

This Guide provides information on how to manage health and safety risks associated with the manufacture, storage, handling, generation¹ and use of isocyanates in the workplace.

Isocyanates in the workplace can present significant risks to workers. Workers exposed to isocyanates can develop a range of short and long-term health problems.



What are isocyanates?

Isocyanates are hazardous chemicals.

Isocyanates are widely used in manufacturing materials like polyurethane foams, rubbers, plastics, varnishes, adhesives and paints. A list of the most widely used industrial organic isocyanates and their main uses is in Table 1.

Table 1 Isocyanate compounds

Name	Form	Main uses
Toluene diisocyanate (TDI)	Liquid (mix of 2,4- and 2,6-isomers)	Flexible polyurethane foam production
Methylene diphenyl diisocyanate (MDI)	Low-melting point solid	Rigid polyurethane foam production
Hexamethylene diisocyanate (HDI)	Liquid	Spray paints, lacquers and car re-finishing
Napthalene diisocyanate (NDI)	Solid	Elastomers and synthetic rubbers
Methyl isocyanate (MIC)	Liquid (highly volatile)	Intermediate in the production of some pesticides
Isophorone diisocyanate (IPDI)	Liquid	Manufacture of coating and adhesive polymers and polyurethane foams

Isocyanates are supplied in different forms. A paint hardener product labelled as containing no free isocyanates—that is no isocyanate monomers²—may still be toxic because of its high proportion of other isocyanate forms including polymeric isocyanates. Isocyanates can also be generated from thermal decomposition of polyurethane materials including coated metals.

Isocyanates should not be confused with cyanates, isocyanides or cyanides which have different properties and health effects.



Workers at greatest risk from exposure to isocyanates

The most common work activities and situations in which workers may be exposed to isocyanates are summarised in Table 2.

1 Isocyanates can be generated as a result of breakdown of other materials, for example breaking down of polyurethane materials by heating.

2 A monomer reacts with other monomers and molecules to form a long chain of molecules called polymers.

Table 2 Isocyanate exposure to workers

Work activity	Source of exposure
<p>Spraying operations e.g. spray painting and spraying of resins, lacquers and adhesives containing isocyanates</p>	<ul style="list-style-type: none"> ■ Unreacted or partially cured isocyanates may be present during or after spraying. These may potentially be inhaled or come into contact with skin. ■ Workplaces where two-pack mix isocyanate substances are sprayed. This can include vehicle repairers (paint), furniture and cabinet makers (paints, lacquers, adhesives and vinyl wrapping) and spa manufacturers (application of insulating foam and resins). ■ Spray painters who use two-pack mix polyurethane paints are at high risk of exposure. The repair and refinishing of cars usually involves the spraying of isocyanate-containing coatings. Isocyanates like HDI used in paints are often also present as pre-polymers and polymeric isocyanates. Pre-polymers and polymeric isocyanates have the same health effects as free isocyanates when sprayed due to the generation of aerosols and overspray that may be inhaled.
<p>Manufacturing operations e.g. polyurethane foams, synthetic rubbers, plastics production, insulation making, furniture making and cores for foundry castings</p>	<ul style="list-style-type: none"> ■ Foaming operations involving the formation of gases or a blowing agent. This can enhance the release of isocyanate vapour or aerosols. ■ Heating isocyanates before mixing with resins. This can increase the volatility of isocyanates. ■ Inhaling isocyanates during storage of product while they are still curing. There may be unreacted isocyanates which can evaporate creating an unsafe atmosphere. ■ Hot wire-cutting of polyurethane foams. In this situation isocyanate vapours can be released. ■ High temperature bonding involving polyurethane based sealers.
<p>General transportation and storage</p>	<ul style="list-style-type: none"> ■ Incorrect storage or transportation e.g. where water entry is allowed or where spillages occur and control measures are not in place to eliminate or minimise the risk of exposure. ■ Storage of newly made polyurethane products while they are still curing and emitting isocyanate fumes.
<p>Welding of pipe work</p>	<ul style="list-style-type: none"> ■ Hot welding of pipe work lagged with polyurethane foams. This can cause the foam to break down and release isocyanates.
<p>Varnishes e.g. in timber floor finishing</p>	<ul style="list-style-type: none"> ■ Varnishes that are not fully cured. Some varnishes contain isocyanates which may continue to be released until the varnish is fully cured. ■ Hot removal of varnish. This may result in the release of isocyanates.
<p>Mining e.g. filling tyres with two-pack mix polyurethane foam (flat proofing), spraying ground and strata surfaces and injecting voids to make them stable for mining operations</p>	<ul style="list-style-type: none"> ■ Mixing a two-pack mix material in tyre fitting workshops and injecting it into tyre voids. ■ Isocyanates being released from tyres filled with polyurethane foam if the tyres are damaged or catch fire during use or maintenance. ■ Transferring isocyanates and polyol by hose over distances underground and mixing isocyanates and polyol in underground restricted spaces and ventilated areas. ■ Polyurethane resins being sprayed or injected by workers. This can also affect others nearby.

