

**NATIONAL CODE OF PRACTICE
FOR THE CONTROL AND SAFE USE OF
INORGANIC LEAD AT WORK
[NOHSC:2015(1994)]**

1. TITLE	37
2. PURPOSE	38
3. SCOPE AND APPLICATION	39
4. DEFINITIONS	40
5. CONSULTATION	41
How Consultation Should Take Place	41
What Consultation Should Address	41
Information that Should be Available	41
6. PROVISION OF INFORMATION — SUPPLIERS' DUTIES	42
Material Safety Data Sheets	42
Labels	42
Other Relevant Information	43
7. PROVISION OF INFORMATION — EMPLOYERS' DUTIES	44
Information for Job Applicants	44
Material Safety Data Sheets	44
Labels	45
Registers	45
Other Relevant Information	45
8. INDUCTION AND TRAINING	46
Employer Responsibilities	46
Those Employees Needing Induction and Training	46
Elements of an Induction and Training Program	46
Training Methods	47
Review of Induction and Training	48
Records of Induction and Training	48

9. ASSESSMENT	49
Purpose of Assessment	49
The Assessment Duty	49
Generic Assessments	51
Suitable and Sufficient Assessment	51
Recording of Assessment Reports	51
Revision of Assessment Reports	51
Length of Time Assessment Reports Must be Kept	52
Access to Assessment Reports	52
10. CONTROL	53
Consideration of Necessary Control Measures	53
Role of Exposure Standard	53
Program for Control Measures	53
Hierarchy of Control Measures	54
Containment of Lead Contamination	56
Cleaning and Prohibition of Some Cleaning Methods	57
Eating, Drinking and Smoking	58
Changing Rooms, Washing, Showering and Toilet Facilities	58
Administrative Control Measures	60
Personal Protective Equipment	60
Maintenance, Examination and Test of Control Measures	63
Emergency Procedures	64

11. ATMOSPHERIC MONITORING	65
What Atmospheric Monitoring is	65
A Competent Person to Undertake Atmospheric Monitoring	65
When Atmospheric Monitoring is Required	65
Lead in Air Levels Requiring Review of Control Measures	65
Procedures for Monitoring	65
Results from Atmospheric Monitoring	65
How Atmospheric Monitoring Results Should be Kept	66
Length of Time Atmospheric Monitoring Results Must be Kept	66
Access to Atmospheric Monitoring Results	66
12. EXCLUSION FROM WORKING IN A LEAD-RISK JOB	67
13. HEALTH SURVEILLANCE	68
Purpose of Health Surveillance	68
Those Employees Requiring Health Surveillance	68
Responsibility for Health Surveillance	68
Biological Monitoring	68
Employer Responsibilities	69
A Suitably Trained Medical Practitioner	70
The Authorised Medical Practitioner's Responsibilities	70
14. COUNSELLING	72
15. MEDICAL EXAMINATIONS	74
Schedule for Medical Examinations	74
Length of Time Health Surveillance Results Shall be Kept	75

16. RECORD KEEPING	76
What the Employer Needs to Keep as Records	76
Storage of Records	76
When an Employer Ceases to Trade	76
17. EMPLOYEES' DUTIES	77
Employee Responsibilities	77
18. RELEVANT PUBLIC AUTHORITIES AND EMERGENCY SERVICES	78
Access to Information	78
APPENDIXES	
1. PROTECTIVE CLOTHING	79
2. AIR SAMPLING TECHNIQUES AND STRATEGIES	81
3. LABELLING	86
4. ASSESSMENT	87
5. HIERARCHY OF CONTROL MEASURES	90
6. ATMOSPHERIC MONITORING	94
REFERENCED DOCUMENTS	95
MEMBERSHIP OF THE LEAD WORKING GROUPS	97

1. TITLE

1.1 This national code of practice may be cited as the *National Code of Practice for the Control and Safe Use of Inorganic Lead at Work* [NOHSC:2015(1994)].

2. PURPOSE

2.1 This national code of practice provides a practical guide on how to comply with the *National Standard for the Control of Inorganic Lead at Work* [NOHSC:1012(1994)] so as to minimise risk of disease and injury due to exposure to lead in the workplace. It can be used to develop specific workplace programs for the control of exposure to inorganic lead.

3. SCOPE AND APPLICATION

3.1 This national code of practice is specifically concerned with occupational exposure to inorganic lead. It does not apply to occupational exposure to organic lead, specifically lead alkyls.

4. DEFINITIONS

4.1 The *National Standard for the Control of Inorganic Lead at Work's* [NOHSC:1012(1994)] section 7, Interpretation, should be consulted for definitions of terms used in this national code of practice. Additional terms and information are included below.

‘Competent Laboratory’ means a laboratory with sufficient equipment, personnel and expertise to be able to carry out the determination of lead in whole blood according to relevant Australian Standards or by an alternative method of equivalent accuracy and precision. Accreditation by the National Association of Testing Authorities (NATA) and participation in an inter-laboratory quality control scheme is recommended.

‘Competent person’ means a person who has, through a combination of training, education and experience, acquired knowledge and skills enabling that person to perform correctly a specified task.

‘Confirmed blood lead’ should be sampled in accordance with Australian Standard (AS) AS 2636¹ and determined in accordance with AS 2411².

‘Material Safety Data Sheet (MATERIAL SAFETY DATA SHEET)’. Guidance on the compilation of a Material Safety Data Sheet may be found in the National Occupational Health and Safety Commission document *National Code of Practice for the Preparation of Material Safety Data Sheets* [NOHSC:2011(1994)]³ (as amended from time to time).

5. CONSULTATION

Consultation involves the sharing of information and exchange of views between employers, employees and employee representatives. It provides the opportunity to contribute to timely decision-making to resolve any problems.

HOW CONSULTATION SHOULD TAKE PLACE

5.1 Consultation between employers, employees and employee representatives should take place during the implementation of the *National Standard for the Control of Inorganic Lead at Work* [NOHSC:1012(1994)]. Employee representatives should have access to all information relating to lead exposure and relevant lead processes which is available to employees.

WHAT CONSULTATION SHOULD ADDRESS

5.2 The consultation process should address the general implementation of the *National Standard for the Control of Inorganic Lead at Work* [NOHSC:1012(1994)] and in particular:

- (a) any supply of a new lead-containing substance to the workplace and introduction of new lead processes;
- (b) the assessment of lead exposure;
- (c) control measures;
- (d) the requirements for health surveillance including the choice of an authorised medical practitioner; and
- (e) the induction and training required.

INFORMATION THAT SHOULD BE AVAILABLE

5.3 The following information for all lead-containing hazardous substances and processes involving the use of lead should be available to employees and employee representatives:

- (a) the register of lead-containing hazardous substances used in the workplace;
- (b) Material Safety Data Sheets compiled in accordance with the National Commission's *Code of Practice for Preparation of Material Safety Data Sheets* [NOHSC:2011(1994)]³,
- (c) labels on containers compiled in accordance with the National Commission's *Code of Practice for the Labelling of Workplace Substances* [NOHSC:2012(1994)]⁴,
- (d) reports prepared as a result of workplace assessment;
- (e) the results of atmospheric monitoring;
- (f) the results of health surveillance programs provided that medical confidentiality is maintained; and
- (g) any other relevant information.

6. PROVISION OF INFORMATION — SUPPLIERS' DUTIES

The purpose of this Chapter is to establish a chain of communication from suppliers to end users. The material communicated shall include Material Safety Data Sheets (MSDS) and labels. Suppliers shall also provide, on request, other relevant information on their products.

The Material Safety Data Sheet Repository is a national collection which can provide alternative access to Material Safety Data Sheet.

MATERIAL SAFETY DATA SHEETS

6.1 The purpose of Material Safety Data Sheet is to provide the information needed to allow the safe handling of hazardous substances used at work. The Material Safety Data Sheet of a substance describes its identity, relevant health hazard information, precautions for use and safe handling information. A Material Safety Data Sheet should be in accordance with the National Commission's *National Code of Practice for the Preparation of Material Safety Data Sheets* [NOHSC:2011(1994)]³.

Production of Material Safety Data Sheets

6.2 Manufacturers and importers shall produce Material Safety Data Sheets for lead-containing hazardous substances which they supply.

Supply of a Material Safety Data Sheet

6.3 A supplier shall provide a Material Safety Data Sheet:

- (a) on or before the first supply of a lead-containing hazardous substance to each purchaser; and
- (b) on request.

Australian National Material Safety Data Sheet Repository

6.4 Manufacturers and importers shall send a copy of each Material Safety Data Sheet to the Australian National Material Safety Data Sheet Repository.

LABELS

6.5 The purpose of labelling is to make sure that the contents within a container can be readily identified by product name. The label should also provide sufficient information to permit the safe use of a lead-containing substance in the workplace.

Labelling of Substances

6.6 Guidance on the labelling of lead-containing substances is given in the National Occupational Health and Safety Commission's *National Code of Practice for the Labelling of Workplace Substances* [NOHSC:2012(1994)]⁴.

Responsibility For Labelling

6.7 Suppliers are responsible for the correct labelling of lead-containing substances which they supply to others.

OTHER RELEVANT INFORMATION

6.8 Suppliers are responsible for providing, on request, National Industrial Chemicals Notification and Assessment Scheme (NICNAS) Summary Reports⁵ that have been prepared, and any further information regarding the safe use of lead-containing hazardous substances they supply.

7. PROVISION OF INFORMATION — EMPLOYERS' DUTIES

The purpose of this Chapter is to establish a flow of information from employers to employees and employee representatives. The information which shall be available includes labels, Material Safety Data Sheets, registers and assessment reports.

INFORMATION FOR JOB APPLICANTS

7.1 Employers shall ensure that the information supplied to job applicants includes as a minimum the following:

- (a) lead is a toxic substance which is retained within the body long-term;
- (b) lead can affect the nervous and reproductive systems, kidneys and interfere with the ability of the body to make haemoglobin;
- (c) the unborn child and infants are particularly susceptible to the effects of lead and, on this basis, employees who are pregnant or breastfeeding are excluded from working in lead-risk jobs;
- (d) in accordance with (b) and (c) above, some people may be assessed as unsuitable for employment in lead-risk jobs;
- (e) employees should cooperate with employers to minimise their exposure to lead; and
- (f) it is a condition of employment that employees periodically have appropriate blood tests and medical examinations. The purpose of this is to protect employees' health by confirming that employees are not excessively exposed to lead.

MATERIAL SAFETY DATA SHEETS

7.2 Employers shall ensure that all employees and employee representatives have ready access to and are encouraged to read Material Safety Data Sheets, for lead-containing hazardous substances, which they may be exposed to in their work.

Obtaining material safety data sheets

7.3 Employers should obtain a Material Safety Data Sheet from the supplier of lead-containing hazardous substances as far in advance of the first supply as is practicable.

If the Employer is an Importer

7.4 Where an employer imports a lead-containing hazardous substance to be used at the workplace, a material safety data sheet set out in accordance with the National Occupational Health and Safety Commission's *National Code of Practice for Preparation of Material Safety Data Sheets* [NOHSC:2011(1994)]³ may not be immediately available. In these circumstances the employer should, after consultation with employees and employee representatives, arrange for the overseas material safety data sheet to be made available as an interim measure, pending the production by the employer of an appropriate Material Safety Data Sheet.

If the Employer is a Manufacturer

7.5 Where the employer manufactures a lead-containing hazardous substance, the employer shall produce a Material Safety Data Sheet for that substance.

LABELS

7.6 All containers of substances supplied to, used in or handled in the workplace should be labelled to allow people to use lead-containing substances safely.

