may occur.

Table 1 below lists industry sectors where exposures to isocyanates are known to occur, although not all establishments in these listed industries have worker exposure to isocyanates. This is not an exhaustive industry sector list of where worker exposure to isocyanates may potentially occur.

Table 1

<b>Industry Sector</b>	<b>NAICS 2007</b>	<b>NAICS Code Title</b>
Painting (interior or exterior) or Wall Covering (interior)	238320	Painting and Wall Covering Contractors
Electrical Work	238210	Electrical Contractors
Masonry, Stonework, Tile Setting, and Plastering	238310	Drywall and Insulation Contractors
Floor Laying	238330	Flooring Contractors
Glazing Work	238150	Glass and Glazing Contractors
Coated Fabrics	314992	Tire Cord and Tire Fabric Mills
Automotive Trimmings	336360	Motor Vehicle Seating and Interior Trim Manufacturing

<b>Industry Sector</b>	<b>NAICS 2007</b>	<b>NAICS Code Title</b>
Automotive Trimmings, Apparel Findings, and Related Products	336360	Motor Vehicle Seating and Interior Trim Manufacturing
Millwork, Veneer, Plywood & Structural Wood	321911	Wood Window and Door Manufacturing
Millwork, Veneer, Plywood & Structural Wood	321211	Hardwood Veneer and Plywood Manufacturing
Millwork, Veneer, Plywood & Structural Wood	321212	Softwood Veneer and Plywood Manufacturing
Reconstituted Wood Products	321219	Reconstituted Wood Product Manufacturing
Public Building Furniture	336360	Motor Vehicle Seating and Interior Trim Manufacturing
Drapery Hardware	337920	Blind and Shade Manufacturing
Commercial Printing	323112	Commercial Flexographic Printing
Paints, Varnishes, Lacquers, Enamels, And Allied	325510	Paint and Coating Manufacturing
Rubber/Plastics Hose	326220	Rubber and Plastics Hoses and Belting Manufacturing
Molded, Extruded	326291	Rubber Product Manufacturing for Mechanical Use
Fabricated Rubber Products, NEC	326299	All Other Rubber Product Manufacturing
Laminated Plastics	326130	Laminated Plastics Plate, Sheet (except Packaging), and Shape Manufacturing
Plastics Foam Products	326150	Urethane and other Foam Product (except Polystyrene) Manufacturing
Plastics Plumbing	326191	Plastics Plumbing Fixture Manufacturing
Plastic Products	337215	Showcase, Partition, Shelving, and Locker Manufacturing
Gray/Ductile Iron Foundries	331511	Iron Foundries
Copper Foundries	331525	Copper Foundries (except Die-Casting)

<b>Industry Sector</b>	<b>NAICS 2007</b>	<b>NAICS Code Title</b>
Coating/Engraving	332812	Metal Coating, Engraving (except Jewelry and Silverware), and Allied Services to Manufacturers
Industrial Valves	332911	Industrial Valve Manufacturing
Internal Combustion Engines	333618	Other Engine Equipment Manufacturing
	336399	All Other Motor Vehicle Parts Manufacturing
Air-Conditioning	333415	Air-Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment Manufacturing
Household Cooking	335222	Household Refrigerator and Home Freezer Manufacturing
Electronic Coils	334416	Electronic Coil, Transformer, and Other Inductor Manufacturing
Motor Vehicle Parts	336322	Other Motor Vehicle Electrical and Electronic Equipment
Aircraft	336411	Aircraft Manufacturing
Boat Building and Repairing	336612	Boat Building
Orthopedic	339999	All Other Miscellaneous Manufacturing
Jewelry	339911	Jewelry (except Costume) Manufacturing
Mfg Industries, NEC	3261 99	All Other Plastics Product Manufacturing
Water Transportation	483211	Inland Water Freight Transportation
Transportation Services	488999	All Other Support Activities for Transportation
Electric Services	221119	Other Electric Power Generation
Gas and other Services Combined	221210	Natural Gas Distribution

<b>Industry Sector</b>	<b>NAICS 2007</b>	<b>NAICS Code Title</b>
Automotive Repair	811121	Automotive Body, Paint, and Interior Repair and Maintenance
Automotive Repair	811111	General Automotive Repair
Automotive Repair	811118	Other Automotive Mechanical and Electrical Repair and Maintenance
Automotive Repair	484110 811122 811191 811198	Motor Vehicle Towing, Automotive Glass Replacement Shops, Automotive Oil Change and Lubrication Shops and all other Automotive Repair and Maintenance



**APPENDIX B**  
**SYNONYMS**

(Adapted from NIOSH published information and other sources)

Note: This list is not meant to restrict the application of this directive to only what is included here.

