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**Fact Sheet****Hazard Evaluation System and Information Service**

850 Marina Bay Parkway  
Building P, 3rd Floor  
Richmond, CA 94804

(866) 282-5516



# Isocyanates

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**Health Hazard Summary:** *Isocyanates can cause asthma and other lung problems, even with very low exposure levels. Isocyanates can also irritate your eyes, nose, throat, and skin.*

## **HOW TO FIND OUT IF YOU ARE WORKING WITH ISOCYANATES**

**Jobs and Industries Where Isocyanates Are Used:** Isocyanates are the raw materials from which all polyurethane products are made. Jobs that may involve exposure to isocyanates include painting, foam-blowing, and the manufacture of many products, such as chemicals, polyurethane foam, insulation materials, surface coatings, car seats, furniture, foam mattresses, under-carpet padding, packaging materials, shoes, laminated fabrics, polyurethane rubber, adhesives, and other

polyurethane products.

The major isocyanate compounds are:

TDI	toluene diisocyanate
MDI	methylene bis-phenylisocyanate (diphenylmethane diisocyanate)
HDI	hexamethylene diisocyanate
NDI	naphthalene diisocyanate
HMDI	methylene bis-cyclohexylisocyanate (hydrogenated MDI)
IPDI	isophorone diisocyanate

The most-used isocyanates are TDI and MDI. TDI is used mainly to make soft, flexible foams for padding or insulation. MDI is used mainly to make hard, rigid foams for insulation in buildings, vehicles, refrigeration equipment, and industrial equipment. Isocyanates are also widely used in surface coatings such as paints, sealants, and finishes, and in the manufacture of rubbery plastics such as those used to coat wires.

Some trade names that may refer to isocyanate products are:

Centari	Desmodur	Hylene
Imron	Isonate	Mondur
Nacconate	Niax	PAPI
Rubinate		

Isocyanates chemically react to form a solid polyurethane foam or a plastic coating. The finished product is almost non-toxic, unless it is burned or caused to generate a dust. Any polyurethane material will give off isocyanates and other highly toxic substances if it is burned or welded.

The isocyanates in single-component coating products such as Varathane are pre-polymerized (already chemically reacted), so that very little of the raw isocyanate remains; thus they are fairly safe even during application. Two-component coating products contain unreacted isocyanates and are usually much more hazardous to work with.

**Odor and Appearance:** Isocyanates are used in liquid form or dissolved in other liquids. They have a sharp, fruity odor, but most people cannot smell the odor until the amount of the chemical in the air is far above safe levels. Don't count on your sense of smell to warn you that you are being overexposed.

TDI and HDI are especially hazardous, because they can evaporate quickly to produce harmful levels in the air. However, in jobs such as spray painting or foam blowing that can create mists and dusts, other isocyanates can be just as hazardous as TDI and HDI.

**Your Right to Know:** Under the Hazard Communication Standards (California *GISO 5194* and U.S. *29 CFR 1910.1200*), your employer must tell you if you are working with any hazardous substances, including isocyanates, and must train you to use them safely. If you think you may be exposed to hazardous chemicals at work, ask to see the Material Safety Data Sheets (MSDSs) for the products in your work area.

An MSDS lists the hazardous chemical contents of a product, describes its health and safety hazards, and gives methods for its safe use, storage, and disposal. It should also include information on fire and explosion hazards, reactivity, first aid, and procedures for handling leaks and spills. Your employer must have an MSDS for any workplace product that contains a hazardous substance, and must make it available to employees on request.

**Note:** In many specialty paints, isocyanates make up less than 1% of the product, and therefore do not have to be listed on the MSDS. Nevertheless, all polyurethane products probably contain isocyanates, even if they are not listed on the label or the MSDS.

This Fact Sheet is an aid for worker training programs. It does not take the place of a Material Safety Data Sheet.

## HOW ISOCYANATES ENTER AND AFFECT YOUR BODY

Isocyanates can affect you when they evaporate into the air you breathe or when they form a mist or a dust in the air, or if they come into contact with your skin. The main effects of overexposure are asthma and other lung problems, as well as irritation of the eyes, nose, throat, and skin.

**Lungs:** Isocyanates cause asthma. The symptoms of asthma include coughing, shortness of breath, wheezing, and chest tightness. Symptoms can occur soon after exposure or several hours later.

Isocyanates can also cause hypersensitivity pneumonitis, a lung disease whose symptoms include fever, body aches, shortness of breath, and cough with phlegm or sputum.

About one out of twenty people who work with isocyanates becomes "sensitized" to them. Being "sensitized" to isocyanates means that you may have an asthma attack any time you are exposed to them, even to extremely small amounts. Sensitivity to isocyanates can be permanent. Also, continuing to work with isocyanates after you become sensitized can cause asthma itself to become permanent, so that attacks can occur even without any further exposure to isocyanates.

Once you become sensitized, you cannot continue to work in any job where you could be exposed to isocyanates.

You can become sensitized to isocyanates without ever having had any other symptoms of overexposure. There is no evidence that people with other allergies are more likely to become sensitized to isocyanates.

Daily exposure to levels of isocyanates too low to sensitize you or cause asthma or pneumonitis may still cause a reduction in lung capacity and function.

