

## What are Isocyanates and Di-Isocyanates?

Isocyanates are a family of highly reactive, low molecular weight chemicals. They are widely used in the manufacture of flexible and rigid foams, fibres, coatings such as paints and varnishes, and elastomers, and are increasingly used in the automobile industry, autobody repair, and building insulation materials.



The most widely used compounds are di-isocyanates, which are most commonly used with compounds known as polyols in a reaction that creates polyurethanes. Among other uses, di-isocyanates can react with water to produce CO<sub>2</sub> and compounds known as amines.

All isocyanates can cause adverse health effects to include asthma, dermatitis, cancer and lung disease even at low concentrations, so it is important that they are handled, used, and disposed of safely.

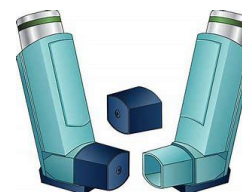
Almost all organisations use substances that could cause harm to you or others. Every year, thousands of workers are made ill by hazardous substances, and this doesn't just affect the person using or applying the substance. It can affect anyone in close proximity to the substance.

## How can these affect my Health?

Di-isocyanates can affect your health in a number of ways. They can cause:

- Irritation of the eyes, nose and throat.
- Dermatitis: a skin condition that can include redness, weeping, cracking, blistering and swelling
- Occupational Asthma: respiratory sensitisation often caused by inhalation,

Health effects can be short term (often referred to as an acute effect) such as coughing, difficulty breathing, tight chest, watering eyes or itching. They can also be long term (often referred to as a chronic effect) such as asthma. Those who suffer chronic effects may never fully recover and depending on the level of exposure, some symptoms may not occur until several hours after the exposure.



## Exposure to Di-Isocyanates

In order to manage exposure levels, it is important to understand how hazardous substances can enter the body. The main routes of entry are as follows:

- Inhalation: breathing in the substance.
- Ingestion: eating or swallowing the substance for example if you eat after handling chemicals but without washing your hands first.
- Skin contact: direct contact with the substance.
- Skin absorption: the substance is absorbed through the skin and into the bloodstream.
- Injection: puncture of the skin by a sharp object with a hazardous substance on it.
- Eye contact: splashes, vapours and mists entering the eye.

In some cases, for example when using chemicals in a manufacturing process, the substance you are using may be a hazardous chemical in pure form. In other cases, hazardous chemicals may be present as a component of a substance for example paints and inks may be composed of a number of chemicals.

## Occupational Exposure Limit Values

As set out in EH40 (2005) and also detailed in produce safety data sheets, are regulated maximum limits on the acceptable concentration of a hazardous substance in the air in a workplace.

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## Sensitisation

Sensitisation is an allergic response of the immune system to a substance which can arise from short term exposure to the substance above the established workplace exposure limits. Once sensitised, it is not normally possible to reverse the condition and could mean that you are unable to work with di-isocyanates again. **This is why it is really important that you complete this training and follow the guidelines and controls in the risk assessment.**

In the case of di-isocyanates, sensitisation may be induced through long term or repeated over exposure through inhalation (breathing in fumes from paint spraying) or by skin contact and further exposure can then trigger allergic symptoms such as occasional breathing difficulties.

## Odour

Odour should never be used as an indication of hazard. Whilst many substances have an odour, by the time the concentration of a substance in the air has reached a level that you can smell, it will already be above the safe exposure limit. Just because you can't smell anything, doesn't mean the hazardous substances aren't there. You should therefore never rely on odour as an indication of hazard.

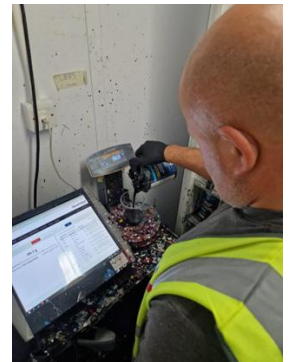
## Composition of Di-Isocyanates

The risk of exposure to di-isocyanates depends on a number of factors including:

- The physical properties of the substance (e.g how volatile the substance is).
- The amount of substance used.
- The concentration of di-isocyanates in the substance.
- How the substance is used.

