

VINYL CHLORIDE

BASELINE HEALTH MONITORING BEFORE STARTING WORK IN A VINYL CHLORIDE PROCESS

1. Collection of demographic data

2. Work history

3. Medical history

There are many non-work factors associated with hepatocellular carcinoma, including excessive alcohol consumption and viral hepatitis that the medical practitioner needs to be aware of. The following details about the worker's medical history will be collected by the medical practitioner:

- presence of symptoms
- smoking history
- alcohol consumption
- viral hepatitis - hepatitis B or C
- haemachromatosis
- other liver disease

4. Physical examination

A physical examination will be conducted only if work and medical history indicates this is necessary, for example if the symptoms of vinyl chloride exposure are present.

5. Investigation

In addition to medical history and physical examination, there are a number of test methods that can be used to assess exposure to vinyl chloride. These are:

- full blood count including mean cell volume and platelets
- liver function tests including aspartate transaminase (AST), alanine transaminase (ALT), gamma glutamyl transpeptidase (GGT), alkaline phosphatase and bilirubin.

The registered medical practitioner may choose to conduct these tests to assess the worker's exposure to vinyl chloride.

The medical practitioner should consider testing for viral markers for hepatitis B and hepatitis C after pre-test counselling.

Note: There is no specific biological marker for angiosarcoma of the liver (ASL) and hepatocellular carcinoma (HCC) due to vinyl chloride monomer exposure.

BACKGROUND INFORMATION ON VINYL CHLORIDE EXPOSURE

With the level of potential exposure in vinyl chloride monomer/polyvinyl chloride (VCM/PVC) plants at such a low level these days, it is unlikely workers will develop ASL—only one case has been diagnosed in Australia in 1978—or HCC due to VCM. However, workers should be made aware of the additional risk of developing HCC when they have hepatitis B virus (HBV) or hepatitis C virus (HCV) or when their alcohol consumption is too high.

If workers are suffering from active hepatitis, the registered medical practitioner should discuss with the treating gastroenterologist possible exemption from working in duties potentially exposing them to VCM.

DURING EXPOSURE TO A VINYL CHLORIDE PROCESS

6. Monitoring exposure to vinyl chloride

Medical examinations should occur every two years, with laboratory tests repeated annually where required.

7. Medical examination

The person conducting a business or undertaking should arrange an appointment with the registered medical practitioner for workers who are excessively exposed to vinyl chloride, are suspected of being excessively exposed to vinyl chloride, or have concerns about vinyl chloride exposure.

AT TERMINATION OF WORK IN A VINYL CHLORIDE PROCESS

8. Final medical examination

A final medical examination will be conducted and may include tests used by the registered medical practitioner to assess exposure including:

- full blood count including mean cell volume and platelets
- liver function tests including AST, ALT, GGT, alkaline phosphatase and bilirubin.

SUPPLEMENTARY INFORMATION ON VINYL CHLORIDE

9. Work activities that may represent a high risk exposure

Examples of work activities involving vinyl chloride which require special attention when assessing exposure include production of polyvinyl chloride (PVC), in particular during cleaning of autoclaves.

Special attention should also be given to acute exposures that may occur in the above vinyl chloride processes.

10. Non-work sources

Vinyl chloride is not known naturally although it has been found in landfill, gas and groundwater as a degradation product of chlorinated hydrocarbons deposited as solvent wastes in landfills. The level of residual vinyl chloride in PVC has been regulated since the late 1970's in many countries. Since then, release of vinyl chloride monomer from the thermal degradation of PVC is either not detectable or is at very low levels. Vinyl chloride is also present in cigarette smoke.

POTENTIAL HEALTH EFFECTS FOLLOWING EXPOSURE TO VINYL CHLORIDE

11. Route of entry into the body

The primary routes of vinyl chloride entry into the body are through inhalation and ingestion.

12. Target organ/effect

Liver – fibrosis, angiosarcoma.

CNS – dizziness, ataxia, visual disturbance, coma, death.

Irritant – eyes, mucous membranes, respiratory tract.

Skin – scleroderma.

Circulatory – Raynaud's syndrome.

Bone – resorption particularly of the fingertips—acro-osteolysis.