7.7 If a container does not have a label or is improperly labelled, action should be taken to correctly label the container in accordance with the requirements of the National Occupational Health and Safety Commission's *National Code of Practice for the Labelling of Workplace Substances* [NOHSC:2012(1994)]⁴.

REGISTERS

7.8 The register provides a listing of all lead-containing hazardous substances which are used or produced in the workplace. The register should be updated as new lead-containing hazardous substances are introduced into the workplace and the use or production of existing lead-containing hazardous substances is discontinued. Employers, employees and employee representatives should use the register as a source of information and as a tool to manage these substances used at work.

7.9 The minimum information which shall be included in the register is the Material Safety Data Sheet for all lead-containing hazardous substances which are used or produced in the workplace. The completion of assessments should also be noted in the register.

Access to the Register

7.10 Employees with the potential for exposure to lead-containing hazardous substances, employee representatives, emergency services and relevant public authorities shall have ready access to the registers. The register can be centrally located or kept in the workplace to which it pertains.

OTHER RELEVANT INFORMATION

7.11 Employers should make other relevant information regarding all lead-containing hazardous substances available to employees and employee representatives. This will be necessary for lead-containing hazardous substances produced in the workplace for which a Material Safety Data Sheet is not available. Information should be obtained about health effects, precautions for use and safe handling.

7.12 Employers should provide relevant information to employees and employee representatives on equipment used with lead-containing hazardous substances. The employer should make the following information available:

- (a) the use for which the equipment is designed and the conditions necessary for its safe use; and
- (b) results of relevant tests which have been carried out in connection with the safe operation of such equipment.

8. INDUCTION AND TRAINING

The purpose of induction and training is to provide employees with the skills and knowledge needed to apply information provided to them, and to use the control measures including personal protective equipment and emergency procedures provided for their protection. Induction and training should also enable participation in decisions about the use of lead-containing hazardous substances at work.

EMPLOYER RESPONSIBILITIES

8.1 Employers have the responsibility to induct and train employees with potential for exposure to lead-containing hazardous substances. The training provided shall be commensurate with the associated risks as identified in the assessment process. The employer shall give particular attention to induction, training and control measures for those employees who, because their removal levels are lower than the maximum blood lead level defined for a lead-risk job, are at higher risk.

THOSE EMPLOYEES NEEDING INDUCTION AND TRAINING

8.2 Training should be provided to:

- (a) those employees whose work potentially exposes them to lead; and
- (b) those employees who are supervising others using lead-containing hazardous substances at work.

ELEMENTS OF AN INDUCTION AND TRAINING PROGRAM

8.3 The amount of detail and extent of training required in an induction and training program will depend on the nature of the hazard associated with the work activity, the complexity of the work procedures and control measures required to minimise the risk of exposure. In this regard, the assessment process provides important guidance.

8.4 An induction and training program appropriate to the workplace where lead processes are carried out should incorporate the:

- (a) information about lead-containing hazardous substances to which employees are or may be exposed in the course of their work. Information should include the nature of the hazard, risks to health arising from exposure, the degree of exposure and routes of entry into the body of lead (special attention should be paid to effects on the nervous and reproductive systems, pregnancy and foetal development);
- (b) assessment process and how the employee can contribute;
- (c) measures used to control exposure to lead-containing hazardous substances, including any information that the employee requires for the correct use and maintenance of control measures;

- (d) work practices and procedures to be followed in the use, handling, processing, storage, transportation, cleaning up and disposal of lead-containing hazardous substances;
- (e) importance of minimising the creation of lead dust or fumes in the workplace atmosphere, and the specific nature of operations which could result in lead exposure;
- (f) proper use and fitting of personal protective equipment, as well as any special decontamination procedures to be followed, if required by employees required to use personal protective equipment;
- (g) nature of, and reasons for, any atmospheric monitoring, if required and access to the results of monitoring;
- (h) reasons for exclusions which apply to employment in a lead-risk job;
- (i) nature of, and reasons for, any health surveillance required in order to detect the effects of exposure to lead-containing hazardous substances;
- (j) importance of maintaining a high level of personal hygiene and not smoking in the workplace;
- (k) procedures to be followed in case of an emergency involving lead-containing hazardous substances;
- (l) first aid and incident reporting procedures to be followed in case of injury or illness;
- (m) labelling of containers of lead-containing substances, the information that each part of the label provides and why the information is being provided;
- (n) availability of Material Safety Data Sheets for lead-containing hazardous substances, how to access the Material Safety Data Sheet and the information that each part of the Material Safety Data Sheet provides;
- (o) employees' rights to be advised of the intention to use a new lead-containing hazardous substance where they are likely to be exposed in the course of their work and the right to be consulted in the process of assessment of a lead-containing hazardous substance;
- (p) employees' rights and obligations in relation to health surveillance; and
- (q) suppliers', employers' and employees' duties under the *National Standard for the Control of Inorganic Lead at Work* [NOHSC:1012(1994)].

TRAINING METHODS

8.5 In general, induction and training programs should be designed to draw on and build on employees' current knowledge and previous experience. Language and literacy factors should be taken into account in determining the most suitable training methods. If the literacy level is low, then verbal methods or visual methods should be used. If the employees are of a non-English speaking background then training should be provided in appropriate languages used by employees in the workplace. The training provided should be practical and include hands-on

training where this is relevant, for example, proper use and fitting of personal protective equipment, routine and emergency procedures.

8.6 Training should be evaluated to ensure that employees have an adequate understanding of the matters covered.

REVIEW OF INDUCTION AND TRAINING

8.7 Employers should review the content of induction and other training when there is a significant change in the hazard information available, work practices or control measures in order to ensure that employees are aware of significant changes.

RECORDS OF INDUCTION AND TRAINING

8.8 The employer shall keep a record of the induction and training programs provided. Records should include:

- (a) the names of employees receiving training and date of attendance;
- (b) an outline of the course content; and
- (c) the names of persons providing the induction and training.

9. ASSESSMENT

PURPOSE OF ASSESSMENT

9.1 The purpose of assessment is to evaluate the health and safety risks to employees arising from the use of lead-containing hazardous substances in the workplace, and to determine the control measures necessary to minimise these risks to enable decisions to be made.

9.2 An assessment is the critical appraisal of the use of lead-containing hazardous substances in the workplace, with particular emphasis on the potential risk of exposure to employees.

THE ASSESSMENT DUTY

9.3 The employer has the responsibility to ensure that a suitable and sufficient assessment is made of any work involving potential exposure to any lead-containing hazardous substance. It is expected that the employer or manager of the workplace in consultation with employees and employee representatives will conduct the assessment.

9.4 It is only necessary to assess work where there is potential for exposure. For example, work involving the handling of unopened containers of lead-containing hazardous substances would not need to be assessed if those containers are unlikely to be opened or damaged. However, if those containers are opened or damaged so that exposure to the contents might occur, an assessment would be required.

9.5 The assessment focuses on work situations rather than individual substances. A practical way to carry out assessments in a workplace would be to divide the work up into jobs or tasks and assess the risks involved in each of these.

9.6 The employer should ensure that an assessment of exposure of employees to lead is carried out by a person with appropriate qualifications and knowledge. Relevant professional consultants, for example, occupational hygienists, may assist with elements of an assessment which require special expertise. This person should have received sufficient information, instruction and training about the hazards, work processes and engineering controls regarding lead exposure specific to the workplace which is being assessed.

9.7 Initially an assessment should include:

- (a)** identification of lead-containing hazardous substances used or produced in the workplace;
- (b)** observation of the lead processes which should be categorised into identifiable units, for example handling, transport, storage, processing, manufacturing and maintenance;
- (c)** identification of:
 - (i)** those employees involved in lead processes and an assessment of the frequency and duration of their exposure, taking account of changing work patterns, and
 - (ii)** identification of other employees who may be exposed to lead, for example, outside contractors carrying out maintenance work;

- (d) determination of the atmospheric lead levels in the breathing zone of exposed employees which should be measured by the method described in Appendix 2 or some other method which has a standard of accuracy equivalent to, or better than, this method;
- (e) collation of the results of atmospheric monitoring;
- (f) collation of the results of biological monitoring of employees employed in each lead process over the 12 months prior to the assessment; and
- (g) assessment of the risk to health and safety.

9.8 The employer should also ensure that analyses of samples collected during atmospheric lead monitoring are performed by a competent laboratory.

9.9 If the assessment shows that there is no likelihood of risk to health from the way lead-containing hazardous substances are used at the workplace, the assessment is complete and no further precautions need to be taken.

9.10 If the assessment shows that there is a risk to health or safety, that is the job is a lead-risk job, further decisions will need to be taken to:

- (a) select appropriate measures to achieve and sustain control;
- (b) ensure that those hazard control measures are properly used and maintained; and
- (c) arrange induction and training.

9.11 The relevant public authority needs to be advised when a workplace becomes one at which a lead-risk job takes place.

9.12 The employer should assess the exposure to lead of the following employees:

- (a) those engaged in lead processes; and
- (b) those who could be affected by lead due to, for example, proximity to the lead process.

9.13 The results of the individual assessments in subsections 9.7 (c) to (e) should be grouped under the units of the lead processes identified in subsection 9.7 (b). This should facilitate quick and ready identification of those areas which may present a lead exposure hazard to employees so that control measures can be implemented.

9.14 Where a new lead process is being undertaken, the potential lead exposure should be estimated before the work commences so that appropriate control measures can be initiated to minimise potential lead exposure.

Lead-risk Job

9.15 The results of assessments carried out under subsection 9.3 should be used to identify lead-risk jobs.

Such jobs may be those where there is continued working exposure to a TWA atmospheric lead level of 0.03 mg/m³ (which correlates to some degree with a blood lead level approximately 1.45 µmol/L (30 µg/dL), intermittent high exposures of airborne lead dust or fumes, or exposure to lead-containing dusts on surfaces or to lead-containing pastes.

The assessment of lead risk should take into account the levels, frequency and duration of exposure. Historical blood lead levels will also provide a useful guide.

9.16 The employer should provide employees with results and employee representatives with the aggregate results of lead exposure assessments of employees in the designated work group. The employers should consult with employees and employee representatives about what actions are being undertaken to minimise the risk of lead exposure where this exists.

9.17 The evaluation of the results of assessment should be carried out by the employer in consultation with the employees and their representatives.

GENERIC ASSESSMENTS

9.18 Often lead-containing hazardous substances are used in the same or similar circumstances in a number of different workplaces, for example, radiator repair, spray painting workshops and fire assay laboratories, or locations within the one workplace. In such situations, the nature of the hazard and the degree of risk may be comparable. Accordingly, a single assessment of one representative work situation can be applied to other workplaces where the circumstances of use of lead-containing hazardous substances are essentially the same.

9.19 Such generic assessments for lead-containing hazardous substances may be undertaken where a single employer controls many similar workplaces or by a trade association on behalf of a number of different employers with essentially identical workplaces. In each case the individual employer retains the responsibility to ensure the generic assessment is valid for that workplace.

SUITABLE AND SUFFICIENT ASSESSMENT

9.20 An assessment is considered to be suitable and sufficient if it is carried out by a competent person and is in accordance with procedures given in this national code of practice and the *Guidance Note for the Assessment of Health Risks Arising from the Use of Hazardous Substances in the Workplace* [NOHSC:3017(1994)]⁶.

RECORDING OF ASSESSMENT REPORTS

9.21 Assessment reports shall be recorded to demonstrate compliance with the national lead standard and as a guide to operations in the workplace.

