

United States Department of Labor

Occupational
Safety &
Health
Administration

Compliance Assistance

for users of

Methylene Diphenyl Isocyanate (MDI)

Methylene Diphenyl Isocyanate (MDI)
(CAS No. 101-68-8)

a.k.a.

- **Methylene bisphenyl isocyanate**
- **Diphenyl methane diisocyanate**
- **Methane diisocyanate**

MDI Exposure Levels

The OSHA exposure levels for this chemical are regulated under 1910.1000.

MDI only has a ceiling limited under OSHA.

The ceiling is 0.02ppm or 0.2mg/m³.

Ceiling limits (for OSHA) are 15 minute samples that cannot exceed this limit at any time during the day.

Common Uses for MDI

**Flexible and rigid
polyurethane foams**

**Foundry core
binders**

Adhesives

Sealants

Spandex fibers

**Spray-on polyurethane
coatings**

MDI

MDI is used in the rapidly expanding business of spray on truck bedliners. The application involves mixing a two component product and spraying the polymerizing liquid onto a cleaned and scuffed truck bed.

Adverse Health Effects of MDI

Acute effects of overexposure:

- Allergic sensitization – a person becomes allergic; this could appear as wheezing, shortness of breath or coughing.
- Irritation of eyes and respiratory tract.
- Upset stomach, vomiting.
- Elevated body temperature (fever).
- A feeling of tightness in the chest.
- Stuffiness of the nose.
- Sore throat.

Adverse Health Effects of MDI

Chronic effects of overexposure:

- Permanent breathing or chest problems, including asthma, even when no longer exposed.
- Increased respiratory sensitivity to isocyanates and related compounds. Once sensitized, an individual may experience severe asthma at concentrations well below the established limits, which could result in death of the sensitized individual.

Source: WISHA Hazard Alert, March 2003

Michigan, 2/20/03: An employee with a previous acute exposure to MDI dies after spraying an isocyanate-based truck bed liner inside a van.



STATE OF MICHIGAN

Jennifer M. Granholm
GOVERNOR

DEPARTMENT OF LABOR & ECONOMIC GROWTH
DAVID C. HOLLISTER
DIRECTOR

Michigan Occupational
Safety & Health Administration
(MIOSHA)

MIOSHA ISOCYANATE ALERT **Spray-on Truck-bed Liner Operation Proves Fatal**

Fatality Summary

In 2003, the MIOSHA program investigated a fatality related to the spraying of truck-bed liners. The spray-on truck-bed liner product contained a very toxic chemical, methylene bisphenyl isocyanate (MDI). This alert provides information on isocyanate use, the hazards associated with isocyanates, steps to take to protect yourself, and contact information for the MIOSHA Consultation Education & Training (CET) Division, which provides free assistance to employers in the State of Michigan.

The fatality occurred at a small auto and truck accessory and detailing shop that purchased the franchise rights to apply the spray-on truck-bed liner product. The individual spraying the product had a previous acute exposure to the MDI and had become sensitized. Due to inadequate training on the hazards of isocyanate use, the individual was not aware of this increased sensitivity. In addition, the facility did not have a spray area with appropriate ventilation and had inadequate respiratory protection for the employees. When a subsequent exposure to the MDI occurred, it caused a fatal asthmatic reaction.

How do You Protect Yourself and Others from Exposure to MDI?

- **Education and training on the hazards associated with the use of MDI.**
- **Assessment of employees' potential exposure to MDI.**
- **Adequate ventilation.**
- **Respiratory protection.**
- **Personal protective equipment.**
- **Medical surveillance.**

Education and Training

- ▶ 1910.1200 Hazard Communications
 - ▶ 1910.1200(h) requires employees to be trained on the chemicals in their work areas.
 - ▶ This training should include:
 - Signs and Symptoms of exposure
 - PPE
 - Hazards Associated with the chemical
- Don't Forget the MSDS....OOH and 1910.134 also requires training on the chemical.

ASSESSMENT OF EXPOSURE or Sample sample sample

The worksite shall be assessed. The Respiratory Protection standard requires this assessment.



▶ 1910.134(d)(1)(iii) Respiratory Protection.
States that you must identify and evaluate
the respiratory hazards in the workplace.

Ventilation Protection

- Ventilation requirements are covered in section 1910.1000. This is a requirement for engineering controls when an overexposure to MDI occurs.



Respiratory Protection

- ▶ This is covered under 1910.134.
- ▶ Studies have shown that OV respirators alone are not as effective as OV respirators with a particulate filter for aerosolized MDI.
- ▶ Cartridge respirators should not be used without an adequate exposure assessment.

