

LEAD (INORGANIC)

DEFINITIONS

The following definitions apply to this Guideline.

blood lead level monitoring means the testing of the venous or capillary blood of a person by a laboratory accredited by the National Association of Testing Authorities (NATA), under the supervision of a registered medical practitioner, to determine the blood lead level.

blood lead level means the concentration of lead in whole blood expressed in micromoles per litre ($\mu\text{mol/L}$) or micrograms per decilitre ($\mu\text{g/dL}$).

biological monitoring means:

- a. the measurement and evaluation of a substance, or its metabolites, in the body tissue, fluids or exhaled air of a person exposed to the substance; or
- b. blood lead level monitoring.

female of reproductive capacity means a female other than a female who provides information stating that she is not of reproductive capacity.

lead means lead metal, lead alloys, inorganic lead compounds and lead salts of organic acids.

lead risk work means work carried out in a lead process that is likely to cause the blood lead level of a worker carrying out the work to be more than:

- a. for a female of reproductive capacity— $10\mu\text{g/dL}$ ($0.48\mu\text{mol/L}$); or
- b. in any other case— $30\mu\text{g/dL}$ ($1.45\mu\text{mol/L}$).

Note: examples of lead processes can be found at Part 11.

lead process area means a workplace or part of a workplace where a lead process is carried out.

BASELINE HEALTH MONITORING BEFORE STARTING WORK IN AN INORGANIC LEAD PROCESS

1. Baseline health monitoring

Baseline health monitoring of the worker is required:

- before the worker first starts lead risk work
- one month after the worker first starts lead risk work.

If work is identified as lead risk work after a worker starts the work, health monitoring of the worker must be provided:

- a. as soon as practicable after the lead risk work is identified
- b. one month after the first monitoring of the worker under paragraph (a).

2. Collection of demographic data

3. Work History

4. Medical history

The following details about the worker's medical history will be collected by the medical practitioner:

- presence of symptoms with an emphasis on reproductive history including current pregnancy or breast feeding, neuropsychologic problems, haematological disorders and renal disorders
- prior history of non-work-related lead exposure e.g. hobbies like shooting (exposure to gun powder) and fishing (exposure to lead sinkers)
- history of medication or medical treatment including recent chelating agent therapy e.g. EDTA
- smoking history.

5. Physical Examination

A physical examination will be conducted, with an emphasis on the gastrointestinal, haematopoietic, renal, cardiovascular, reproductive and neurological systems.

Assessment of the pulmonary status is also warranted in cases where respiratory protective equipment is likely to be needed. Worker should be counselled that respirator fit can be poor and protection ineffective if they have a beard or facial hair.

6. Investigation

The following tests may be conducted to test the worker's baseline exposure:

- full blood examination
- blood lead in whole blood or packed red cells
- serum creatinine
- routine urinalysis
- pulmonary function test in cases where respiratory protection is likely to be required.

7. Counselling

The registered medical practitioner supervising the health monitoring should take into consideration whether medical counselling is required for the worker. If medical counselling is required, the level of counselling and recommended timeframe/level of urgency should be recorded in the Health Monitoring Report, see Appendix 1. For further information about counselling see Appendix 2.

Counselling for lead risk work should include the following health and personal hygiene advice.

Health effects of lead	Workers should be informed of the potential health effects associated with exposure to inorganic lead including the different risks to men and women and people of younger age (<18).
Family planning	Workers who consider they have not completed their family should be counselled on the health effects of lead on male and female reproduction, as appropriate.
Pregnancy	Workers who are pregnant or breastfeeding should be advised to seek alternative work during that period from their PCBU which does not involve lead risk work.

Personal hygiene

Workers should be encouraged to use changing rooms and washing, showering and toilet facilities at the workplace in order to minimise secondary lead exposure from contaminated clothing; minimise ingestion of lead; and avoid the spread of lead contamination.

Workers who bite their nails should be counselled on the increased risk it places on lead intake.

Eating, drinking and smoking

Workers should be reminded:

- they are not permitted to smoke, carry smoking materials, eat, chew gum or drink in a lead process area
- the importance of removing lead contaminated clothing and equipment and to wash their hands and faces before entering areas provided for eating and drinking.

A full explanation of the reasons for these restrictions and the benefits to be gained by compliance should be given.

Those workers with smoking history should be counselled on the possible additional lead burden from smoking.

