



# Right to Know Hazardous Substance Fact Sheet

Common Name: **HEXAMETHYLENE DIISOCYANATE**

Synonyms: HDI; 1,6-Diisocyanatohexane

Chemical Name: Hexane,1,6-Diisocyanato-

Date: April 1999

Revision: August 2009

CAS Number: 822-06-0

RTK Substance Number: 0995

DOT Number: UN 2281

## Description and Use

**Hexamethylene Diisocyanate** is a clear, colorless to yellow liquid with a sharp, irritating odor. It is used to make other chemicals, polyurethane, dental materials, contact lenses and medical absorbants.

- ▶ **ODOR THRESHOLD = 0.001 ppm**
- ▶ Odor thresholds vary greatly. Do not rely on odor alone to determine potentially hazardous exposures.

## Reasons for Citation

- ▶ **Hexamethylene Diisocyanate** is on the Right to Know Hazardous Substance List because it is cited by ACGIH, DOT, NIOSH, DEP, IRIS and EPA.

[SEE GLOSSARY ON PAGE 5.](#)

## FIRST AID

### Eye Contact

- ▶ Immediately flush with large amounts of cool water for at least 15 minutes, lifting upper and lower lids. Remove contact lenses, if worn, while flushing. Seek medical attention immediately.

### Skin Contact

- ▶ Quickly remove contaminated clothing. Immediately wash contaminated skin with large amounts of soap and water.

### Inhalation

- ▶ Remove the person from exposure.
- ▶ Begin rescue breathing (using universal precautions) if breathing has stopped and CPR if heart action has stopped.
- ▶ Transfer promptly to a medical facility.
- ▶ Medical observation is recommended for 24 to 48 hours after overexposure, as pulmonary edema may be delayed.

## EMERGENCY NUMBERS

**Poison Control: 1-800-222-1222**

**CHEMTREC: 1-800-424-9300**

**NJDEP Hotline: 1-877-927-6337**

**National Response Center: 1-800-424-8802**

**EMERGENCY RESPONDERS >>>> SEE BACK PAGE**

## Hazard Summary

Hazard Rating	NJDOH	NFPA
<b>HEALTH</b>	2	-
<b>FLAMMABILITY</b>	1	-
<b>REACTIVITY</b>	1	-
COMBUSTIBLE POISONOUS GASES ARE PRODUCED IN FIRE		

*Hazard Rating Key: 0=minimal; 1=slight; 2=moderate; 3=serious; 4=severe*

- ▶ **Hexamethylene Diisocyanate** can affect you when inhaled and may be absorbed through the skin.
- ▶ Contact can severely irritate and burn the skin and eyes with possible eye damage.
- ▶ Exposure can irritate the nose and throat.
- ▶ Inhaling **Hexamethylene Diisocyanate** can irritate the lungs. Higher exposures may cause a build-up of fluid in the lungs (pulmonary edema), a medical emergency.
- ▶ Exposure to **Hexamethylene Diisocyanate** can cause headache, dizziness, nausea and vomiting.
- ▶ **Hexamethylene Diisocyanate** may cause a skin allergy and an asthma-like allergy.
- ▶ If **Hexamethylene Diisocyanate** is involved in a fire it can release *Hydrogen Cyanide*. Consult the *Right to Know Hazardous Substance Fact Sheet on HYDROGEN CYANIDE*.

## Workplace Exposure Limits

NIOSH: The recommended airborne exposure limit (REL) is **0.005 ppm** averaged over a 10-hour workshift and **0.02 ppm**, not to be exceeded during any 10-minute work period.

ACGIH: The threshold limit value (TLV) is **0.005 ppm** averaged over an 8-hour workshift.

- ▶ The above exposure limits are for air levels only. When skin contact also occurs, you may be overexposed, even though air levels are less than the limits listed above.