9.22 Assessment reports should reflect the detail of the assessment and record sufficient information to show why decisions about risks and precautions have been arrived at.

REVISION OF ASSESSMENT REPORTS

9.23 The assessment for a particular operation involving lead should be revised if:

- (a) recommended in an earlier assessment;

- (b) the process, plant or lead-containing hazardous substance is modified;
- (c) new information on the hazards of lead becomes available, for example, when a revised exposure standard is adopted;
- (d) atmospheric monitoring or health surveillance indicate inadequate exposure control; or
- (e) new or improved control measures become practicable.

9.24 In any case, the validity of the assessment shall be reviewed at least every five years. A total new assessment may not be required, particularly if the operation and degree of exposure to employees is similar to that initially assessed.

LENGTH OF TIME ASSESSMENT REPORTS MUST BE KEPT

9.25 Assessment reports indicating a need for atmospheric monitoring and/or health surveillance, in keeping with subsection 9.23, shall be retained by the employer for a period of not less than 30 years.

9.26 Assessment reports not indicating a need for atmospheric monitoring and/or health surveillance, in keeping with subsection 9.23 shall be retained by the employer for a period of not less than five years.

9.27 The time periods stated above are taken from the last entry into that report or after it is superseded by a new assessment report.

9.28 Notwithstanding the requirements stated above, an assessment report should be retained by the employer for seven years after cessation of the use of lead-containing hazardous substances or a process in which they are used.

ACCESS TO ASSESSMENT REPORTS

9.29 Assessment report should be kept in a convenient location on or near to the work area so as to be accessible to all employees with potential for exposure to lead-containing hazardous substances, employee representatives and relevant public authorities.

9.30 Further information on assessment is at Appendix 4 of this national code of practice.

10. CONTROL

The purpose of control measures is to prevent, or where that is not practicable, control exposure to lead-containing hazardous substances so as to minimise employee exposure to lead. So far as practicable, the prevention or control of lead-containing hazardous substances shall be secured by measures other than the provision of personal protective equipment. Control measures should be implemented in accordance with the hierarchy of controls.

CONSIDERATION OF NECESSARY CONTROL MEASURES

10.1 Exposure to lead should be either prevented or, where that is not practicable, adequately controlled so as to minimise risks to health using the hierarchy of control measures detailed in subsection 10.12.

10.2 Control measures are not mutually exclusive and in some circumstances it will be appropriate for the employer to use two or more control measures to reduce exposure to as low a level as is practicable.

10.3 Consideration of the methods used to control exposure to lead should be an integral part of the planning of any new workplace or modifications to an existing workplace. The costs of the control should be considered in the same way, and at the same time, as all the other plant and process costs.

10.4 When considering methods to control exposure, all the possible routes of entry of lead should be taken into account.

ROLE OF EXPOSURE STANDARD

10.5 Employers shall ensure that employee exposure to lead is not greater than the lead exposure standard listed in the National Occupational Health and Safety Commission's *Adopted National Exposure Standards for Atmospheric Contaminants in the Occupational Environment* [NOHSC:1003(1991)]⁷, as amended from time to time.

10.6 Compliance with this exposure standard should not preclude further efforts to reduce exposure. Exposure standards do not represent 'no effect' levels at which every employee can be guaranteed protection. Therefore, it is a good general policy to keep the level of exposure to lead as low as is practicable.

PROGRAM FOR CONTROL MEASURES

10.7 Each employer should establish and implement a written program on the procedures to be adopted to reduce atmospheric lead exposure to below the exposure standard. Control measures should be adequately documented and reviewed at regular intervals.

10.8 The control program should be developed in consultation with employees and employee representatives, and copies made available to them.

10.9 The control of lead in the workplace should not be at the expense of the external environment (which is controlled by other legislation). Where emissions of lead dust or fumes to the general environment may occur, permissible emission levels of the appropriate jurisdiction regulations should not be exceeded.

10.10 Control measures should always be set in the context of the total work environment with the aim of reducing exposure to lead through all stages of the work cycle. Methods of work should be planned and implemented to minimise lead exposure as far as practicable. For example, when exhaust booths are used for weighing out lead materials, attention should be given to how the materials are brought to the booth and how they are handled after work has been completed inside the booth. It is not sufficient to concentrate only on one aspect of the work and neglect other aspects which can be equally hazardous.

10.11 Effectiveness of control measures should be assessed by:

- (a) static atmospheric monitoring;
- (b) personal lead in air monitoring (in the breathing zone of the employee); and
- (c) biological monitoring of employees in lead-risk jobs.

HIERARCHY OF CONTROL MEASURES

10.12 Control of exposure to lead should be achieved as far as practicable through application of the following hierarchy of hazard control measures:

- (a) elimination;
- (b) substitution;
- (c) isolation;
- (d) engineering control measures;
- (e) adoption of safe work practices;
- (f) administrative control measures; and
- (g) suitable, approved personal protective equipment where other effective means of controlling lead exposure are not practicable.

Use of the hierarchy of control measures involves a series of graduated actions which an employer should undertake to control lead exposure in the workplace. Consideration of the possible control measures should continue down the hierarchy until a control measure or a combination of measures can achieve the required reduction in exposure. The hierarchy of control measures in the sequence in which they should be implemented is given below and in more detail at Appendix 5 of this national code of practice.

Elimination, Substitution and Isolation

10.13 Where a work activity involving the use of a lead-containing hazardous substance is not essential, these substances should be eliminated wherever practicable.

10.14 Substitution includes:

- (a) the use of materials with a lower lead content; and
- (b) the use of lead compounds in emulsion, paste or other wet forms which will prevent or minimise the formation of dusts.

10.15 Isolation of the lead process by distance, or by the employment of barriers can be used to prevent employee exposure, for example, the containment of lead dust or fumes in a totally enclosed plant and in enclosed containers such as drums and bags. The enclosure should not allow lead dust or fumes to leak out and where opening of the enclosure is required, this should be done under exhaust ventilation.

Engineering Controls

10.16 Engineering controls are plant, processes or systems of work which minimise the generation of lead dust or fumes, suppress or contain lead dust or fumes or which limit the area of contamination in the event of spills and leaks.

10.17 Engineering controls are the single most effective means of control.

10.18 Engineering control measures adopted to reduce atmospheric lead levels could include, where appropriate and practicable, one or more of the following:

- (a) The use of temperature controls to maintain the temperature of molten lead below 450°C, at which level fume emission is less significant. However, it should be noted that the formation of lead oxide and the generation of dust is still possible below this temperature.
- (b) Where total enclosure is not practicable, an effective local exhaust ventilation system, which should consist of all of the following:
 - (i) Partial enclosures such as booths which contain lead emission at the source and prevent its escape outside the enclosure by the application of an exhaust draught.
 - (ii) Various types of hoods in which the air movement entrains lead dust, fumes or vapour and draws the airborne lead away from the employees' breathing zone.
 - (iii) Duct work with an airflow of adequate conveying velocity to transport the lead contaminate.
 - (iv) Dust and/or fume collection units with filtration or arrestment facilities such as a baghouse, wet scrubber or electrostatic precipitator. Lead contaminated air from the exhaust system should not be discharged after filtration from the system into work areas.

- (v) Fans or other air movers of a suitable type for the system. These should be placed in the system after the collection and filtration unit so that the unit is kept under negative pressure thus minimising the escape of lead.

10.19 Exhaust ventilation should be designed and installed by a person trained and experienced in industrial ventilation. Equipment should include provision for the routine measurement of static pressure behind each hood.

10.20 Care should be taken to avoid creating external ledges on plant on which lead dust can settle. Plant surfaces should be smooth and impervious to facilitate cleaning; joints and seals should be maintained to prevent leakages.

Safe Work Practices

10.21 Safe work practises are administrative practices which require people to work in safer ways, for example, wet work methods.

10.22 Wet work methods could include the wetting of lead materials and surfaces during activities such as grinding and rubbing or scraping down lead painted surfaces, and wetting of floors and work benches while work is being carried out, for example, during some handling of dry lead compounds and pasting processes in the manufacture of batteries.

10.23 The wetting process should be thorough enough to prevent the formation of dust. Any wetted materials or surfaces should not be allowed to dry out as this can create dry lead dust which is liable to be hazardous if it becomes airborne.

10.24 Wetting should not be used where such methods are liable to be unsafe, as at furnaces where the use of wet methods could constitute an explosion risk or where electrical safety cannot be maintained. Wetting should not be used where lead materials containing arsenides or antimonides could, on contact with water, evolve arsine or stibine gases. Methods should not be used which result in splashing of employees' clothing with materials containing lead.

10.25 Water sprays should not normally be used to control an airborne dust cloud as they are unlikely to be effective.

CONTAINMENT OF LEAD CONTAMINATION

10.26 Lead should not be spread outside lead process areas, resulting in the exposure to lead of:

- (a) employees not engaged in a lead process;
- (b) other persons, such as families of employees; or
- (c) the general public in the surrounding environment.

10.27 This can be achieved by:

- (a) the control of lead in areas where the lead process is being carried out; and
- (b) the control of all lead emissions from these areas by whatever means they are carried, for example, air, water, vehicle wheels, shoes, etc.

10.28 The control measures recommended should, if properly used and maintained, contain most of the lead within the lead process areas.

10.29 Some ways of preventing the spread of contamination are:

- (a) keeping lead dross and lead waste in enclosed containers and ensuring their safe disposal;
- (b) using ventilation systems fitted with collection units;
- (c) taking steps to ensure that employees do not carry lead outside premises, for example, on their bodies or clothing; and
- (d) locating washing, showering and changing facilities so that employees leaving work do not have to pass through lead contaminated areas after using these facilities.

CLEANING AND PROHIBITION OF SOME CLEANING METHODS

10.30 Cleaning of areas which may be contaminated with lead should be done as frequently as is necessary to ensure cleanliness and the removal of lead deposits, thus reducing the risk of inhalation and ingestion of lead. In particular, the following should be cleaned at the minimum frequency given below:

- (a) floors and workbenches — at least once per day;
- (b) external plant surfaces, for example, chemical reactors and machines, where practicable and according to the degree of contamination — once per day;
- (c) washing and changing rooms and facilities for eating and drinking should be washed, cleaned — at least once per day; and
- (d) the frequency of cleaning inside walls and ceilings will vary according to the degree of contamination. Overhead ledges and fixtures should be cleaned as frequently as necessary to prevent the accumulation of lead deposits.

10.31 The methods of cleaning should not create a risk from lead to the cleaners or other persons. Compressed air or dry sweeping should not be used for cleaning. In addition, the methods of cleaning should not spread contamination of lead. Acceptable methods of cleaning include:

- (a) the use of fixed vacuum cleaning apparatus or an approved mobile, portable vacuum system; and
- (b) wet cleaning methods, such as mopping.

EATING, DRINKING AND SMOKING

10.32 Employers shall ensure that employees do not eat, drink, chew gum or smoke in any lead process areas. Drinking from fountains is permitted if they are free from lead contamination.

The dining area should be:

- (a) away from areas of lead work; and
- (b) close to washing and changing facilities.

10.33 Walls, floors and furniture in dining and changing areas should have smooth, impervious surfaces for easy cleaning. There should be suitable facilities for storage of food, drink or smoking materials. Food should not be stored in lockers used for protective clothing or respiratory equipment. Smoking materials should not be carried into lead process areas.

CHANGING ROOMS, WASHING, SHOWERING AND TOILET FACILITIES

10.34 The changing and washing facilities provided should enable an employee to meet a high standard of personal hygiene so as to:

- (a) minimise secondary lead exposure from contaminated clothing;
- (b) minimise ingestion of lead from, for example, hands and face; and
- (c) avoid the spread of lead contamination to the employee's family, especially young children.

