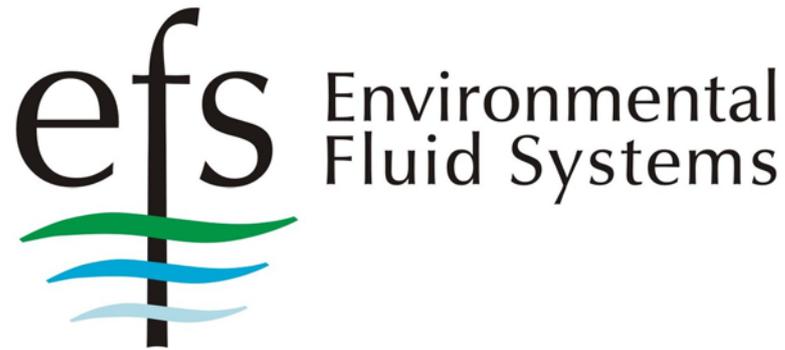


Company:**Project:**

Parts Cleaner Risk Assessment

Scope:

Comparative Assessment for Selected Parts Cleaner Products

Date of Review:19th January 2012**HAZTEK Ref:**

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Prepared by:Maurice Barnes
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HAZTEK Pty Ltd**Objective:**

To assess and compare the risks of exposure to selected parts cleaner products when cleaning materials.

TABLE OF CONTENTS		PAGE
Executive Summary		1
1 Introduction.....		5
2 Methodology		5
3 References.....		7
4 Background.....		9
5 Hazardous Substance Risk Assessment		9
5.1 Health Hazards.....		9
5.2 Exposure Routes		9
6 Health Hazards.....		10
6.1 Purasolve Parts Cleaner		10
6.2 Parts Cleaner (Solvent Naphtha).....		11
6.3 Parts Cleaner Kerosene		13
6.4 Parts Cleaner (2-Butoxyethanol).....		14
6.5 Parts Washers (Triethanolamine and Glycol Ethers).....		15
7 Risk Assessment		17
7.1 Hazard Identification.....		17
7.2 Consequence		19
7.3 Exposure Characterisation & Likelihood.....		19
7.4 Hazard / Risk Ranking		19
7.5 Risk Assessment Results.....		20
7.6 Risk Assessment Findings		21
8 Discussion		23
9 Recommendations / Conclusion		25
Annex A: Consequence Rating for Hazards		26
Annex B: Chemical Exposure Rating Descriptors.....		32
Annex C: Risk Assessment, Action Identification and Prioritisation.....		35

Appendix List

1. Risk Assessment - Purasolve Parts Cleaner
2. Risk Assessment - Naphtha Solvent Parts Cleaner
3. Risk Assessment - Kerosene Parts Cleaner
4. Risk Assessment - Ethylene Glycol Monobutyl Ether Parts Cleaner
5. Risk Assessment - Triethanolamine Parts Cleaner

EXECUTIVE SUMMARY

This report details risk analysis of exposure during parts cleaning of materials and a comparative assessment for selected parts cleaner products. Within the context of this assessment the following activities were assessed:

- Parts cleaning activities with Purasolve Parts Cleaner;
- Parts cleaning activities with Naphtha Solvent Parts Cleaner;
- Parts cleaning activities with Kerosene Parts Cleaner;
- Parts cleaning activities with Triethanolamine Parts Cleaner;
- Parts cleaning activities with Ethylene Glycol Mono Butyl Ether (EGBE) Parts Cleaner.

The assessment was conducted following the guidelines outlined in the Australian Institute of Occupational Hygienists, Simplified Occupational Hygiene Risk Management Strategies.

Parts cleaners are typically used in maintenance and repair workshops to remove grease or oil from engineering components. Parts cleaners are mostly solvent based formulations. The parts to be cleaned are immersed and soaked in the solution for the required time, usually a few hours, to remove or loosen grease and oil. Most parts washers incorporate a pump and hose to assist in grease and oil removal.

Exposure to parts cleaner can occur when removing grease and oil using the pump and hose or when manually scrubbing the parts. Exposure can also occur during the decanting process.

The assessment showed that with the same level of control measures the exposure risk would be significantly lower with Purasolve Parts Cleaner compared to commonly available solvent parts cleaner products including; Solvent Naphtha Parts Cleaners, Kerosene Parts Cleaners, Ethylene Glycol Monobutyl Ether (EGBE) Parts Cleaners and Triethanolamine Parts Cleaners.

ERS Parts Cleaners is a Solvent Naphtha Parts Cleaner, the solvent Naphtha is not Hydrotreated. The active ingredients listed on the MSDSs are Solvent Naphtha (petroleum), heavy aliphatic at 100% (MSDS 2008). The mixture consists of three major groups: paraffins (30-50%), cycloalkanes (30-40%) and aromatic hydrocarbons (10-20%) (ATSDR 1995, ATSDR 1999).

Within the aromatic hydrocarbon group, there are several substances that are known to be toxic, including substituted benzenes, naphthalenes, and substituted toluenes. The contributions of benzenes, naphthalenes, and toluenes are slight since each contributes less than 1% of the total composition of the solvent mixture. However, the toxicity of the mixture is not governed by any single component. The toxicity of the mixture depends on the interactions of all the components. Some components, when found together, may act additively or synergistically to enhance toxic effects. It cannot always be predicted how a mixture will behave based on the toxicity of its individual components (ATSDR 1995, ATSDR 1999).

Solvent Naphtha is a skin, eye and throat irritant. Inhalation of high concentrations may cause central nervous effects characterized by headache and dizziness, nausea, loss of consciousness and some neurobehavioral disorders. Solvent Naphtha causes respiratory tract irritation and affects the

sense organs. Repeated high exposures may affect the blood, kidneys, nervous system and liver (ATSDR 1995, ATSDR 1999).

Kerosene is a skin and eye and throat irritant. Inhalation of high concentrations may cause central nervous effects characterized by headache and dizziness and nausea. The low vapour pressure of the kerosene and the moderately high average molecular weight produce low volatility not sufficient to produce an inhalation risk except under circumstances of elevated temperatures, misting or confined space entry (ACGIH 2003a)

The Simple Green All Purpose Cleaners contains ethylene glycol monobutyl ether (EGBE), water and additives. EGBE Parts Cleaner products commonly contain a 4 to 6 % solution of EGBE (MSDS 2011a, MSDS 2011b). EGBE is a moderate eye, skin and respiratory irritant. Absorption through the skin may be a significant source of exposure. EGBE may damage the foetus at high concentration and may damage the male reproductive system at moderate concentrations (NICNAS 1996).

The Simple Green Parts Washer contains Triethanolamine and Propylene glycol n-butyl ether. Triethanolamine Parts Cleaner products commonly contain an 11 % solution of Triethanolamine (MSDS 2010). Triethanolamine is a moderate skin irritant, which may cause sensitization or an allergic skin reaction in some individuals. Triethanolamine may affect the kidneys, liver and nerve fibres (OECD 2004).

The toxicity of these solvents requires that safe work procedures and adequate supervision are provided to ensure control measures are maintained.

The Solvent Naphtha in Pursolve Parts Cleaner is Hydrotreated. Pursolve Parts Cleaner contains a 60 % solution of Hydrotreated Solvent Naphtha (MSDS 2011c). Hydrotreated is a process in which the Aromatics are converted into Naphthenes and a product is obtained consisting of 50% Paraffins and 50% Naphthenes. These are called De-Aromatised or Low-Aromatic Solvents (ATSDR 1995, ATSDR 1999).