Work activity	Source of exposure
	<ul style="list-style-type: none"> ■ Polyurethane used in ground or strata control for coal mines may act as an insulator and increase the risk of spontaneous combustion. Polyurethane should not be used where coal is prone to spontaneous combustion. ■ Polyurethane and toxic gases are released e.g. hydrogen cyanide (HCN). This can promote the spread of fires. ■ Welding sparks ignite polyurethane foam and create a fire underground.



Who has duties under the law in relation to handling isocyanates?

Everyone in the workplace has work health and safety duties. General duties relating to the handling of isocyanates are summarised in Table 3.

Table 3 General health and safety duties for handling isocyanates

Who	Duties
A person conducting a business or undertaking	<p>A person conducting a business or undertaking must ensure, so far as is reasonably practicable, that workers and other people are not exposed to health and safety risks arising from the business or undertaking.</p> <p>A 'person conducting a business or undertaking' is a term that includes all types of working arrangements such as organisations, partnerships, sole traders or small business owners. For example, a builder, a construction business, a crane hire company, a franchisee and a self-employed person operating their own business are all persons conducting a business or undertaking.</p> <p>A person conducting a business or undertaking who has management or control of a workplace must ensure, so far as is reasonably practicable, the workplace, the means of entering and exiting the workplace and anything arising from the workplace is without risks to health and safety.</p>
Designers, manufacturers, suppliers and importers	Designers, manufacturers, suppliers and importers of chemicals must ensure, so far as is reasonably practicable, the chemicals are without risks to health and safety.
Officers	Officers , such as company directors, have a duty to exercise due diligence to ensure the business or undertaking complies with the Work Health and Safety (WHS) Act and Regulations. This includes taking reasonable steps to ensure the business or undertaking has and uses appropriate resources and processes to eliminate or minimise risks from using isocyanates in the workplace.
Workers and others	Workers and other people at the workplace must take reasonable care for their own health and safety, co-operate with reasonable policies, procedures and instructions and not adversely affect other people's health and safety.

HAZARD IDENTIFICATION

Safety data sheets (SDS) and labels should be checked to determine if products used at the workplace contain isocyanates.

Classifying and labelling isocyanates

Products containing isocyanates must be labelled in accordance with the Globally Harmonized System of Classification and Labelling of Chemicals (GHS).

See Table 4 for key elements on an isocyanate product label. Further information is in the [Code of Practice: Labelling of workplace hazardous chemicals](#).

Table 4 GHS health hazard label elements for isocyanates

Product Identifier	Product (Contains: Isocyanates)
Pictograms	
Signal word	DANGER
Hazard statements	<p>May cause allergy or asthma symptoms or breathing difficulties if inhaled.</p> <p>May cause an allergic skin reaction.</p> <p>Suspected of causing cancer³.</p> <p>Causes serious eye irritation. Causes skin irritation. May cause respiratory irritation.</p>
Suggested precautionary statements	<p>Avoid breathing dust/fume/gas/mist/vapours/spray.</p> <p>Wear protective gloves.</p> <p>In case of inadequate ventilation wear respiratory protection.</p> <p>IF INHALED: If breathing is difficult remove victim to fresh air and keep at rest in a position comfortable for breathing.</p> <p>If experiencing respiratory symptoms: Call a POISON CENTRE or doctor.</p>
Details	My Company, My Street, My Town, My State, 0000
Telephone	Tel: (99) 9999 9999



Health hazards

Exposure to isocyanates may potentially cause severe adverse health effects.