10.35 Where Schedule 1 lead processes are carried out, an employer should:

- (a) provide two separate changing rooms for employees, of which:
 - (i) one should be used exclusively for dressing, undressing and storage of personal clothing; and
 - (ii) the other should be used exclusively for dressing, undressing and storage of work clothing, protective clothing and all equipment worn or used in the lead process area;
- (b) provide one locker in each change room for each employee; and
- (c) ensure that every changing room is constructed to avoid lead contamination from the lead process area.

10.36 If a Schedule 2 process is being carried out, an employer should provide two lockers for each employee, one for the contaminated items and one for the uncontaminated items.

10.37 Where Schedule 1 lead processes are carried out, changing rooms should be constructed so that the washing and shower facilities are located between the two changing rooms, where practicable. This enables employees to remove all lead contaminated protective clothing, respiratory equipment and footwear in one room before moving into the washing area to wash or shower and then on to the other changing room where personal clothing should be stored.

10.38 Personal clothing should not be allowed in the changing room intended for protective clothing, and *vice versa*, so as to avoid the contamination of personal clothing.

10.39 For certain types of work which are carried out infrequently, for example, buffing or sanding a lead coated surface for resurfacing, it may not be practicable to provide such formal changing and washing facilities. In such cases, contamination of personal clothing by lead should be avoided, either from exposure arising from the workplace process or from contact with protective clothing. This can be achieved by providing an area away from the workplace process and keeping protective and personal clothing separate. Workers should be encouraged to wash thoroughly before changing into personal clothing.

10.40 Changing areas should be located as far away from the lead process area as necessary to avoid contamination. In locating changing areas, the employer should also take into account their relationship to other facilities such as the dining rooms so as to minimise the spread of lead contamination and encourage washing and changing before using these other facilities.

10.41 Sufficient lockers, hangers, hooks and other storage appliances in each changing room should be provided to cope with the maximum number of persons required to use the changing rooms.

10.42 Arrangements should be made to provide facilities for outside contractors or visitors who may be exposed to lead.

10.43 Where lead contamination of protective clothing is heavy, such clothing should be vacuumed prior to removal, or respiratory protective equipment should be worn during disrobing of the contaminated items and only be removed when the contaminated items have been totally removed. Compressed air should never be used for cleaning protective clothing.

10.44 Adequate washing facilities should be provided by the employer for the use of employees and should include:

- (a) wash basins of sufficient dimensions to enable arms to be immersed up to the elbows;
- (b) a constant supply of running hot and cold or warm water for:
 - (i) basins as above, and
 - (ii) showers;
- (c) sufficient soap or other cleansing agents;
- (d) nail brushes; and
- (e) individual clean towels for each employee or other means of drying.

10.45 There should be sufficient washing facilities to cater for the maximum number of people expected to use them.

10.46 Toilet facilities should be provided in accordance with the appropriate jurisdiction legislation (to be defined on a jurisdiction by jurisdiction basis).

ADMINISTRATIVE CONTROL MEASURES

10.47 Administrative control measures should be implemented in association with other measures, when engineering and work practice measures are not in themselves adequate to ensure that lead exposure will not exceed the exposure standard.

10.48 Where appropriate and practicable, administrative controls should seek reductions in the level and duration of exposure of employees to lead. For example, reduction may be achieved by:

- (a) work organisation;
- (b) job rotation; and
- (c) limits on overtime.

PERSONAL PROTECTIVE EQUIPMENT

10.49 Control of exposure should be achieved as far as is practicable by measures other than the use of personal protective equipment. The use of personal protective equipment as a control measure shall be regarded as applicable only where other control techniques are not practicable or do not adequately control exposure to lead. Where personal protective equipment is used, employers shall ensure that it is:

- (a) properly selected for the individual and task;
- (b) readily available;
- (c) clean and functional;
- (d) correctly used when required; and
- (e) maintained by appropriately trained staff in accordance with a personal protective equipment maintenance and servicing program.

Respiratory Protective Equipment

10.50 There may be some circumstances where respiratory protection is necessary because it is impracticable to use other control measures, for example, maintenance operations and work in baghouses. Respiratory protective equipment should be in accordance with Australian Standard AS 1716⁸ as updated from time to time.

10.51 The selection, use and maintenance of respiratory protective equipment should be based upon the recommendations in Australian Standard AS 1715⁹, as updated from time to time, and should take into account:

- (a) the extent of the airborne lead hazard;
- (b) the nature of the hazard, that is, whether it is dust or fumes;
- (c) the standard of protection afforded by different types of respiratory protective equipment;
- (d) work requirements and conditions, for example, the length of time the equipment is to be worn and the type of work done; and
- (e) whether a particular respirator provides sufficient face fit for the wearer to avoid leakage around the mask.

10.52 Respiratory protective equipment should be selected by a competent person, for example, a trained and experienced occupational hygienist. Selection should follow an estimation of the level of airborne contamination within the employee's breathing zone using the nominal protection figures for the equipment as outlined in Australian Standard AS 1715⁹.

10.53 Where the effectiveness of the equipment depends on achieving a close fit against the face of the wearer, the initial fitting of the respiratory protective equipment should be tested by a quantitative or qualitative face seal test, for example, the isoamyl or saccharin mist test as described at Appendix C of Australian Standard AS 1715⁹. Employees in these situations should be clean shaven.

10.54 Non-disposable respiratory protective equipment needs to be cleaned regularly, at least at the end of every shift. The employer shall be responsible for cleaning and maintaining respiratory protective equipment.

10.55 All users of respiratory protective equipment should be provided with information and training concerning:

- (a) the need for wearing respiratory protective equipment;
- (b) how to fit the equipment;
- (c) how to routinely test the fit;
- (d) the importance of good facial fit and, when applicable, the employee being clean shaven;
- (e) how to detect failure of the equipment;
- (f) care of the equipment; and
- (g) the arrangements made for the maintenance and replacement of the equipment.

10.56 When not in use, respiratory protective equipment should be stored in a place where it is not likely to be contaminated on the inside by lead. This may be a cupboard, locker or some other enclosure, away from the immediate lead process area.

Wearing of Respiratory Protective Equipment

10.57 Control of exposure to atmospheric lead should be achieved as far as is practicable by measures other than the use of respiratory protective equipment. The use of respiratory protective equipment as a control measure shall be regarded as applicable only where other control techniques are not practicable or do not adequately control exposure. Employees shall wear respirators:

- (a) at workstations where the atmospheric lead level is equal to, or higher than, the exposure standard and results of atmospheric lead monitoring in a employee's breathing zone indicate an eight hour time-weighted average exposure that exceeds the atmospheric exposure standard. Such workstations should be clearly signposted and the signs should comply with Australian Standard AS 1319¹⁰;
- (b) at workstations where atmospheric lead levels exceed three times the exposure standard, irrespective of the time spent by the employee at such workstations. These workstations should be clearly signposted and the signs should comply with Australian Standard AS 1319¹⁰; and
- (c) at the request of the authorised medical practitioner.

Protective Clothing

10.58 All protective clothing should be issued, maintained and replaced at no cost to the employee.

10.59 Protective clothing should reduce exposure to lead by protecting employee's personal clothing and their bodies from contamination by lead. Such clothing also helps prevent the spread of lead to the employee's family by reducing the chance of contaminated clothing being taken home. The type and design of protective clothing and the material from which it is made will be governed by the nature and amount of lead to which employees are exposed. Where the exposure to lead exists in conjunction with other health and safety hazards such as molten metal, corrosives, wet processes or bad weather, then these should be taken into account in the design of the clothing and a balance achieved to afford the best overall protection that is practicable.

10.60 In many cases normal overalls should give adequate protection, provided that they are in good repair and are kept clean. Protection for the face and hands may often not be considered necessary.

10.61 Where additional clothing is required, for example, during outdoor work in bad weather, and if that clothing is worn on top of the overalls, it too should be classified and issued as protective clothing.

10.62 Where the assessment of exposure indicates that the amount of lead to which employees are liable to be exposed is such that normal overalls would not afford adequate protection, then the selection of the protective clothing should take into account:

- (a) the ability of the materials to resist penetration by lead dust;
- (b) the dust release characteristics of the material;
- (c) the design of the protective clothing, for example, the clothing should be close fitting at neck and arm openings and should not have any pockets which may trap lead dust; and
- (d) the effectiveness of the proposed laundering methods in removing lead dust from the clothing.

10.63 Protective clothing and footwear should be issued on a personal or job basis, as appropriate, and should be clearly identifiable so that it can be easily sorted and correctly allocated after cleaning or repair. For most items of clothing at least two sets should be provided: one to wear and one for cleaning and/or repair. Laundering should be carried out at least weekly where contamination is minimal and more often where contamination is more severe.

10.64 Protective clothing should be cleaned at the premises where work with lead is carried out. If protective clothing is sent to outside agencies for cleaning, the agencies should be alerted to the lead contamination and the need to ensure that cleaning is carried out without risk to their employees or any other persons. Protective clothing shall not be taken away from the workplace by an employee.

10.65 When lead contaminated protective clothing is sent out for cleaning, it should be placed in suitable impermeable containers or bags which should be labelled as follows:

‘LEAD CONTAMINATED CLOTHING’

10.66 Where in-plant laundering is carried out, arrangements should be made which are sufficient to prevent the spread of lead contamination.

MAINTENANCE, EXAMINATION AND TEST OF CONTROL MEASURES

10.67 The employer should ensure that all control measures perform as originally intended and continue to prevent or adequately control exposure of employees to lead. The object of maintenance should be to ensure that any defects which could result in a loss of efficiency of the control measures are detected and remedied.

10.68 Maintenance should not merely refer to work carried out by maintenance workers engaged, for example, on plant repair but also to any work which is carried out to secure the efficiency of control measures.

10.69 All control measures should be examined visually, at least weekly, for any obvious defects such as damage or wear. Visual examinations of control measures should be undertaken by a competent person such as a supervisor.

10.70 In addition, a more thorough examination and testing of control measures, such as exhaust ventilation and calibration of thermostatic controls, should be carried out at least every three months. Thorough examinations and testing will need to be performed by a competent person with suitable qualifications and training to carry out such examinations. For example, in the case of examination of exhaust ventilation, the testing should be performed with appropriate testing facilities by a ventilation engineer or some other suitably trained person.

10.71 The control measures which should be regularly examined include (but are not limited to):

- (a) exhaust ventilation including the enclosure, ducting, filtration and mechanical efficiency of the equipment;
- (b) thermostatic controls on melting pots and reaction vessels;
- (c) seals and gaskets on reaction vessels or containers;
- (d) safe work practices, for example, whether materials are handled, contained and covered in such a manner as to stop the spread of contamination of lead; and
- (e) housekeeping and cleanliness controls.

10.72 A procedure should be put in place where remedial action is initiated immediately any faults or defects are identified in any control measures. (The United Kingdom Health and Safety Executive's *Guide to Testing and Monitoring Local Exhaust Ventilation Systems*¹¹ may be referred to for guidance.)

10.73 All defects and maintenance of control measures should be recorded and it should include the date the defect was found and the date of completion of remedial action including repair or replacement.

EMERGENCY PROCEDURES

10.74 In spite of the implementation of all practicable control measures, a leak, spill or uncontrolled release of a lead-containing hazardous substance could still occur. Established emergency procedures, procedures for safe disposal of the substance and sufficient suitable personal protective equipment should be used, where appropriate, to enable the source of the release to be safely identified and repairs to be made. All persons not concerned with the emergency action should be excluded from the area of contamination.