13. Acute effects

CNS: The central nervous system (CNS) is the primary target of vinyl chloride acute toxicity. Vinyl chloride is thought to depress the CNS via a solvent effect on lipids and protein components of neural membranes that interrupts signal transmission. **There may be a latent period of hours to days between exposure and symptom onset.** Symptoms include euphoria, dizziness, ataxia, fatigue, drowsiness, headache and loss of consciousness. With inhalational exposure, signs and symptoms increase in severity over a range of 8000 to 20 000 ppm in air. Exposure to higher concentrations can cause death. Sub-lethal CNS effects resolve quickly when the victim is removed from further exposure.

Respiratory: Vinyl chloride gas inhalation can cause mild respiratory tract irritation, wheezing and chemical bronchitis. These effects are transient and resolve quickly following removal from exposure.

Cardiovascular: Vinyl chloride may lower the myocardial threshold to the dysrhythmogenic effects of catecholamines.

Dermal, Ocular: Exposure to escaping compressed gas or liquid can cause frostbite injury with redness, blistering, and scaling of the skin and corneal and conjunctival irritation or burns.

14. Chronic effects

Chronic exposure to lower levels of around 100-1000 ppm has been associated with a spectrum of symptoms collectively termed 'vinyl chloride disease' which includes Raynaud's syndrome, scleroderma and acro-osteolysis—bone resorption of the terminal phalanges of the fingers.

Liver and spleen fibrosis, portal hypertension and cirrhosis can occur. Other effects of chronic exposure include sensory-motor polyneuropathy; pyramidal, extrapyramidal, and cerebellar abnormalities and immunopathologic phenomena like purpura and thrombocytopaenia.

15. Carcinogenicity

Vinyl chloride is genotoxic.

A large number of epidemiological studies [1] and case reports have substantiated the causal association between vinyl chloride and haemangiosarcoma of the liver. It was recognised that the cause of haemangiosarcoma was likely to be inhalation of vinyl chloride at concentrations of probably a few hundred parts per million over long periods.

In June 2007, IARC concluded exposure to vinyl chloride also causes hepatocellular carcinoma (HCC) [2]. From Maltoni's work with rats, the VCM exposure required to induce a HCC is ten times that required to produce an angiosarcoma of the liver (ASL).

The World register of ASL contains 231 cases. Sixteen cases of HCC are published that are probably related to VCM exposure. In all cases, the first exposure was before 1974.

There are many non-work factors associated with HCC including excessive alcohol consumption and viral hepatitis. Mastrangelo's work in 2004 [3] suggested exposure to vinyl chloride and excessive alcohol consumption had a synergistic effect on the development of HCC.

16. Carcinogen classification¹

Vinyl chloride is classified according to the GHS as Carcinogenicity Category 1A (May cause cancer).

REFERENCED DOCUMENTS

1. International Agency for Research on Cancer, *Overall Evaluations of Carcinogenicity: An Updating of IARC Monographs Volumes 1-42*, Supplement No. 7, International Agency for Research on Cancer, Lyon, 1987.
2. International Agency for Research on Cancer, *IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Volume 97: Vinyl Chloride*, pp 311-443, International Agency for Research on Cancer, Lyon, 2008.
3. Mastrangelo G, Fedeli U, Fadda E, Valentini F, Agnesi R, Magarotto G, Marchi T, Buda A, Pinzani M, Martines D, 'Increased Risk of Hepatocellular Carcinoma and Liver Cirrhosis in Vinyl Chloride Workers: Synergistic Effect of Occupational Exposure with Alcohol Intake', *Environmental Health Perspectives* (2004) vol 112(11), pp 1188-92, 2004.

FURTHER READING

Agency for Toxic Substances and Disease Registry, *Case Studies in Environmental Medicine 2: Vinyl Chloride Toxicity*, Agency for Toxic Substances and Disease Registry, United States Department of Health and Human Services, Public Health Service, Atlanta, 1990.