Workers who work with, or may work with isocyanates, must be warned about the risks of exposure and the potential health effects. They must also be advised of any health monitoring requirements.

INHALATION EFFECTS

Symptoms of inhaling isocyanates may include:

- irritation of the respiratory tract including the nose, mouth, throat and lungs—most isocyanates have a strong irritating effect on the respiratory tract

³ Some isocyanates are classifiable according to the GHS as Carcinogenicity Category 2 (suspected of causing cancer).

- difficulty in breathing
- tightness of the chest, coughing, wheezing and shortness of breath
- other asthma-like symptoms, and
- headache and discomfort.

If a worker develops respiratory symptoms consistent with isocyanate exposure, particularly wheezing, coughing or difficulty breathing, a medical practitioner should assess the relationship between symptoms and exposures. Depending on the severity, the worker may not be allowed further exposure to any amount of isocyanate.

Respiratory effects may be delayed resulting in symptoms occurring at night or several hours after working with isocyanates. It is important workers are informed of the potential for the delayed onset of adverse health effects. Workers should report adverse health effects which may be related to isocyanate exposure so hazard controls can be urgently reviewed. Workers with increased risk must undergo more frequent health monitoring.

SKIN AND EYE EFFECTS

Isocyanates are skin and eye irritants. Skin and eye contact with isocyanates can lead to blistering, swelling, reddening and skin irritation. Exposure of the skin to isocyanates over a longer period can lead to chronic skin conditions like dermatitis. Splashes to the eyes can cause chemical conjunctivitis.

SENSITISATION

Many isocyanates are potential respiratory sensitisers and some are skin sensitisers resulting in allergic dermatitis. This may not be limited to the point of contact, so the surrounding skin is also affected. It is thought respiratory problems can result from skin exposure.

People who develop sensitisation to isocyanates usually do so some time following their first exposure. This time period is highly variable. It can be several weeks or up to two years or more. In around 20 percent of cases it can be 10 years or more.

Once sensitised, a person's subsequent exposure to airborne concentrations well below the exposure standard can cause asthmatic reactions like chest tightness, wheezing, shortness of breath and airway narrowing. This can be life threatening if exposure continues.

Exposing sensitised workers to isocyanates may reduce their respiratory capacity immediately on exposure, some hours later or both. The high likelihood of chronic work-related asthma means preventing sensitisation is a high priority.

Exposure to higher concentrations from spills may increase the risk of sensitisation, and even a single high exposure event may lead to sensitisation.

Lower level chronic exposures may lead to sensitisation or a decline in lung function.

If a worker is diagnosed as sensitised they should be removed from potential exposure.

There is currently no screening test to identify individuals susceptible to respiratory sensitisation.

CARCINOGENICITY

Exposure to carcinogens should be eliminated or minimised to as low as reasonably practicable. The following isocyanates are classifiable according to the GHS as Carcinogenicity Category 2—suspected of causing cancer⁴:

- 4,4'-methylene diphenyl diisocyanate.
- 2,2'-methylene diphenyl diisocyanate.
- o-(p-isocyanatobenzyl) phenyl isocyanate.

4 European Union's Annex VI to Regulation (EC) No 1272/2008, updated by the 1st Adaption to Technical Progress to the Regulation. For more information search the [European Chemicals Agency database](#).

- Toluene-2,4-diisocyanate.
- Toluene-2,6-diisocyanate.

Physical hazards

With the exception of methyl isocyanate which has a low flash point of -7° C, most isocyanates have relatively high flash points (see Table 5) and generally present a low fire hazard.

Table 5 Examples of isocyanate compounds with high flash points

Name	Flash point °C ⁵
Toluene diisocyanate (TDI)	132 (2,4 isomer)
Methylene diphenyl diisocyanate (MDI)	196
Hexamethylene diisocyanate (HDI)	140
Napthalene diisocyanate (NDI)	155
Isophorone diisocyanate (IPDI)	155-161

However, there are situations where the fire hazard is increased when:

- isocyanates are present in a mixture with flammable solvents
- the exothermic heat reaction during foam manufacture is not properly controlled, and
- isocyanates are stored at elevated temperatures to prevent solidifying.