DURING EXPOSURE TO AN INORGANIC LEAD PROCESS

8. Monitoring exposure to inorganic lead

Biological monitoring must be arranged for each worker who carries out lead risk work at the following times:

For females not of reproductive capacity and males

- six months after the last biological monitoring of the worker if the last monitoring shows a blood lead level of less than 30µg/dL (1.45µmol/L); **or**
- three months after the last biological monitoring of the worker if the last monitoring shows a blood lead level of 30µg/dL (1.45µmol/L) or more but less than 40µg/dL (1.93µmol/L); **or**
- six weeks after the last biological monitoring of the worker if the last monitoring shows a blood lead level of 40µg/dL (1.93µmol/L) or more.

For females of reproductive capacity

- three months after the last biological monitoring of the worker if the last monitoring shows a blood lead level of less than 10µg/dL (0.48µmol/L); **or**
- six weeks after the last biological monitoring of the worker if the last monitoring shows a blood lead level of 10µg/dL (0.48µmol/L) or more.

The frequency of biological monitoring must be increased if the worker carries out an activity that is likely to significantly change the nature or increase the duration or frequency of the worker's lead exposure. If the above biological exposure limits are breached, workplace practices and controls should be immediately reviewed as this suggests current controls are not performing satisfactorily.

9. Removal of a worker from a lead risk work

A worker must be immediately removed from carrying out lead risk work if:

1. biological monitoring of the worker shows that the worker's blood lead level is, or is more than:
 - for females not of reproductive capacity and males—50µg/dL (2.42µmol/L); **or**
 - for females of reproductive capacity—20µg/dL (0.97µmol/L); **or**
 - for females who are pregnant or breastfeeding—15µg/dL (0.72µmol/L); **or**
2. following a medical examination of the worker, the medical practitioner who supervised the health monitoring recommends that the worker must be removed from carrying out the lead risk work; **or**
3. there is an indication that a risk control measure has failed and as a result, the worker's blood lead level is likely to reach the relevant level for the worker mentioned above.

If a worker's blood lead level is above the prescribed removal level, the Health Monitoring Report should advise immediate removal to alternative duties. A second medical examination should be conducted within seven days after the day the worker is removed from lead risk work.

10. Return to work

The frequency of repeat blood lead level tests after removal from lead risk work is at the discretion of the medical practitioner supervising the health monitoring, but should be done at least every three to six weeks until the appropriate fall in blood lead levels has occurred.

The worker should be examined periodically to determine whether the worker is suitable to return to carrying out lead risk work.

A worker must not return to lead risk work until the worker's blood lead level is less than:

- for females not of reproductive capacity and males—40µg/dL (1.93µmol/L); **or**
- for females of reproductive capacity—10µg/dL (0.48µmol/L); **AND**

they have been assessed as medically fit to return to lead risk work by the medical practitioner supervising the health monitoring.

SUPPLEMENTARY INFORMATION ON INORGANIC LEAD

11. Work activities that may represent a high risk exposure (lead processes)

It is a requirement of the regulations that a PCBU determines whether a job is a lead risk job requiring health monitoring. The following **lead processes** may involve significant exposures to lead:

- a. work that exposes a person to lead dust or lead fumes arising from the manufacture or handling of dry lead compounds
- b. work in connection with the manufacture, assembly, handling or repair of, or parts of, batteries containing lead that involves the manipulation of dry lead compounds, or pasting or casting lead
- c. breaking up or dismantling batteries containing lead, or sorting, packing and handling plates or other parts containing lead that are removed or recovered from the batteries