Agency for Toxic Substances and Disease Registry, *Medical Management Guidelines for Vinyl Chloride*, Agency for Toxic Substances and Disease Registry, United States Department of Health and Human Services, Public Health Service, Atlanta, 2008. <http://www.atsdr.cdc.gov/MMG/index.asp>

Agency for Toxic Substances and Disease Registry, *Toxicological Profile for Vinyl Chloride*, Agency for Toxic Substances and Disease Registry, United States Department of Health and Human Services, Public Health Service, Atlanta, 2006. <http://www.atsdr.cdc.gov/toxprofiles/index.asp>

■ 1 This classification information is provided on an advisory basis and is taken from the European Union's Annex VI to Regulation (EC) No 1272/2008, updated by the 1st Adaption to Technical Progress to the Regulation. Other hazard classes and categories may apply - see <http://esis.jrc.ec.europa.eu/index.php?PGM=cla>. These classifications are legally binding within the European Union.

European Centre for Ecotoxicology and Toxicology of Chemicals, *Technical Report 31: The Mutagenicity and Carcinogenicity of Vinyl Chloride—A Historical Review and Assessment*, European Centre for Ecotoxicology and Toxicology of Chemicals, Brussels, 1988.

International Program for Chemical Safety, *Environmental Health Criteria 215 Vinyl Chloride*, WHO Geneva, 1999. www.inchem.org

Lauwerys RR, Hoet P, *Industrial Chemical Exposure Guidelines for Biological Monitoring*, 3rd Ed, Lewis Publishers, Boca Raton, 2001.

HEALTH MONITORING REPORT VINYL CHLORIDE

This health monitoring report is a **confidential** health record and must not be disclosed to another person except in accordance with the Work Health and Safety Regulations or with the consent of the worker.

There are two sections. Complete both sections and all questions if applicable.

Section 1 is to be forwarded to the PCBU who has engaged your services. A copy of laboratory report(s) must be attached > > >

Section 2 may contain confidential information which may not be relevant to the health monitoring program being carried out. This section should be retained by the medical practitioner. Information which is required to be given to the PCBU should be summarised in part 7 of section 1.

SECTION 1 - THIS SECTION TO BE RETURNED TO THE PCBU			
1. PERSON CONDUCTING A BUSINESS OR UNDERTAKING			
Company / Organisation name:			
Site address:			
Suburb:			Postcode:
Site Tel:	Site Fax:	Contact Name:	
2. OTHER BUSINESSES OR UNDERTAKINGS ENGAGING THE WORKER			
Company / Organisation name:			
Site address:			
Suburb:			Postcode:
Site Tel:	Site Fax:	Contact Name:	
3. WORKER (✓) all relevant boxes			
Surname:		Given names:	
Date of birth: DD/MM/YYYY	Sex:	<input type="checkbox"/> Male	<input type="checkbox"/> Female
Address:			
Suburb:			Postcode:
Current Job:	Tel(H):	Mob:	
Date started employment : DD/MM/YYYY			
4. EMPLOYMENT IN VINYL CHLORIDE RISK WORK (✓) all relevant boxes			
1. <input type="checkbox"/> New to vinyl chloride work			
2. <input type="checkbox"/> New worker but not new to vinyl chloride work			
3. <input type="checkbox"/> Current worker continuing in vinyl chloride work			
4. Worked with vinyl chloride since DD/MM/YYYY			
5. Satisfactory personal hygiene (for example nail biting, frequency of hand washing)		<input type="checkbox"/> Yes	<input type="checkbox"/> No
6. Risk assessment completed		<input type="checkbox"/> Yes	<input type="checkbox"/> No

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5. WORK ENVIRONMENT ASSESSMENT		(✓) all relevant boxes
Date of assessment: DD/MM/YYYY		
Vinyl Chloride Industry		
<input type="checkbox"/> Polyvinyl Chloride Production <input type="checkbox"/> Other (specify):	Controls: Wear gloves <input type="checkbox"/> Yes <input type="checkbox"/> No Respirator use <input type="checkbox"/> Yes <input type="checkbox"/> No Local exhaust ventilation <input type="checkbox"/> Yes <input type="checkbox"/> No Overalls / work clothing <input type="checkbox"/> Yes <input type="checkbox"/> No Laundering by employer <input type="checkbox"/> Yes <input type="checkbox"/> No Wash basins & showers (with hot & cold water) <input type="checkbox"/> Yes <input type="checkbox"/> No Smoking or eating in workshop <input type="checkbox"/> Yes <input type="checkbox"/> No	
	Personal hygiene: Clean Shaven <input type="checkbox"/> Yes <input type="checkbox"/> No Shower & change into clean clothes at end of shift <input type="checkbox"/> Yes <input type="checkbox"/> No	
6. BIOLOGICAL MONITORING RESULTS		Include at least the previous two test results (if available)
Date	Tests performed	Recommended Action and/or Comment
1. DD/MM/YYYY		
2. DD/MM/YYYY		
3. DD/MM/YYYY		
4. DD/MM/YYYY		
5. DD/MM/YYYY		
6. DD/MM/YYYY		
7. DD/MM/YYYY		

