

Health monitoring

Guide for 4,4'-methylene bis(2-chloroaniline) (MOCA)





Contents

Intro	duction	3
4,4'-r	methylene bis(2-chloroaniline) (MOCA)	4
1.	Health monitoring for MOCA under the WHS Regulations	4
2.	Monitoring exposure to MOCA	5
۷	Norkplace exposure standard	6
F	Removal from work	6
F	Return to work	6
3.	Final medical examination	6
4.	Route of occupational exposure	7
5.	Target organ/effect	7
6.	Acute effects	8
7.	Chronic effects	8
8.	Carcinogenicity	8
9.	GHS classification	8
So	urce documents	8
Healt	th monitoring report – MOCA	11
Se	ection 1 – A copy of this section to be provided to the PCBU	11
Se	ction 2 – This section to be retained by the registered medical practitioner	14

Introduction

This guide is intended to be read by a registered medical practitioner with experience in health monitoring who is engaged by person conducting a business or undertaking (PCBU) to carry out or supervise health monitoring. It provides practical guidance to registered medical practitioners about requirements under the work health and safety (WHS) laws for health monitoring.

This guide applies to all workplaces covered by the WHS Regulations where health monitoring is required.

How to use this guide

This guide includes references to the legal requirements under the WHS Act and WHS Regulations. These are included for convenience only and should not be relied on in place of the full text of the WHS Act or WHS Regulations.

The words 'must', 'requires' or 'mandatory' indicate a legal requirement exists that must be complied with. The word 'should' is used in this guide to indicate a recommended course of action, while 'may' is used to indicate an optional course of action.

This guide provides information for those registered medical practitioners engaged by a PCBU to carry out or supervise health monitoring for workers. This guidance should be read in conjunction with the following:

- Health monitoring guide for registered medical practitioners
- Health monitoring guides for hazardous chemicals
- Health monitoring guide for workers
- Health monitoring guide for persons conducting business or undertakings (PCBUs).

Health monitoring under the WHS Regulations

In certain circumstances, the model WHS Regulations place duties on a PCBU to provide health monitoring to workers. These requirements arise if the worker is carrying out work with hazardous chemicals including lead and asbestos. In addition, the work being carried out must be the kind of work specified in the WHS Regulations. A PCBU has the duty to determine if health monitoring is required.

The WHS Regulations prescribe that health monitoring is carried out by or supervised by a registered medical practitioner with experience in health monitoring.

4,4'-methylene bis(2-chloroaniline) (MOCA)

MOCA (CAS 101-14-4) is a light brown to colourless crystalline solid that has been primarily used as a curing agent for isocyanate-based polyurethane products. These products are then used in the manufacture of wear resistant industrial products including industrial tyres, polyurethane gears, gaskets, belts, rollers, sport boots and rollerskate wheels.

MOCA is also used as a coating to set other glues, plastics and adhesives.

Synonyms: MBOCA, 4,4'-methylenebis(ortho-chloroaniline), 4,4'-diamino-3,3'-dichlorodiphenylmethane, 2,2'-dichloro-4,4'-methylenediamine and curalin M.

Work activities that may represent a high risk exposure

Under the Work Health and Safety (WHS) Regulations, MOCA is listed as a restricted carcinogen and must not be used at concentrations greater than 0.1 per cent without authorisation from a relevant work health and safety regulator.

Due to the regulatory restriction there will be very few workplace uses for MOCA in Australia.

Examples of work activities involving MOCA that require special attention when assessing exposure include:

- dispensing MOCA powder
- processes where spattering of MOCA in the dry or molten state occurs, and
- manual moulding of semi-set polyurethane products.

Sources of non-occupational exposure

MOCA is not known to occur in nature therefore non-work exposure is rare. Exposure has been reported from contact with contaminated soils.

1. Health monitoring for MOCA under the WHS Regulations

Collection of demographic, medical and occupational history

Physical examination

Urinary total MOCA

Dipstick analysis of urine for haematuria

Urine cytology

Health monitoring before starting work in a MOCA process

Health monitoring for MOCA may be required before the worker starts work so that changes to the worker's health can be detected.