The study was sponsored by International Isocyanate Institute, Inc.

Personal Protective Equipment

- ▶ Check with chemical manufacturers prior to using any protective equipment for breakthrough information.
- ▶ Mixtures of chemicals can change the breakthrough time.
- ▶ API Technical Bulletin, January 2002, provides breakthrough times for MDI and MDI with several other chemicals.

Medical Surveillance

- ▶ The only OSHA regulation where medical surveillance for MDI is required is under Respiratory Protection, 1910.134. (When respiratory protection is required.)
- ▶ Several governmental and nongovernmental institutions recommend medical surveillance for MDI.

Most Frequently Cited Standards Cited During MDI LEP Inspections (Region VIII)

- 1 1910.1200(e)(1) – Lack of a hazard communication program.
- 2 1910.134(c)(1) – Lack of a respiratory protection program.
- 3 1910.1000(a)(1) –Overexposure to MDI.
- 4 1910.1000(e)(1) – Failure to implement engineering controls.
- 5 1910.134(d)(1) – Inappropriate respirator selection for inhalation hazard.

Most Frequently Cited Standards Cited During MDI LEP Inspections (Region VIII)

- ⑥ 1910.134(e)(1) – Lack of medical evaluation.
- ⑦ 1910.134(f)(2) – Failure to provide a fit test.
- ⑧ 1910.134(k)(1) – Failure to provide training to employees required to use respirators.
- ⑨ 1910.134(h)(1) – Failure to clean and disinfect respirators.
- ⑩ 1910.134(h)(2) – Failure to store respirators properly.

Examples of Standard Industrial Classification (SIC) Codes where Spray-on Bed Lining Operations are Performed*



<u>SIC Code</u>	<u>Industry</u>
5013	Motor Vehicle Supplies and New Parts
5531	Auto and Home Supply Stores
5561	Recreational Vehicle Dealers
7532	Top, Body, and Upholstery Repair Shops and Paint Shops
7538	General Automotive Repair Shops
7549	Automotive Services, Except Repair and Carwashes

* Additions to or deletions from the inspection list will be made based on local knowledge of whether an establishment is engaged in the targeted process or not.

Route of Exposure to MDI

The major route of exposure to MDI during spray-on bedliner operations is by inhalation of the vapor or aerosol. Variables which may affect employee exposure to MDI during spray application include:

- Whether the material to be applied is **heated**
- Whether the material is applied under **pressure**
- The percentage of MDI in the isocyanate component and the MDI:resin ratio of the material being applied
- Work practice (is the technician located inside or outside the truck bed; is the product applied such that it “rains” upon the truck bed in order to create a fine texture)

Modes of Application

● **Heated High Pressure:** Isocyanate and resin material components are pumped out of separate 55 gallon drums at approximately 150° F and pressurized to about 2200 PSI. The material is sent via heated hoses to the spray gun in a 1:1 (isocyanate:resin) volume ratio. The material is mixed and is usually applied from outside the truck bed. Depending on the product and application process, the lining may harden within 3-30 seconds.

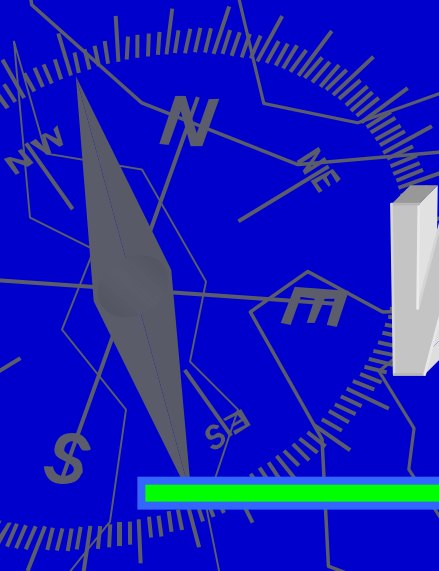
Modes of Application

● **Cold low pressure:** Isocyanate and resin material are pumped out of separate 55 gallon drum at room temperature (approximately 85° F) and pressurized to about 100 PSI. The material is sent to the spray gun in a 1:2 volume ratio. The material is mixed and is usually applied from inside the truck bed. Depending on the product and application process, the lining may harden within 3-30 seconds.

Modes of Application

● **Cold Batch Premix:** Isocyanate, resin and in some cases, a catalyst are mixed in small quantities at room temperature using a non-explosive high speed drill. The mixture is poured into a hopper gun and applied at 30-60 PSI. The bed will usually be “tack free” in 30-60 minutes.