## Volatility

Volatility tends to increase with temperature. The higher the volatility, the greater the potential for there to be hazardous levels of di-isocyanates in the air and therefore the greater the risk of inhalation. Very high levels can be present when aerosols are created and in use such as when spraying. Tasks that involve spraying or high temperature are therefore particularly high-risk activities.



## Viscosity

Viscosity is a measure of how easily a liquid flows, the higher the viscosity the thicker a liquid is and the greater the resistance to flow. Viscosity can affect how likely it is that a liquid will splash (e.g. when being poured, mixed, stirred etc.) or when being applied (e.g. by brush or roller).



## Controlling the Risk of Exposure

### Typical risks and control measures

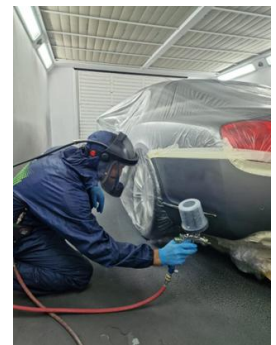
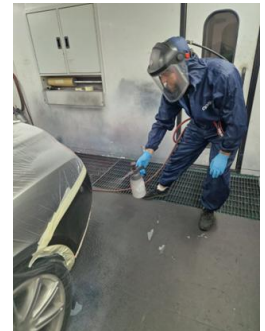
When handling open mixtures at ambient temperatures for example, open containers of adhesives, paints, sealants, mixing paints and two pack formulations include:

- Risk of spills when handling open containers leading to skin contact and splashes which may enter the eye.
- Risks of leakage leading to skin contact.

- Risks of inhalation when handling volatile substances.
- Refer to the safety data sheet for the substance and any other guidance for detailed information.
- Follow safety data sheet and work instructions.
- Wear gloves and suitable clothing when handling open containers.
- Good ventilation is required.
- Local exhaust ventilation recommended.
- RPE required if insufficient ventilation.
- Other PPE as appropriate to the activity (gloves, glasses, safety boots, coveralls etc).

## Risk and controls when performing application by brush, rolling, dipping and pouring etc. can include:

- Risks of splashing when applying by brush or roller leading to eye and skin contact
- Risks of dripping and splashing when applying by dipping and pouring leading to eye and skin contact.
- Risk of splashes when cleaning brushes, rollers, applicators etc. leading to skin contact, in some cases there is also a risk of inhaling aerosols.
- Risks of inhalation of open containers of volatile substances.
- Refer to the safety data sheet for the substance and any other guidance for detailed information.
- Follow safety data sheet and work instructions.
- Wear gloves and suitable clothing when handling open containers and applying substances.
- Good ventilation required.
- Local exhaust ventilation recommended.
- RPE required if insufficient ventilation.
- Other PPE as appropriate to the activity (gloves, glasses, safety boots, coveralls etc).



## Risks and controls associated with spraying in a ventilated booth include:

- High risk of inhalation when spraying.
- High risk of skin and eye contact with aerosol mists.
- Refer to the safety data sheet for the substance and any other guidance for detailed information.
- Follow safety data sheet and work instructions.
- RPE required for walk in spray booths, this will typically be air fed breathing apparatus.
- Tight fitting filtered face masks may be suitable for work in an open booth.
- Wear gloves and suitable clothing.
- Goggles or face masks to prevent eye contact.
- Full body covering for spraying in a walk-in booth.
- For walk in booths make sure you know the clearance time for the booth. Once spraying stops, the paint mist is diluted and displaced by the extract air and eventually removed. The time taken for mist removal

is known as the clearance time and will vary depending on the design and air movement. An up-to-date clearance time should be displayed at all entrances.

- Do not remove any aspect of PPE or RPE while in a spray booth. Do not lift visors of face masks.
- Make sure the extraction is running before spraying begins.
- Keep the extraction running for the whole of the clearance time after spraying.
- Do not enter a spray booth or spray room without RPE during the clearance time.
- Do not use the spray booth or room if negative pressure cannot be achieved. Positive pressure may indicate that the booth filter requires changing.