Steps should be taken to minimise the risk of fire or explosion. Isocyanates should not come into contact with an ignition source, for example open flames or electrical sparks.

Isocyanates decompose on heating producing toxic fumes which may contain nitrogen oxides, hydrogen cyanide and carbon monoxide. The polyurethanes, particularly the foams, may burn releasing diisocyanate vapour, hydrogen cyanide and large quantities of smoke.

Isocyanates may react with certain substances including alcohols, amines, strong oxidising agents and water. Where this reaction is not intended and potentially hazardous, this makes them incompatible. Always check the SDS for information on hazards, physical properties and incompatible substances. Suitable storage and segregation is required to minimise the likelihood of isocyanates inadvertently coming into contact with incompatible substances.

ASSESSING THE RISKS

Before starting any work using isocyanates a risk assessment should be carried out to determine the most reasonably practicable controls.

An assessment of the risks arising from the use, storage, handling or disposal of isocyanates in the workplace should consider how they are used or generated and the ways workers might be exposed. This includes considering potentially hazardous reactions of isocyanates with other substances or reactions that could generate isocyanates.

Exposure to isocyanates in the workplace commonly occurs through inhaling vapours, mists, aerosols or dusts. Isocyanates or breakdown products can also be absorbed through the skin or eyes.

The risk of exposure depends on the volatility of the compound, the application process and the duration and frequency of exposure. The most volatile isocyanates are those with low molecular weight like HDI and TDI used in spray painting and polyurethane foam manufacturing. Isocyanates like HDI and TDI are partially polymerised into pre-polymers so they are less volatile and contain less free isocyanate. However, aerosols of these partially polymerised isocyanates generated during spraying operations have the same health effects as the free isocyanates and pose the same health risks when sprayed.

5 International Labour Organization's (ILO) *Encyclopaedia of Occupational Health & Safety*.

Isocyanates may be heated during use and they may generate heat during reactions, both of which increase vaporisation. Spray painting also creates a mist of easily inhaled fine particles.

Dusts from solid forms of isocyanates not fully cured are also a hazard and should not be inhaled. Sanding polyurethane paint which has not fully cured can generate dusts containing un-reacted isocyanates.



Compliance with exposure standards and air monitoring

Workers must not be exposed to isocyanates at atmospheric concentrations greater than the workplace exposure standard for isocyanates (see Table 6).

Table 6 Workplace exposure standard for isocyanates

	8 hr TWA**, mg/m ³	STEL***, mg/m ³	Notices
Isocyanates, all*	0.02	0.07	Sensitiser

* The isocyanate fraction of the compound is measured.

** Time-weighted average measurement over 8 hours.

*** Short term exposure limit—time-weighted average measurement over 15 minutes.

Air monitoring may be required to ensure exposure standards are not exceeded. Atmospheric concentrations of isocyanates can be worked out by direct reading instruments and detection badges or more complex methods for aerosols of higher molecular weight monomers and pre-polymers.

If air monitoring demonstrates the exposure standard for isocyanates is being approached or has been exceeded, corrective action must be taken immediately to minimise exposure, so far as is reasonably practicable. If unsure how to go about measuring levels of airborne contaminants, seek advice from a competent person like an occupational hygienist.

Further information on complying with exposure standards and air monitoring requirements is in:

- *Workplace exposure standards for airborne contaminants, and*
- *Guidance on the interpretation of workplace exposure standards for airborne contaminants.*

Major hazard facilities

If above-the-threshold quantities of chemicals listed in Table 15.1 or Table 15.2 of the WHS Regulations are present in a facility, then that facility may be subject to licensing as a major hazard facility (MHF) under the WHS Regulations. For MIC the threshold quantity is 0.15 tonnes. For TDI it is 200 tonnes.

CONTROLLING THE RISKS



Hierarchy of controls

The WHS laws require a business or undertaking do all that is reasonably practicable to eliminate or minimise risks. The ways of controlling risks are ranked from the highest level of protection and reliability to the lowest. This ranking is known as the hierarchy of controls. You must work through this hierarchy to manage risks.