- d. spraying molten lead metal or alloys containing more than five per cent by weight of lead metal
- e. melting or casting lead alloys containing more than five per cent by weight of lead metal in which the temperature of the molten material exceeds 450°C
- f. recovering lead from its ores, oxides or other compounds by thermal reduction process
- g. dry machine grinding, discing, buffing or cutting by power tools alloys containing more than 5 per cent by weight of lead metal
- h. machine sanding or buffing surfaces coated with paint containing more than one per cent by dry weight of lead
- i. a process by which electric arc, oxyacetylene, oxy gas, plasma arc or a flame is applied for welding, cutting or cleaning, to the surface of metal coated with lead or paint containing more than one per cent by dry weight of lead metal
- j. radiator repairs that may cause exposure to lead dust or lead fumes
- k. fire assays if lead, lead compounds or lead alloys are used
- l. hand grinding and finishing lead or alloys containing more than 50 per cent by dry weight of lead
- m. spray painting with lead paint containing more than one per cent by dry weight of lead;
- n. melting lead metal or alloys containing more than 50 per cent by weight of lead metal if the exposed surface area of the molten material exceeds 0.1 square metre and the temperature of the molten material does not exceed 450°C
- o. using a power tool, including abrasive blasting and high pressure water jets, to remove a surface coated with paint containing more than one per cent by dry weight of lead and handling waste containing lead resulting from the removal
- p. a process that exposes a person to lead dust or lead fumes arising from manufacturing or testing detonators or other explosives that contain lead
- q. a process that exposes a person to lead dust or lead fumes arising from firing weapons at an indoor firing range
- r. foundry processes involving:
 - melting or casting lead alloys containing more than one per cent by weight of lead metal in which the temperature of the molten material exceeds 450°C
 - dry machine grinding, discing, buffing or cutting by power tools lead alloys containing more than one per cent by weight of lead metal
- s. a process decided by the regulator to be a lead process under regulation 393.

12. Observed health effects and blood lead levels

Lead affects people of all ages, but the effects of lead are considered most serious in young children. Inorganic lead uptake occurs as a result of ingestion or inhalation of inorganic lead particles. Not only are particulates in air, like dusts and fumes, important sources of exposure in the workplace, but also from eating and smoking with contaminated hands due to poor personal hygiene.

The respiratory tract provides the most efficient route of absorption while gastrointestinal absorption is relatively poor in adults. When inhaled, most inorganic forms of lead deposited in the alveolar regions appear to be almost completely absorbed, although it is possible lead compounds of low solubility like lead sulphide may accumulate to some extent in the lung. Absorption of inhaled lead is affected by various factors including personal characteristics, physical activity, particle size and solubility of the airborne lead.

In 2007, Kosnett et al published *Recommendations for Medical Management of Adult Lead Exposure*, which shows a summary of the adverse health risks associated with different blood lead concentrations and presents corresponding medical management recommendations that range from discussion of risks and reductions of lead exposure at low levels to removal from lead exposure accompanied by probable chelation therapy at the highest levels, see Appendix 3.

The publication notes that research conducted in recent years has increased concern about the toxicity of lead at low blood lead levels and supports a reappraisal of the levels of lead exposure that may be safely tolerated in the workplace. Consistent with the American Conference of Governmental Industrial Hygienists (ACGIH) recommendations, it recommends individuals be removed from work lead exposure if a single blood lead measurement exceeds 30µg/dL.

It focuses on four categories of health effects – hypertension, renal function, cognitive dysfunction, and adverse reproductive outcome; however, it does not mention carcinogenicity. Since there is no dose-response relationship for cancer, the risk of this disease applies to all blood lead level bands. The designation of risks as either “short-term” or “long-term,” depending on whether the risks are associated with exposure lasting less than or more than one year, reflects a qualitative understanding of the duration of lead exposure that may be required to elicit certain adverse health effects of lead. The categorisation of risks in Appendix 3 by discrete bands of blood lead concentration is a qualitative assessment.

Inhibition of the mitochondrial enzyme, ferrochelatase, which is the next most sensitive enzyme, results in accumulation of free erythrocyte protoporphyrin (FEP) in the red blood cells primarily as zinc protoporphyrin (ZPP) and increased urinary excretion of coproporphyrin. Because ZPP remains in the erythrocyte for the average lifespan of the red blood cell, the blood ZPP level reflects averaged exposure over a three-month period.

Blood ZPP levels can therefore be used as a measure of lead exposure. There is a lot of individual variability in the protoporphyrin response to lead absorption and it is suggested results are compared with previous results from the same individual. Monitor the individual response rather than interpret a particular level. The protoporphyrin response lags behind the current blood lead level as an increase only becomes measurable in the peripheral blood as affected erythrocytes mature and are released from the bone marrow. The lag is around two to three months. It is recommended the testing for ZPP as a measure of lead exposure only be considered once removal limits have been reached¹. Continued removal from lead work is recommended until levels return to satisfactory levels.

13. Inorganic lead toxicity

One of the main targets of inorganic lead toxicity in adults is the nervous system—central and peripheral. Severe exposures may cause encephalopathy that is progressive degeneration of certain parts of the brain, coma or death. Historically, high, chronic workplace exposure to lead damages the peripheral nervous system, resulting in local paralysis, or ‘lead palsy’. Workers with lower levels of exposure may experience fatigue, irritability, depression, insomnia, headaches and subtle evidence of intellectual decline.