Pursolve Parts Cleaner is a slight skin, eye and throat irritant. Inhalation of high concentrations may cause central nervous effects characterized by headache and dizziness and nausea. The low vapour pressure of the Hydrotreated Solvent Naphtha and the moderately high average molecular weight produce low volatility not sufficient to produce an inhalation risk except under circumstances of elevated temperatures, misting or confined space entry (ACGIH 2003). As with all solvents skin and eye contact should be avoided and the use of eye protection and gloves is recommended.

The assessment found that with the same level of control measures the exposure risk would be significantly lower with Purasolve Parts Cleaner compared to commonly available solvents parts cleaner products. Detailed hazard identification and risk assessment are provided within the report.

A summary of risk findings is provided in table 1 to 5.

Table 1. Purasolve Parts Cleaner

Route	Consequence	Likelihood	Health Risk
Eye Contact	Moderate	Unlikely	Medium
Dermal Contact	Minor	Unlikely	Low
Inhalation	Minor	Unlikely	Low

Table 2. Naphtha Solvent Based Parts Cleaner

Route	Consequence	Likelihood	Health Risk
Eye Contact	Major	Unlikely	Medium
Dermal Contact	Major	Unlikely	Medium
Inhalation	Major	Unlikely	Medium

Table 3. Kerosene Based Parts Cleaner

Route	Consequence	Likelihood	Health Risk
Eye Contact	Moderate	Unlikely	Medium
Dermal Contact	Moderate	Unlikely	Medium
Inhalation	Minor	Unlikely	Low

Table 4. EGBE Based Parts Cleaner

Route	Consequence	Likelihood	Health Risk
Eye Contact	Moderate	Unlikely	Medium
Dermal Contact	Moderate	Unlikely	Medium
Inhalation	Moderate	Unlikely	Medium

Table 5. Triethanolamine Based Parts Cleaner

Route	Consequence	Likelihood	Health Risk
Eye Contact	Moderate	Unlikely	Medium
Dermal Contact	Moderate	Unlikely	Medium
Inhalation	Moderate	Unlikely	Medium

Work Health and Safety Legislation requires that the hierarchy of control be applied when selecting control measures. Substitution, replacing with something less harmful, should be considered in all situations as a risk reduction method. Reliance on safe work procedures and Personal Protective Equipment (PPE) has been shown to be unreliable.

The assessment found that a significant risk reduction would be achieved through the substitution of commonly available Parts Cleaners with Purasolve Parts Cleaner. This substitution would also reduce the requirements for detailed safe work procedures and supervision.

1 INTRODUCTION

This report details risk analysis of exposure during parts cleaning activities and a comparative assessment for selected parts cleaner products. Within the context of this assessment the following activities were assessed:

- Parts cleaning activities with Purasolve Parts Cleaner;
- Parts cleaning activities with Naphtha Solvent Parts Cleaner;
- Parts cleaning activities with Kerosene Parts Cleaner;
- Parts cleaning activities with Triethanolamine Parts Cleaner;
- Parts cleaning activities with Ethylene Glycol Mono Butyl Ether (EGBE) Parts Cleaner.

The aims of this risk assessment were to:

1. Identify chemical hazards from selected parts cleaner products;
2. Analyse the risk in terms of consequence and likelihood;
3. Provide a comparative assessment of selected parts cleaner products;
4. Provide suggested risk treatments for dealing with assessed risks.

2 METHODOLOGY

The principles of AS/NZS 4360 were applied using the Australian Institute of Occupational Hygienists, Simplified Occupational Hygiene Risk Management Strategies. The risks were assessed on the principle of what was reasonably foreseeable, refer figure 1 for summary of risk assessment process.

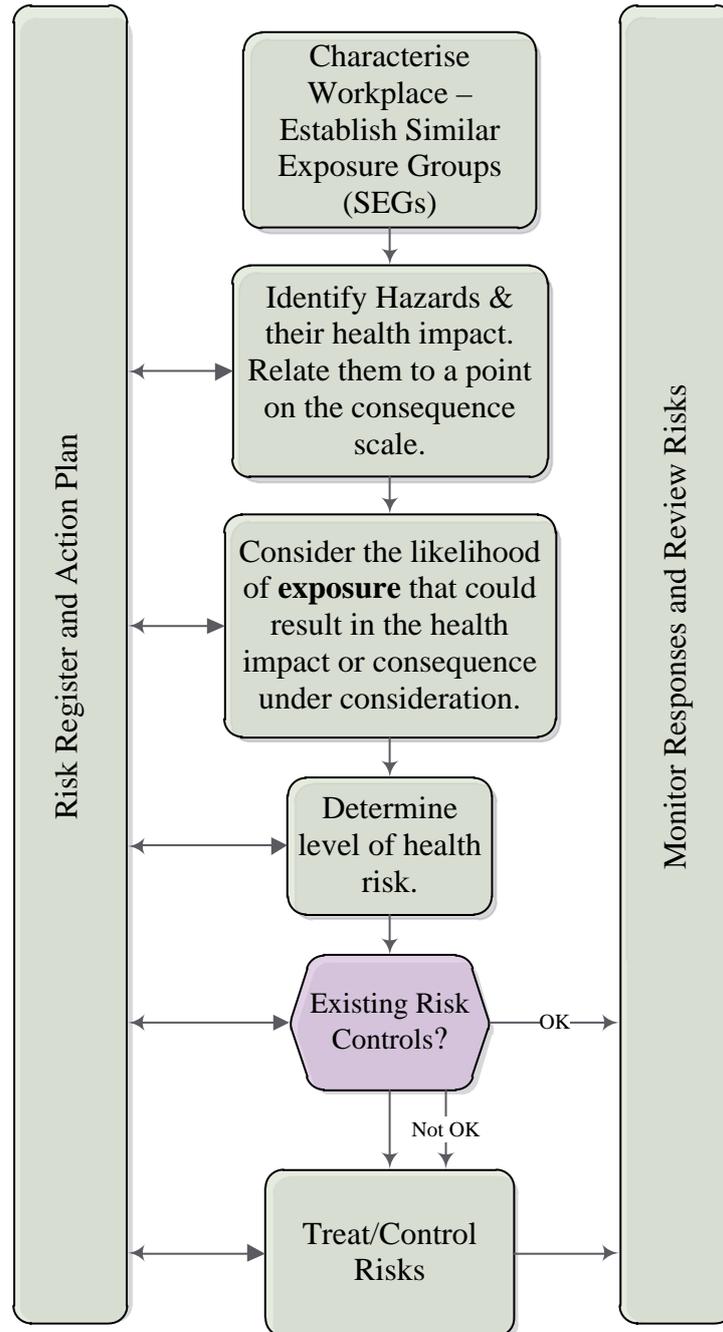
Information from the following sources were used as the primary source of data:

- A review of the assessment reports and toxicological information on selected products;
- A review of parts cleaning work practices and discussions with the representative personnel, including; processes, equipment, materials use, physical environment, products / by-products, etc;
- The hours of work and frequency of exposure e.g. Hours of work greater than an 8 hour day, 5 day week (40 hour week) and range of tasks, both routine and occasional.

In undertaking this assessment the author makes the following concessions:

- The review includes assumptions regarding exposure frequency and implemented work practices. These assumptions are based on typical work schedules and recommended safe work procedures for the selected products. This assessment may not be applicable for all work schedules and practices.

Figure 1: Risk Management Process Schematic (adapted from AS/NZS 4360)*



* **Note:** Australian Institute of Occupational Hygienists, Simplified Occupational Hygiene Risk Management Strategies Guidelines.

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(IARC 1989a) International Agency for Research on Cancer (IARC), Monograph 45, Kerosene, 1989.