## Determining Your Exposure

- ▶ Read the product manufacturer's Material Safety Data Sheet (MSDS) and the label to determine product ingredients and important safety and health information about the product mixture.
- ▶ For each individual hazardous ingredient, read the New Jersey Department of Health Hazardous Substance Fact Sheet, available on the RTK website ([www.nj.gov/health/eoh/rtkweb](http://www.nj.gov/health/eoh/rtkweb)) or in your facility's RTK Central File or Hazard Communication Standard file.
- ▶ You have a right to this information under the New Jersey Worker and Community Right to Know Act, the Public Employees Occupational Safety and Health (PEOSH) Act if you are a public worker in New Jersey, and under the federal Occupational Safety and Health Act (OSHA) if you are a private worker.
- ▶ The New Jersey Right to Know Act requires most employers to label chemicals in the workplace and requires public employers to provide their employees with information concerning chemical hazards and controls. The federal OSHA Hazard Communication Standard (29 CFR 1910.1200) and the PEOSH Hazard Communication Standard (N.J.A.C. 12:100-7) require employers to provide similar information and training to their employees.

This Fact Sheet is a summary of available information regarding the health hazards that may result from exposure. Duration of exposure, concentration of the substance and other factors will affect your susceptibility to any of the potential effects described below.

## Health Hazard Information

### Acute Health Effects

The following acute (short-term) health effects may occur immediately or shortly after exposure to **Hexamethylene Diisocyanate**:

- ▶ Contact can severely irritate and burn the skin and eyes with possible eye damage.
- ▶ Exposure can irritate the nose and throat.
- ▶ Inhaling **Hexamethylene Diisocyanate** can irritate the lungs causing coughing and/or shortness of breath. Higher exposures may cause a build-up of fluid in the lungs (pulmonary edema), a medical emergency, with severe shortness of breath.
- ▶ Exposure to **Hexamethylene Diisocyanate** can cause headache, dizziness, nausea and vomiting.

### Chronic Health Effects

The following chronic (long-term) health effects can occur at some time after exposure to **Hexamethylene Diisocyanate** and can last for months or years:

### Cancer Hazard

- ▶ There is no evidence that **Hexamethylene Diisocyanate** causes cancer in animals. This is based on test results presently available to the NJDOH from published studies.

### Reproductive Hazard

- ▶ There is no evidence that **Hexamethylene Diisocyanate** affects reproduction. This is based on test results presently available to the NJDOH from published studies.

### Other Effects

- ▶ Skin allergy can occur with itching, redness and/or an eczema-like rash. If allergy develops, very low future exposure can trigger symptoms.
- ▶ **Hexamethylene Diisocyanate** may cause an asthma-like allergy. Future exposure can cause asthma attacks with shortness of breath, wheezing, coughing, and/or chest tightness.

## Medical

### Medical Testing

Before beginning employment and at regular times thereafter, (at least annually), the following are recommended:

- ▶ Lung function tests. The results may be normal if the person is not having an attack at the time of the test.

If symptoms develop or overexposure is suspected, the following are recommended:

- ▶ Evaluation by a qualified allergist can help diagnose skin allergy.
- ▶ Consider chest x-ray after acute overexposure

Any evaluation should include a careful history of past and present symptoms with an exam. Medical tests that look for damage already done are not a substitute for controlling exposure.

Request copies of your medical testing. You have a legal right to this information under the OSHA Access to Employee Exposure and Medical Records Standard (29 CFR 1910.1020).

### Mixed Exposures

- ▶ Smoking can cause heart disease, lung cancer, emphysema, and other respiratory problems. It may worsen respiratory conditions caused by chemical exposure. Even if you have smoked for a long time, stopping now will reduce your risk of developing health problems.

## Workplace Controls and Practices

Very toxic chemicals, or those that are reproductive hazards or sensitizers, require expert advice on control measures if a less toxic chemical cannot be substituted. Control measures include: (1) enclosing chemical processes for severely irritating and corrosive chemicals, (2) using local exhaust ventilation for chemicals that may be harmful with a single exposure, and (3) using general ventilation to control exposures to skin and eye irritants. For further information on workplace controls, consult the NIOSH document on Control Banding at [www.cdc.gov/niosh/topics/ctrlbanding/](http://www.cdc.gov/niosh/topics/ctrlbanding/).

The following work practices are also recommended:

- ▶ Label process containers.
- ▶ Provide employees with hazard information and training.
- ▶ Monitor airborne chemical concentrations.
- ▶ Use engineering controls if concentrations exceed recommended exposure levels.
- ▶ Provide eye wash fountains and emergency showers.
- ▶ Wash or shower if skin comes in contact with a hazardous material.
- ▶ Always wash at the end of the workshift.
- ▶ Change into clean clothing if clothing becomes contaminated.
- ▶ Do not take contaminated clothing home.
- ▶ Get special training to wash contaminated clothing.
- ▶ Do not eat, smoke, or drink in areas where chemicals are being handled, processed or stored.
- ▶ Wash hands carefully before eating, smoking, drinking, applying cosmetics or using the toilet.