■ 1 Wooller, KK (2003) Occupational Medicine Handbook (Eleventh Edition), Information for WorkCover Authority of NSW Authorised Medical Practitioners.

Exposure to inorganic lead may also damage the formation and functioning of red blood cells. Anaemia is one of the most characteristic symptoms of high and prolonged exposure. Low to moderate exposure may result in cardiovascular effects, including increased blood pressure and electrocardiographic abnormalities.

When inorganic lead enters the body it does not undergo biological transformation. Lead is a cumulative poison. This means if more lead is being absorbed by the body than it is able to excrete, the amount stored in the body will increase over time.

Adults have an approximate 94 per cent body burden, that is more is stored in the body than circulated in the blood. Once in the body, lead is transported in the bloodstream, entering all body tissues. Only two to five per cent of the total body lead is found in red blood cells.

Lead is preferentially stored in the skeleton and in regions undergoing the most active calcification at the time of exposure—cortical and trabecular. Acute lead poisoning is uncommon today in work settings.

Distribution of lead to various organs has variable elimination rates. Soft tissue is fast whereas skeletal is slow. Blood lead clearance shortly after exposure changes is approximately 20-35 days - red blood cells have a half life of 120 days. Redistribution from bone, however, is much slower and takes approximately three to 30 years.

Body recovery is slower each time exposure occurs and body burden builds up over a lifetime. Clinical treatment using chelation therapy to reduce lead levels may decrease total lead body burden but not the risk of cognitive effects.

14. Carcinogen and reproductive toxicant classifications²

The following are examples of lead chemicals with GHS carcinogen and reproductive toxicant classifications:

- Lead hexafluorosilicate: Repr. 1A
- Silicic acid, lead nickel salt: Carc. 1A (May cause cancer by inhalation), Repr. 1A
- Lead compounds with the exception of those specified elsewhere in Annex VI: Repr. 1A
- Lead diazide: Repr. 1A
- Lead diazide, [\geq 20% phlegmatiser]: Repr. 1A
- Lead chromate: Carc. 1B, Repr. 1A
- Lead di(acetate): Repr. 1A
- Trilead bis(orthophosphate): Repr. 1A
- Lead acetate, basic: Carc. 2, Repr. 1A
- Lead(II) methanesulphonate: Repr. 1A
- Lead sulfochromate yellow: Carc. 1B, Repr. 1A
- Lead chromate molybdate sulfate red: Carc. 1B, Repr. 1A
- Lead hydrogen arsenate: Carc. 1A (May cause cancer), Repr. 1A

■ 2 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.

Key

Abbreviation	Meaning	Hazard statement
Carc. 1A	Carcinogenicity Category 1A	May cause cancer.
Carc. 1B	Carcinogenicity Category 1B	May cause cancer
Carc. 2	Carcinogenicity Category 2	Suspected of causing cancer
Repr. 1A	Reproductive Toxicity Category 1A	May damage the unborn child, suspected of damaging fertility

FURTHER READING

Association of Occupational and Environmental Clinics (AOEC), *Medical Management Guidelines for Lead-Exposed Adults* Revised 04/24/2007.

Sourced AOEC - <http://www.aoec.org/principles.htm>

Australian Institute of Occupational Hygienists Position Paper, *Inorganic Lead and Occupational Health Issues*, March 2009.

Cherrie JW, Semple S, Christopher Y, Saleem A, Hughson GW, Phillips A, 'How Important is Inadvertent Ingestion of Hazardous Substances at Work?', *Annals of Occupational Hygiene*, vol 50(7): pp 693-704, 2006. <http://annhyg.oxfordjournals.org/cgi/content/full/50/7/693>

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

Lead Development Association International (LDAI), *Voluntary Risk Assessment Report on Lead and Some Lead Compounds*, Human Health Section, Interim Revised Draft, March 2008, prepared by the ILZRO and EBRC consulting under contract to the LDAI Lead Risk Assessment Working Group.

Lundström N-G, Nordberg G, Englyst V, Gerhardsson L, Hagmar L, Jin T, Rylander L, Wall S, 'Cumulative Lead Exposure In Relation to Mortality and Lung Cancer Morbidity in a Cohort of Primary Smelter Workers', *Scand J Work Environ Health*, vol 23(1); pp 24-30, 1997.