(MSDS 2011a) Simple Green, Crystal Simple Green, CIPL Pty Ltd, 2011.

- (MSDS 2011b) Simple Green, Simple Green All Purpose Cleaner, CIPL Pty Ltd, 2011.
- (MSDS 2011c) Environmental Fluid Systems, Purasolve Parts Cleaner, EFS 2011.
- MSDS 2010) Simple Green, Simple Green Parts Washer, CIPL Pty Ltd, 2010.
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- (NICNAS 1996) National Industrial Chemicals Notification and Assessment Scheme (NICNAS), 2-Butoxyethanol, Priority Existing Chemical Number 6, 1996
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- (Qld 2011b) Queensland Work Health and Safety Act 2011 (Qld 2011b).

4 BACKGROUND

Parts cleaners are typically used in maintenance and repair workshops to remove grease or oil from engineering components. Parts cleaners are mostly solvent based formulations. The parts to be cleaned are immersed and soaked in the solution for the required time, usually a few hours, to remove or loosen grease and oil. Most parts washers incorporate a pump and hose to assist in grease and oil removal.

Exposure to the parts cleaner can occur during the decanting process. Exposure can also occur when removing grease and oil using the pump and hose or when manually scrubbing the parts.

5 HAZARDOUS SUBSTANCE RISK ASSESSMENT

Hazardous Substances are regulated through the Queensland Work Health and Safety Regulation 2011 Chapter 7 Hazardous Chemicals (Qld 2011a), the regulations are enforceable under the Work Health and Safety Act 2011 (Qld 2011b). The regulations require risk assessments, appropriate to the complexity of the risks, to be conducted for hazardous substances. The Australian Institute of Occupational Hygienist developed the Simplified Occupational Hygiene Risk Management Strategies Guidelines to assist industry in meeting their requirements to identify, assess and control risk arising from workplace exposures (AIOH 2006).

5.1 HEALTH HAZARDS

When considering the hazards associated with any workplace, it is essential to understand the relationship between 'hazard' and 'risk'. 'Hazard' is the potential for an agent or process to do harm. 'Risk' is the likelihood that an agent will produce injury or disease under specified conditions.

Health effects can occur only if a worker is actually exposed to the hazard. The risk of injury or disease usually increases with the duration and frequency of exposure to the agent, and the intensity/concentration and toxicity of the agent. Toxicity refers to the capacity of an agent to produce disease or injury. The evaluation of toxicity takes into account the route of exposure and the actual concentration of an agent in the body.

5.2 EXPOSURE ROUTES

The harmful effects of these chemicals follow inhalation of vapour, eye and skin contact with liquid or vapour, or ingestion, which are described below:

- Inhalation is usually the most significant route of entry by which vapours enter the human body at work.
- Absorption can occur through the skin or cause damage to the skin itself.
- Ingestion is of relatively minor significance in occupational exposure.

Toxic atmospheric contaminants may have local effects if they harm only the part of the body they come in contact with, or systemic effects causing changes to the function of other organs.

6 HEALTH HAZARDS

6.1 PURASOLVE PARTS CLEANER

The ingredients listed on the MSDS for Purasolve Parts Cleaner are Naphtha (Petroleum), Hydrotreated Heavy and Water. Naphtha (Petroleum), Hydrotreated Heavy is listed in the MSDS at > 60%. Water is list at < 40% (MSDS 2011c).

Solvent Naphtha (petroleum), heavy aliphatic is a mixture of numerous hydrocarbons derived by refining crude oil. It is a petroleum distillate with a boiling range of 154-254°C and a flashpoint of 61-78°C. The Solvent Naphtha in Pursolve Parts Cleaner is Hydrotreated. Hydrotreated is a process in which the Aromatics are converted into Naphthenes and one obtains a product consisting of 50% Paraffins and 50% Naphthenes. These are called De-Aromatised or Low-Aromatic Solvents (ATSDR 1995, ATSDR 1999).

Purasolve Parts Cleaner is a slight skin and eye and throat irritant. Inhalation of high concentrations may cause central nervous effects characterized by headache and dizziness and nausea. The low vapour pressure of the Hydrotreated Naphtha and the moderately high average molecular weight produce low volatility not sufficient to produce an inhalation risk except under circumstances of elevated temperatures, misting or confined space entry (ACGIH 2003).

In experimental animals, samples of petroleum solvents with a high aromatic content had greater acute toxicity and were more irritating than those that were virtually aromatic-free (IARC 1989). Hydrotreated solvents have the more toxic aromatic hydrocarbons removed, and are recommended as substitutes for regular solvents.

Safework Australia has not assigned Naphtha Solvent an exposure standard (HSIS 2011). ACGIH have not assigned an exposure standard to Naphtha Solvent (ACGIH 2011)

There are no existing guidelines concerning potential carcinogenicity that specifically pertain to Solvent Naphtha.

There are no existing guidelines concerning potential reproductive, developmental or genotoxic that specifically pertain to Solvent Naphtha.

6.2 PARTS CLEANER (SOLVENT NAPHTHA)

ERS Parts Cleaners is a Solvent Naphtha Parts Cleaner. The active ingredients listed on the MSDSs are Solvent Naphtha (petroleum), heavy aliphatic at 100% (MSDS 2008).

Solvent Naphtha (petroleum), heavy aliphatic is a mixture of numerous hydrocarbons derived by refining crude oil. It is a petroleum distillate with a boiling range of 154-254°C and a flashpoint of 61-78°C (ATSDR 1995, ATSDR 1999).

The mixture consists of three major groups: linear and branched alkanes, also known as paraffins (30-50% of the total mixture); cycloalkanes, also called cycloparaffins or naphthenes (not to be confused with naphthalenes which are bicyclic aromatics) (30-40%), and aromatic hydrocarbons (10-20%). A straight-run product of this kind is termed aliphatic, because it mainly consists of aliphatic (saturated) hydrocarbons (ATSDR 1995, ATSDR 1999).

Aliphatic hydrocarbons, also called petroleum distillates, tend to be less toxic than most other solvents. They have a mild narcotic effect and can cause lung irritation in large amounts. If ingested, they may cause pulmonary edema (chemical pneumonia) and possible death due to aspiration into the lungs. Petroleum distillates are also skin irritants (ATSDR 1995, ATSDR 1999).

Within the aromatic hydrocarbon group, there are several substances that are known to be toxic, including substituted benzenes, naphthalenes, and substituted toluenes. The contributions of benzenes, naphthalenes, and toluenes are slight since each contributes less than 1% of the total composition of the solvent mixture. However, the toxicity of the mixture is not governed by any single component. The toxicity of the mixture depends on the interactions of all the components. Some components, when found together, may act additively or synergistically to enhance toxic effects. It cannot always be predicted how a mixture will behave based on the toxicity of its individual components. However, the toxic characteristics of the individual components may be an indicator of the potential toxicological responses of the mixture (ATSDR 1995, ATSDR 1999).

Solvent Naphtha is a skin and eye and throat irritant. Inhalation of high concentrations may cause central nervous effects characterized by headache and dizziness, nausea, loss of consciousness and some neurobehavioral disorders. Solvent Naphtha causes respiratory tract irritation and affects the sense organs. Repeated high exposures may affect the blood, kidneys, nervous system and liver (ATSDR 1995, ATSDR 1999).

Safework Australia has not assigned Naphtha Solvent an exposure standard (HSIS 2011). ACGIH have not assigned an exposure standard to Naphtha Solvent (ACGIH 2011). The ERS Parts Cleaners MSDS refers to the NIOSH USA exposure standard of 100 ppm for kerosene. The ACGIH have assigned an exposure standard of 200 mg/m³, total hydrocarbon vapour to Hydrotreated Kerosene. The applicability of these exposure standards is questionable as hydrotreated solvents have the high risk aromatics converted to naphthenes which are of a lesser health risk.