Initial discussions about a health monitoring program should include:

- possible health effects from exposure to MOCA
- how to recognise and report symptoms, and
- what is involved in the health monitoring program, for example the frequency of testing and the tests that may be needed.

In particular, workers should be made aware of the potential for MOCA to be absorbed through the skin and the need to maintain a high standard of personal hygiene and housekeeping practices.

MOCA is a respiratory irritant and it is important to investigate respiratory symptoms. However, spirometry may not be required at this stage.

During exposure to a MOCA process

2. Monitoring exposure to MOCA

Where workers are exposed, suspected of being exposed or are concerned about exposure to MOCA, the person conducting the business or undertaking (PCBU) has a duty to arrange a health monitoring appointment with a registered medical practitioner. For example, an appointment should be arranged following spills or loss of containment of MOCA resulting in excessive exposure to workers or when workers develop symptoms of MOCA exposure.

The following tests should be carried out twice annually at the time of peak exposure or use:

- urinary total MOCA •
- spot creatinine corrected urine for total MOCA, and •
- dipstick urinalysis for haematuria.

More frequent urine sampling may be warranted if the biological exposure standard is exceeded.

Dipstick urinalysis results should be compared with the worker's baseline dipstick urinalysis. Urine cytology should also be carried out annually.

Special care should be taken to prevent contamination of the urine samples. Samples should be collected in a clean room, following the removal of contaminated clothing and washing hands.

The following values should be considered when assessing exposure to MOCA using a urinary test:

Biological exposure standard for MOCA¹

Urinary MOCA:

15 µmol/mol creatinine (35 µg/L)

MOCA levels are usually higher at the end of the shift and reflect exposure over the preceding two to three days. The biological half-life of MOCA is approximately 20 hours. Urine samples should be collected towards the end of shift.

Urinary measurement of total MOCA and the urinary bladder cancer detection technique of urinalysis for haematuria are the methods best suited for health monitoring for MOCA work. Measurement of urinary MOCA levels is a specific indicator of MOCA exposure.

Urinary total MOCA estimations based on the spot creatinine corrected urine method is not without limitations. Unmetabolised MOCA is measured in this method and dose-response curves are lacking. However, its use is a reasonable means of monitoring the effectiveness of engineering controls, personal protective equipment and work practices.

Urine cytology and cystoscopy are useful as case management tools but not as routine screening tests. Cystoscopy has too many risks to consider as a mass screening procedure.

¹ See <u>Chemical analysis branch handbook, 9th Edition, Workplace and biological monitoring exposure analysis</u>, WorkCover NSW (PDF 3.39MB) for more details

Positive haematuria and cytology test results are not specific for MOCA exposure, as they may be due to other, unrelated medical conditions. Further testing may be warranted to elucidate the cause of positive results.

Workplace exposure standard

The workplace exposure standard for MOCA is:

• eight hour time weighted average (TWA) of 0.02 ppm (0.22 mg/m³).

A physical examination and urinary test may be indicated if the results of air monitoring indicate frequent or potentially high exposure (half of the TWA or above).

NOTE: MOCA is readily absorbed through the skin and air monitoring results may not be a true indication of exposure.

Removal from work

Where a medical examination indicates the worker is displaying symptoms of exposure to MOCA or where results of biological monitoring indicate exposure that may cause adverse health effects, the registered medical practitioner should consider recommending the worker be removed from MOCA-related work.

Where testing shows a level greater than or equal to 15 µmol/mol creatinine in urine, this may indicate the worker has been occupationally exposed to MOCA. In these instances:

- repeat confirmation tests should be performed at the same time of the day
- a medical examination should be carried out, and
- the registered medical practitioner supervising the health monitoring should consider removing the worker from MOCA work.

When removal from MOCA-related work is indicated the registered medical practitioner must provide the PCBU with the following recommendations:

- the worker should be removed from work with MOCA, and
- the PCBU should review control measures and carry out recommended remedial action.

The worker must be informed of the results of health monitoring.

Return to work

Should a worker be removed from MOCA-related work, they must not return until the registered medical practitioner has:

- assessed them as medically fit, and
- made a recommendation to the PCBU that the worker can return to remediated MOCA-related work.