11. ATMOSPHERIC MONITORING

Atmospheric monitoring is needed for assessment and control of exposure to lead.

WHAT ATMOSPHERIC MONITORING IS

11.1 Atmospheric monitoring involves the periodic and/or continuous sampling of workplace atmospheres to derive a quantitative estimate of the exposure of employees to lead by inhalation. Air sampling techniques and strategies for estimating atmospheric lead concentrations are set out at Appendix 2 of this national code of practice. The results of atmospheric monitoring should be compared with the lead exposure standard.

A COMPETENT PERSON TO UNDERTAKE ATMOSPHERIC MONITORING

11.2 Monitoring should only be carried out by a competent person who has sufficient knowledge, skills and experience in the appropriate techniques and procedures detailed at Appendix 6 of this national code of practice.

WHEN ATMOSPHERIC MONITORING IS REQUIRED

11.3 Atmospheric monitoring may be required as part of the assessment of risk where it is necessary to obtain a quantitative estimate of exposure, or to determine the effectiveness of measures introduced to control exposure to lead.

LEAD IN AIR LEVELS REQUIRING REVIEW OF CONTROL MEASURES

11.4 Where the results of atmospheric monitoring indicate that the atmospheric lead level is routinely at or above the exposure standard, control measures should be reviewed in consultation with employees and employees representatives. This review should include, but is not limited to:

- (a) engineering controls, such as process enclosure, exhaust ventilation;
- (b) cleaning of workplaces and regular plant maintenance; and
- (c) safe work practices, such as wetting of surfaces.

PROCEDURES FOR MONITORING

11.5 Procedures for monitoring should detail:

- (a) when and how the monitoring is to be done;
- (b) the sampling procedures and analytical methods to be used;
- (c) the sites and frequency of sampling; and
- (d) how the results are to be interpreted.

RESULTS FROM ATMOSPHERIC MONITORING

11.6 The results of monitoring should be recorded in sufficient detail to determine:

- (a) the level of lead measured and when the monitoring was done;
- (b) what monitoring procedures were adopted, including the duration of sampling;

- (c) the locations where samples were taken, the operations in progress at the time and, in the case of personal samples, the names of those individuals concerned;
- (d) whether the results reflect normal operating conditions;
- (e) how the results were interpreted; and
- (f) the effectiveness of control.

HOW ATMOSPHERIC MONITORING RESULTS SHOULD BE KEPT

11.7 The records may be kept in any format, but in all cases the information shall be readily retrievable and in an easily understood form. Records should be kept in such a way that the results can be compared with any health records required under the health surveillance requirements of the *National Standard for the Control of Inorganic Lead at Work* [NOHSC:1012(1994)].

LENGTH OF TIME ATMOSPHERIC MONITORING RESULTS MUST BE KEPT

11.8 The results of monitoring shall be kept for a period of 30 years from the date of the last entry made in the records.

ACCESS TO ATMOSPHERIC MONITORING RESULTS

11.9 Records of workplace monitoring shall be available to employees, employee representatives and relevant public authorities.

11.10 Further information on monitoring is at Appendix 6 of this national code of practice.

12. EXCLUSION FROM WORKING IN A LEAD-RISK JOB

12.1 The authorised medical practitioner, employers, employees and applicants for employment in lead processes should consider a number of issues relating to occupational exposure to lead when assessing people for working in a lead-risk job:

- (a) Individuals with certain medical conditions (such as impaired renal function, anaemia, haemoglobinopathies, neuropathies and reproductive problems) may be more susceptible to the adverse effects of lead on health. Exclusion from working in a lead-risk job on such grounds shall be in accordance with sections 14 and 15 of the national standard, *Exclusion from Working in a Lead-Risk Job and Health Surveillance*.
- (b) Lead is a particular health risk to the foetus. A pregnant employee should keep her blood lead level below 0.72 µmol/L (15 µg/dL) and as low as possible.
- (c) Infants are more susceptible to the health effects of lead than adults. A breastfeeding employee should keep her blood lead level below 0.72 µmol/L (15 µg/dL) and as low as possible.

12.2 When considering whether a person should work in a particular lead-risk job, the employer should take into account the issues set out in section 14 of the *National Standard for the Control of Inorganic Lead at Work* [NOHSC:1012(1994)] and sections 12.1, 14 and 15 of this national code of practice.

13. HEALTH SURVEILLANCE

13.1 The purpose of surveillance is to determine that the health of employees is not adversely affected while they are working in lead-risk jobs. Health surveillance should not be used as an alternative to the maintenance of control measures.

PURPOSE OF HEALTH SURVEILLANCE

13.2 Health surveillance which includes biological monitoring can assist in minimising the risk to health from exposure to lead by:

- (a) confirming that the absorbed dose of lead, determined as blood lead, is below the specified removal level of the *National Standard for the Control of Inorganic Lead at Work* [NOHSC:1012(1994)];
- (b) indicating biological effects requiring cessation or reduction of exposure to lead;
- (c) ensuring that individuals who should be excluded from working in lead-risk jobs because of personal medical conditions, are appropriately identified; or
- (d) collecting data to evaluate effects of exposure to lead.

THOSE EMPLOYEES REQUIRING HEALTH SURVEILLANCE

13.3 Health surveillance is required for employees who are to commence work in lead-risk jobs or who work in lead-risk jobs.

13.4 Employees shall participate in the health surveillance program unless there is some compelling reason to the contrary, in which case the matter should be discussed with the authorised medical practitioner responsible for the health surveillance program.

RESPONSIBILITY FOR HEALTH SURVEILLANCE

13.5 The employer is responsible for providing health surveillance which is established as necessary as a result of the assessment process. An authorised medical practitioner shall be responsible for the supervision of the health surveillance either by directly carrying out the health surveillance program or by supervising it. Part of the program, for example biological monitoring, may be carried out by a suitably qualified person, such as an occupational health nurse. Selection of an authorised medical practitioner to conduct health surveillance is the responsibility of the employer in consultation with the employees concerned and employee representatives.

BIOLOGICAL MONITORING

13.6 Although atmospheric monitoring of lead gives an indication of the levels to which an employee may be exposed, biological monitoring is a much more effective means of evaluating the amount of lead which an employee has actually absorbed by inhalation and ingestion at work and elsewhere. Hence, it is a superior indicator of individual exposure.

13.7 The frequency of biological monitoring should be greatest during the first months of an employee's work in a lead-risk job, while the employee becomes accustomed to the job and a steady-state blood lead level is reached. Thereafter, the frequency of biological monitoring should be inversely related to the individual employee's history of blood lead levels.

13.8 Blood lead determination gives a direct measure of the amount of lead circulating in the body and is a good index of current or recent lead absorption, when the employee is not anaemic and when the employee has not taken any chelating agents recently.

13.9 Blood lead levels do not necessarily indicate the total body burden of lead and are not adequate measures of past exposure. Consequently, a high blood lead may only represent recent heavy exposure to lead without a significant total body excess and likewise a low blood lead level does not exclude an elevated total body burden of lead.

13.10 While not required in the *National Standard for the Control of Inorganic Lead at Work* [NOHSC:1012(1994)], there are biochemical tests which indirectly measure the amount of absorbed lead by measuring the adverse metabolic effect of lead. Biochemical tests, which measure the effect of lead on haemoglobin synthesis are the most convenient and include blood zinc protoporphyrin, free erythrocyte protoporphyrin, urine coproporphyrins, blood delta aminolaevulinic acid dehydratase activity and urine delta aminolaevulinic acid. Blood zinc protoporphyrin (ZPP) is the preferred test for measuring the biochemical effects of lead exposure.

13.11 The blood ZPP test measures an adverse metabolic effect of lead and as such may be a better indicator of lead toxicity than the level of blood lead itself. The level of blood ZPP reflects lead absorption over the preceding three to four months and therefore is a better indicator of lead body burden. The blood ZPP requires more time than the blood lead to reach significant levels. The return to normal after discontinuing lead exposure is also slower. The blood ZPP level may be useful in assessing recovery in an employee subject to medical removal from a lead-risk job.

13.12 Blood ZPP has a limited correlation to blood lead levels. Blood ZPP elevation (above 100 µg/dL) may occur at blood lead levels as low as 1.21-1.45 µmol/L (25-30 µg/dL) in some employees. Blood lead levels 1.93-3.14 µmol/L (40-65 µg/dL) are associated with exponential increases in blood ZPP. With blood lead levels greater than 3.14 µmol/L (65 µg /dL) the increase in ZPP falls off and may underestimate the haemopoietic disturbance. Free erythrocyte protoporphyrin analysis gives a better correlation with blood lead levels greater than 3.14 µmol/L (65 µg /dL).

13.13 Blood ZPP levels are often elevated in the presence of iron deficiency anaemia. Serum iron, total iron binding capacity and full blood count may be needed for accurate assessment in individual cases.

13.14 Tests carried out under the *National Standard for the Control of Inorganic Lead at Work* [NOHSC:1012(1994)] should be performed by a competent laboratory.

EMPLOYER RESPONSIBILITIES

13.15 The responsibilities of employer are to:

- (a) inform employees of the purpose and procedures for health surveillance;

- (b) make acceptable arrangements for employees to participate in the health surveillance;
- (c) pay any reasonable expenses due to health surveillance, for example, medical fees, travelling expenses and time off work;
- (d) ensure that health surveillance results obtained are retained as a confidential record for the purposes of the national lead standard;
- (e) notify the relevant public authority of any adverse effect prescribed by that authority from information provided by the authorised medical practitioner;
- (f) provide the authorised medical practitioner with access to the register of lead-containing hazardous substances, and a Material Safety Data Sheet for these substances; and
- (g) permit the authorised medical practitioner to inspect any relevant assessment reports.

13.16 Where the employer receives notice from the authorised medical practitioner of an adverse health surveillance result considered by the practitioner to be related to exposure to lead in the workplace, action should be taken, as soon as is practicable, to reassess the workplace and to provide appropriate control measures to minimise any further risks to health or safety.

13.17 Where an authorised medical practitioner certifies that an employee is unfit to work in a lead-risk job, is unfit to continue working in a lead-risk job or should only work under conditions specified by the medical practitioner, the employer is required to follow the recommendations of the authorised medical practitioner unless otherwise approved by the relevant public authority. This may involve relocating the employee to suitable alternative work or changes to the work to prevent exposure.

A SUITABLY TRAINED MEDICAL PRACTITIONER

13.18 Where there are no medical practitioners authorised by the relevant public authority for the health surveillance of employees in lead-risk jobs, the medical practitioner should be adequately trained to undertake the health surveillance. The medical practitioner should also have an understanding of the employees' work activities and be aware of his or her duties under the *National Standard for the Control of Inorganic Lead at Work* [NOHSC:1012(1994)].

THE AUTHORISED MEDICAL PRACTITIONER'S RESPONSIBILITIES

13.19 The responsibilities of the authorised medical practitioner are to:

- (a) assist with the planning and implementation of health surveillance;
- (b) maintain medical records and ensure their confidentiality;
- (c) advise each employee of the results of his or her health surveillance and explain the meaning and significance of the results;
- (d) arrange treatment, preventive measures or rehabilitation, if necessary;

- (e) decide if a clinical finding or examination result is abnormal, if a trend is significant and whether this indicates an unacceptable level of exposure to lead;
- (f) notify the employer of the outcome of health surveillance and of any trends which indicate inadequate control and the need for remedial action (the information provided to the employer shall allow the authorised medical practitioner to maintain medical confidentiality) (adverse results include trends detected over a period of time or trends where a large number of employees are examined);
- (g) notify the relevant public authority of any adverse effect prescribed by that authority; and
- (h) ensure that health surveillance results are maintained as confidential medical records, and in doing so:
 - (i) clearly identify them from records obtained for other purposes such as records of examinations not connected with health surveillance; and
 - (ii) undertake to offer the relevant public authority all health surveillance records in his or her possession on cessation of the medical practice.