**Skin:** Skin contact with isocyanates can cause severe skin rashes, both where the material contacts your skin and on other parts of your body. A rash can also be caused by inhaling isocyanate dusts, mists, or vapors. Skin contact with isocyanates can "sensitize" you to them.

**Eyes, Nose, and Throat:** Isocyanates are very irritating to the eyes, nose, and throat. The legal workplace exposure limits (see below) are much lower than the levels which typically cause irritation, so, under proper conditions, irritation should not occur. Eye irritation is a strong indication that you are being overexposed and that immediate steps should be taken to reduce your exposure.

**Cancer and Reproductive Effects:** TDI causes cancer in laboratory animals. Most other isocyanates have not been tested. We don't know whether TDI or other isocyanates can cause cancer in humans. Isocyanate compounds have not been tested in animals to see whether they can affect fertility or the developing offspring, and there have been no studies to look for such effects in exposed workers. However, at the very low exposure levels which do not cause irritation or other health effects, it is unlikely that isocyanates could have any effect on pregnancy or any significant effect on your lifetime cancer risk.

## **TESTS FOR EXPOSURE AND MEDICAL EFFECTS**

Workers who are regularly exposed to isocyanates should be given a complete physical examination, including an occupational and medical history, at the beginning of their employment. The examination should give special attention to the respiratory system, including lung function tests and information about any history of asthma, bronchitis, emphysema, allergies, or any other lung or breathing problems. You should also receive yearly follow-up examinations, which should include lung function tests at the beginning and end of a single shift or work week. If you develop symptoms of isocyanate overexposure, a pulmonary specialist can judge whether you have become sensitized.

## **LEGAL EXPOSURE LIMITS**

California's Division of Occupational Safety and Health (DOSH, or "Cal/OSHA") makes and enforces regulations for chemical exposure in the workplace. Cal/OSHA has established the limits shown below for the amounts of certain isocyanates measured in the air in your breathing zone.

TDI	.02 ppm*
MDI	.02 ppm*
HDI	.02 ppm*
NDI	.01 ppm*
HMDI	.01 ppm*
IPDI	.01
ppm*	

\*Also, .005 ppm TWA

These limits are "ceiling" limits, which means that you may *never* legally be exposed to higher levels, even for a short period of time. Cal/OSHA also has a "time-weighted average" (TWA) limit for TDI, which means that your *average* exposure over any 8-hour period must not exceed 0.005 parts per million (ppm) **and** your exposure must never exceed the ceiling limit of 0.02 ppm. Health professionals now consider an 8-hour average of 0.005 ppm to be an appropriate limit for all isocyanates.

Your sense of smell will not warn you that you are being overexposed to isocyanates. Measuring the amount of a substance in the air is the only reliable way to determine the exposure level.

If you work with isocyanates and have any of the symptoms described above, you may be exposed at more than the legal limit or may be sensitized. Talk to your doctor, your supervisor, and/or your union. If you might be exposed to any substance at more than the legal exposure limit, your employer must measure the amount of the chemical present in the air in your work area (Cal/OSHA regulation *GISO 5155*). You have the right to see the results of such monitoring relevant to your work (*GISO 3204*).

You also have the right to see and copy your own medical records and records of exposure to toxic substances. These records are important in determining whether your health has been affected by your work. If your employers have such records, they must keep them and make them available to you for at least 30 years after the end of your employment.

## **REDUCING YOUR EXPOSURE**

Your employer is required to protect you from being exposed at levels above the legal limits. For

information about how Cal/OSHA and Cal/OSHA Consultation Service can help you and your employer, see the "Resources" section below.

**Engineering Controls:** Engineering control methods must be used if possible. Engineering control methods include installing ventilation, changing the work process, and changing work practices. Containers of liquid isocyanates or isocyanate paints should be tightly covered to prevent evaporation. Certain work processes can be isolated, enclosed or automated to reduce exposures. Local exhaust ventilation systems ("hoods") are the most effective type of ventilation control. These systems capture contaminated air at its source before it spreads into the air in your breathing zone.

**Personal Protective Equipment:** When engineering controls cannot sufficiently reduce exposures, a respirator must be worn and a respiratory protection program must be developed by the employer, as described in Cal/OSHA regulations (*GISO 5144*). An industrial hygienist or other knowledgeable person should be consulted to ensure that your equipment is appropriate and is used correctly. A dust mask will **not** protect you against isocyanate vapors.

Isocyanates have very poor warning properties, so you may not know when the cartridge on an air-purifying respirator has worn out and needs replacement. Therefore, only a supplied-air respirator is approved.

If skin contact with isocyanates is unavoidable or if splashing may occur, other protective equipment such as gloves or faceshields should be worn. Protective clothing should be made of a material resistant to isocyanates. Butyl rubber gives the best protection. Natural (latex) rubber, nitrile rubber, chlorinated polyethylene, and polyvinyl alcohol are fairly good. Neoprene and polyvinyl chloride are not very good. Even the most resistant materials will be penetrated quickly and should be replaced often.

**Substitution:** The most effective way to reduce hazardous chemical exposures is to use a safer chemical, if one is available. For example, MDI and NDI evaporate much more slowly than TDI and HDI, so they are not as quick to reach hazardous levels in the air.

However, the chemical characteristics of isocyanates make them difficult to replace. Also, the physical and health hazards of any substitute must be carefully considered to ensure that it is actually safer.