This assessment should take into consideration the clinical condition of the worker, the worker's urinary MOCA levels and remediation of the circumstances that led to the symptoms if possible.

At termination of work in a MOCA process

3. Final medical examination

A final medical examination should be carried out and include:

- urine cytology for haematuria
- dipstick urinalysis, and
- a medical review of health monitoring records.

Workers with health conditions or continuing symptoms due to MOCA exposure should be advised to seek continuing medical examinations as organised by the registered medical practitioner supervising the health monitoring program. The registered medical practitioner should consider whether there is an ongoing need for urine cytology and dipstick urinalysis.

A health monitoring report from the registered medical practitioner should be provided to the PCBU as soon as practicable after the completion of the monitoring program, and at regular intervals for longer term or ongoing health monitoring processes. The report must include:

- the name and date of birth of the worker
- the name and registration number of the registered medical practitioner
- the name and address of the PCBU or undertaking who commissioned the health monitoring
- the date of the health monitoring
- any test results that indicate whether or not the worker has been exposed to a hazardous chemical
- any advice that test results indicate that the worker may have contracted an injury, illness or disease as a result of carrying out the work that triggered the requirement for health monitoring
- any recommendation that the PCBU take remedial measures, including whether the worker can continue to carry out the type of work that triggered the requirement for health monitoring, and
- whether medical counselling is required for the worker in relation to the work that triggered the requirement for health monitoring.

Potential health effects following exposure to MOCA

4. Route of occupational exposure

Skin absorption is the primary route of exposure to MOCA and is associated with the following factors:

- poor housekeeping—visible MOCA granules on floors and work benches
- poor personal hygiene practices, and
- inadequate personal protection.

5. Target organ/effect

The target organs and potential effects of MOCA exposure include:

Table 1 Target organs and potential effects of MOCA exposure

Target organ	Effect				
Blood	Methaemoglobinaemia causing hypoxia and cyanosis				
Respiratory system	Irritation				
Eyes	Irritation				
Kidney	HaematuriaProteinuria				
Bladder	Suspected carcinogen causing bladder cancer				

6. Acute effects

Contact with MOCA can cause irritation to eyes, skin or respiratory tract. Workers have reported burning sensations of the skin, face and eyes, conjunctivitis and feeling unwell in the stomach after accidental exposures.

Accidental exposures have resulted in the detection of protein in the urine within the first five hours post exposure, suggesting damage to the renal tubules. Mild, transient haematuria has also been reported.

7. Chronic effects

Retrospective worker studies have demonstrated atypical cells with negative cancer readings in exfoliative cytology tests and positive urinalysis for haematuria. One worker in the study with negative cytology was diagnosed with a tumour of the urinary bladder.

8. Carcinogenicity

MOCA has been classified as a Category 1B carcinogen according to the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) as it is presumed to cause cancer in humans.

MOCA is an aromatic amine that is structurally similar to benzidine, a known human bladder carcinogen. MOCA has been shown to cause hepatoma in mice and rats, lung and mammary carcinomas in rats and bladder cancer in dogs. There are two reported cases of bladder cancer in MOCA exposed workers.

9. GHS classification

The following GHS health hazard classification for MOCA has been taken from Safe Work Australia's Hazardous Chemicals Information System.

Hazard category

Carcinogenicity – category 1B

Acute toxicity - category 4 (harmful if swallowed)

Source documents

American Conference of Governmental Industrial Hygienists (ACGIH) (2011) Documentation of the Biological Exposure Indices, 7th Ed, Cincinnati.

American Conference of Governmental Industrial Hygienists (ACGIH) (2001) Documentation of the Threshold Limit Values for Chemical Substances, 7th Ed, Cincinnati.

<u>Chemical analysis branch handbook, 9th Edition, Workplace and biological monitoring</u> <u>exposure analysis</u>, WorkCover NSW (PDF 3.39MB).