## Personal Protective Equipment

The OSHA Personal Protective Equipment Standard (29 CFR 1910.132) requires employers to determine the appropriate personal protective equipment for each hazard and to train employees on how and when to use protective equipment.

The following recommendations are only guidelines and may not apply to every situation.

### Gloves and Clothing

- ▶ Avoid skin contact with **Hexamethylene Diisocyanate**.  
Wear personal protective equipment made from material which can not be permeated or degraded by this substance. Safety equipment suppliers and manufacturers can provide recommendations on the most protective glove and clothing material for your operation.
- ▶ Safety equipment manufacturers recommend Butyl, Viton/Butyl and Silver Shield®/4H® for gloves, and Tychem® fabrics and Zytron® 400, or the equivalent, as protective materials for clothing.
- ▶ All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work.

### Eye Protection

- ▶ Wear indirect-vent, impact and splash resistant goggles when working with liquids.
- ▶ Wear a face shield along with goggles when working with corrosive, highly irritating or toxic substances.

### Respiratory Protection

**Improper use of respirators is dangerous.** Respirators should only be used if the employer has implemented a written program that takes into account workplace conditions, requirements for worker training, respirator fit testing, and medical exams, as described in the OSHA Respiratory Protection Standard (29 CFR 1910.134).

- ▶ Where the potential exists for exposure over **0.005 ppm**, use a NIOSH approved supplied-air respirator with a full facepiece operated in a pressure-demand or other positive-pressure mode. For increased protection use in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive-pressure mode.
- ▶ Where the potential exists for exposure over **1 ppm**, use a NIOSH approved self-contained breathing apparatus with a full facepiece operated in a pressure-demand or other positive-pressure mode equipped with an emergency escape air cylinder.

## Fire Hazards

If employees are expected to fight fires, they must be trained and equipped as stated in the OSHA Fire Brigades Standard (29 CFR 1910.156).

- ▶ **Hexamethylene Diisocyanate** is a COMBUSTIBLE LIQUID.
- ▶ Use dry chemical, CO<sub>2</sub>, water spray or foam as extinguishing agents.
- ▶ POISONOUS GASES ARE PRODUCED IN FIRE, including *Nitrogen Oxides* and *Hydrogen Cyanide*.
- ▶ Use water spray to keep fire-exposed containers cool.
- ▶ Hazardous polymerization (self reaction) occurs at temperatures above 392°F (200°C).

## Spills and Emergencies

If employees are required to clean-up spills, they must be properly trained and equipped. The OSHA Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120) may apply.

If **Hexamethylene Diisocyanate** is spilled or leaked, take the following steps:

- ▶ Evacuate personnel and secure and control entrance to the area.
- ▶ Eliminate all ignition sources.
- ▶ Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers.
- ▶ Ventilate and wash area after clean-up is complete.
- ▶ It may be necessary to contain and dispose of **Hexamethylene Diisocyanate** as a HAZARDOUS WASTE. Contact your state Department of Environmental Protection (DEP) or your regional office of the federal Environmental Protection Agency (EPA) for specific recommendations.

## Handling and Storage

Prior to working with **Hexamethylene Diisocyanate** you should be trained on its proper handling and storage.

- ▶ **Hexamethylene Diisocyanate** may react violently with ALCOHOLS; AMINES; STRONG BASES (such as SODIUM HYDROXIDE and POTASSIUM HYDROXIDE); ORGANOTIN; OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE); STRONG ACIDS (such as HYDROCHLORIC, SULFURIC and NITRIC); and CARBOXYLIC ACIDS.
- ▶ **Hexamethylene Diisocyanate** reacts with WATER to form *Carbon Dioxide* and decomposes in WATER to form *Amine* and *Polyureas*.
- ▶ Store in tightly closed containers in a cool, well-ventilated area away from HEAT and COPPER.
- ▶ Sources of ignition, such as smoking and open flames, are prohibited where **Hexamethylene Diisocyanate** is used, handled, or stored in a manner that could create a potential fire or explosion hazard.

