safe work australia

HEALTH MONITORING IN MINING

Code of Practice

safe work australia

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FOREWORD

This Code of Practice on health monitoring in mining is an approved code of practice under section 274 of the *Work Health and Safety Act* (the WHS Act).

An approved code of practice is a practical guide to achieving the standards of health, safety and welfare required under the WHS Act and the Work Health and Safety Regulations (the WHS Regulations).

A code of practice applies to anyone who has a duty of care in the circumstances described in the code. In most cases, following an approved code of practice would achieve compliance with the health and safety duties in the WHS Act, in relation to the subject matter of the code. Like regulations, codes of practice deal with particular issues and do not cover all hazards or risks which may arise. The health and safety duties require duty holders to consider all risks associated with work, not only those for which regulations and codes of practice exist.

Codes of practice are admissible in court proceedings under the WHS Act and Regulations. Courts may regard a code of practice as evidence of what is known about a hazard, risk or control and may rely on the code in determining what is reasonably practicable in the circumstances to which the code relates.

Compliance with the WHS Act and Regulations may be achieved by following another method, such as a technical or an industry standard, if it provides an equivalent or higher standard of work health and safety than the code.

An inspector may refer to an approved code of practice when issuing an improvement or prohibition notice.

This Code has been developed by Safe Work Australia in conjunction with the National Mine Safety Framework Steering Group as a model code of practice under the Council of Australian Governments' *Inter-Governmental Agreement for Regulatory and Operational Reform in Occupational Health and Safety* for adoption by the Commonwealth, state and territory governments.

A draft of this Code of Practice was released for public consultation on [*to be completed*] and was endorsed by the Select Council for Workplace Relations on [*to be completed*].

SCOPE AND APPLICATION

This Code provides practical guidance for the mine operator who has duties under the WHS Act and its Regulations to provide health monitoring that:

- assesses the health status of all mining industry workers on a regular basis
- analyses collected data to detect adverse health effects at the earliest opportunity
- evaluates the control measures employed to control exposure and enabling appropriate and timely corrective action to be taken where necessary, and
- provides data for future epidemiological studies.

It also provides guidance on milestones for a health monitoring system for effective monitoring of new and existing workers in the mining industry (***Appendix A***).

The Code also provides information for registered medical practitioners to assist them in planning and implementing a program of health monitoring in the mining industry, including details of competency levels and useful questionnaires for some types of health monitoring.

This Code applies to, and is targeted at, all types of work and all workplaces covered by the WHS Act. It includes workplaces that may be permanent, fixed, mobile, temporary or remote

where hazardous chemicals associated with mining are explored, extracted, processed, handled, stored and transported.

This Code refers to both health effects and causative hazardous chemicals, which may also be an airborne contaminant (for example, particulates and fibres in ore 'dust') encountered in mining activities that present a significant level of risk to a person's health.

This Code complements the *Code of Practice: Health Monitoring* which addresses hazardous chemicals in general workplaces. However, such workplaces may also be a mine site or associated with mining activities. A mine operator should be aware that both codes relating to health monitoring may be relevant to a mine site and activities. For example, if a laboratory on a mine site uses general hazardous chemicals, both codes will be appropriate.

This Code does not cover health monitoring specifically covered in other codes, for example, health monitoring for asbestos.

There may be exemptions from applying the health monitoring regime outlined in Appendix A to certain workers, who are not *normally* exposed to significant levels of hazardous chemicals. This should be done through the process of risk assessment with on-going monitoring and review to ensure that any exposure to risk is eliminated, or where this is not reasonably practicable, minimised. Please note that such written risk assessments need to take account of the nature of the chemicals, the type of exposure, the extent of exposure and assessment of current scientific knowledge to assess whether an identifiable disease or adverse effect that can develop from the exposure, by virtue of available epidemiology, information on human exposure, human and animal toxicological data and extrapolation from information about similar chemicals or situations.

Who should use this Code?

You should use this Code if you have duties to ensure health and safety under the WHS Act and its regulations as a person conducting a mining-related business or undertaking, whether you are an employer, self-employed, a principal contractor, a person with management or control of a workplace, a designer, manufacturer, importer or supplier.

This approved code is intended for use to determine if health monitoring needs to be undertaken for workers in relation to mining operations. It is also intended to provide information to medical and occupational professionals in the competencies and timelines they need to undertake health monitoring. It provides useful tools to assess health impacts experienced by workers using hazardous chemicals.