Cocker, J., Boobis, A.R., Wilson, H.K. and Gompertz, D. (1990) Evidence that a ß-N-Glucuronide of 4,4'-Methylenebis (2-chloroaniline) (MbOCA) is a Major Urinary Metabolite in Man: Implications for Biological Monitoring. *Br. J. Ind. Med.* 47: 154-161.

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National Industrial Chemicals Notification and Assessment Scheme; Human Health Tier II Assessment for <u>Benzenamine, 4,4'-methylenebis[2-chloro-.</u>

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Safe Work Australia; Hazardous Chemicals Information System.

Schulte, P.A., Ringen, K. and Hemstreet, G.P. (1986) Optimal Management of Asymptomatic Workers at High Risk of Bladder Cancer. *J. Occ. Med.* 28(1): 13-17.

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Ward, E., Halperin, W., Thun, M., Grossman, H.B., Funk, B., Koss, L., Osorio, A.N. and Schulte, P. (1990) Screening Workers Exposed to 4,4'-Methylene-(2-chloroaniline) for Bladder Cancer by Cystoscopy. In: International Conference on Bladder Cancer Screening in High-Risk Groups, September 13-14, 1989. *J. Occ. Med.* 32(9): 865-868.

Ward, E., Smith, A.B. and Halperin, W. (1987) 4,4' - Methylene bis (2 - chloroaniline): An Unregulated Carcinogen. *Am. J. Ind. Med.* 12: 537-549.

Ward, E., Halperin, W., Thun, M., Grossman, H.B., Fink, B., Koss, L., Osorio, A.M. and Schulte, P. (1988) Bladder Tumours in Two Young Males Occupationally Exposed to MOCA. *Am. J. Ind. Med.* 14: 267-72.

Ward, E., Clapp, D., Tolos, W. and Groth, D. (1986) Efficacy of Urinary Monitoring for 4,4'-Methylenebis (2-Chloroaniline). *J. Occ. Med.* 28(8): 637-642.



Health monitoring report



Health monitoring report – MOCA

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 as applicable.

Section 1 A copy of this section should be forwarded to the person conducting the business or undertaking (PCBU) who has engaged your services.

Section 2 may contain confidential health information. Information that is required to be given to the PCBU should be summarised in Section 1.

Section 1 – A copy of this section to be provided to the PCBU

Person conducting a business or undertaking

Company/organisation name: Click here to enter text.

Site address: Click here to enter text.

Suburb: Click here to enter text.	Postcode: Click here to enter text.
Site Tel: Click here to enter text.	Site Fax: Click here to enter text.

Contact Name: Click here to enter text.

Other businesses or undertakings engaging the worker (include a separate section for each PCBU)

□ N/A

Company/organisation name: Click here to enter text.

Site address: Click here to enter text. Suburb: Click here to enter text. Site Tel: Click here to enter text. Contact Name: Click here to enter text.

Postcode: Click here to enter text. **Site Fax:** Click here to enter text.

Worker details (tick all relevant boxes)

Surname: Click here to enter text.	Given names: Click here to enter text.				
Date of birth: Click here to enter a date.	Sex: 🗆 Male 🗆 Female				
Address: Click here to enter text.					
Suburb: Click here to enter text.	Postcode: Click here to enter text.				
Current job: Click here to enter text.					
Tel (H): Click here to enter text. Mob: Click here to enter text.					
Date started employment: Click here to enter a date.					

Employment in MOCA risk work (tick all relevant boxes) (information provided by the PCBU)

 $\hfill\square$ New to MOCA work

 \Box New worker but not new to MOCA work

□ Current worker continuing in MOCA work

Worked with MOCA since: Click here to enter a date.

Risk assessment completed: □ Yes □ No

Work environment assessment (tick all relevant boxes) (information provided by the PCBU)

Date of assessment: Click here to enter a date.

MOCA industry/use

 \Box Polyurethane production \Box Other (specify):

Other chemicals the worker may be exposed to: Click here to enter text.