## Occupational Health Information Resources

The New Jersey Department of Health offers multiple services in occupational health. These services include providing informational resources, educational materials, public presentations, and industrial hygiene and medical investigations and evaluations.

### For more information, please contact:

New Jersey Department of Health  
Right to Know  
PO Box 368  
Trenton, NJ 08625-0368  
Phone: 609-984-2202  
Fax: 609-984-7407  
E-mail: [rtk@doh.state.nj.us](mailto:rtk@doh.state.nj.us)  
Web address: <http://www.nj.gov/health/eoh/rtkweb>

***The Right to Know Hazardous Substance Fact Sheets are not intended to be copied and sold for commercial purposes.***

## GLOSSARY

**ACGIH** is the American Conference of Governmental Industrial Hygienists. They publish guidelines called Threshold Limit Values (TLVs) for exposure to workplace chemicals.

**Acute Exposure Guideline Levels (AEGs)** are established by the EPA. They describe the risk to humans resulting from once-in-a-lifetime, or rare, exposure to airborne chemicals.

**Boiling point** is the temperature at which a substance can change its physical state from a liquid to a gas.

A **carcinogen** is a substance that causes cancer.

The **CAS number** is unique, identifying number, assigned by the Chemical Abstracts Service, to a specific chemical.

**CFR** is the Code of Federal Regulations, which are the regulations of the United States government.

A **combustible** substance is a solid, liquid or gas that will burn.

A **corrosive** substance is a gas, liquid or solid that causes destruction of human skin or severe corrosion of containers.

**DEP** is the New Jersey Department of Environmental Protection.

**DOT** is the Department of Transportation, the federal agency that regulates the transportation of chemicals.

**EPA** is the Environmental Protection Agency, the federal agency responsible for regulating environmental hazards.

**ERG** is the Emergency Response Guidebook. It is a guide for emergency responders for transportation emergencies involving hazardous substances.

**Emergency Response Planning Guideline (ERPG)** values are intended to provide estimates of concentration ranges where one reasonably might anticipate observing adverse effects.

A **fetus** is an unborn human or animal.

A **flammable** substance is a solid, liquid, vapor or gas that will ignite easily and burn rapidly.

The **flash point** is the temperature at which a liquid or solid gives off vapor that can form a flammable mixture with air.

**IARC** is the International Agency for Research on Cancer, a scientific group.

**Ionization Potential** is the amount of energy needed to remove an electron from an atom or molecule. It is measured in electron volts.

**IRIS** is the Integrated Risk Information System database maintained by federal EPA. The database contains information on human health effects that may result from exposure to various chemicals in the environment.

**LEL or Lower Explosive Limit**, is the lowest concentration of a combustible substance (gas or vapor) in the air capable of continuing an explosion.

**mg/m<sup>3</sup>** means milligrams of a chemical in a cubic meter of air. It is a measure of concentration (weight/volume).

A **mutagen** is a substance that causes mutations. A **mutation** is a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

**NFPA** is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

**NIOSH** is the National Institute for Occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

**NTP** is the National Toxicology Program which tests chemicals and reviews evidence for cancer.

**OSHA** is the federal Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

**PEOSHA** is the New Jersey Public Employees Occupational Safety and Health Act, which adopts and enforces health and safety standards in public workplaces.

**Permeated** is the movement of chemicals through protective materials.

**PIH** is a DOT designation for chemicals which are Poison Inhalation Hazards.

**ppm** means parts of a substance per million parts of air. It is a measure of concentration by volume in air.

A **reactive** substance is a solid, liquid or gas that releases energy under certain conditions.

**STEL** is a Short Term Exposure Limit which is usually a 15-minute exposure that should not be exceeded at any time during a work day.

A **teratogen** is a substance that causes birth defects by damaging the fetus.

**UEL or Upper Explosive Limit** is the highest concentration in air above which there is too much fuel (gas or vapor) to begin a reaction or explosion.

**Vapor Density** is the ratio of the weight of a given volume of one gas to the weight of another (usually *Hydrogen*), at the same temperature and pressure.

The **vapor pressure** is a measure of how readily a liquid or a solid mixes with air at its surface. A higher vapor pressure indicates a higher concentration of the substance in air and therefore increases the likelihood of breathing it in.