Managers, workers and their health and safety representatives are encouraged to refer to this Code to ensure that health monitoring at their mine site is being managed properly.

How to use this code of practice

This Code includes references to both mandatory and non-mandatory actions. The references to legal requirements contained in the WHS Act and Regulations (highlighted in text boxes in this Code) are not exhaustive and are included for context only.

The words 'must', 'requires' or 'mandatory' indicate that legal requirements exist, which must be complied with. The word 'should' indicates a recommended course of action, while 'may' indicates an optional course of action.

1. INTRODUCTION

1.1 Who has duties in relation to health monitoring in mining?

The WHS Act requires all persons who conduct a business or undertaking to ensure, so far as is reasonably practicable, that workers and other persons are not put at risk from work carried out as part of the business or undertaking.

This duty includes ensuring, so far as reasonably practicable that:

- The provision and maintenance of a work environment are without risks to health
- The safe use, handling and storage of chemicals, and
- The health of workers and the conditions at the workplace are monitored for the purpose of preventing illness or injury of workers arising from the conduct of the business or undertaking.

The WHS Regulations requires the mine operator to ensure that health monitoring is carried out in relation to a worker at the mine who is exposed to a risk associated with mining operations that may reasonably be expected to have an adverse effect on the worker's health.

Managing risks

The first step is to identify all hazardous chemicals and activities in the mine. The next is to determine the potential and actual exposure levels for all workers, who may come in contact with the hazardous chemicals or be affected by the activities.

With regard to mined ores, some selective leaching and mineral concentration processes may concentrate undesired contaminants including toxic heavy metals. Hazardous contaminants must be tested for throughout the process to identify whether workers could be exposed to elevated concentrations. Exposure may occur through inhalation, ingestion (from contaminated food or drink) or absorption through the skin. As a common route of occupational exposure is inhalation, assessing the exposure risk is usually done by sampling the air within the breathing zone of the worker. Also known as *personal exposure monitoring*, this technique indicates how much of the chemical or contaminant is present in the air (the airborne concentration) that could be inhaled. The rate and amount of contaminant taken up by the body depends on factors such as:

- size and nature of the contaminant
- atmospheric conditions
- breathing rate of the worker
- whether a respirator is worn
- whether the chemical can enter the body via routes other than breathing, e.g absorption invasion, injection or ingestion, and
- individual differences such as personal hygiene habits, age, gender and fitness level.

Further information on managing risks can be found in the *Code of Practice: How to Manage Work Health and Safety Risks.*

Consultation

When health monitoring is required, the mine operator must consult with their workers and other persons at the mine including other persons conducting a business or undertaking at the workplace.

For example, the mine operator must consult with the worker in relation to the selection of the registered medical practitioner and the timing of the monitoring.

Further guidance on consultation, cooperation and coordination can be found in the *Code of Practice: Consulting Workers and Consulting, Cooperating and Coordinating with Others on Work Health and Safety Matters.*

1.2 What is health monitoring in mining?

Health monitoring means the monitoring (including biological monitoring and medical examination) of individuals for the purpose of identifying changes in health status due to occupational exposure to a hazard including hazardous chemicals, noise and vibration. In this document, health monitoring refers to health monitoring in relation to exposure to hazardous chemicals in mining.

Health monitoring includes biological monitoring, but does not include air monitoring or other measures used to control exposure to hazardous chemicals in the workplace. Examples of health monitoring include testing for minimised lung function in workers exposed to silica & coal dust, or testing for blood lead levels in workers who carry out operations in mines containing lead ores.

Health monitoring also includes counselling. For example identifying and informing workers of possible risks. Informing workers of new potential risks as a result of changes that are possibly caused outside of work but may leave them more susceptible ie. cardiovascular disease and asthma.

Health monitoring does not have to be intrusive and can be about observation ie. skin discoloration, weight, mental health. Health monitoring can include questions that will indicate the source of the exposure i.e. via work or personal behaviour (do you bring lunch to work, do you smoke?). It can take into consideration factors such as medical and occupational history, environmental factors, behavioural patterns, personal hygiene, eating, drinking and smoking, family history, reproductive capacity, family planning and neurological factors.

Health monitoring must never be used as an alternative to the implementation and proper maintenance of risk control measures in the workplace.

