

# Di- and triisocyanates

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## Executive summary

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Health Council of the Netherlands



At the request of the Ministry of Social Affairs and Employment, the Health Council of the Netherlands has derived a health-based advisory value for isocyanates. This advisory report has been prepared by the Dutch Expert Committee on Occupational Safety (DECOS). More information on the tasks of this permanent committee of the Health Council of the Netherlands can be found at [www.gezondheidsraad.nl](http://www.gezondheidsraad.nl). The members of the Committee are listed on the last page of this report.

### **Isocyanates: risk of asthma in various types of industry**

Diisocyanates and triisocyanates (further referred to as isocyanates) are substances that can cause allergic complaints of the airways when inhaled. Isocyanates are starting materials for polyurethane, which is used in different products including varnishes, lacquers, foams, and adhesives. These products are being used among others in construction work, automobile industry, shipbuilding industry, paints industry, and in the production of plastics and electronics.

Workers using these types of products might be exposed to isocyanates, usually as gasses or vapours. Exposure can also occur via the skin.

### **Advisory value based on 1% extra risk**

A chemical-induced allergic reaction is preceded by sensitisation: the moment the immune system is triggered, yet no (significant) complaints occur. For inhaled allergens it is generally not possible to derive a concentration below which no sensitisation occurs. For the purpose of setting an exposure limit for these kind of substances, the Minister of Social Affairs and Employment has set a risk level of 1% extra risk of sensitisation due to occupational exposure. Simply explained, this means: if in the general population 2 out of 100 people are sensitised, the target level is to limit the number in the workplace to 3 out of 100. For its recommendation, the Committee estimates which concentration of the substance corresponds to a risk level of 1%.

### **Measuring exposure and effects**

Much is unclear about the mechanism(s) by which isocyanates cause allergic complaints of the airways. It is likely that sensitisation can not only occur after inhalation, but also after exposure of the skin. It is clear that the reactive NCO-groups – present in all isocyanates – play a role. This advisory report deals with isocyanates with 2 or 3 NCO-groups (diisocyanates or triisocyanates). In this report, the isocyanate concentration in the air is expressed as  $\mu\text{g NCO per m}^3$ . Different validated methods are available to determine NCO-levels in the air.

Whether people have been exposed to isocyanates can be determined by measuring breakdown products in the blood or urine. For the most widely used isocyanates, validated methods for measuring these breakdown products are available.

Often, sensitisation can be reliably determined by measuring antibodies that people produce. In many workers who developed asthma after



exposure to isocyanates, however, no specific antibodies were detected. The Committee has therefore focussed on the adverse effects on the airways that can occur after sensitisation to isocyanates.

### Consulted research

Both animal studies and studies relating to humans on the effects of isocyanates after inhalation are available. The Committee prefers the use of data on humans.

To derive an advisory value most reliably, the Committee requires information on the occurrence of effects at multiple exposure concentrations. Then, an exposure-response relationship can be established, which is the basis of deriving a concentration that corresponds with an extra risk of 1% for occurrence of adverse effects of the airways.

Bronchial hyperreactivity (BHR) is an excessive bronchial narrowing that is characteristic for (occupational) asthma. The Committee is of the

opinion that studies on BHR are most informative for the estimation of the occurrence of occupational asthma due to exposure to isocyanates. Few studies on occupational exposure to isocyanates have addressed BHR. For one of those studies, on car spray painters who have been exposed to hexamethylene diisocyanate (HDI), an exposure-response relationship has been derived. Based on data from this study, the Committee calculated an exposure concentration of  $0.10 \mu\text{g NCO}/\text{m}^3$ , corresponding with a 1% extra risk of adverse effects on the airways (in this case BHR).

Another study that provides information on an exposure-response relationship involves workers in production facilities exposed to toluene di-isocyanate (TDI) and complaints that are consistent with occupational asthma. From these data the Committee derived a concentration of  $0.14 \mu\text{g}/\text{m}^3$ , corresponding to a 1% extra risk of adverse effects of the airways (in this case complaints consistent with occupational asthma).

Based on the available data on humans, the Committee recommends a risk-based advisory values of  $0.1 \mu\text{g NCO}/\text{m}^3$ , as a mean concentration during an 8h-working day.

### Notation for skin absorption

Because skin exposure can contribute to the development of respiratory allergic complaints, the Committee recommends to apply a skin notation.

### Advice to the State Secretary

For occupational exposure to di- and triisocyanates, the Committee derives a health-based advisory value of  $0.1 \mu\text{g NCO}/\text{m}^3$ , as a mean concentration during an 8-h working day. At this concentration, workers have an extra risk of 1% of bronchial hyperreactivity (BHR), compared to the general population. Because skin exposure can contribute significantly to the development of respiratory allergic complaints, the Committee recommends to apply a skin notation for di- and triisocyanates.



The Health Council of the Netherlands, established in 1902, is an independent scientific advisory body. Its remit is “to advise the government and Parliament on the current level of knowledge with respect to public health issues and health (services) research...” (Section 22, Health Act).

The Health Council receives most requests for advice from the Ministers of Health, Welfare and Sport, Infrastructure and Water Management, Social Affairs and Employment, and Agriculture, Nature and Food Quality. The Council can publish advisory reports on its own initiative. It usually does this in order to ask attention for developments or trends that are thought to be relevant to government policy.

Most Health Council reports are prepared by multidisciplinary committees of Dutch or, sometimes, foreign experts, appointed in a personal capacity. The reports are available to the public.

This publication can be downloaded from [www.healthcouncil.nl](http://www.healthcouncil.nl).

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