Skerfving S, *Criteria Document for Swedish Occupational Standards: Inorganic Lead - an update 1991-2004*, The Swedish Group for Occupational Standards, Department of Occupational and Environmental Medicine, Lund, Sweden, 2005. <https://gupea.ub.gu.se/dspace/handle/2077/4356>

HEALTH MONITORING REPORT LEAD (INORGANIC)

APPENDIX 1

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 LEAD RISK WORK		(✓) all relevant boxes	
1. <input type="checkbox"/> New to lead work			
2. <input type="checkbox"/> New worker but not new to lead work			
3. <input type="checkbox"/> Current worker continuing in lead work			
4. Worked with lead since DD/MM/YYYY			

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5. DD/MM/YYYY		
6. DD/MM/YYYY		
7. RECOMMENDATIONS (by Medical Practitioner) (✓) all relevant boxes		
1. <input type="checkbox"/> Suitable for work with lead		
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 lead		On DD/MM/YYYY
6. <input type="checkbox"/> Medical examination by Medical Practitioner		On DD/MM/YYYY
7. <input type="checkbox"/> Fit to resume lead 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:

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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 disorders		<input type="checkbox"/> Yes	<input type="checkbox"/> No
Irritation of eyes, nose or throat		<input type="checkbox"/> Yes	<input type="checkbox"/> No
Cough		<input type="checkbox"/> Yes	<input type="checkbox"/> No
CNS		<input type="checkbox"/> Yes	<input type="checkbox"/> No
Peripheral nervous system symptoms		<input type="checkbox"/> Yes	<input type="checkbox"/> No
Others:		<input type="checkbox"/> Yes	<input type="checkbox"/> No
Pregnant		<input type="checkbox"/> Yes	<input type="checkbox"/> No
Breastfeeding		<input type="checkbox"/> Yes	<input type="checkbox"/> No
Smoker		<input type="checkbox"/> Yes	<input type="checkbox"/> No

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Height ____cm Weight ____kg Bp ____/____ mmHg		
5. OTHER MEDICAL HISTORY, FAMILY MEDICAL HISTORY, CURRENT MEDICATION, COMMENTS, TESTS OR RECOMMENDATIONS (use separate sheet if necessary)		
Medical Practitioner (responsible for supervising health monitoring)		
Name:	Signature	Date: DD/MM/YYYY
Tel:	Fax:	Registration Number:
Medical Practice:		
Address:		
Suburb:	Postcode:	

APPENDIX 2 COUNSELLING

Counselling is a process of dialogue between an individual worker and the various parties involved in the management of work exposure to lead.

Workers who are to start work in lead risk jobs or who work in lead risk jobs must be counselled on the health effects of lead. Workers excluded from working in lead risk jobs should also be counselled.

Counselling will usually be an informal discussion about a workplace or workstation, work practice, personal hygiene practice, and about the health effects of lead, between the worker and the medical practitioner at the time of attendance for biological monitoring. More formal discussion about these matters should take place during a medical examination carried out by the medical practitioner. If the worker is to be removed from work exposure to lead then there should be an emphasis on the health effects of lead and actions to prevent a recurrence of removal.

Workers who consider they have not completed their family should be counselled in particular on the effects of lead on male and female reproduction, as appropriate. Female workers working in lead-risk jobs should be counselled on the effects of lead on foetal and childhood development, in particular cognitive development. The level of counselling should be such that the worker can make an informed decision in regard to the risk to their own health and to a future foetus. Male workers should be told exposure to lead may adversely affect reproductive function. Female workers should be told exposure to lead during pregnancy may be associated with pregnancy complications and may pose a risk to the development of the foetus or eventual child.

Counselling may cover the following topics:

Physical maturity. As a guide people under the age of 16 should not be employed in lead processes.

Medical conditions. Individuals with certain medical conditions, for example impaired renal function and anaemia, haemoglobinopathies, neuropathies and reproductive problems may be more susceptible to adverse health effects of lead.

Lead accumulation in the body, particularly in bones. This can be mobilised in some circumstances including pregnancy and old age.

Females of reproductive capacity should be informed about the reproductive hazards where blood lead level may exceed 10µg/dL (0.48µmol/L). It is highly recommended that in order to give maximum protection to the foetus, women who are planning a pregnancy should endeavour to limit lead to a level **well below** 10µg/dL (0.48µmol/L) for a period of at least a year prior to pregnancy.