Controls		
Wear gloves	□ Yes	🗆 No
Respirator use	□ Yes	🗆 No
Respirator type	Click here	to enter text.
Local exhaust ventilation	□ Yes	🗆 No
Overalls/work clothing	□ Yes	🗆 No
Laundering by employer	□ Yes	🗆 No
Wash basins and showers (with hot and cold water)	□ Yes	🗆 No
Other please specify		
	•••••••••••••••••••••••••••••••••••••••	••••••

Health monitoring results

Biological monitoring results

Include/attach test results that indicate whether or not the worker has been exposed

Date	Tests performed	Recommended action or comment
Click here to enter text.	Click here to enter text.	Click here to enter text.
Click here to enter text.	Click here to enter text.	Click here to enter text.
Click here to enter text.	Click here to enter text.	Click here to enter text.
Click here to enter text.	Click here to enter text.	Click here to enter text.

Comments about health monitoring results (for example any early indications or diagnosis of injury, illness or disease): Click here to enter text.

Recommendations (by registered medical practitioner) (tick all relevant boxes)

Further/additional health monitoring for worker

□ This is the final health monitoring report

□ Repeat health assessment in Click here to enter text. month(s) / Click here to enter text. week(s)

- \Box Counselling required
- □ Medical examination by registered medical practitioner. On Click here to enter a date.
- □ Referred to Medical Specialist (respiratory/dermatology/other). On Click here to enter a date.

Recommendations to PCBU

- $\hfill\square$ The worker is suitable for work with MOCA
- □ Review workplace controls
- □ The worker should be removed from work with MOCA. On Click here to enter a date.
- □ The worker is fit to resume work. On Click here to enter a date.
- □ Biological monitoring results indicate unacceptably high exposure levels

Specialist's name: Click here to enter text.

Additional comments or recommendations: Click here to enter text.

Registered medical practitioner (responsible for supervising health monitoring)

Name: Click here to enter text.

Signature:

Date: Click here to enter a date.

Tel: Click here to enter text.

Fax: Click here to enter text.

Registration Number: Click here to enter text.

Medical Practice: Click here to enter text.

Address: Click here to enter text.

Suburb: Click here to enter text.

Postcode: Click here to enter text.

Section 2 – This section to be retained by the registered medical practitioner

Person conducting a business or undertaking					
Company/organisation name: Click here to enter Site address: Click here to enter text. Suburb: Click here to enter text. Site Tel: Click here to enter text. Contact Name: Click here to enter text.	Postcode: Click here to enter text. Site Fax: Click here to enter text.				
Other businesses or undertakings engaging	ng the worker	□ N/A			
Company/organisation name: Click here to enter Site address: Click here to enter text. Suburb: Click here to enter text. Site Tel: Click here to enter text. Contact Name: Click here to enter text.	Pr text. Postcode: Click here to enter text. Site Fax: Click here to enter text.				
Worker details (tick all relevant boxes)					
Surname: Click here to enter text. Given names: Click here to enter text. Date of birth: Click here to enter a date. Sex: □ Male □ Female □ Pregnant/breastfeeding Address: Click here to enter text.					
Suburb: Click here to enter text. Current job: Click here to enter text.	Postcode: Click here to enter text.				
Tel (H): Click here to enter text.Mob: Click here to enter text.Date started employment: Click here to enter a date.					
Past employment/exposure details (tick all relevant boxes)					

Have you ever worked in any of the following jobs?

If you answered 'yes' to any of the questions, please advise if you experienced any symptoms such as cough or wheeze or asthma when working.

			Comments (all 'yes' answers)
Manufacturing of polyurethane products	□ No	□ Yes	Click here to enter text.
Other (please specify)	🗆 No	□ Yes	Click here to enter text.

General health questionnaire (tick all relevant boxes)

			Comments (all 'yes' answers)
Did you suffer any incapacity lasting two weeks or longer in the last two years	□ No	□ Yes	Click here to enter text.
Have you ever had any operations or accidents or been hospitalised for any reason	□ No	□ Yes	Click here to enter text.
Are you currently being treated by a doctor or other health professional for any illness or injury	□ No	□ Yes	Click here to enter text.
Are you currently receiving any medical treatment or taking any medications. Please detail.	□ No	□ Yes	Click here to enter text.
Do you practice personal hygiene at work, for example nail biting, frequency of hand washing, eating or smoking, clean shaven, shower and change into clean clothes at end of shift	□ No	□ Yes	