**TDI [584-84-9]**

- 2,4-Diisocyanato-1-methylbenzene
- 2,4-Diisocyanatotoluene
- 2,4-TDI
- 2,4-Tolylene diisocyanate
- 4-Methyl-phenylene
- Di-iso-cyanatoluene
- Isocyanic acid, 4-methyl-m-phenylene ester
- Isocyanic acid, methylphenylene ester
- m-tolylene diisocyanate
- Toluene-2,4-diisocyanate
- Toluene diisocyanate

**MDI [CAS 101-68-8]**

- 1,1-Methylenebis (4-isocyanatobenzene)
- 4,4'-Diisocyanatodiphenylmethane
- 4,4'-Diphenylmethane diisocyanate
- 4,4'-Methylenebis (phenyl) diisocyanate
- 4,4'-Methylenediphenyl diisocyanate
- Bis (1,4-isocyanatophenyl) methane
- Bis (4-isocyanatophenyl) methane
- Diphenylmethane 4,4'-diisocyanate
- Diphenylmethane diisocyanate
- Methylenebis (4-isocyanatobenzene)
- Methylenebis (4-phenylene) diisocyanate
- Methylene bisphenyl diisocyanate
- Methylene-di-p-phenylene diisocyanate
- Methylene di (phenylene) diisocyanate

**HDI [CAS 822-06-0]**

- 1,6-Diisocyanatohexane
- 1,6-Hexamethylene diisocyanate
- 1,6-Hexanediol diisocyanate
- Hexamethylene-1,6-diisocyanate
- Hexamethylene diisocyanate
- Isocyanic acid, hexamethylene ester

**HMDI [CAS 5124-30-1]**

Hydrogenated MDI  
4,4'-Methylenebis (cyclohexyl isocyanate)  
4,4' Dicyclohexylmethane diisocyanate  
HMDI (4,4' dicyclohexylmethane)

HDI-BT [CAS 4035-89-6]

Hexamethylene diisocyanate Biuret  
Imidodicarbonic diamide, N,N',2-tris(6-isocyanatohexyl)-  
HDI Biuret  
Biuret of Hexamethylene diisocyanate  
Desmodur N  
polymeric hexamethylene diisocyanate  
hexamethylene diisocyanate polymer  
Hexane, 1,6-diisocyanato-, Homopolymer  
Hexamethylene diisocyanate, homopolymer  
homopolymer of HDI

HDI-IC [CAS 28182-81-2]

1,6-Hexamethylene diisocyanate Homopolymer  
polymeric hexamethylene diisocyanate  
hexamethylene diisocyanate polymer  
Hexamethylene diisocyanate, homopolymer  
1,6-Hexamethylene diisocyanate polycyclotrimer  
Desmodur N3300  
1,6-Diisocyanato-Hexane Homopolymer  
homopolymer of HDI

References

Lewis RJ Sr. [1993] Hazardous chemicals desk reference, 3rd ed. New York, NY: Van Nostrand Reinhold Publishers.

NIOSH [1995] Registry of toxic effects of chemical substances. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease and Control and Prevention, National Institute for Occupational Safety and Health.

Sax NI, Lewis RJ Sr. [1987] Hawley's Condensed Chemical Dictionary, 11th ed. New York, NY: Van Nostrand Reinhold Publishers.