14. COUNSELLING

14.1 Counselling is a process of dialogue between an individual employee and any one or more of the various parties involved in the management of occupational exposure to lead.

14.2 All employees who are to commence work in lead-risk jobs or who work in lead-risk jobs should be counselled on the health effects of lead. All employees excluded from working in lead-risk jobs as detailed in subsection 12.1 of this national code of practice, should also be counselled.

14.3 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 employee and the occupational health nurse 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 authorised medical practitioner. If the employee is to be removed from occupational exposure to lead, then there should be an emphasis on the health effects of lead and actions to prevent a recurrence of removal.

14.4 Counselling may also involve employee representatives and occupational hygienists, and an employee's supervisor when work practices or workplace conditions are discussed.

14.5 It is emphasised that counselling is part of a process of managing an individual employee's exposure to lead, and is not a process to apportion fault or blame to any party.

14.6 Employees who consider that they have not completed their family should be counselled in particular on the effects of lead on male and female reproduction, as appropriate. Female employees 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 employee can make an informed decision in regard to the risk to their own health and to a future foetus. Male employees should be advised that exposure to lead may adversely affect reproductive function. Female employees should be advised that 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.

14.7 Counselling may cover the following topics:

- (a) Physical maturity. As a guide people under the age of 16 should not be employed in lead processes.
- (b) 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.
- (c) Lead accumulates in the body, particularly in bones. This lead can be mobilised in some circumstances including pregnancy and old age.

Lead is a particular health risk to the foetus. A pregnant employee should keep her blood level constantly below 0.72 $\mu\text{mol/L}$ (15 $\mu\text{g/dL}$) to ensure no risk to the foetus.

Current statistics show that one in four pregnancies in Australia is unplanned, and because there is limited information on bone-lead mobility during pregnancy it is therefore prudent to maintain blood lead levels for females who may later become pregnant below 0.97 $\mu\text{mol/L}$ (20 $\mu\text{g/dL}$).

It is for these reasons that females of reproductive capacity are not normally assessed as suitable for employment in lead-risk jobs.

In certain circumstances, conception methods such as in-vitro fertilisation may need to be considered in assessing reproductive capacity.

- (d) Infants are more susceptible to the health effects of lead than adults. A breast feeding employee should keep her blood lead level below 0.72 $\mu\text{mol/L}$ (15 $\mu\text{g/dL}$) and as low as possible.

15. MEDICAL EXAMINATIONS

15.1 Medical examinations carried out under the national lead standard are designed to identify individuals with personal medical conditions which exclude them from working in lead-risk jobs, to monitor the health of employees in lead-risk jobs and to provide individual counselling to these employees.

Medical examinations should be carried out on at least the following occasions:

- (a) prior to an employee commencing work in a lead process;
- (b) when the results of biological monitoring indicate medical removal;
- (c) prior to return after medical removal; and
- (d) at a routine frequency of between one and five years depending on age, medical status, occupation, time in the job and blood lead levels, as determined by the authorised medical practitioner.

SCHEDULE FOR MEDICAL EXAMINATIONS

15.2 When considered appropriate by the authorised medical practitioner, the following components are applicable to medical examinations when the results of biological monitoring are excessive and when it is considered that excessive exposure to lead has occurred:

- (a) a detailed work history and a medical history, with particular attention to past lead exposure (occupational and non-occupational), personal habits (smoking, personal hygiene), and the gastrointestinal, haemopoietic, renal, cardiovascular, reproductive and neurological systems;
- (b) a thorough physical examination, with attention to the gastrointestinal, haemopoietic, renal, cardiovascular, and neurological systems. Pulmonary status and assessment for facial fit should be evaluated if the use of respiratory protection is to be considered;
- (c) a blood pressure measurement;
- (d) pathology examinations which determine:
 - (i) blood lead and if deemed applicable by the authorised medical practitioner, indicators of biological effect such as zinc protoporphyrin;
 - (ii) full blood examination; and
 - (iii) serum creatinine;
- (e) a routine urinalysis with microscopic examination of urine for casts and cells;
- (f) any laboratory or other test which the authorised medical practitioner deems necessary; and
- (g) counselling of the employee on the health effects of lead.

15.3 The following components are applicable to medical examination before an employee may return to a lead-risk job after medical removal:

- (a) physical examination the content of which should be determined by the authorised medical practitioner;
- (b) blood sample and analysis which determines blood lead and where considered appropriate, an indicator of biological effect such as zinc protoporphyrin; and
- (c) any laboratory or other test which the authorised medical practitioner deems necessary.

15.4 The following components are applicable for the medical examination aimed at identification of employees who should be excluded from working in lead-risk jobs, in accordance with section 14 of the *National Standard for the Control of Inorganic Lead at Work* [NOHSC:1012(1994)] and section 12 of this national code of practice:

- (a) physical examination the content of which should be determined by the authorised medical practitioner; and
- (b) any laboratory or other test which the authorised medical practitioner deems necessary.

LENGTH OF TIME HEALTH SURVEILLANCE RESULTS SHALL BE KEPT

15.5 The results of health surveillance shall be kept by the employer for a period of not less than 30 years from the date of the last entry.

16. RECORD KEEPING

The purpose of record keeping is to keep account of employees' lead exposure and any health effects experienced by employees.

WHAT THE EMPLOYER NEEDS TO KEEP AS RECORDS

16.1 Assessment reports which indicate a need for monitoring and/or health surveillance together with the results of atmospheric monitoring and health surveillance and medical removal and return records shall be kept as records in a suitable form for at least 30 years from the date of the last entry made. Retention for a 30 year period is necessary because some health effects, such as cancers, may take a long time to become evident. The information kept will be valuable in epidemiological studies and developing effective control strategies.

16.2 All other records including assessment reports not indicating a need for atmospheric monitoring or health surveillance, the register and records of training shall be maintained for at least five years in a suitable form.

STORAGE OF RECORDS

16.3 Records should be located conveniently so that employers, employees and employee representatives can access the information. Suitable storage systems for records include traditional book entry records, microfiche or computerised databases.

16.4 The employer should provide to the relevant public authority all records required to be kept for 30 years, after that period has expired.

WHEN AN EMPLOYER CEASES TO TRADE

16.5 If an organisation ceases to trade, then the records shall be provided to the relevant public authority. Where ownership of an organisation is transferred, the records shall be maintained and kept for the required period by the subsequent owner.

17. EMPLOYEES' DUTIES

All employees working with or near lead-containing hazardous substances need to maintain safe work practices so that their health and safety, and the health and safety of people working with them, is maintained.

EMPLOYEE RESPONSIBILITIES

17.1 Employees have a responsibility to maintain safe work practices to the extent that they are capable. This is specifically addressed in Jurisdiction occupational health and safety legislation and is dependent upon adequate induction, training and supervision by the employer.

17.2 Employees should use the control measures in the way they are intended to be used and, in particular, should:

- (a) cooperate with their employer in performing the assessments of lead in the workplace;
- (b) participate in suitable induction and training programs;
- (c) use the control measures provided for lead-containing hazardous substances, plant and processes;
- (d) wear, in a proper manner, the personal protective equipment provided;
- (e) store personal protective equipment in the accommodation provided when it is not in use;
- (f) remove from their bodies any protective equipment which could cause contamination, and wash before eating, drinking or smoking;
- (g) practise a high standard of personal hygiene, and make proper use of the facilities provided for washing, showering or bathing and for eating and drinking;
- (h) report promptly to their employer, through their supervisor, any defects discovered in any control measure, label or item of personal protective equipment which may affect compliance with the provisions of the *National Standard for the Control of Inorganic Lead at Work* [NOHSC:1012(1994)], and
- (i) cooperate with their employers in the conduct of appropriate atmospheric monitoring or health surveillance programs that arise from assessments.

18. RELEVANT PUBLIC AUTHORITIES AND EMERGENCY SERVICES

Public authorities responsible for occupational health and safety need information so that they can do their job properly. Emergency Services need to have information on the lead-containing hazardous substances in a workplace so that they can protect themselves and the public when dealing with an emergency.

ACCESS TO INFORMATION

18.1 Relevant public authorities shall have access to all relevant records maintained by the employer for the purpose of the *National Inorganic Lead Standard* [NOHSC:1012(1994)].

18.2 It is essential that emergency services have information on the hazards present at any location involving the manufacture, use, storage or disposal of lead-containing hazardous substances, as well as other relevant information, for example, location of water hydrants, the workplace register, assessment reports and emergency response plan. However, it is not appropriate or necessary for emergency services to have access to confidential information such as health surveillance or atmospheric monitoring results.

18.3 Employers should prepare a suitable emergency response plan in consultation with emergency services, where appropriate.

PROTECTIVE CLOTHING

TYPES OF CLOTHING

A1.1 The following should be considered in specifying the clothing and equipment necessary for any particular occupation or task:

Outwear	Underwear	Headgear
Boiler Suit One-piece overall Bib and brace Dust coat Jacket Shirt	Vest Underpants (these could be disposable)	Safety helmet Dust cap with/without snood Disposable paper hat
Footwear	Hand Protection	Miscellaneous
Boots Shoes Gaiters	Gloves (permeable or impermeable) Mitts	Apron Goggles (permeable or impermeable) Face shield

PROPERTIES OF MATERIALS

A1.2 The choice of material for protective clothing should be made having regard for all requirements of the specific situations where the protective clothing is to be used:

- (a) **Cotton** has the advantages that it is lightweight, reasonably hard wearing, generates no static electricity, resists penetration of corrosives and is unaffected by oils. Its disadvantages are that it is liable to shrinkage unless treated, is more flammable than wool and is vulnerable to hot splashes.
- (b) **Wool** resists rapid penetration of direct splashes (more effectively than cotton), resists penetration of dust, is very absorbent and its porosity absorbs perspiration. Its disadvantage is that it takes up water and dirt and is therefore difficult to wash. Wool, relative to cotton and artificial fibres provides substantial protection to hot splashes.
- (c) **Artificial Fibres** (Nylon, Terylene) are very hard wearing and can have good acid resistance. However, such artificial fibres do not resist hot splashes, are initially costly, can allow dust to pass through and static electricity can cause rapid soiling. Nevertheless, artificial fibres are finding favour in the battery industry in acid areas and in battery breaking. Ceramic coating of fibres can render them dust proof.

- (d) **PVC** is impervious, non-flammable, chemically and biologically resistant and resistant to abrasion. PVC is not resistant to hot splashes and can cause sweating unless well ventilated. It can be used alone or impregnated on fabric.
- (e) **Paper** is hygienic if disposable. It is fairly resistant to chemicals if treated with polythene film, but liable to wetting if not treated with polythene film. Paper has little strength, is flammable and is not resistant to hot splashes. Paper could possibly be used for disposable underwear or for visitors' clothing.
- (f) **Polythene** is hygienic and can be disposable. It is also impervious. However, polythene has low abrasion resistance, does not resist hot splashes, and its low melting point could cause adhesion to skin. It is suitable for disposable gloves.