There are no existing national guidelines concerning potential carcinogenicity that specifically pertain to Solvent Naphtha. The International Agency for Research on Cancer (IARC) has determined that some petroleum distillates are probably carcinogenic to humans for occupational exposure in petroleum refining (IARC 1989); however, petroleum solvents as a group have not yet been evaluated.

There are no existing guidelines concerning potential reproductive, developmental or genotoxic that specifically pertain to Solvent Naphtha. Many aromatics are suspected of being reprotoxic, teratogenic or mutagenic in humans.

6.3 PARTS CLEANER KEROSENE

Kerosene is commonly used as a parts cleaner due to its low cost and ease of availability. Kerosene is also known as paraffin oil and fuel oil no. 1. Kerosene is a mixture of numerous hydrocarbons derived by refining crude oil. It is a petroleum distillate with a boiling range of 177-329°C and a flashpoint of 38-52°C (ATSDR 1995a).

Straight run kerosene, consists of hydrocarbons mostly in the C10-C16 to range. It consists of a complex mixture of aliphatic and aromatics hydrocarbons. Aliphatic alkanes (paraffins) and cycloalkanes (naphthenes) are hydrogen saturated and constitute the major part of kerosene. Aromatics comprise 20 – 25% of the mixture (ATSDR 1995a).

Kerosene is a skin and eye and throat irritant. Inhalation of high concentrations may cause central nervous effects characterized by headache and dizziness and nausea. The low vapour pressure of the kerosene and the moderately high average molecular weight produce low volatility not sufficient to produce an inhalation risk except under circumstances of elevated temperatures, misting or confined space entry (ACGIH 2003a).

Safework Australia has not assigned kerosene an exposure standard (HSIS 2011). The ACGIH have assigned an exposure standard of 200 mg/m³, total hydrocarbon vapour to Hydrotreated Kerosene (ACGIH 2003a).

IARC have classified kerosene as Group 3 ‘not classifiable as to carcinogenicity in humans’ (IARC 1989a)

Kerosene does not have a measureable effect on human reproduction or development (ACGIH 2003a).

6.4 PARTS CLEANER (2-BUTOXYETHANOL)

2-Butoxyethanol parts cleaner products include Simple Green Crystal Simple Green and Simple Green All Purpose Cleaner. The ingredients listed on the MSDSs are ethylene glycol monobutyl ether (EGBE), water and additives. EGBE Parts Cleaner products commonly contain a 4 to 6 % solution of EGBE (MSDS 2011a, MSDS 2011b).

Ethylene Glycol Mono Butyl Ether (EGBE) is commonly referred to as 2-Butoxyethanol or Butyl Cellosolve. 2-Butoxyethanol is a colourless liquid with a mild ethereal odour. The major routes of exposure to 2-Butoxyethanol are to vapours or skin contact. 2-Butoxyethanol is irritating to the skin, at high exposures head, nausea and vomiting may occur. The health effects are considered reversible (NICNAS 1996).

According to the Safework Australia criteria EGBE is listed as a hazardous substance. Safework Australia has assigned 2-Butoxyethanol an 8h-TWA limit of 20 ppm and a 15 minute STEL of 50 ppm to protect workers from upper respiratory tract, eye and skin irritation (HSIS 2011). A skin notation has been assigned to 2-Butoxyethanol for 'Absorption through the skin may be a significant source of exposure' (NICNAS 1996).

Safework Australia (HSIS) has assigned the following risk phrase classifications to a < 25% concentration of 2-Butoxyethanol to minimise the potential for irritant effects:

- R36: Irritating to eyes;
- R38: Irritating to skin.

The European Commission (EC 2008) has assigned the following hazard statements to 2-Butoxyethanol:

- H332: Harmful if inhaled;
- H312: Harmful in contact with skin;
- H302: Harmful if swallowed;
- H319: Causes serious eye irritation;
- H315: Causes skin irritation.

IARC have classified 2-Butoxyethanol as Group 3 'not classifiable as to carcinogenicity in humans' (IARC 2004). The ACGIH have classified 2-Butoxyethanol as A3 – confirmed animal carcinogen with unknown relevance to humans (ACGIH 2003).

Based on a number of reliable studies 2-Butoxyethanol is not severely reprotoxic, teratogenic or mutagenic in humans. At high exposures 2-Butoxyethanol may damage the foetus. There is limited evidence that 2-Butoxy Ethanol may damage the male reproductive system (including decreasing the sperm count) in animals and may affect female fertility in animals (OECD 2004).

6.5 PARTS WASHERS (TRIETHANOLAMINE AND GLYCOL ETHERS)

The ingredients listed on the MSDS for Simple Green Parts Washer are Triethanolamine, propylene glycol n-butyl ether, ethoxylated fatty alcohol, fatty alkyl cocoamide and water (MSDS 2010). Triethanolamine is listed in the Simple Green Parts Washer MSDS at < 11%. Propylene glycol n-butyl ether is listed at < 5%.

TRIETHANOLAMINE

Triethanolamine is a colourless to pale yellow viscous, hygroscopic liquid with a slight ammonia like odour. The most likely route of exposure is skin contact, with some potential for exposure by inhalation of vapour and mists. Triethanolamine is irritating to the eye and skin, prolonged or widespread contact may result in the absorption of potentially harmful amounts. Repeated overexposure may cause damage to the kidneys and liver. Skin contact may cause sensitization or an allergic skin reaction in a small proportion of individuals (ACGIH 2001).

According to the Safework Australia criteria Triethanolamine is listed as a hazardous substance. Safework Australia has assigned Triethanolamine an 8h-TWA limit of 5mg/m³ to minimise the potential for eye and skin irritation, contact dermatitis and injury to the kidneys, liver and nerve fibres (HSIS 2011). A skin sensitizer notation has been assigned to Triethanolamine.

Safework Australia (HSIS) has assigned the following risk phrase classifications to a < 25% concentration of Triethanolamine to minimise the potential for irritant effects:

- R36: Irritating to eyes;
- R38: Irritating to skin.

IARC have classified Triethanolamine as Group 3 ‘not classifiable as to carcinogenicity in humans’ (IARC 2000).

Based on a limited number of studies Triethanolamine is not mutagenic in humans. There is limited evidence that Triethanolamine may be genotoxic in animals (OECD 2004).

PROPYLENE GLYCOL N-BUTYL ETHER

Propylene glycol n-butyl ether is also commonly referred to as 1-Butoxy-2-Propanol or 3-butoxypropan-2-ol. Propylene glycol n-butyl ether is a colourless liquid with an ether odour. The most likely route of exposure is eye and skin contact, with some potential for exposure by inhalation of vapour and mists. Propylene glycol n-butyl ether is irritating to the skin, at high exposures head, nausea and vomiting may occur. The health effects are considered reversible (OECD 2003).

According to the Safework Australia criteria Propylene glycol n-butyl ether is listed as a hazardous substance. Safework Australia has assigned Propylene glycol n-butyl ether an 8h-TWA limit of 100 ppm and a STEL of 150 ppm to minimise the potential for eye and skin irritation (HSIS 2011). Propylene glycol n-butyl ether is not considered a skin sensitizer.

The European Commission (EC 2008) has assigned the following hazard statements to Propylene glycol n-butyl ether:

- H319: Causes serious eye irritation;
- H315: Causes skin irritation.

IARC have classified Propylene glycol n-butyl ether as Group 3 'not classifiable as to carcinogenicity in humans' (OECD 2003).