The first thing to consider is whether hazards can be completely removed from the workplace. If it is not reasonably practicable to completely eliminate the risk, then consider one or more of the following options in the order they appear below to minimise risks, so far as is reasonably practicable:

- Substitute the hazard for something safe.
- Isolate the hazard from people.
- Use engineering controls.

If after implementing the above control measures a risk still remains, consider the following controls in the order below to minimise the remaining risk, so far as is reasonably practicable:

- Use administrative controls.
- Use personal protective equipment (PPE).

A combination of the controls set out above may be used if a single control is not enough to minimise the risks.

You need to consider all possible control measures and make a decision about which are reasonably practicable for your workplace. Deciding what is reasonably practicable includes the availability and suitability of control measures, with a preference for using substitution, isolation or engineering controls to minimise risks before using administrative controls or PPE. Cost may also be relevant but you can only consider this after all other factors have been taken into account.

Manufacturing processes where isocyanates are used or produced should be designed so isocyanates are not released into the workplace atmosphere. Skin contact should also be minimised. A combination of control measures may be required in order to manage the risks associated with handling and using isocyanates.

Table 7 illustrates how the hierarchy of control may be applied, when eliminating exposure is not reasonably practicable.

Table 7 Examples of the application of the hierarchy of control

Approach	Examples
Substitution	<ul style="list-style-type: none"> ■ Using isocyanate-free single-pack paint instead of a two-pack paint containing isocyanates e.g. for rust protection. ■ Substituting isocyanates with a less hazardous alternative or using a less hazardous process e.g. using brushing instead of spraying or using high volume, low pressure (HVLP) spray guns instead of conventional spray guns that create large amounts of fine aerosol. ■ Using a polyurethane product that includes a fire retardant.
Isolation	<ul style="list-style-type: none"> ■ Isolating isocyanates from incompatible substances like alcohols, amines, acids, oxidising agents and water. ■ Enclosing totally or automating processes in which TDI or HDI is used and where other isocyanates are heated over 60° C or are sprayed. ■ Distancing other workers not involved with isocyanate work to minimise, so far as reasonably practicable, their exposure to isocyanates.
Engineering controls	<ul style="list-style-type: none"> ■ Automating handling and processing operations where isocyanates are used e.g. transferring and drying. ■ Using enclosures with a ventilation system e.g. fume cupboards, spray and downflow booths. ■ Using local exhaust or dilution ventilation.
Administrative controls	<ul style="list-style-type: none"> ■ Restricting access to areas where isocyanates are being used, processed or stored to authorised personnel only. ■ Limiting workers' time near isocyanates. ■ Providing workers with relevant information, training and instruction including information from SDS. ■ Placing prominent notices of action to be taken in case of an emergency in areas where isocyanates are used.
Personal protective equipment	<ul style="list-style-type: none"> ■ Wearing respiratory equipment e.g. supplied air (positive pressure) respirator. ■ Wearing chemical-resistant gloves, overalls, aprons and eye protection when handling isocyanates.

Ventilation systems

Care in the selection, design, installation, operation and training in the use of ventilation systems is essential to ensure these systems minimise airborne concentrations of isocyanates in the workplace. Common ventilation systems for controlling exposure to isocyanates are outlined below.

SPRAY BOOTHS

Spray booths offer an effective method of controlling exposure to isocyanates during spraying operations.

There are several types of systems available and an assessment for the correct type to suit each process is required. Safety information should be posted on the booth including the booth clearance time and warnings about flammable and toxic vapours.

Spray booths should be:

- designed and constructed in accordance with AS/NZS 4114.1: *Spray painting booths, designated spray painting areas and paint mixing rooms - Design, construction and testing*, and
- installed and maintained in accordance with AS/NZS 4114.2: *Spray painting booths, designated spray painting areas and paint mixing rooms - Installation and maintenance*.

Spray booths may not sufficiently protect the operator during spraying therefore respiratory protection may also be required. However, they do provide good containment, removal of vapour and mist post-spraying and protect other workers.