## Some examples of risks and controls when cleaning spray guns and paint mixing include:

- Risks of inhalation of open containers of volatile substances.
- Risks of inhalation and skin/eye contact during the cleaning or mixing process e.g from splashes or mists generated.
- Refer to the safety data sheet for the substance and any other guidance for detailed information.
- Follow safety data sheet and work instructions.
- Local exhaust ventilation recommended.
- RPE required if insufficient ventilation.
- Keep the lids on any drums, tins, bins etc. to help prevent the release of fumes and spillage of chemicals.
- Only mix chemicals if you are sure how they will react.
- Where possible, use a proprietary pain mixing system as this will help to minimise wastage and minimise vapour given off during mixing.
- For gun cleaning, spray to dry in the spray booth or room whilst wearing RPE.
- Local exhaust ventilation is required for gun cleaning machines that create mist.
- Where possible perform gun cleaning in a sealed, correctly ventilated machine.

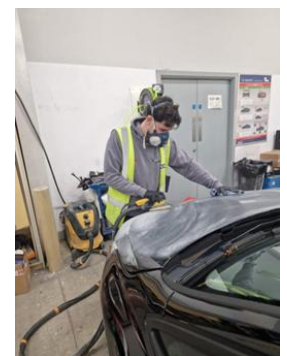
Measures should be taken to control the risk of exposure. These include:

### Personal Hygiene

- Wash your hands after work and before eating, drinking, and smoking.
- Use hand cream to protect your skin against drying.
- Never use solvents to clean your skin.
- Change/remove contaminated clothing.
- Change clothing after working with hazardous substances and ensure that contaminated clothing is washed before being re-used.
- Keep your workplace clean and tidy.
- Never eat, drink, or smoke in the work area.
- To prevent items becoming contaminated, only bring those items into work that you need.

### Personal Protective Equipment

BCA has in place a number of measures to control exposure to hazardous substances. These can include substituting hazardous substances for less hazardous ones, engineering controls to enclose processes and work instructions to safely manage the use of substances.



Where it is not possible to eliminate risks by other measures then personal protective equipment (PPE) may be required. This should be a last resort as PPE only protects the wearer and not others in the vicinity.

Where PPE is required, it is important that you know the correct procedures for using, removing, maintaining the equipment and its limitations.

PPE to protect the skin typically involves clothing to protect the body and gloves to protect the arms.

Typically, clothing will have long sleeves to protect the arms and will either be single use or will need to be washed regularly, including when contaminated. In some situations, clothing will need quick release fastenings to enable quick removal in the event of an emergency.

It is important that protective clothing is removed with care to avoid contaminating the wearer.



Gloves should be suitable for the type of chemical being used. Guidance for the appropriate type of glove for a substance can be found in the safety data sheet for the substance and any specific workplace instructions. Chemical resistant gloves e.g nitrile or neoprene are usually required for handling di-isocyanates and will need to be long enough to cover the wrist. Latex gloves are not normally recommended as they can be permeable to certain substances and can cause an allergic reaction.

Before wearing gloves, you should check they are in good condition and are the right size.

Over time, chemicals can break through glove material, so it is important to regularly change gloves. The manufacturer or supplier should have information on breakthrough time, you should check this before use and make sure you don't use gloves for longer than the recommended period. Contaminated gloves should be changed immediately.



It is important that you know how to remove gloves safely without contaminating yourself and that you wash your hands after removing your gloves.

In the event of skin contact, the usual recommended response is to immediately remove contaminated clothing and thoroughly wash the affected area.

For some processes, an emergency shower procedure may be required. You should seek medical assistance if symptoms such as rashes develop.

Where there is a risk of chemicals contacting the eyes then eye protection should be worn. Options include safety spectacles, goggles, face screens, face shields and visors.

It is highly recommended that contact lenses are not worn as this can complicate treatment if chemicals don't enter the eye. Prescription eye protection or protection which fits over your normal glasses is preferred.

In the event of eye contact, the usual recommended response is to hold the affected eye open and flush for at least 15 minutes using water or an eye wash station, then seek medical assistance.

PPE to protect against inhalation risks is known as respiratory protective equipment or RPE. The two main types of RPE are:

Respirators which use filters to remove contaminants from the air being breathed in. They can be either:



- Non powered – which rely on the wearers breathing to draw air through the filter or ;
- Powered – which use a motor to draw air through the filter to give a supply of clean air.