Based on a number of reliable studies Propylene glycol n-butyl ether is not reprotoxic, teratogenic or mutagenic in humans.

7 RISK ASSESSMENT

The processes involved in conducting risk assessments are to establish the context and hazard of the assessment then analyse these to identify the breakdown event. From this the risk assessment can be conducted using the formula ‘Risk = Consequence × Likelihood’ to determine the ‘Hazard Risk Ranking’. The Australian Institute of Occupational Hygienists, Simplified Occupational Hygiene Risk Management Strategies Guidelines was used to conduct the assessment. The guidelines are for use in the Australian work environment on how to meet the Australasian Safety and Compensation Council’s requirements for employers to identify, assess and control risks arising from workplace exposures.

Within the context of this assessment the following activities were assessed:

- Parts cleaning activities with Purasolve Parts Cleaner;
- Parts cleaning activities with Naphtha Solvent Parts Cleaner;
- Parts cleaning activities with Kerosene Parts Cleaner;
- Parts cleaning activities with Triethanolamine Parts Cleaner;
- Parts cleaning activities with Ethylene Glycol Mono Butyl Ether (EGBE) Parts Cleaner.

7.1 HAZARD IDENTIFICATION

The first step in the risk assessment process is to identify the hazards and relate them to a point on the consequence scale should the event being examined transpire. The Health Hazard Identification form as detailed in Appendix 1 to 5 was used to inventory identified hazards. A summary of the Health Hazard Identification is provided in tables 6 to 10.

Table 6. Purasolve Parts Cleaner

Product	Hazardous Ingredients	Percentage Composition	OES 8 hr TWA/15 min STEL/ other
Purasolve Parts Cleaner	Naphtha (Petroleum), Hydrotreated Heavy Water	> 60 %.	Not Specified
	Water	< 40 %.	Not Specified

Table 7. Naphtha Solvent Based Parts Cleaner

Product	Hazardous Ingredients	Percentage Composition	OES 8 hr TWA/15 min STEL/ other
ERS Parts Cleaning Fluid	Solvent Naphtha (petroleum), heavy aliphatic	100 %.	Not Specified

Table 8. Kerosene Based Parts Cleaner

Product	Hazardous Ingredients	Percentage Composition	OES 8 hr TWA/15 min STEL/ other
Kerosene	C2 Fuel Oil	> 100 %.	200 mg/m ³

Table 9. EGBE Based Parts Cleaner

Product	Hazardous Ingredients	Percentage Composition	OES 8 hr TWA/15 min STEL/ other
EGBE Parts Cleaner and Degreaser	Ethylene Glycol Monobutyl Ether (EGBE)	> 4- 6 %.	(Australia HSIS) 8h-TWA - 20 ppm 15 minute STEL - 50 ppm
	Water	> 80 %.	Not Specified
	Additives	< 10 %	Not Specified

Table 10. Triethanolamine Based Parts Cleaner

Product	Hazardous Ingredients	Percentage Composition	OES 8 hr TWA/15 min STEL/ other
Triethanolamine Parts Cleaner	Triethanolamine	< 11 %.	(Australia HSIS) 8h-TWA limit of 5mg/m ³
	Propylene glycol n-butyl ether	< 5 %.	(Australia HSIS) 8h-TWA - 100 ppm STEL - 150 ppm
	Water	> 60 %	Not Specified
	ethoxylated fatty alcohol	< 5 %	Not Specified
	fatty alkyl cocoamide	< 5 %	Not Specified

7.2 CONSEQUENCE

Having established the context and hazard, the next step in the risk assessment process is to determine the consequence for each hazard. Consequence was assessed as the potential outcome or impact of a hazard. The inherent capacity of a health hazard to cause harm (consequence) was assessed against the tables as detailed in the Consequence Rating for Hazards Annex A. Risk assessments are detailed at Appendix 1 to 5.

7.3 EXPOSURE CHARACTERISATION & LIKELIHOOD

Likelihood was determined as a product of the probability and frequency of exposure leading to the particular consequence that is associated with the hazard under consideration. In determining likelihood it is necessary to consider the exposure to a hazard and the probability that harm will occur following that exposure. Exposure was determined in terms of frequency, that is, how often or how long one is exposed, and the concentration, or the level, of the contaminant. Risk assessments are detailed at Appendix 1 to 5.

Annex B Chemical hazards table 1 was used when defining in-air exposure potential qualitatively based on the perceived concentration of exposure.

Annex B Chemical hazards table 4 was used when defining qualitative exposure for dermal exposure potential.

7.4 HAZARD / RISK RANKING

To enable risks to be graded against each other (prioritised) a uniform single process for describing the risk level is required. For the determination of risk levels the risk matrix is used, as detailed in the AIOH Simplified Occupational Hygiene Risk Management Strategies was used to determine relative (not absolute) risk, refer AIOH Simplified Occupational Hygiene Risk Management Strategies Guidelines Annex C table 1 and 2. The outcome of risk assessments will determine the action required; this will be implementation, information gathering, a combination of the two or no action. Generally the need for information gathering will be greater if the information that the risk assessment was based upon has a high degree of uncertainty, for example, if there is limited exposure data. A summary of risk ranking is detailed below.

7.5 RISK ASSESSMENT RESULTS

A summary of risk findings is provided at table 11 to 15. Hazard Identification and Risk Assessment are attached as appendix 1 & 5.

Table 11. Purasolve Parts Cleaner

Route	Consequence	Likelihood	Health Risk
Eye Contact	Moderate	Unlikely	Medium
Dermal Contact	Minor	Unlikely	Low
Inhalation	Minor	Unlikely	Low

Table 12. Naphtha Solvent Based Parts Cleaner

Route	Consequence	Likelihood	Health Risk
Eye Contact	Major	Unlikely	Medium
Dermal Contact	Major	Unlikely	Medium
Inhalation	Major	Unlikely	Medium

Table 13. Kerosene Based Parts Cleaner

Route	Consequence	Likelihood	Health Risk
Eye Contact	Moderate	Unlikely	Medium
Dermal Contact	Moderate	Unlikely	Medium
Inhalation	Minor	Unlikely	Low

Table 14. EGBE Based Parts Cleaner

Route	Consequence	Likelihood	Health Risk
Eye Contact	Moderate	Unlikely	Medium
Dermal Contact	Moderate	Unlikely	Medium
Inhalation	Moderate	Unlikely	Medium

Table 15. Triethanolamine Based Parts Cleaner

Route	Consequence	Likelihood	Health Risk
Eye Contact	Moderate	Unlikely	Medium
Dermal Contact	Moderate	Unlikely	Medium
Inhalation	Moderate	Unlikely	Medium

7.6 RISK ASSESSMENT FINDINGS

PARTS CLEANING USING PURASOLVE PARTS CLEANER

The eye contact risk was found to be **medium**; the risk was attributed to the potential for periodic incidental contact to a moderate eye irritant.

The dermal contact risk was found to be **low**; the risk was attributed to the potential for periodic incidental contact to a slight skin irritant.

The inhalation risk was found to be **low**; the risk was attributed to potential exposure to a low volatility slight respiratory irritant.

PARTS CLEANING USING NAPHTHA SOLVENT BASED PARTS CLEANER

The eye contact risk was found to be **medium**; the risk was attributed to the potential for periodic incidental contact to a moderate eye irritant.

The dermal contact risk was found to be **medium**; the risk was attributed to the potential for periodic incidental contact to a moderate skin irritant.

The inhalation risk was found to be **medium**; the risk was attributed to potential exposure to low to moderately volatile respiratory irritant, which may affect the blood, kidneys, nervous system and liver.