Statistics show one in four pregnancies in Australia is unplanned, and because there is limited information on bone-lead mobility during pregnancy it is prudent to maintain blood lead levels for females who may later become pregnant below 20µg/dL (0.97 µmol/L).

It is for these reasons females of reproductive capacity should endeavour not to seek employment in lead risk jobs.

In certain circumstances, conception methods like *in vitro* fertilisation may need to be considered in assessing reproductive capacity.

Infants are more susceptible to the health effects of lead than adults. A breast feeding worker should keep her blood lead level below 10µg/dL (0.48 µmol/L) and as low as possible.

APPENDIX 3

Health-based management recommendations for lead-exposed adults*

Blood lead level ($\mu\text{g}/\text{dL}$)	Short-term risks (lead exposure < 1 year)	Long-term risks (lead exposure ≥ 1 year)	Medical Management Recommended
< 5	None documented	None documented	None indicated
5-9	Possible spontaneous abortion Possible postnatal developmental delay	Possible spontaneous abortion Possible postnatal developmental delay Possible hypertension and kidney dysfunction	Discuss health risks Reduce lead exposure for women who are or may become pregnant
10-19	Possible spontaneous abortion Possible postnatal developmental delay Reduced birth weight	Possible spontaneous abortion Reduced birth weight Possible postnatal developmental delay Hypertension and kidney dysfunction Possible subclinical neurocognitive deficits	As above for BLL 5-9 $\mu\text{g}/\text{dL}$, plus: Decrease lead exposure Increase biological monitoring Consider removal from lead exposure to avoid long-term risks if exposure control over an extended period does not decrease BLL < 10 $\mu\text{g}/\text{dL}$, or if medical condition present that increases risk with continued exposure ^a
20-29	Possible spontaneous abortion Possible postnatal developmental delay Reduced birth weight	Possible spontaneous abortion Possible postnatal developmental delay Reduced birth weight Hypertension and kidney dysfunction Possible subclinical neurocognitive deficits	Remove from lead exposure if repeat BLL measured in 4 weeks remains ≥ 20 $\mu\text{g}/\text{dL}$
30-39	Spontaneous abortion Possible postnatal developmental delay Reduced birth weight	Spontaneous abortion Reduced birth weight Possible postnatal developmental delay	Remove from lead exposure

* Table is reproduced from: Recommendations for Medical Management of Adult Lead Exposure, Michael J Kosnett, Richard P Wedeen, Stephen J Rothenberg, Karen L Hipkins, Barbara L Materna, Brian S Schwartz, Howard Hu, and Alan Woolf. Environmental Health Perspectives, Volume 115, Number 3, March 2007.

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	(lead exposure < 1 year)	(lead exposure ≥1 year)	Medical Management Recommended
		Hypertension and kidney dysfunction Possible neurocognitive deficits Possible nonspecific symptoms ^b	
40-79	Spontaneous abortion Reduced birth weight Possible postnatal developmental delay Nonspecific symptoms ^b Neurocognitive deficits Sperm abnormalities	Spontaneous abortion Reduced birth weight Possible postnatal developmental delay Nonspecific symptoms ^b Hypertension Kidney dysfunction/nephropathy Subclinical peripheral neuropathy Neurocognitive deficits Sperm abnormalities Anemia Colic Possible gout	Remove from lead exposure Refer for prompt medical evaluation Consider chelation therapy for BLL > 50 µg/dL with significant symptoms or signs of lead toxicity
≥80	Spontaneous abortion Reduced birth weight Possible postnatal developmental delay Nonspecific symptoms ^b Neurocognitive deficits Encephalopathy Sperm abnormalities Anemia Colic	Spontaneous abortion Reduced birth weight Possible postnatal developmental delay Nonspecific symptoms ^b Hypertension Nephropathy Peripheral neuropathy Neurocognitive deficits Sperm abnormalities Anemia Colic Gout	Remove from lead exposure Refer for immediate/urgent medical evaluation Probable chelation therapy
<p>BLL = blood lead level.</p> <p>a. Medical conditions that may increase the risk of continued exposure include chronic renal dysfunction (serum creatinine > 1.5 mg/dL for men and > 1.3 mg/dL for women, or proteinuria), hypertension, neurologic disorders, and cognitive dysfunction.</p> <p>b. Non-specific symptoms may include headache, fatigue, sleep disturbance, anorexia, constipation, arthralgia, myalgia, and decreased libido.</p>			