**APPENDIX C**  
Health Surveillance Form – Exposure (Non-mandatory)

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 exposure, consider asking the worker to sign a medical release to obtain a copy of their personal medical records or obtain a medical access order (MAO) for their 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? (Describe):	Do you think your symptoms are brought on by any particular work activity, chemical exposure, or work area? (Describe):
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 exposure? YES NO

Other comments:

**APPENDIX D**  
Sample Isocyanates Hazard Alert Letter

*Note: This letter must be adapted to the specific circumstances noted in each inspection. The letter below is an example of the type of letter 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 Oregon OSHA compliance use only and should not be included in the letter.*

Dear Employer:

An inspection of your workplace and evaluation of your Oregon OSHA recordkeeping logs at *(location)* on *(date)* disclosed the following conditions that are consistent with employee exposure to *(list isocyanates)*, 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 overexposures, 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 some risk factors related to the occurrence 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 the risk factors. These include workplace analysis of jobs and tasks to assess hazards and the steps to abate them, product substitutions, engineering, administrative and work practice controls, accurate injury and illness recordkeeping and medical management, education and training of employees, and management oversight. When respiratory sensitization/asthma or other risk factors 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 need to be implemented.

We have examined available information on the risk factors related to these jobs/tasks, as well as your efforts to address these hazards. The evaluation suggests that the following actions should be taken to deal with these conditions.

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)

## 2. Administrative and Work Practices

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

- (List possible controls such as: limiting the time employees are exposed);
- (Job rotation);
- (Monitoring employee exposures on a regular basis);
- (Limiting the number of employees who have access to areas where the operation occurs);
- (Provide separate lockers for work cloths and street clothes);
- (No eating, drinking, applying cosmetics or using tobacco products in work area(s));
- (Do not leave the workplace wearing protective work clothing or equipment or take it home for laundering);
- (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);
- (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 OAR 437-002-0134 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*);
- Employers requiring the use of respiratory protection must establish, implement, and maintain a written respiratory protection program in accordance with 1910.134(c); Use a Supplied-Air Respirator (SAR) or Air-Purifying Respirator (APR) with adequate change-out schedule.

## 4. Training and Information

Employers must comply with the Hazard Communication standard 1910.1200. 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 exposure, and the need to inform their supervisor if they develop any of those symptoms;
- 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;
- Methods that may be used to detect the presence of the isocyanates in the workplace, such as workplace monitoring; and
- The results of any industrial hygiene sampling the employer or others have conducted for levels of isocyanates.

*(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 Office with progress reports on your efforts to address these conditions. Oregon OSHA may return to your worksite to further examine the conditions noted above.

Enclosed is a list of available resources that may be of assistance to you in preventing work-related injuries and illnesses in your workplace.

If you have any questions, please feel free to call *[name and phone number]* at *[address]*.

Sincerely,

## APPENDIX E

### Publications and Resources

Oregon OSHA publications are available at [www.orosha.org/standards/publications.html](http://www.orosha.org/standards/publications.html) or call the Oregon OSHA Resource Center at 503-947-7453 or 800-922-2689.

#### **Oregon OSHA online resources from the A-Z topic index:**

[Isocyanates](#)

[Hazard Communication](#)

[Personal Protective Equipment](#)

[Respiratory Protection](#)

[Spray Finishing](#)

[Ventilation](#)

Additional safety and health topics can be found online at [Oregon OSHA's A-Z Topic Index](#)

#### **Oregon OSHA publications:**

[Oregon OSHA's guide to the GHS-aligned Hazard Communication Standard Hazard](#)

[Breathe right! Oregon OSHA's guide to respiratory protection for small-business owners and managers](#)

[PPE hazard assessment for general industry quick guide](#)

#### **Federal OSHA resources:**

[OSHA/NIOSH Spirometry Info Sheet](#)

[OSHA/NIOSH Spirometry Worker Info](#)

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](#)

#### **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: [www.ncbi.nlm.nih.gov/pubmed/23067057](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](http://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: [www.ncbi.nlm.nih.gov/pmc/articles/PMC1849909/](http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1849909/)



**APPENDIX F**  
Division 1 Violation Language

Where exposures to isocyanates exist and the conditions meet the elements of violation, a general duty citation using Division 1 can be written. Below is an example of the language to use on a citation.

