

# Isocyanates



## What are Isocyanates?

An isocyanate is any chemical that contains at least one isocyanate group in its structure. An isocyanate group is a group of atoms containing one nitrogen atom attached by a double covalent bond to one carbon atom, which in turn is attached by a second double bond to an oxygen atom (indicated in structure as  $-N=C=O$ ). (Do not confuse this with the cyanate functional group which is arranged as  $-O-C\equiv N$ ). A chemical containing two such isocyanate groups is called a diisocyanate. Common examples are toluene diisocyanate (TDI), hexamethylene diisocyanate (HDI) and methylene diphenylmethane diisocyanate (MDI).

Isocyanates (a description which includes diisocyanates) are the raw materials that make up all polyurethane products. Isocyanates react with compounds containing alcohols to produce polyurethane polymers - which are used in polyurethane foams, thermoplastic elastomers and "2 pack" type polyurethane paints to improve the performance, durability and finish of painted surfaces. Jobs that may involve exposure to isocyanates include painting with polyurethane products, foam-blowing and the manufacture of polyurethane products like insulation materials, surface coatings, furniture, foam mattresses, under-carpet padding, packaging materials, laminated fabrics, polyurethane rubber, adhesives and also exposure can occur during the thermal degradation of polyurethane products.

## Health Effects

Exposure to hazardous materials may be acute or chronic. Acute exposures refer to single high concentration exposures over shorter periods, while chronic exposures are repeated or continuous exposures over longer periods. Exposures to any toxic material may have either acute, immediate effects and/or chronic, long term health effects.

### Inhalation:

Isocyanates are known to have a strong effect on the respiratory tract in some people. It is reported that there is a susceptible group in the population (estimated to be 5-20% of workers who are exposed occupationally) who can become sensitised to Isocyanates. Sensitization is the body's hyper-reactive (allergy-like) response to a substance which has been touched or inhaled by a susceptible individual. Sensitization may develop as a result of a large single overexposure, for example, from a spill or accident, or from repeated overexposure at lower levels. Once sensitised, these people, when later exposed to even very low concentrations of isocyanates even at levels below the exposure standard, can react by developing asthma-like symptoms, such as chest tightness, cough, wheezing and shortness of breath. Such attacks may occur up to several hours after cessation of exposure (for example, during the night after exposure) but, if a person is particularly sensitive, the attack can occur earlier or immediately. This sensitisation is essentially irreversible and can prevent any further work for the individual in their job using or

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any position associated with use of Isocyanates - even at very low levels below the regulated exposure level and that may not affect others. Many spray painters working in smash repair shops have had to leave the industry because they are sensitised to isocyanates.

An individual's response to isocyanate exposure can be immediate or may be delayed for several years. Asthmatic people are more prone to sensitisation and other adverse reactions. Persons with a history of asthma, allergies, hay fever, recurrent acute bronchitis or any occupational chest disease or impaired lung function is advised against risking exposure to isocyanates. In rare cases, death has occurred from a severe asthma attack after significant isocyanate exposure.

### Skin

Isocyanates are also skin irritants (causing inflammation and dermatitis) and there is some evidence that skin exposure can also cause respiratory sensitisation.

### Eyes

Isocyanates are an irritant to the eyes. Splashes can cause severe chemical conjunctivitis.

### Other Health Effects

Other health effects which have been reported include liver and kidney dysfunction. Some Isocyanate materials are considered to be potential human carcinogens (IARC).

### Spraying Isocyanate Paints

Spray painters need to understand the health risks involved in spraying polyurethane paints - these are the two-pack mixes of polyurethane paints and possibly also in the one-pack moisture-cured mixes. These products are widely used in the automotive and other industries because of their excellent gloss, hardness, adhesion and chemical resistance.

The major hazard with spraying polyurethane paints is breathing the mist or aerosol droplets of the paint spray and absorbing the isocyanate and other components into your lungs.

The odour threshold for isocyanates, i.e. the level at which an individual can smell an isocyanate, is typically higher than the allowed exposure limits. In other words, if a painter smells the sweet, fruity, pungent odour of an isocyanate, they are probably already overexposed. That is why the recommended respiratory protection for employees spraying isocyanates is a supplied air respirator and not an air purifying respirator (i.e. filter cartridge style). The issue with use of air purifying respirators is that they will reach a point at which the filter becomes saturated and will no longer capture the isocyanate or other solvents. When that filter breakthrough happens, an

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overexposure can occur, potentially causing an irreversible sensitization. Use of a supplied air system removes this filter change factor - it does not rely on the painter changing his gas/vapour filters at appropriate intervals.

Note: if isocyanate-containing paint is applied by brush, roller or dipping, in a well ventilated area, there is generally no more hazard than with ordinary paints. These application methods usually do not produce the higher concentrations of isocyanate vapour associated with spraying.

After curing, polyurethane paints contain no free isocyanates and are not hazardous under normal use. However, welding or burning of polyurethane coated surfaces can release a range of contaminants. Gases or vapours evolved can include HDI, TDI, MDI as well as many other compounds (metal fumes, organic gases or vapours, particulates), depending on the original polyisocyanate resin used. When welding or cutting metal coated with a polyurethane coating, a worker may be exposed to a range of these decomposition products which will vary depending on type of process being used to weld or cut, the nature of the base metal and type of coating. Respiratory protection that is suitable for welding applications will also provide suitable respiratory protection in these cases - e.g. the 3M™ 6000 or 7500 series half fitted with a rated organic vapour filter if there is significant release of decomposition products from a large area e.g. 3M 6051 and 5925 filters and the 501 retainer.

Selection of specific products for use in specific applications should be made by a qualified person and all equipment should be appropriately fitted, used and maintained according to AS/NZS1715 "Selection, use and maintenance of respiratory protective devices".

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