Observed Exposures and Work Practices



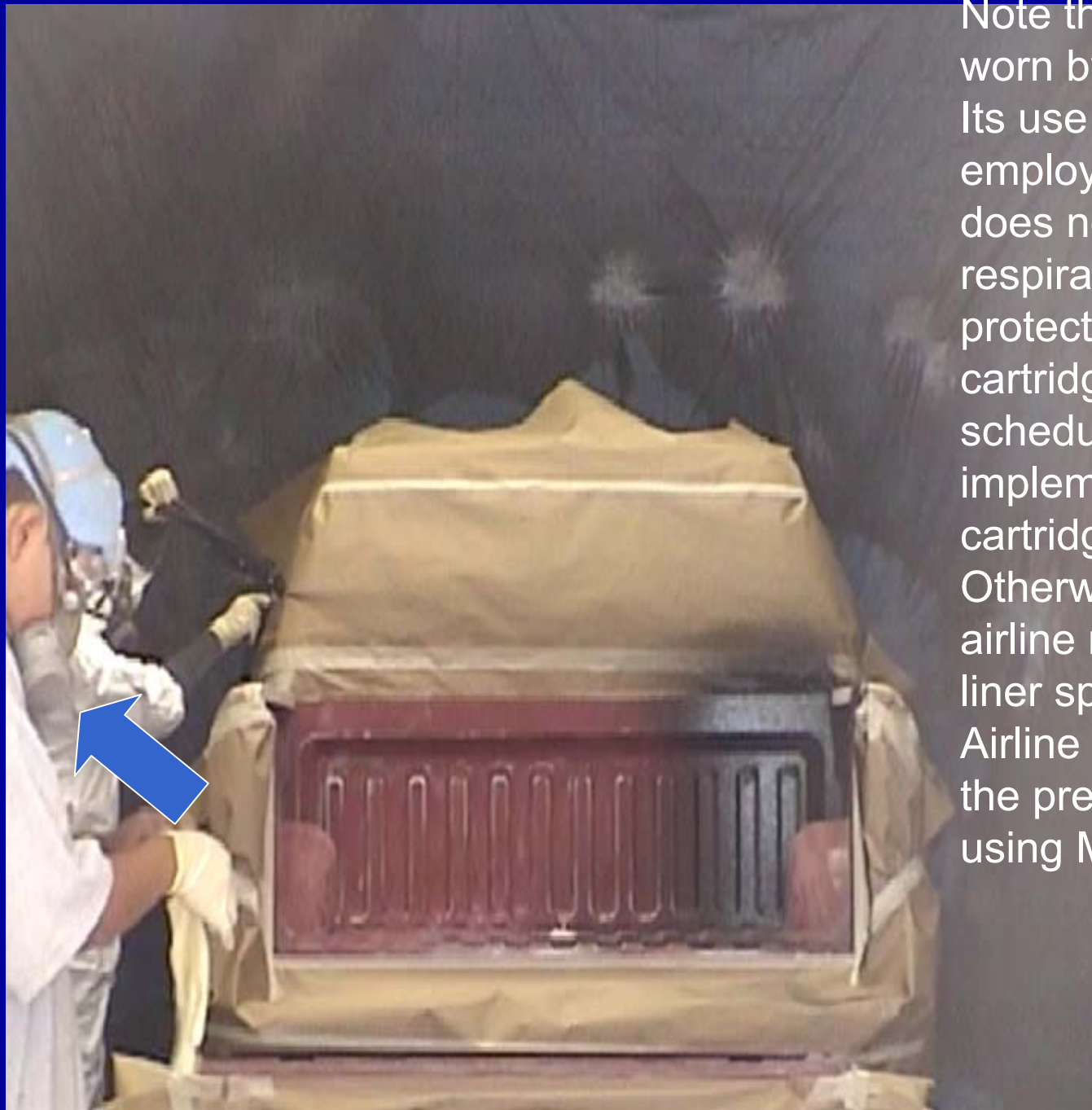


This slide depicts the components of a heated high pressure system .

While Region VIII has documented overexposures in approximately 50% of the establishments inspected which use this application method, there was a 95% incidence of overexposures in the establishments using the cold low pressure system.

The most likely reason for the disparity:

The location of the technician inside the truck bed when using the cold low pressure system.