OAR 437-001-0760(1)(c) The employer did not provide the health hazard control measures necessary to protect the employees' health from harmful or hazardous conditions and maintain such control measures in a good working order or in use:

On (date), (list employee titles, or use employees) working in the (name areas) 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).

**Use these based on the specific circumstances pertaining to the inspection:**

The employer may adopt any measures that are effective in reducing or eliminating employee risk of developing (asthma or other effects of exposure/disease). Examples of such measures may include:

- 1) Engineering controls. Where feasible, occupational exposures should be limited, through the use of engineering controls such as: (list controls, like ventilation, substitution, etc.), to that ensure employees are not exposed to harmful levels of (chemical name).
- 2) Administrative and Work Practice Controls. Where engineering controls are not available or do not sufficiently reduce employee exposures, the use of administrative and work practice controls to reduce employee exposure to (name chemical) may be needed. Such control measures may include:

(list measures: rotation, cleaning working surfaces, maintenance of engineering controls, etc.).

## **APPENDIX G**

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

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. See Personal Protective Equipment, General Requirements, 437-002-0134 and 437-003-0134, Personal Protective Equipment, for more information.

#### **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 millimeters 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.

#### **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, this 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 face shield is required when working with isocyanates.

### **Respiratory Protection - General**

An effective written respiratory protection program must be developed and implemented in accordance with 1910.134. 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. Some factors that should 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 Oregon OSHA Ceiling Limits; Methyl 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, ACGIH TLV, or German AGS. Paragraph 1910.134(d)(3)(i) requires the employer to “provide a respirator that is adequate to protect the health of the employee and ensure compliance with all other Oregon 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. Paragraph 1910.134(d)(3)(i)(A) discusses the protection factors of the respirators. The respirator chosen must protect the employee from the concentration of to which they are being exposed.

Paragraph 1910.134(d)(1)(i) 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.”

Paragraph 1910.134(d)(3)(iii) (B) further states that for protection against gases and vapors that are below the Immediately Dangerous to Life or Health (IDLH) an air-purifying respirator may be used, provided that:

- A. The respirator is equipped with an end-of-service life indicator (ESLI) certified by NIOSH for the contaminant; or
- B. 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.

Oregon 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). PAPR cartridges also need to be changed out. See above 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**

Oregon OSHA's Respiratory Protection standard, 1910.134, 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.

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. More information on change out schedules may be found [here](#).

The International Isocyanate Institute<sup>1</sup> 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/m<sup>3</sup>) total MDI concentrations.

---

<sup>1</sup> Information on the International Isocyanate Institute, Inc. may be found at [www.diisocyanates.org](http://www.diisocyanates.org).

### **Other Respirator Information**

Vapors of isocyanates 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 437-002-0134(8) and 437-003-0134(8) 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 437-002-0134 and 437-003-0134, Personal Protective Equipment. 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 diisocyanate exposure, the employer must take appropriate action. Paragraph 1910.134(e)(7)(i) 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 is necessary – i.e., why diisocyanates are a hazard that require skin and breathing protection;
- How the PPE will protect them;
- 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, and 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, and Allergy and Immunology (especially if focused on asthma care)

**General recommendations** for an isocyanates medical surveillance program include: Pre-placement, 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 ([www.osha.gov/Publications/osha3415.html](http://www.osha.gov/Publications/osha3415.html)) and Spirometry Worker Information sheet ([www.osha.gov/Publications/osha3418.html](http://www.osha.gov/Publications/osha3418.html))).

Workers with a history of respiratory conditions should be informed of the potential for increased health risk. 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"  
[www.oem.msu.edu/userfiles/file/Resources/asthmaprotocol.pdf](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  
[www.getastmahelp.org/Work\\_related\\_asthma\\_screening.asp](http://www.getastmahelp.org/Work_related_asthma_screening.asp)

#### **General Occupational Medicine Resources:**

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

Other recommendations are found at

[www.michigan.gov/documents/cis\\_wsh\\_cet5045\\_90179\\_7.doc](http://www.michigan.gov/documents/cis_wsh_cet5045_90179_7.doc)