PARTS CLEANING USING KEROSENE PARTS CLEANER

The eye contact risk was found to be **medium**; the risk was attributed to the potential for periodic incidental contact to a moderate eye irritant.

The dermal contact risk was found to be **medium**; the risk was attributed to the potential for periodic incidental contact to a skin irritant.

The inhalation risk was found to be **low**; the risk was attributed to potential exposure to a low volatility respiratory irritant.

PARTS CLEANING USING EGBE BASED PARTS CLEANER

The eye contact risk was found to be **medium**; the risk was attributed to the potential for periodic incidental contact to a moderate eye irritant.

The dermal contact risk was found to be **medium** the risk was attributed to the potential for periodic incidental contact to a moderate skin irritant.

The inhalation risk was found to be **medium**; the risk was attributed to potential exposure to low volatility respiratory irritant, which may damage the foetus and high concentration and may damage the male reproductive system at moderate concentrations.

PARTS CLEANING USING TRIETHANOLAMINE BASED PARTS CLEANER

The eye contact risk was found to be **medium**; the risk was attributed to the potential for periodic incidental contact to a moderate eye irritant

The dermal contact risk was found to be **medium**; the risk was attributed to the potential for periodic incidental contact to a moderate skin irritant, which may cause sensitization or an allergic skin reaction in some individuals.

The inhalation risk was found to be **medium**; the risk was attributed to potential exposure to low volatile respiratory irritant, which may affect the kidneys, liver and nerve fibres.

8 DISCUSSION

Work Health and Safety Legislation requires that the hierarchy of control be applied when selecting control measures. Substitution, replacing with something less harmful, should be considered in all situations as a risk reduction method.

Parts cleaners are typically used in maintenance and repair workshops to remove grease or oil from engineering components. Parts cleaners are mostly solvent based formulations. The parts to be cleaned are immersed and soaked in the solution for the required time, usually a few hours, to remove or loosen grease and oil. Most parts washers incorporate a pump and hose to assist in grease and oil removal.

Exposure to the concentrated parts cleaner can occur during the decanting process. Exposure can also occur when removing grease and oil using the pump and hose or when manually scrubbing the parts.

The assessment showed that with the same level of control measures the exposure risk would be significantly lower with Purasolve Parts Cleaner compared to commonly available solvent parts cleaner products.

ERS Parts Cleaner is a Solvent Naphtha Parts Cleaner, the solvent Naphtha is not Hydrotreated. The mixture consists of three major groups: paraffins (30-50%), cycloalkanes (30-40%) and aromatic hydrocarbons (10-20%) (ATSDR 1995, ATSDR 1999).

Within the aromatic hydrocarbon group, there are several substances that are known to be toxic, including substituted benzenes, naphthalenes, and substituted toluenes. The contributions of benzenes, naphthalenes, and toluenes are slight since each contributes less than 1% of the total composition of the solvent mixture. However, the toxicity of the mixture is not governed by any single component. The toxicity of the mixture depends on the interactions of all the components. Some components, when found together, may act additively or synergistically to enhance toxic effects. It cannot always be predicted how a mixture will behave based on the toxicity of its individual components. However, the toxic characteristics of the individual components may be an indicator of the potential toxicological responses of the mixture (ATSDR 1995, ATSDR 1999).

Solvent Naphtha is a skin and eye and throat irritant. Inhalation of high concentrations may cause central nervous effects characterized by headache and dizziness, nausea, loss of consciousness and some neurobehavioral disorders. Solvent Naphtha causes respiratory tract irritation and affects the sense organs. Repeated high exposures may affect the blood, kidneys, nervous system and liver (ATSDR 1995, ATSDR 1999).

Kerosene is a skin and eye and throat irritant. Inhalation of high concentrations may cause central nervous effects characterized by headache and dizziness and nausea. The low vapour pressure of the kerosene and the moderately high average molecular weight produce low volatility not sufficient to produce an inhalation risk except under circumstances of elevated temperatures, misting or confined space entry (ACGIH 2003a)

The Simple Green All Purpose Cleaner contains ethylene glycol monobutyl ether (EGBE), water and additives. EGBE Parts Cleaner products commonly contain a 4 to 6 % solution of EGBE (MSDS 2011a, MSDS 2011b). EGBE is a moderate eye, skin and respiratory irritant. Absorption

through the skin may be a significant source of exposure. EGBE may damage the foetus at high concentration and may damage the male reproductive system at moderate concentrations (NICNAS 1996).

The Simple Green Parts Washer contains Triethanolamine and Propylene glycol n-butyl ether. Triethanolamine is a moderate skin irritant, which may cause sensitization or an allergic skin reaction in some individuals. Triethanolamine may affect the kidneys, liver and nerve fibres (OECD 2004).

The toxicity of these solvents requires that safe work procedures and adequate supervision are provided to ensure control measures are maintained.

The Solvent Naphtha in Pursolve Parts Cleaner is Hydrotreated. Hydrotreated is a process in which the Aromatics are converted into Naphthenes and a product is obtained consisting of 50% Paraffins and 50% Naphthenes. These are called De-Aromatised or Low-Aromatic Solvents (ATSDR 1995, ATSDR 1999).

Pursolve Parts Cleaner is a slight skin and eye and throat irritant. Inhalation of high concentrations may cause central nervous effects characterized by headache and dizziness and nausea. The low vapour pressure of the Hydrotreated Naphtha and the moderately high average molecular weight produce low volatility not sufficient to produce an inhalation risk except under circumstances of elevated temperatures, misting or confined space entry (ACGIH 2003). As with all solvents skin and eye contact should be avoided and the use of eye protection and gloves is recommended.

9 RECOMMENDATIONS / CONCLUSION

Work Health and Safety Legislation requires that the hierarchy of control be applied when selecting control measures. Substitution, replacing with something less harmful, should be considered in all situations as a risk reduction method. Reliance on safe work procedures and Personal Protective Equipment (PPE) has been shown to be unreliable.

The assessment found that with the same level of control measures, safe work procedures and PPE, the exposure risk would be significantly lower with Purasolve Parts Cleaner compared to commonly available solvents parts cleaner products.

If you have any questions in regards to this analysis or to arrange for a meeting to discuss a Continuous Improvement Action Plan please do not hesitate to contact the under signed.

Regards,

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Annex List

- Annex A: Consequence Rating for Hazards
- Annex B: Chemical Exposure Rating Descriptors
- Annex C: Risk Assessment, Action Identification and Prioritisation

Appendix List

1. Risk Assessment - Purasolve Parts Cleaner
2. Risk Assessment - Naphtha Solvent Parts Cleaner
3. Risk Assessment - Kerosene
4. Risk Assessment - Ethylene Glycol Monobutyl Ether Parts Cleaner
5. Risk Assessment - Triethanolamine Parts Cleaner

Note: The advice and recommendations contained herein are based on the information supplied during the consultancy. HAZTEK Pty Ltd believes that the advice and information herein are accurate and reliable but no warranty of accuracy or reliability is given and no responsibility arising in any other way whatsoever for errors or omissions (including responsibility to any person by reason of negligence) is accepted by HAZTEK Pty Ltd or officer or employee.

ANNEX A: CONSEQUENCE RATING FOR HAZARDS

The consequence scale is as follows:

- | | | |
|----------|-------------------|---|
| 5 | Severe | can cause multiple fatalities or significant irreversible effects. |
| 4 | Major | can cause a single fatality or irreversible health effects or disabling illness to one or more persons. |
| 3 | Moderate | can cause severe reversible health effects of concern – could result in a lost time illness |
| 2 | Minor | can cause reversible health effects of concern that would typically result in a medical treatment with no lost time |
| 1 | Negligible | can cause reversible health effects of little concern, requiring first aid treatment at most. |

Note that a rating of 5 is considered the most serious hazard, while a rating of 1 is least hazardous.