Or

Breathing apparatus, which needs a supply of breathing quality air from an independent source (e.g an air cylinder or air compressor)

Respirators and breathing apparatus are available in a range of styles, dividing into two main groups:

## Tight fitting face pieces

Tight fitting face pieces (often referred to as masks) rely on having a good seal with the wearers face. These are available as both powered and non-powered respirators and breathing apparatus.

**A face fit test should be carried out to ensure the RPE can protect the wearer.**

Facial hair can break the seal between the mask and the skin allowing contaminated air to leak in, meaning that this type of RPE is not normally suitable for workers with beard s.

## Loose fitting face pieces

Loose fitting face pieces rely on enough clean air being provided to the wearer to prevent contaminant leaking in (only available as powered respirators or breathing apparatus). Examples include hoods, helmets, visors and suits.

Where RPE uses filters to remove contaminants from the air being breathed, it is made sure that the filters used are suitable for the type of chemical.

**It is important to note that filters will lose effectiveness over time, and so should be replaced regularly.**

Further information about the type of filter to be used and how frequently they should be changed, can be found in workplace instructions, suppliers' information and chemical information sheets.

In the event of inhaling di-isocyanate chemicals, the usual recommended response is to remove the affected person to fresh air and away from the source of exposure, then seek medical assistance.

PPE must be looked after and stored properly when not in use (for e.g in a clean, dry cupboard). Re-useable PPE must be cleaned after use and kept in good condition.

When maintaining PPE it is important that;

- The correct replacement parts that match the original equipment are available for example respirator filters.
- Replacement PPE is readily available in the event of loss, damage or faults.
- You know how to maintain any PPE provided and that it is your responsibility to look after it.

Further information about the type of PPE required and emergency and first aid response procedures can be found on the safety data sheet for the chemical. These safety data sheets also include an emergency telephone number where you can obtain further guidance when responding to incidents.

## Application Process

The level of risk also depends on the application process.



Processes where substances are fully contained in a dedicated closed system or activities such as handling finished items where di-isocyanate coatings have fully cured, present no risk of exposure in normal use. Processes such as applying paints or coatings by brush or roller, applying adhesives using an applicator, spraying in a ventilated booth, present a risk of exposure.

Other examples of processes where there is a risk of exposure include:

- Handling open mixtures
- Handling waste (e.g. empty containers).
- Cleaning (brushes, rollers, equipment etc.)
- Activities that include dipping and pouring.
- Applying adhesives and sealants in small packaging.
- Pressure injection application of resins.
- Mixing paints and two pack formulations.

In these cases, the risks typically arise from skin contact, splashes entering the eye and inhalation of aerosols created by spraying or fumes created by volatile substances which may contain unreacted di-isocyanates. Residual unreacted di-isocyanates can also be inhaled or come into contact with the skin when handling warm, freshly created or coated products where the chemicals have not yet fully cured. A higher risk of exposure exists when handling formulations at higher temperatures, spraying in areas with little ventilation, carrying out maintenance and repair work on processing systems etc.

## Ventilation

Good workplace ventilation can be a vital part of managing the risk of exposure to di-isocyanates through inhalation.

Local exhaust ventilation systems (LEV) are designed to reduce risks by carrying away harmful airborne contaminants such as dust, gas, vapour, fumes and mist.

It does this by drawing contaminated air through a system and either ventilating it in a safe location or passing it through filters to extract contaminants e.g. into dust bags.

Examples include, on tool extraction, fixed and moveable capture hoods, small and walk in booths.

Whatever type of system, you should aim to enclose the source as much as possible and limit the distance between the source and the extraction.

It is also important to:

- Ensure the system is suitable for its intended purpose.
- Ensure the system is switched on before use.
- Check the airflow before starting work and check this at regular intervals.
- Keep the air intake and surroundings clean.
- Carry out regular maintenance including changing filters at required intervals.
- Workrooms where di-isocyanates are used should also be well ventilated and the flow of air should move any contaminants away from the worker.



## Cleaning, Leakages and Maintenance

To ensure that it operates in a safe and efficient manner equipment will need to be regularly maintained and cleaned. This includes equipment for handling hazardous substances such as spray guns, brushes, rollers etc. and equipment for controlling risks such as PPE, RPE and ventilation systems. Anyone carrying out these works/task must be aware of the risks and control measures required to include use of PPE.