Information about the use of isocyanates in spray painting and ventilation systems is in the [Code of Practice: Spray painting and powder coating](#).

A checklist on hazardous substances related issues for spray painting is in [Hazardous Substances in Spray Painting](#) (Information Kit, Government of Western Australia, Department of Commerce).

LOCAL EXHAUST VENTILATION

Local exhaust ventilation systems capture isocyanate vapours and mists as close to the potential source of release as possible. Local exhaust ventilation should be fitted with a particulate filtration system to filter isocyanates. High efficiency filters should be used on exhaust outlets.

Local exhaust ventilation is essential where TDI or HDI is used or where isocyanate or polyurethane is sprayed if total enclosure of the process is not feasible. Local exhaust ventilation must have specifications on air flow and the air flow should be regularly checked.

DILUTION VENTILATION

Dilution ventilation systems dilute and displace contaminated air with fresh air supplied to the work area by mechanical exhaust fans or natural air currents through doors, windows or other openings in the building. This system can be used to supplement local exhaust ventilation. While dilution ventilation by itself is not sufficient in areas where isocyanates are used, it may be sufficient in storage areas.

DESIGN OF VENTILATION SYSTEMS

The design of effective ventilation systems is a highly skilled area of expertise and should only be done by those competent to do so.

Ventilation inlets and outlets should always be kept clear. Air from extraction exhausts should not be recirculated back into the work area or released close to air intakes or compressors supplying breathing air.

Regular planned preventative maintenance of ventilation systems is essential.

INFORMATION, INSTRUCTION, TRAINING AND SUPERVISION

Before isocyanates or products containing isocyanates are used in the workplace, workers must be provided with the information, training, instruction or supervision necessary to protect them and others from the risks associated with isocyanates in the workplace. This should cover:

- potential hazards and risks associated with working with isocyanates
- the hazard controls for safe use, handling and storage of isocyanates
- the operation and maintenance of engineering control measures including regular testing of ventilation and emergency systems
- safe procedures for handling chemical containers using forklifts and other mobile plant
- the proper use and maintenance of PPE
- emergency procedures at the workplace e.g. procedures to be followed in case of fire, spill or leak
- the potential health impacts and symptoms and how to report these for action
- health monitoring procedures, and
- first aid procedures.

Training should be provided to workers by a competent person. Any information, training and instruction should be presented so it is easily understood by workers. This may mean information and training material is provided in different languages.

Workers should be supervised to ensure safety procedures are being followed, particularly if administrative control measures are being used to minimise risks.



Use of personal protective equipment

PPE is the lowest and least effective control measure in the hierarchy of control. PPE should only be provided to supplement other control measures where the risk of exposure has not been eliminated. Given the potentially significant risks isocyanates pose to workers, particularly in some work activities like spray painting, PPE should be used where a risk assessment shows isocyanate exposure may occur.

PPE should be chemically resistant to isocyanates. For example, thin latex gloves are not suitable for handling isocyanate-containing paints. Nitrile gloves of the same thickness provide more resistance to penetration. Normally, thicker gloves provide greater protection from skin exposure.

Further information on chemically resistant gloves is in AS/NZS 2161 (Set): *Occupational protective gloves*.

Full-face respirators should be used rather than half-face respirators as this minimises the area for potential skin and eye contact. If air-line respirators are used, positive pressure is required. Air quality should be checked regularly in accordance with AS/NZS 1715: *Selection, use and maintenance of respiratory protective equipment* (AS/NZS 1715).

There are some operations where minimising exposure to isocyanates by enclosure and ventilation is not reasonably practicable, for example during on-site mixing of paints, spray painting, foaming and maintenance of machine and ventilation systems. In these situations, air-line respirators or self-contained breathing apparatus complying with AS/NZS 1716: *Respiratory protective devices* should be used and maintained according to AS/NZS 1715.

Organic vapour respirators with particulate pre-filters and powered air-purifying respirators are not suitable when spraying isocyanates, as they do not provide adequate protection.

AS/NZS 1715 contains information about respiratory protection programs covering matters like facial fit testing and cleaning and testing of respirators.