A general description of the health effects for each rating on the consequences scale is provided in the shaded boxes below. Specific agents are listed in Table 2.1 with their respective consequence ratings.

5. Severe - can cause multiple fatalities or significant irreversible effects.

Hazards that can cause the following are considered to be potential sources of a “severe” health impact.

- occupational carcinogens
- reproductive toxins
- chemical asphyxiants (e.g. hydrogen sulphide, hydrogen cyanide, carbon monoxide)
- life-threatening respiratory illness agents
- life-threatening zoonoses (i.e. diseases transmitted by animals to humans)
- viral diseases & vector borne diseases that can be fatal

Occupational Carcinogens (there are about 300-350 substances). The most common cancers resulting from these exposures are cancers of the lung, bladder, skin, mesothelium, liver, haematopoietic tissue, bone and soft connective tissue. Refer to the list below for some of the more common agents. Check with the International Agency for Research on Cancer (IARC) for others (<http://www-cie.iarc.fr/monoeval/grlist.html>)

Reproductive Toxins in the workplace include around 200-300 chemicals. The reported adverse effects include infertility, spontaneous abortion, foetal death, teratogenesis, mutagenesis, foetal cancer, foetotoxicity and retarded development of the foetus or newborn. Both male and female workers may be affected by the hazards.

4. Major - can cause a single fatality or irreversible health effects or disabling illness to one or more persons.

Hazards that can cause the following are considered to be potential sources of a “major” health impact.

- progressive chronic conditions with a known cause
 - noise induced hearing loss (NIHL)
 - dust induced diseases e.g. silicosis
 - chronic obstructive pulmonary diseases
- systemic poisoning following vapour of fume exposure
- occupational asthma caused by exposure to organic dusts and aerosols
- hematologic disturbance agents (that cause anaemia, methaemoglobinaemia)
- skin disease – allergic skin diseases are some of the most prevalent occupational diseases. However, physical, chemical or biological agents may cause skin diseases.
- infectious blood borne diseases that can result in progressive chronic disease
- permanent central nervous system damage
- pulmonary oedema
- cardiac arrhythmia
- chronic/long-term organ toxicity e.g. cumulative lung damage
- acute toxicity – high risk – possibly fatal

3. Moderate - can cause severe reversible health effects of concern – could result in a lost time illness.

Hazards that can cause the following are considered to be potential sources of a “moderate” health impact.

- acute toxicity
- short-term physical effects
 - extreme temperature effects (e.g. sunstroke, frostbite)
- mineral acid effects on teeth
- substances that cause elevated irritation of mucous membranes (eyes, nose or throat)
- substances that cause elevated irritation of the skin
- progressive chronic conditions with a known cause
 - musculo-skeletal effects – disorder of muscles, tendons, bones and joints (e.g. back strain and over-use syndrome). Specific work activities or environments can contribute to musculo-skeletal diseases where particular risk factors are present (e.g. rapid or repetitive motion, forceful exertion, awkward postured, vibration).
 - vibration-induced disorders of muscles, tendons, bones, joints, peripheral blood vessels or peripheral nerves.
 - nervous system effects (e.g. cholinesterase inhibition) other than narcosis
- non-fatal infectious air-borne diseases

2. Minor - can cause reversible health effects of concern that would typically result in a medical treatment with no lost time

Hazards that can cause the following are considered to be potential sources of a “minor” health impact.

- some temperature effects (e.g. heat rash)
- some travel effects (e.g. sea sickness, jet lag)
- psychological stress (e.g. work carried out at risk of violence)
- sunburn
- narcosis
- moderate irritation of eyes, nose, throat and / or skin

1. Negligible - can cause reversible health effects of little concern, requiring first aid treatment at most.

Hazards that can cause the following are considered to be potential sources of a “minor” health impact.

- minor irritations of eyes, throat, nose and / or skin
- offensive smells
- nuisance noises
- minor muscular discomfort
- minor headaches

Agent	Type Of Hazard	Health Impact	Consequence Scale Rating
Aluminium potroom aerosols	Chemical	Occupational asthma	4
Ammonia	Chemical	Eye damage, upper respiratory tract (URT) irritation	4
Anthrax	Biological	Pulmonary disease often fatal	5
Arsenic	Chemical	Carcinogen	5
Asbestos	Chemical	Carcinogen	5
Avian bird flu	Biological	Severe pulmonary disease with high mortality rate	5
Bacteria	Biological	Allergic response	4
Benzene	Chemical	Carcinogen	5
Beryllium and beryllium compounds	Chemical	Carcinogen	5
Cadmium and compounds	Chemical	Carcinogen	5
Carbon disulphide	Chemical	Peripheral nervous system impairment	4
Carbon monoxide	Chemical	Chemical asphyxiant Carboxyhaemoglobin aemia	5
Ceramic fibres, refractory	Chemical	Carcinogen Pulmonary fibrosis	5
Chromium (VI) and compounds	Chemical	Carcinogen	5
Coal tar pitch volatiles	Chemical	Carcinogen	5
Cold temperatures		Hypothermia chilblains, frostbite	2
Cotton dust	Chemical	Asthma	4
Diesel exhaust particulate	Chemical	Carcinogen	5
Ethylene oxide	Chemical	Carcinogen, Central nervous system impairment	5
Falciparum malaria	Biological	Haematological disease with severe systemic symptoms	5
Fluorine	Chemical	Upper respiratory tract, eye & skin irritation	4
Fungi	Biological	Allergic response	4
Heat (heat cramps, prickly heat, dehydration)	Physical	Hyperthermia	2

Table 2.1
Consequence Rating for Specific Hazards

NB These ratings do not take into account additive effects, nor any other combined effects that exposure to more than one chemical or agent may cause.

Agent	Type Of Hazard	Health Impact	Consequence Scale Rating
Hepatitis A virus	Biological	Inflammatory condition of the liver	3
Hepatitis B & C virus	Biological	Severe liver disease	4
HIV/AIDS	Biological	Compromised immune system resulting in severe opportunistic infections	5
Hydrogen cyanide	Chemical	Chemical asphyxiant	5
Hydrogen sulphide	Chemical	Chemical asphyxiant	5
Ionising radiation	Physical	Carcinogen	5
Iron	Chemical	URT & skin irritation	2
Isocyanates	Chemical	Occupational asthma	4
Lead	Chemical	Haematological disturbances	4
Legionella bacteria	Biological	Acute lung disease	4
Leptospirosis	Biological	Renal failure	5
Malaria	Biological	Severe infectious	5
Mercury	Chemical	CNS impairment	4
Mould	Biological	Allergic response	4
Musculo-skeletal injury	Physical	Progressive chronic condition	3
Nickel and compounds	Chemical	Pneumoconiosis, Carcinogen	5
Noise induced hearing loss	Physical	Progressive chronic condition	4
Oil mist, mineral	Chemical	LRT irritation, Suspected Carcinogen	5
Organo-phosphorus pesticides	Chemical	CNS dysfunction	3
Ozone	Chemical	Respiratory tract irritation	3
Phosgene	Chemical	URT irritation, emphysema	3
Q-fever	Biological	Acute febrile illness	3
Radon and its decay products	Chemical	Carcinogen	5
Silica, respirable crystalline	Chemical	Carcinogen	5
Solvents	Chemical	CNS depression	3
Sulphuric dioxide	Chemical	URT & LRT irritation	3
Sulphuric acid mist	Chemical	Suspected Carcinogen	5
Talc containing asbestos fibres	Chemical	Carcinogen	5

Table 2.1
Consequence Rating for Specific Hazards

NB These ratings do not take into account additive effects, nor any other combined effects that exposure to more than one chemical or agent may cause.