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7. RECOMMENDATIONS (by Medical Practitioner)		(✓) all relevant boxes
1. <input type="checkbox"/> Suitable for work with vinyl chloride		
2. <input type="checkbox"/> Counselling required		
3. <input type="checkbox"/> Review workplace controls		
4. <input type="checkbox"/> Repeat health assessment in _____ month(s) / _____ week(s)		
5. <input type="checkbox"/> Removal from work with vinyl chloride		On DD/MM/YYYY
6. <input type="checkbox"/> Medical examination by Medical Practitioner		On DD/MM/YYYY
7. <input type="checkbox"/> Fit to resume vinyl chloride risk work		From DD/MM/YYYY
8. <input type="checkbox"/> Referred to Medical Specialist (respiratory/dermatology/other): On DD/MM/YYYY		
Specialist's name:		
Additional comments or recommendations arising from health monitoring:		
Medical Practitioner (responsible for supervising health monitoring)		
Name:		Date: DD/MM/YYYY
Signature		
Tel:	Fax:	Registration Number:
Medical Practice:		
Address:		
Suburb:		Postcode:

HEALTH MONITORING REPORT VINYL CHLORIDE

SECTION 2 - THIS SECTION TO BE RETAINED BY THE MEDICAL PRACTITIONER			
1. PERSON CONDUCTING A BUSINESS OR UNDERTAKING			
Company / Organisation name:			
Site address:			
Suburb:			Postcode:
Site Tel:	Site Fax:	Contact Name:	
2. OTHER BUSINESSES OR UNDERTAKINGS ENGAGING THE WORKER			
Company / Organisation name:			
Site address:			
Suburb:			Postcode:
Site Tel:	Site Fax:	Contact Name:	
3. WORKER (✓) all relevant boxes			
Surname:		Given names:	
Date of birth: DD/MM/YYYY	Sex:	<input type="checkbox"/> Male	<input type="checkbox"/> Female
		<input type="checkbox"/> Pregnant/Breast Feeding?	
Address:			
Suburb:			Postcode:
Current Job:		Tel(H):	Mob:
Date started employment : DD/MM/YYYY			
4. GENERAL HEALTH ASSESSMENT (if applicable)			
Symptoms of:	Comments	Further testing?	
Skin disorders		<input type="checkbox"/> Yes	<input type="checkbox"/> No
Headaches, dizziness		<input type="checkbox"/> Yes	<input type="checkbox"/> No
Respiratory tract		<input type="checkbox"/> Yes	<input type="checkbox"/> No
Eyes		<input type="checkbox"/> Yes	<input type="checkbox"/> No
Mucous Membranes		<input type="checkbox"/> Yes	<input type="checkbox"/> No
CNS		<input type="checkbox"/> Yes	<input type="checkbox"/> No
Others		<input type="checkbox"/> Yes	<input type="checkbox"/> No
Height ____cm			
Weight ____kg			
Bp ____/____ mmHg		<input type="checkbox"/> Yes	<input type="checkbox"/> No

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5. OTHER MEDICAL HISTORY, FAMILY MEDICAL HISTORY, CURRENT MEDICATION, COMMENTS, TESTS OR RECOMMENDATIONS (use separate sheet if necessary)

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Medical Practitioner (responsible for supervising health monitoring)

Name:		Signature		Date: DD/MM/YYYY	
Tel:		Fax:		Registration Number:	
Medical Practice:					
Address:					
Suburb:				Postcode:	