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Regulations set out requirements for the regular thorough examination and maintenance of certain types of equipment such as local exhaust ventilation systems. However, all equipment needs to be maintained in a safe and efficient manner, ensuring maintenance workers/providers are not exposed to risks.

When carrying out maintenance activities there can be a risk of skin contact with, or inhaling residual product which has not been cured which has been left in the system. The risk of inhalation may be higher if the maintenance process involves heating.

General maintenance controls will include:

- Making sure you are aware of the hazards and controls set out in the safety data sheets for relevant substances.
- Being aware of and following any specific maintenance instructions such as manufacturers guidance and work instructions
- Wearing gloves and suitable clothing to protect against skin contact.
- Wearing eye protection where there is a risk of splashing or eye contact e.g drips from above.
- Using local ventilation or respiratory protection where there is an inhalation risk.

BCA has a procedure in place in relation to spillages which must be read in conjunction with this training document. The spillage procedure highlights what equipment is provided, when it should be used and by whom and when to seek assistance from a third party such as GreenSpark or the Emergency Services. Repercussions of not dealing with a spillage or dealing with it ineffectively can be significant with BCA being liable for the cost of any clean up and significant fines levied for Environmental pollution.

For all spills, you must check what has been spilt, to make sure you are keeping yourself and others safe. Safety data sheets should be referred to as necessary. Waste should not be discharged into the environment in particular into water courses, drains or ground where surface water may be affected.

## Protection of Bystanders

Risks associated with hazardous substances don't just affect the person handling the substance but can also affect those around you including your colleagues, members of the public and others in the area.

It is important that these bystanders are aware of the risks and that controls are in place to control these risks. This could include wearing suitable PPE and taking steps to ensure unprotected persons are prevented from entering hazardous area.

## Behaviour Based Health & Safety

Adopting safe workplace behaviours can significantly reduce the risk associated with di-isocyanates.

- Make sure you are aware of the hazards and controls required for specific substances as set out in the safety data sheets
- Make sure you are aware of and follow the instructions for your workplace activities.
- Use your PPE for the purpose for which it was intended and keep it in good condition. Highlight any deficiencies to your line manager.
- Secure the lids of any drums and containers of hazardous substances when not in use and store them correctly with appropriate identification labels, away from direct sunlight and sources of ignition.

- Do not eat, drink, smoke etc. when using hazardous materials and ensure hands are washed thoroughly prior to consumption.
- Food/drink must be stored away from the work area where it could become contaminated.
- Do not use equipment which you find to be damaged or faulty but report to your supervisor or line manager who will remove the item(s) from service until repaired or replaced.
- Should you see any unsafe practices or behaviours, don't be afraid to highlight these to the operative concerned or to your supervisor/line manager. Unsafe practices and behaviours should be challenged to ensure the health and safety of everyone working in the area.

## Change Management & Continuous Improvement

Whenever there are changes in workplace activities, there is the potential for unintentional increase in the levels of risk.

It is important to ensure that any changes to process, equipment, material and/or chemicals are communicated to the workforce ensuring suitable and sufficient information, instruction, training, and supervision is provided to them.

All existing health and safety documentation and control measures are regularly reviewed in line with industry standards, manufacturer's instructions for use and operation, regulatory changes, and associated guidance notes.

## Health Surveillance

BCA operates a health surveillance programme. If requested by your employer as part of health surveillance programme, you should attend your appointment for skin checks, lung function testing and biological monitoring. Operatives are not permitted to "opt out" of health surveillance, it is a requirement under the COSHH (2002) regulations which are an extension of section 7 of the Health and Safety at Work Etc Act (1974) which requires all persons working or entering the premises to assist BCA in meeting its statutory obligations, as far as is reasonably practicable.



Having read this safety training document and participated in the toolbox talks which accompanies it, should you have any questions, concerns, or recommendations for improvement, please speak with your line manager or supervisor. Please remember, health and safety is everyone's responsibility, from both a legal and moral standpoint. BCA considers the health, safety and welfare of all its people of paramount importance and we strive to continually improve working practices and working processes.

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