SELECTION CRITERIA

A1.3 Selection of clothing and equipment should be guided by the following considerations:

- (a) the nature of the risk and the method of contamination, for example, wet or dry, dust, fume, corrosive;
- (b) the degree of risk of contamination, for example, slight, moderate, high;
- (c) the requirements of the task being performed, for example, extensive handling of rough articles;
- (d) the convenience to the person using it; and
- (e) the likelihood of hot splashes.

A1.4 In the case of a person employed mainly in one particular type of risk job it should be possible to closely specify the clothing and equipment to be provided.

TYPICAL SPECIFICATIONS

A1.5 Typical specifications could be selected from:

(a) **High-risk jobs:**

Socks, vest, underpants, trousers, shirt, one-piece overall, boots, dust cap, gloves;

(b) **Medium-risk jobs:**

One-piece overall, socks, boots/shoes, gloves; and

(c) **Low-risk jobs:**

Dust coat, boots/shoes.

AIR SAMPLING TECHNIQUES AND STRATEGIES

INTRODUCTION

A2.1 This appendix describes acceptable techniques and strategies to determine atmospheric lead levels for use in connection with the *National Standard for the Control of Inorganic Lead at Work*.

A2.2 Air monitoring can be needed for two reasons. Firstly, it provides essential data to be used as part of the assessment. Secondly, it provides data on a routine basis about the effectiveness of the control measures used to minimise atmospheric lead levels and identifies areas where improvements may be needed. Working conditions and practices vary greatly and air sampling procedures should be developed to suit the particular circumstances.

TECHNIQUES AND STRATEGIES

A2.3 The air sampling strategy should be developed and executed by someone who has adequate information, instruction and training for the task so that he or she can carry it out effectively. Those developing the strategy should be aware of all the lead processes at the workplace and will need information and instruction about:

- (a) the plant and machinery used for transporting and processing lead-containing materials;
- (b) the composition of materials;
- (c) process details, for example, temperatures and cycle times; and
- (d) typical employee tasks.

A2.4 Exposure to airborne lead should be measured using personal air sampling techniques. Everyone exposed to lead should be individually identified. It is important to consider not only those who are continually exposed to lead dust and fumes but also those who may be exposed to significant levels for short or intermittent periods, for example, maintenance employees and cleaners.

A2.5 Static sampling may use the same equipment as that used for personal monitoring but the monitor is fixed to a position or process rather than an employee's breathing zone. Static sampling provides data on the lead concentration in specific areas of a process or plant and may be used to assess engineering control of emissions from a process. The results of static monitoring may not be comparable with the exposure standard which is based on personal monitoring.

A2.6 Where a number of employees are engaged in similar jobs, sampling can be carried out most effectively on a group basis. In this case, those exposed to lead should be divided into groups doing identical or similar work in the same area. If there is considerable variation between the work of each shift, for example, permanent day and night shifts, then each shift should be considered as a separate group. When grouping, care should be taken to identify any individuals with unique exposure patterns so that their exposure can be measured separately. Where a group measurement is planned, the air sample should be carried out on a random number of individuals from the whole group. The number sampled should not be less than one in every ten people

exposed. The numbers of samples taken should be sufficient to cover the range of activities within the group and provide a sound numerical basis on which to assess the exposure of the group and future changes in exposures.

A2.7 Sufficient samples should be taken during routine monitoring to identify any major changes in exposure levels. Any abnormal results, particularly any above the atmospheric lead exposure standard, should be carefully investigated by trained personnel in order to establish the reasons for the abnormality and to ensure that the employees concerned are adequately protected until any further controls are introduced. Employees and their representatives shall be informed as quickly as possible of any results above the atmospheric lead exposure standard and of the reasons established for the excess; they shall also be informed of emergency measures which have been taken to control the effects of such an excess.

A2.8 Where group sampling is carried out, it is important that the results are carefully analysed to make certain that they are valid for all the individuals who make up the group. A wide distribution of results indicates considerable variation within the group and could mean that individuals have not been grouped correctly. In such circumstances further sub-division of the group could focus on those at risk and make more efficient use of resources.

EIGHT HOUR TIME-WEIGHTED AVERAGES

A2.9 If the total sampling period and the normal working shift is eight hours then the atmospheric lead levels obtained can be compared directly with the atmospheric lead exposure standard. If the sampling period is less than eight hours, or the shift is other than eight hours long, the periods over which the samples are taken should be sufficient to give results representative of normal working exposure, including periods of peak exposure, and to enable an eight hour time-weighted average concentration to be calculated. Changing work patterns, including irregular working hours and shifts of longer than eight hours, will require further consideration. In most cases this will entail sampling throughout a normal working day or shift and the sampling period should not normally be less than four hours. If there is considerable variation in the day-to-day working pattern it will be necessary to sample on sufficient days to cover the normally expected variations. It is important to take account of operations carried out at the beginning or end of the work period so that the operations which may significantly influence the overall exposure level, such as weighing out materials, charging of batch mixing machines and machine cleaning, can be included. The results should be reported as an eight hour time-weighted average concentration.

SAMPLING METHOD FOR LEAD DUST AND FUMES

A2.10 The sampling should be carried out in accordance with the Australian Standard AS 3640, *Workplace Atmospheres — Method for Sampling and Gravimetric Determination of Inspirable Dust*¹². However, the Regulations of this standard referring to gravimetric determination would not normally apply to lead sampling since the lead concentration is calculated from the total amount of lead on the filter (determined by chemical analysis) and the volume of air sampled. Additional points for consideration when selecting sampling equipment are the compatibility of the filter with the subsequent analytical procedure and the need for people to be able to work normally while wearing sampling apparatus, including the pump. The pump should be capable of running continuously for at least eight hours at the appropriate flow rate.

A2.11 To minimise contamination, the sampling head filters should be loaded, unloaded and analysed in an area free from lead contamination.

ANALYTICAL METHODS

A2.12 A number of analytical techniques are suitable for lead. Suitable methods include the use of atomic absorption spectrometry or any other method which has a coefficient of variation of 10 per cent or better. Further advice on suitable methods can be obtained from relevant labour authorities, (to be defined on a jurisdiction by jurisdiction basis).*

Calculation Of Eight Hour Time-weighted Averages

A2.13 Results should normally be reported as an eight hour time-weighted average. If one whole shift sample is taken, the results should be calculated as set out below:

- (a) If the working shift is exactly eight hours, the result of a whole shift sample is the eight hour time-weighted average.
- (b) If the working shift is less than eight hours, the time-weighted average can be calculated assuming zero exposure during the remaining time.
- (c) If an eight-hour shift includes breaks taken from actual work (such as meal breaks) then the sampling period should include these breaks, or alternatively the exposure during these breaks should be assumed as zero; if an eight-hour shift excludes breaks taken from actual work then the sampling period should not include these breaks.
- (d) If the working shift is more than eight hours then a time-weighted average should be determined for a representative eight hour period of working shift.
- (e) It may be more convenient, and provide valuable additional information, to split the shift into separate shorter duration sampling periods around natural breaks such as meals. The results of these shorter duration samples should be combined on a time-weighted basis to calculate the eight hour time-weighted average.
- (f) Where exposure is intermittent (that is, a few hours per week) sampling should be carried out during periods of maximum activity so that satisfactory eight hour time-weighted averages can be calculated.

* An example of a standard analytical method is provided by the National Institute of Occupational Safety and Health (United States), *Method No P&CAM - Lead in Air and Blood*, Government Printing Office, Washington DC, 1976¹³.

A2.14 Example 1: (*See* subsection A2.13 (b) above).

An operator works 7 hrs 20 mins on lead processes on shift, during which the measured exposure was 0.12 mg/m³. The eight hour time-weighted average is calculated from:

- (i) 7 hrs 20 mins (7.33 hrs) at 0.12 mg/m³, plus
 - (ii) 40 mins (0.67 hrs) at 0.0 mg/m³
- The 8 hour time-weighted average is therefore:

$$= \frac{7.33 (0.12) + 0.67(0)}{8}$$

$$= \frac{0.88}{8}$$

$$= 0.11 \text{ mg/m}^3$$

This exposure to lead is significant but below the atmospheric lead exposure standard⁷.

A2.15 If the exposure to lead over the working week is for a period in excess of 40 hours, cognisance should be taken of this when interpreting the results. Care will be needed and such interpretation should be carried out by an experienced occupational hygienist. The following example is given as a guide-line for the interpretation of results when an operator has been exposed to lead for a 50-hour working week.^{**} It illustrates the eight hour time-weighted average being increased on a pro-rata basis for comparison with the atmospheric lead exposure standard:

Example 2: (*See* subsection A2.15 (c) above).

An operator works ten-hour shifts for five days, that is, 50 hours per week, during which the eight hour shift sample shows atmospheric lead exposure of 0.07 mg/m³.

As a guideline for interpretation, the eight hour time-weighted average is increased pro-rata.

$$\frac{50}{40} \times 0.07 = 0.088 \text{ mg/m}^3$$

^{**} Altered workshifts are currently under review by the National Occupational Health and Safety Commission. Reference should be made to section 5 of the NOHSC *Guidance Note on the Interpretation of the Exposure Standards for Atmospheric Contaminants in the Occupational Environment* [NOHSC:3008(1991)]⁷.

Calculation of Eight Hour Time-Weighted Average from Split Samples

A2.16 **Example 3:** The operator works the following pattern:

<i>Working Period</i>	<i>Duration of Sampling (Hours)</i>	<i>Sampling Results (mg/m³)</i>
8.00 - 10.30	2.5	0.12
10.45 - 12.45	2.0	0.07
13.30 - 15.30	2.0	0.24
15.45 - 17.15	1.5	0.10

The eight hour time-weighted average is therefore:

$$\begin{aligned} &= \frac{2.5(0.12) + 2(0.07) + 2(0.24) + 1.5(0.10)}{8} \\ &= \frac{0.30 + 0.14 + 0.48 + 0.15}{8} \\ &= 0.13 \text{ mg/m}^3 \end{aligned}$$

This exposure is significant but below the atmospheric lead exposure standard.[#] The individual period results indicate high exposure during one working period (13.30 to 15.30) and this should be investigated for possible changes in working patterns or processes with corrective action taken. This valuable information would not have been apparent from full shift sampling.

[#] Reference should be made to section 6—Guidance on General Excursions in the National Occupational Health and Safety Commission's 'Guidance Note for the Assessment of Health Risks Arising from the Use of Hazardous Substances in the Workplace' in *Adopted National Exposure Standards for Atmospheric Contaminants in the Occupational Environment* [NOHSC:1003(1991)]⁷.

LABELLING

A3.1 Where a lead-containing substance in a workplace is contained in an enclosed system, such as a pipe or piping system, or a process or reactor vessel, it shall be identified. Suitable means of identification include colour coding in accordance with Australian Standard AS 1319 — *Safety Signs for the Occupational Environment*¹⁰ or Australian Standard AS 1345 — *Identification of the Contents of Piping, Conduits and Ducts*¹⁴. Such identification can be used in conjunction with suitable work practices including permit to work systems for enclosed systems and confined spaces.

A3.2 If the container is not properly labelled, for example, if the label has been lost, the container should have a product name attached to it. If the product name is not known, then this shall be clearly marked on the container; for example, '**CAUTION DO NOT USE: UNKNOWN SUBSTANCE**'. Such a container should be stored in isolation until its contents can be identified and the container appropriately labelled. If the contents cannot be identified the contents should be disposed of in a suitable manner.

A3.3 If an employee finds a container that does not have a label, the employer shall be advised immediately.

ASSESSMENT

HOW TO APPROACH AN ASSESSMENT

For guidance on assessments also refer to the *Guidance Note for the Assessment of Health Risks Arising from the Use of Hazardous Substances in the Workplace* [NOHSC:3017(1994)]⁶.