Storage and managing incompatibility of isocyanates with other chemicals

The following controls should be used to eliminate or minimise risks, so far as is reasonably practicable, when storing isocyanates or polyurethane foams:

- Keeping the levels of isocyanates stored to a minimum.
- Storing isocyanates in banded areas. Incompatible material should not be stored in the same bund. Isocyanate pre-polymers may not need to be segregated from other chemicals because of their reduced reactivity. Always refer to the SDS to assess incompatibility issues.
- Ensuring storage areas are isolated as far as reasonably practicable from work areas where isocyanates are used e.g. stored on the surface of an underground mine when used underground.
- Ensuring chemicals not in use are returned to dedicated storage areas.
- Regular checks to ensure containers are not leaking, are tightly sealed and their labels are clearly visible and legible.
- Keeping storage areas moisture free and where reasonably practicable, covered. Drum covers should be used where the storage is not undercover to prevent water entry. Isocyanates react slowly with water to produce carbon dioxide which produces a risk of pressurisation in containers and a subsequent explosion hazard.
- Blanketing TDI with an inert gas like nitrogen or argon when stored in tanks. Transfer systems for isocyanates in bulk storage should be fully enclosed and pump or vacuum systems should be used for transferring the isocyanates.
- Ventilating buildings sufficiently to ensure the workplace exposure standard for isocyanates and other chemicals is not exceeded.
- Supplying areas where polyurethane foam products are stored with good ventilation because residual amounts of unreacted TDI or MDI may be present in the finished foam.
- Leaving sufficient space between foam blocks to allow heat to dissipate and reduce the risk of fire.
- Where isocyanates are stored at elevated temperatures to prevent solidifying—implementing adequate controls to prevent the temperature exceeding 30° C in the case of TDI. Precautions against fire should also be taken.
- Monitoring atmospheric contamination and temperature levels in storage areas.
- Ensuring flammable isocyanates are stored away from possible ignition sources.
- Limiting access to chemical storage areas to authorised workers only.



Decontamination and disposal of empty isocyanate containers

The location for decontamination and disposal of empty isocyanate containers should be selected so risks are minimised, so far as is reasonably practicable. For example, decontamination and disposal should take place at the surface of an underground mine and not in its underground workings. Decontamination should be carried out in a ventilated area using a liquid decontaminant and appropriate PPE should be worn.

Drums and containers which have contained isocyanates should not be re-used or discarded unless they have been completely decontaminated.

When decontaminating large containers, for example 200 litre drums, about five to 25 litres of decontaminant should be put into the drum and the walls thoroughly rinsed. This can be done by spraying the inside thoroughly with liquid decontaminant. The drum should then be left upright for at least 24 hours to ensure complete destruction of the residual isocyanate.

Do not seal the containers being decontaminated. This decontamination procedure generates carbon dioxide and could lead to pressurisation and an explosion hazard if it cannot escape. Disposal of spent materials should be in accordance with state, territory and local hazardous waste disposal procedures and environmental regulations.

Some suppliers may accept returns of containers for recycling.

DECONTAMINANTS FOR ISOCYANATES

Solid decontaminants can be used to absorb initial spills of isocyanates. They generally contain an absorbent material which soaks up the chemical and some pre-absorbed liquid decontaminant which destroys the isocyanate.

Liquid decontaminants can be used to decontaminate empty containers and to finish cleansing areas where spills have been absorbed onto solid decontaminants.

Transport

Information on the transport requirements for isocyanates is in the *Australian Code for the Transport of Dangerous Goods by Road and Rail*.



Reviewing risk control measures

Control measures should be checked regularly to ensure they are effective, taking into consideration any changes. For example, checking the airflow in ventilation systems or spray booths or checking filters in ventilation systems.

Common methods also include inspecting the workplace and consulting, testing and analysing records and data. Control measures must be reviewed and if necessary revised:

- when the control measure is no longer effective in controlling the risk
- before a change at the workplace that is likely to give rise to a new or different health and safety risk where the existing control measure may not effectively control the risk
- if a new hazard or risk is identified
- if health monitoring results indicate a review is necessary
- if the results of consultation indicate a review is necessary, or
- if a health and safety representative or worker requests a review.