Note the half-mask respirator worn by the spray technician. Its use is permitted if: the employee's exposure to MDI does not exceed the respirator's assigned protection factor and a cartridge change out schedule is developed and implemented to ensure the cartridge remains effective. Otherwise, use a full-face, airline respirator during bed liner spray operations. Airline respirator are always the preferred protection when using MDI chemicals.



While the plastic enclosure will protect against overspray, a ventilation system which will capture, contain and dilute spray aerosols to reduce worker exposure to MDI has not been provided.

Larger auto refinishing shops and dealerships will likely have dedicated ventilated areas to perform spray operations. For many spray-on bedliner franchises and small collision and auto repair shops, outfitting their establishments with an effective ventilation system remains a challenge.



As you can see, spray-on liners are not for just truck beds anymore. Here is the interior of vehicle which is being coated with the lining material. There is a greater likelihood for overexposure to MDI in this case due to the confining areas pictured in the slide.



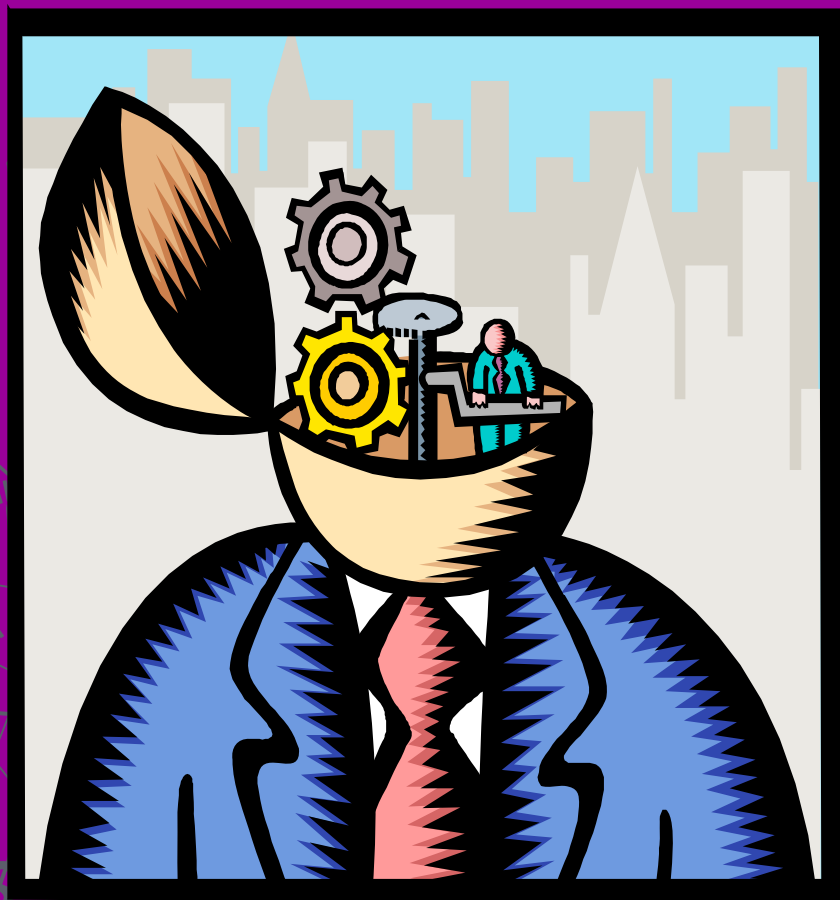
Here is an example of the hopper gun used in the cold batch premix system.

This method of spray application has not proven to be a significant source of exposure to MDI (to date).



Want More Information
About OSHA Requirements
for MDI?

The OSHA Home Page



- www.osha.gov
- User friendly!
- All OSHA information in one place
- Many links to other sites

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The OSHA Website provides public access to a huge database of safety and health information as well as many links to other sources of information



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Included on the OSHA Website are:

- **Copies of OSHA regulations**



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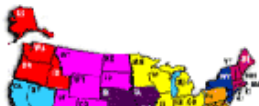
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- Letters of interpretation and compliance memoranda



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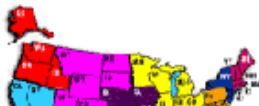


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- **Letters of interpretation and compliance memoranda**
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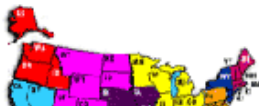
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- Government Printing Office - for copies of OSHA regulations and publications & OSHA CD-ROM (202-512-1800)
- OSHA-funded free onsite consultation services in each state
- Various S&H courses offered by the OSHA Training Institute (Arlington Heights, IL) and the Training Institute Education Center at Keene State College, Manchester, NH (800-449-6742)

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