Specific health questions (tick all relevant boxes)

Do you have or have you ever had:			Comments (all 'yes' answers)
Shortness of breath on exertion	🗆 No	□ Yes	Click here to enter text.
Wheezing, bronchitis or asthma now or in the past	🗆 No	□ Yes	Click here to enter text.
Any other lung or respiratory conditions (emphysema, pneumonia or sinusitis)	□ No	□ Yes	Click here to enter text.
Kidney or bladder disease	🗆 No	□ Yes	Click here to enter text.
Blood disorders	🗆 No	□ Yes	Click here to enter text.
Skin disorders or dermatitis	🗆 No	□ Yes	Click here to enter text.
Any form of cancer	🗆 No	□ Yes	Click here to enter text.
Any other significant health conditions	🗆 No	□ Yes	Click here to enter text.

Registered medical practitioner to provide comments for any 'Yes' responses (reference Question number): Click here to enter text.

General health assessment (if applicable)

Height: Click here to enter text. cm

Weight: Click here to enter text. kg

BP: Click here to enter text. / Click here to enter text. mmHg

Urinalysis

Blood: Normal Abnormal

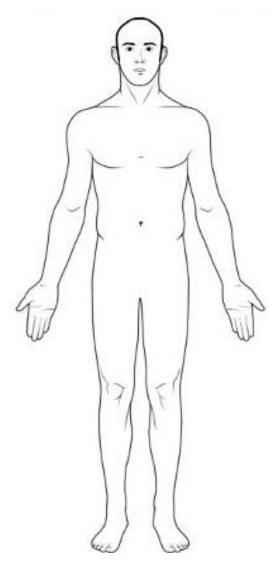
Protein: Click here to enter text.

Sugar: Click here to enter text.

Referred for further testing

 \Box No \Box Yes

Respiratory system			Medical comments (for all abnormal)
Breathing normal and regular in character	□ Yes	□ No	Click here to enter text.
Auscultation normal	□ Yes	🗆 No	Click here to enter text.
Signs of past/present respiratory disease	□ No	□ Yes	Click here to enter text.
Skin			
Eczema, dermatitis or allergy	🗆 No	□ Yes	Click here to enter text.
Skin cancer or other abnormality	□ No	□ Yes	Click here to enter text.
Evidence of nail biting	🗆 No	□ Yes	Click here to enter text.
Other	🗆 No	□ Yes	Click here to enter text.



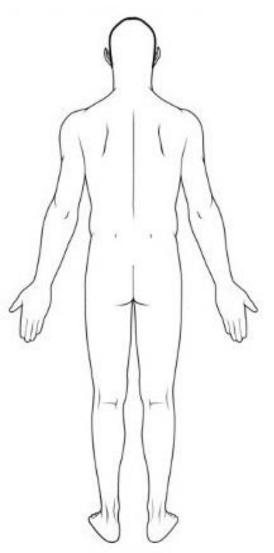


Figure 1 Template of the human body to indicate the location of abnormalities

Eye			Medical comments (for all abnormal)
Evidence of eye irritation	🗆 No	□ Yes	Click here to enter text.

Biological monitoring results

Include/attach at least the previous two test results (if available)

Date	Tests performed	Recommended action or comment
Click here to enter a date.	Click here to enter text.	Click here to enter text.
Click here to enter a date.	Click here to enter text.	Click here to enter text.
Click here to enter a date.	Click here to enter text.	Click here to enter text.
Click here to enter a date.	Click here to enter text.	Click here to enter text.

Other medical history, family medical history, current medication, comments, tests or recommendations (use separate sheet if necessary)

Click here to enter text.

Registered medical practitioner (responsible for supervising health monitoring)

Name: Click here to enter text.

Signature:

Date: Click here to enter a date.		
Tel: Click here to enter text.	Fax: Click here to enter text.	
Registration Number: Click here to enter text.		
Medical Practice: Click here to enter text.		
Address: Click here to enter text.		
Suburb: Click here to enter text.	Postcode: Click here to enter text.	