The control measures must be reviewed at least once every five years. If a person conducting a business or undertaking has concerns they should go back through the risk management steps, review the information and make decisions about control measures.

RESPONDING IN AN EMERGENCY

Developing and implementing effective emergency procedures is critical to managing risks associated with isocyanates at the workplace. To be effective, emergency procedures must be up-to-date, implemented and provide information on:

- medical treatment of workers who may be exposed and suffer adverse health effects
- dealing with spills or losses of containment
- dealing with fires, and
- evacuation procedures.



Emergency response plan

An effective emergency plan for the workplace must be prepared and should include the following details:

- Names and contact details of workers who are appointed first aid officers at the workplace.
- Contact details of emergency services including the location of nearest medical facilities.
- Location of evacuation points where workers can go in an emergency.
- Emergency response actions to be taken if isocyanates are inadvertently released affecting the workplace, neighbouring businesses or residents.
- Procedures for inspecting and maintaining emergency equipment like fire extinguishers and maintaining the contents of first aid kits.



Spills and leaks

To ensure the correct remedial steps are taken quickly workers should be familiar with decontamination procedures if spills or leaks happen. This includes:

- immediate evacuation and ventilation of the affected area
- only permitting trained personnel equipped with appropriate PPE to deal with the spill
- keeping supplies of absorbent materials and decontaminants nearby to quickly deal with spillages or leaks, and
- neutralising spills or leaks by spreading solid decontaminant over the area. This should be left for at least 10 minutes and then collected and placed in a reserved bin that is kept outdoors. These bins must not be sealed as carbon dioxide will be released as the isocyanate reacts. The affected area should then be thoroughly washed with liquid decontaminant and rinsed well with water.

Contaminated clothing should be removed immediately and not re-worn until it is decontaminated. Refer to the SDS or supplier of the isocyanate product for information on the appropriate decontamination procedure. Clothing that is highly contaminated should be properly disposed of.



Fire

Fires involving isocyanates or polyurethane products are likely to produce toxic fumes.

Workers should be trained before attempting fire-fighting in these situations. Suitable fire-fighting and emergency equipment should be readily available for use.

If there is a fire where isocyanates are used or stored:

- Evacuate the area and call emergency services. Keep upwind to avoid inhaling smoke and fumes.
- Anyone entering the area must wear self-contained breathing apparatus and full protective clothing including boots.
- Use suitable fire-fighting equipment if trained, and it is safe to do so. Automatic extinguisher systems should be used to fight fires.



First aid

First aid facilities should comply with the [*Code of Practice: First aid in the workplace*](#) and should be suitable for the hazards in the workplace.

In workplaces where isocyanates are used an alternate supply of oxygen should be available for emergency use by trained personnel. Eye wash, shower facilities and other specific first aid items may also be needed.

Refer to the SDS or supplier of the isocyanate product for first aid information.

HEALTH MONITORING

Health monitoring can identify adverse health effects and provide information about whether a worker's absorbed dose of isocyanates is within acceptable levels. This allows decisions to be made about managing a worker's risk of exposure, for example reassigning to other duties involving less exposure to isocyanates or improving control measures.

Health monitoring must be provided to workers if there is a significant risk to their health because of exposure to isocyanates, for example a worker who regularly spray paints using an isocyanate paint.

Health monitoring must be done under the supervision of a medical practitioner with experience in health monitoring. The frequency of health monitoring should be determined by the medical practitioner.

A health monitoring program for a worker involved in an isocyanate process may involve:

- baseline health monitoring before the worker starts the work
- monitoring after six weeks exposure, then six monthly—however, where monitoring after 12 months shows no adverse health effects the medical practitioner may choose to carry out annual monitoring, and
- a final examination at the termination of the work.



Further information about health monitoring requirements is in:

- *[Health monitoring for exposure to hazardous chemicals - Guide for workers](#)*
- *[Health monitoring for exposure to hazardous chemicals - Guide for persons conducting a business or undertaking](#)*, and
- *[Health monitoring for exposure to hazardous chemicals - Guide for medical practitioners](#)*.



Further information

For further information see the [Safe Work Australia](http://www.swa.gov.au) website (www.swa.gov.au).