Common Name: **HEXAMETHYLENE DIISOCYANATE**

Synonyms: HDI; 1,6-Diisocyanatohexane

CAS No: 822-06-0

Molecular Formula: C<sub>8</sub>H<sub>12</sub>N<sub>2</sub>O<sub>2</sub>

RTK Substance No: 0995

Description: Clear, colorless to yellow liquid with a sharp, irritating odor

**HAZARD DATA**

Hazard Rating	Firefighting	Reactivity
<b>2 - Health</b> <b>1 - Fire</b> <b>1 - Reactivity</b> <b>DOT#:</b> UN 2281 <b>ERG Guide #:</b> 156 <b>Hazard Class:</b> 6.1 (Poison)	<b>Hexamethylene Diisocyanate</b> is a COMBUSTIBLE LIQUID. Use dry chemical, CO <sub>2</sub> , water spray or foam as extinguishing agents. POISONOUS GASES ARE PRODUCED IN FIRE, including <i>Nitrogen Oxides</i> and <i>Hydrogen Cyanide</i> . Use water spray to keep fire-exposed containers cool. Hazardous polymerization (self reaction) occurs at temperatures above 392°F (200°C).	<b>Hexamethylene Diisocyanate</b> may react violently with ALCOHOLS; AMINES; STRONG BASES (such as SODIUM HYDROXIDE and POTASSIUM HYDROXIDE); ORGANOTIN; OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE); STRONG ACIDS (such as HYDROCHLORIC, SULFURIC and NITRIC); and CARBOXYLIC ACIDS. <b>Hexamethylene Diisocyanate</b> reacts with WATER to form <i>Carbon Dioxide</i> and decomposes in WATER to form <i>Amine</i> and <i>Polyureas</i> .

**SPILL/LEAKS**

**Isolation Distance:**

Small Spill: 60 meters (200 feet)

Large Spill: 270 meters (900 feet)

Fire: 800 meters (1/2 mile)

Absorb liquids in vermiculite, dry sand, earth, or a similar material and deposit in sealed containers.

Rapidly degrades in water.

**PHYSICAL PROPERTIES**

<b>Odor Threshold:</b>	0.001 ppm
<b>Flash Point:</b>	284°F (140°C)
<b>LEL:</b>	0.9%
<b>UEL:</b>	9.5%
<b>Auto Ignition:</b>	849°F (454°C)
<b>Vapor Density:</b>	5.81 (air = 1)
<b>Vapor Pressure:</b>	0.05 mm Hg at 77°F (25°C)
<b>Specific Gravity:</b>	1.04 (water = 1)
<b>Water Solubility:</b>	Reacts/Decomposes
<b>Boiling Point:</b>	415°F (213°C)
<b>Molecular Weight:</b>	168.2

**EXPOSURE LIMITS**

**NIOSH:** 0.005 ppm, 10-hr TWA; 0.02 ppm, 10-min Ceiling

**ACGIH:** 0.005 ppm, 8-hr TWA

**IDLH:** None

The Protective Action Criteria values are:

PAC-1 = 0.015 ppm PAC-2 = 0.2 ppm PAC-3 = 3.5 ppm

**PROTECTIVE EQUIPMENT**

<b>Gloves:</b>	Butyl, Viton/Butyl and Silver Shield®/4H® (>8-hr breakthrough)
<b>Coveralls:</b>	Tychem® fabrics and Zytron® 400 (>8-hr breakthrough)
<b>Respirator:</b>	SCBA

**HEALTH EFFECTS**

<b>Eyes:</b>	Severe irritation
<b>Skin:</b>	Severe irritation and burns, redness, eczema-like rash
<b>Inhalation:</b>	Nose, throat and lung irritation with coughing and shortness of breath Headache, dizziness, nausea and vomiting

**FIRST AID AND DECONTAMINATION**

<b>Remove</b> the person from exposure.
<b>Flush</b> eyes with large amounts of water for at least 15 minutes. Remove contact lenses if worn. Seek medical attention immediately.
<b>Quickly</b> remove contaminated clothing. Immediately wash contaminated skin with large amounts of soap and water.
<b>Begin</b> artificial respiration if breathing has stopped and CPR if necessary.
<b>Transfer</b> to a medical facility.
<b>Medical</b> observation is recommended as symptoms may be delayed.