Identification of Lead-containing Hazardous Substances in the Workplace

A4.1 Before an assessment, the lead-containing hazardous substances should be identified by reference to stock lists, inventories, Material Safety Data Sheets, registers and labels. The potential for lead-containing hazardous substances to be produced as intermediates, by-products, finished products, wastes or residues and fugitive emissions should be assessed.

A4.2 In many instances, lead-containing hazardous substances may be created by an operation in the workplace, leading to potential exposure of employees. The *National Standard for the Control of Inorganic Lead at Work* [NOHSC:1012(1994)] will apply in these circumstances. An example is the generation of lead fumes during welding or heat cutting of a metal sheet coated with lead pigment-containing paint or the generation of lead fume when melting or casting lead-containing alloys.

A4.3 Fugitive emissions that may impact on the health and safety of persons at work are also sometimes created by work processes and should be considered during the assessment process.

A4.4 All potential forms in which lead exposure may occur in the workplace should be taken into account. Lead is harmless as a block of metal but is very hazardous as dust or fume.

Information on Hazards to Health and Safety

A4.5 Information on the hazards of lead can be obtained by reference to the labels and Material Safety Data Sheets provided by suppliers. Additional information can be obtained from:

- (a) the supplier;
- (b) scientific and technical literature;
- (c) Worksafe Australia;
- (d) relevant Jurisdiction authorities; and
- (e) appropriate occupational health and safety professionals.

Consideration of the Ways in which Exposure can Occur

A4.6 The potential route of exposure of each lead-containing hazardous substance should be considered, for example:

- (a) breathing in lead fume or dust containing lead;
- (b) swallowing, either directly or from lead dust settling on food, or from eating or smoking with contaminated hands; and
- (c) absorption through the skin, either directly or from contact with contaminated surfaces or clothing. However, the absorption of inorganic lead through the intact skin is of limited significance.

Degree of Exposure

A4.7 The degree of exposure of persons to lead should be estimated by taking into account:

- (a) the levels of the atmospheric lead during exposure;
- (b) the duration of exposure; and
- (c) the frequency of exposure.

A4.8 The level, duration and frequency of exposure will depend on the particular type of work and work processes in which lead is used or produced. These will need to be assessed carefully to take account of all factors which may influence the overall degree of exposure.

A4.9 Specific working conditions, such as work in a confined space which contains lead, will affect the degree of exposure.

A4.10 Consideration should also be given to the persistence of lead in the work environment, for example, on contaminated clothing or working surfaces. This will influence the overall level, duration and frequency of exposure.

A4.11 After consideration of these matters, monitoring may or may not be required. For example, lead may be in solid ingot form and handled very briefly by a small number of employees, or lead may be in a molten liquid form handled in large quantities by many employees over the greater part of their shift. Monitoring may not be required in the former case, but is required in the latter case.

A4.12 Some monitoring should be carried out where the degree of exposure is uncertain.

Evaluation of the Potential Health and Safety Risk in Work Involving Lead-containing Hazardous Substances

A4.13 The health and safety risk should be evaluated by considering:

- (a) the lead-containing hazardous substance involved;
- (b) the nature and severity of potential health and safety effects; and
- (c) the degree of exposure in the operation.

A4.14 The evaluation of the health and safety risk is the basis for determining suitable control measures, emergency procedures and training, as well as possible health surveillance and any ongoing monitoring.

RECORDING OF ASSESSMENT REPORTS

A4.15 Where the assessment has determined that there is no risk to health, the report should simply record this with sufficient information to justify the decision. Where the assessment determines that there is a risk to health, the assessment report should include:

- (a) the health and safety risk to employees for each operation involving lead;
- (b) whether atmospheric monitoring is necessary, including that needed to ensure that the control measures are functioning properly;
- (c) the control measures required and the basis for the recommendations;
- (d) whether health surveillance is necessary;
- (e) the induction and training required for employees;
- (f) information relevant to the Material Safety Data Sheet and the use of the lead-containing hazardous substance;
- (g) the names and positions of those making the assessment; and
- (h) the circumstances under which a review may be needed.

HIERARCHY OF CONTROL MEASURES

Elimination

A5.1 An example of elimination is using lead-free paint in place of lead-containing organic solvent-based paint.

A5.2 The elimination of a lead-containing hazardous substance should not require the adoption of an alternative method that leads to a less effective product or process.

Substitution

A5.3 Examples of substitution include:

- (a) purchasing supplies of a lead-containing material in a ready-cut and sized form rather than carrying out dust producing cutting processes on site; and
- (b) using pastes instead of powders.

A5.4 The substitution of a lead-containing hazardous substance should not require the adoption of an alternative method that leads to a less effective product or process.

Isolation

A5.5 An example is the remote operation of a process.

Engineering Controls

A5.6 Types of engineering controls include enclosure or partial enclosure, local exhaust ventilation and automation of processes.

A5.7 Examples of engineering controls include:

- (a) ventilated booths for spray painting;
- (b) robot welding;
- (c) local extraction systems; and
- (d) closed reaction vessels.

Safe Work Practices

A5.8 Examples of safe work practices include:

- (a) reducing the number of employees exposed;
- (b) excluding any access which is not essential;

- (c) reducing the period of exposure for employees — limiting overtime;
- (d) regular cleaning of contamination from walls and surfaces;
- (e) providing means for safe storage and disposal of lead-containing hazardous substances;
- (f) using brush applications for a lead-containing paint rather than spray application;
- (g) prohibiting eating, drinking and smoking in contaminated areas;
- (h) vacuuming dust from contaminated areas;
- (i) keeping lids on containers when not in use; and
- (j) providing and using facilities for effective washing and showering.

Personal Protective Equipment

A5.9 Personal protective equipment may be used in conjunction with other control measures. In determining if it is reasonably practicable to introduce personal protective equipment, the limitations of equipment, the costs and practical difficulties of ensuring its continued correct use and its effectiveness should be carefully evaluated in the context of the particular work situation and the nature and degree of exposure.

A5.10 Situations where use of suitable personal protective equipment may be necessary include:

- (a) where it is not technically feasible to achieve adequate control of exposure by other control measures. In these cases, exposure shall be reduced so far as is practicable and, in addition, suitable personal protective equipment shall be used to secure adequate control;
- (b) where a new or revised assessment indicates that personal protective equipment is necessary to safeguard health until such time as adequate control is achieved by other means, for example, where urgent action is required because of plant failure; and
- (c) during routine maintenance operations. Although exposure occurs regularly during such work, the infrequency and small number of people involved may make other control measures impracticable.

A5.11 Employers should ensure that personal protective equipment is:

- (a) properly selected for the individual and task;
- (b) readily available;
- (c) clean and functional;
- (d) used when required; and
- (e) maintained by appropriately trained staff.

A5.12 In respect of personal protective equipment, employers should ensure that employees are trained in its:

- (a) appropriate selection and fitting;
- (b) maintenance and storage; and
- (c) use.

Suitable Personal Protective Equipment

A5.13 Suitable personal protective equipment shall be selected and used in compliance with relevant Australian Standards (published by Standards Australia, Sydney) in particular:

- (a) eye protection selection shall comply with AS 1337¹⁵, and selection and use of such devices with AS 1336¹⁶;
- (b) respiratory protection shall comply with AS 1716⁸, and be chosen and used in accordance with AS 1715⁹;
- (c) hand protection shall comply with AS 2161¹⁷, where appropriate;
- (d) foot protection shall comply with AS 2210¹⁸;
- (e) head protection shall comply with AS 1801¹⁹, and be used in accordance with AS 1800²⁰; and
- (f) clothing for the protection against chemicals shall comply with AS 3765²¹.

A5.14 In some emergency situations more specialised equipment may be required.

MAINTENANCE AND SERVICING OF CONTROL MEASURES

A5.15 A system should be established which will allow early detection of any defect which could result in a reduced level of protection. Defects should be identified by routine maintenance including:

- (a) visual checks at appropriate intervals to ensure that control measures are being used properly;
- (b) periodic inspection of administrative and operational control measures; and
- (c) testing and preventive service.

A5.16 Provision should be made for maintenance to be carried out by trained and competent personnel.

A5.17 Where engineering control measures are used to control exposure, they should be thoroughly examined and tested at specified intervals to ensure performance is consistent with that stated in the assessment report.

A5.18 Preventive servicing procedures should be established. These should specify:

- (a) which control measures require servicing;
- (b) the nature of the servicing needed;
- (c) frequency of the servicing;
- (d) who is responsible for the servicing;
- (e) how any defects noted shall be corrected; and
- (f) performance testing and evaluation.

A5.19 The nature of the servicing will depend on the particular control measure under consideration and the consequences of deterioration or failure of the control measure. The examination and test should be no more extensive than is necessary to disclose any defect or any latent defect. Similar considerations should be used to determine suitable intervals between services. The frequency should be matched to the extent of the risk in the event of failure or deterioration of the control measure. The frequency of servicing may need to be increased with the increasing age of the control concerned.

A5.20 All necessary cooperation should be given to the person carrying out the service examination and test to enable it to be carried out correctly and fully. A record of maintenance shall be kept for the period of service of equipment and plant.

ATMOSPHERIC MONITORING

A6.1 Advice on suitable sampling techniques and methods of analysis may be found in publications including:

- (a) Australian Standards, for example:
- AS 3640 *Workplace Atmospheres — Method for Sampling and Gravimetric Determination of Inspirable Dust*¹²;
 - AS 2985 *Workplace Atmospheres — Method for Sampling and Gravimetric Determination of Respirable Dust*²²; and
- (b) National Occupational Health and Safety Commission's *Adopted National Exposure Standards for Atmospheric Contaminants in the Occupational Environment* [NOHSC:1003(1991)]⁷.
- (c) The United Kingdom Health and Safety Executive's 'Monitoring Strategies for Toxic Substances'; *Environmental Hygiene*, No 42, January 1989²³;
- (d) The United Kingdom Health and Safety Executive's *Methods for the Determination of Hazardous Substances, MDHS series*²⁴;
- (e) the United States National Institute of Occupational Safety and Health's (NIOSH) *Manual of Analytical Methods*²⁵; and
- (f) the United States National Institute of Occupational Safety and Health's (NIOSH) *Occupational Exposure Sampling Strategy Manual*, 1977²⁶.

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3. National Occupational Health and Safety Commission, *National Code of Practice for the Preparation of Material Safety Data Sheets* [NOHSC:2011(1994)], Australian Government Publishing Service, Canberra, 1994.
4. National Occupational Health and Safety Commission, *National Code of Practice for the Labelling of Workplace Substances* [NOHSC:2012(1994)], Australian Government Publishing Service, Canberra, 1994.
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9. Standards Australia, AS 1715 *Selection, Use and Maintenance of Respiratory Protective Devices*, Standards Australia, Sydney.
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11. Health and Safety Executive (United Kingdom), *Guide to Testing and Monitoring Local Exhaust Ventilation Systems*.
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19. Standards Australia, AS 1801 *Industrial Safety Helmets*, Standards Australia, Sydney.
20. Standards Australia, AS 1800 *The Selection, Care and Use of Industrial Safety Helmets*, Standards Australia, Sydney.
21. Standards Australia, AS 3765 *Clothing for Protection Against Hazardous Chemicals*, Standards Australia, Sydney.
22. Standards Australia, AS 2985 *Workplace Atmospheres — Method for Sampling and Gravimetric Determination of Respirable Dust*, Standards Australia, Sydney.
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