Agent	Type Of Hazard	Health Impact	Consequence Scale Rating
Temperature – extreme heat or cold	Physical	Sunstroke, frostbite	3
Thallium	Chemical	Alopecia	4
Travel – long distance	Physical	Jet lag	2
Tuberculosis infections	Biological	Chronic granulomatous infection of the lungs	3
Ultraviolet radiation	Physical	Carcinogen	5
Uranium and compounds	Chemical	Carcinogen	5
UV radiation	Physical	Sunburn	2
Vibration-induced disorder	Physical	Progressive chronic condition	3
Wood dust (oak, beech)	Chemical	Carcinogen	5
Wood dust (western red cedar)	Chemical	Asthma	4

ANNEX B: CHEMICAL EXPOSURE RATING DESCRIPTORS
Table 1
Qualitative exposure descriptor for In-air Exposure Potential

A - Almost Certain	Regular contact with the potential hazard at very high concentrations
B – Likely	Periodic contact with the potential hazard at very high concentrations or Regular contact with the potential hazard at high concentrations
C - Possible	Periodic contact with the potential hazard at high concentrations or Regular contact with the potential at moderate concentrations
D – Unlikely	Periodic contact with the potential hazard at moderate concentrations or Regular contact with the potential at low concentrations
E – Rare	Periodic contact with the potential at low concentrations

Table 2
Qualitative exposure descriptor for In-air Exposure Potential

Based on an Estimate of the Mean of the Exposure Profile for a work group relative to the OES (possible criteria for frequency of air monitoring is included)

A - Almost Certain	Mean > 10 x TWA – OES	Reduce exposure and monitor weekly
B – Likely	Mean: > TWA _ OES but < 10 x TWA – OES	Monitor monthly until exposure reduced
C - Possible	Mean: 50% - 100% TWA - OES	Monitor half yearly to quarterly
D – Unlikely	Mean: 10% - 50% TWA - OES	Monitor Yearly
E – Rare	Mean <10% TWA – OES	Monitoring not required (Provided there is no change to the process, material or controls since the last survey.)

Note: A TWA-OES (time-weighted-average occupational exposure standard) is the maximum acceptable average concentration of a chemical agent.

Table 3
Qualitative exposure descriptor for In-air Exposure Potential
Based on an Estimate of the 95th Percentile for a work group relative to the OES

A - Almost Certain	>5% exceedance of 10 x OES (95th percentile > 10x OES)
B – Likely	>5% exceedance of the OES (95th percentile between 1 and 10 x OES)
C - Possible	>5% exceedance of 0.5 x OES (95th percentile between 0.5 and 1 x OES)
D – Unlikely	>5% exceedance of 0.1 x OES (95th percentile between 0.1 and 0.5 x OES)
E – Rare	Little to no exceedance of 0.1 x OES (95th percentile <0.1 x OES)

Table 4
Qualitative exposure descriptor for Dermal Exposure Potential

A - Almost Certain	Regular immersion of hands in contaminant or saturation of clothing
B – Likely	Periodic immersion of hands in contaminant or splashing on clothing or Regular visible contamination of skin or clothing
C - Possible	Periodic visible contamination of skin or clothing; or Regular incidental contact
D – Unlikely	Periodic incidental contact
E – Rare	Minimal to no opportunity for visible contamination of skin or clothing

Semi- Quantitative exposure descriptor for In-air Exposure Potential
Based on the quantities & volatility or “dustiness” of the chemicals handled and the ventilation control¹⁶

	Amount	Dustiness/Volatility	Ventilation
A- Almost Certain	Very large amounts (>1000 L or > 1000 kg)	Very dusty (fine light powder) Highly Volatile (boiling point <50°C)	Natural
	Medium to large amounts (>200 L <1000 L or 200 kg <1000 kg)	Very dusty (fine light powder) Highly Volatile (boiling point <50°C).	Natural
B- Likely	Large amounts (>1000 L or >1000 kg)	Dusty (crystalline/granular solids) Moderate volatile (e.g. Boiling point 50°C or <150°C).	Natural
	As per A [#]	As per A [#]	Dilution
C- Possible	Small to medium quantities (>20 l <200 L or >20 kg or <200 kg)	Very dusty (fine light powder) Highly Volatile (boiling point <50°C)	Natural
	Medium to large amounts (>200 L <1000 L or 200 kg <1000 kg)	Dusty (crystalline/granular solids) Moderate volatile (e.g. Boiling point 50°C or <150°C)	Natural
	Large amounts (>1000 L or >1000 kg)	Low dusting (e.g. Pellet-like solids that don't break up) Low volatility (e.g. boiling point >150°C)	Natural
	As per B [#]	As per B [#]	Dilution
	As per A [#]	As per A [#]	Extraction
D- Unlikely	Small quantities (>1 L <20 L or >1 kg <20 kg)	Very dusty (fine light powder) Highly Volatile (boiling point <50°C)	Natural
	Small to medium quantities (>20 l <200 L or >20 kg or <200 kg)	Dusty (crystalline/granular solids) Moderate volatile (e.g. Boiling point 50°C or <150°C)	Natural
	Medium to large amounts (>200 L <1000 L or 200 kg <1000 kg)	Low dusting (e.g. Pellet-like solids that don't break up) Low volatility (e.g. boiling point >150°C)	Natural
	As per C [#] or As per B [#] or	As per C [#] or As per B [#] or	Dilution Extraction
	As per A [#]	As per A [#]	Fully enclosed
E-Rare	Trace quantities (<1 L or <1 kg)	Very dusty (fine light powder) Highly Volatile (boiling point <50°C)	Natural
	Using small quantities (>1 L <20 L or >1 kg <20 kg)	Dusty (crystalline/granular solids) Moderate volatile (e.g. Boiling point 50°C or <150°C)	Natural
	Using small to medium quantities (>20 l <200 L or >20 kg or <200 kg)	Low dusting (e.g. Pellet-like solids that don't break up) Low volatility (e.g. boiling point >150°C)	Natural
	As per B [#] or As per C [#] or	As per B [#] or As per C [#] or	Dilution Extraction
	As per D [#]	As per D [#]	Fully enclosed

The amount and dustiness/volatility is as per specified in the likelihood scale (A,B,C or D) indicated.

Only the ventilation changes.

ANNEX C: RISK ASSESSMENT, ACTION IDENTIFICATION AND PRIORITISATION

Figure 1

		Consequence Rating (health effect)				
		1 Negligible	2 Minor	3 Moderate	4 Major	5 Severe
Likelihood Rating	A Almost Certain	M	H	H	E	E
	B Likely	M	M	H	H	E
	C Possible	L	M	M	H	H
	D Unlikely	L	L	M	M	H
	E Rare	L	L	L	M	M

Whether the action needed is control, information gathering, or a combination of the two depends on the extent of the potential health risk and the certainty of the exposure assessment, as indicated by the figure below.

Figure 2

Health Risk Rating	E	Control Needed	Control & Information Gathering Needed	Control & Information Gathering Needed
	H	Proactive Management Needed	Control & Information Gathering Needed	Control & Information Gathering Needed
	M	Active Monitoring Needed	Information Gathering Needed	Control & Information Gathering Needed
	L	No Action Needed	Information Gathering Needed	Information Gathering Needed
		Certain	Uncertain	Highly Uncertain
Uncertainty Rating				