Hazardous chemicals under Schedule 14 of the WHS Regulations
Certain hazardous chemicals listed in schedule 14 of the WHS Regulations are known to cause adverse effects or ill-health, so health monitoring is mandatory these chemicals are used and the risk assessment suggests that there is a significant level of risk to worker's health. Typical chemicals on this list encountered in mining are listed in the appendix and all have valid techniques to detect health effects or if valid biological monitoring procedures.

Other chemicals not listed in schedule 14 and certain potentially-hazardous activities may also require health monitoring if an assessment of risk suggests that there is a significant level of risk to worker's health, because there are valid techniques to detect health effects or a valid biological monitoring procedure available; there is further detailed information in the appendices

of this Code. Further information is available in the *Code of Practice: Health Monitoring* for general workplaces.

However, there may be other activities particular to a mine site that a risk assessment identifies as a significant risk to worker's health, where the mine operator believes health monitoring would be appropriate, but it is not mandatory to perform *per se*. This is mainly because valid ways to detect ill-health do not exist yet and / or the link between work and the ill-health condition is uncertain. In these cases, the use of other methods to monitor the health of workers exposed to these risks - such as encouraging symptom-reporting and checking sickness records – should be implemented.

The appendix provides information to medical and occupational health professionals on the timelines required to undertake health monitoring for workers who need it.

1.3 Types of health monitoring

There are different types of health monitoring procedures that can be used. These include:

Biological (or exposure) monitoring	This involves measurement and evaluation of the levels of a hazardous, chemical or its metabolites (break-down products) in body tissues, in body fluids (such as urine or blood), or in exhaled breath, of an exposed person to quantify actual exposure, such as that used in blood lead measurement.
biological (effect) monitoring	This is the measurement and assessment of early biological effects before health impairment occurs in exposed workers (*e.g.* measurement of cholinesterase levels in workers exposed to organophosphate pesticides).
Medical examination	This involves the use of standard clinical and medical assessments, tests and techniques to assess the presence of early or long-term health effects, often at set intervals by a registered medical practitioner. They can include an assessment of medical history, occupational work and / or known previous exposure history, physical examination, lung function tests and radiography (*e.g.* a chest x-ray to determine the level of exposure to asbestos).

The choice of which individual (or combination) of monitoring methods to use depends on the type of substance or activity involved, the way a person is exposed and whether it is possible to be proactive (*e.g.* biological exposure monitoring) rather than reactive (*e.g.* medical examination); being proactive is always preferable under the WHS Act. In many cases, more than one monitoring method needs to be used. Tests must be sensitive, specific enough to detect adverse effects and be reproducible, and be able to link these to the degree of exposure. Health monitoring procedures must be safe, easy to perform, acceptable to workers and where possible, non-invasive.

Where valid ways to detect work-related ill-health prior to injury do not exist yet (*e.g.* work-related upper limb disorders) and / or the link between work and the ill-health condition is uncertain (*e.g.* work that might give rise to stress-related diseases and symptoms), reactive

health effect monitoring could be an on-going overview of sickness records and symptom-reporting and checking. In its simplest form, this type of health monitoring involves workers checking themselves for signs or symptoms of ill-health. However, these 'self-checks' can only be carried out where they are part of a wider health monitoring programme. They will only work where workers have been properly trained on what to look for and know to whom to report symptoms; an example would be workers noticing soreness, redness and itching on their hands and arms, where they work with chemicals that can irritate or damage the skin.

Pre-emptive inspections can prove a useful tool in health monitoring. A responsible person can be trained to make basic checks, such as skin inspections, for signs of rashes. For more complicated assessments, an occupational health nurse can ask about symptoms or carry out an examination. For certain hazards, clinical examinations may need to be carried out by a fully-qualified specialist, preferably one trained in occupational medicine. Ultimately, people must be competent to undertake the health monitoring techniques they administer and / or oversee.

It is important to remember that health monitoring will only work if the mine operator acts on the results – it must be clear how and when people must be referred for further examination and how the results will be used to improve how risks are managed.

Actual exposures can be determined using some of the above techniques and it is important to understand the limitations of any results, as presence within the body does not necessarily correlate with occupational exposures or symptoms or damage to health. As different chemicals cause specific health effects, it is important to obtain specialist advice before implementing any health monitoring program.

Schedule 14 of the WHS Regulations provide details of the tests recommended health monitoring for a number of scheduled chemicals (add as appendix A). The Safe Work Australia Guidelines for Health Monitoring *[under development]* are provided for all scheduled chemicals, asbestos and lead. These are intended for use by the registered medical practitioner when planning and implementing a program of health monitoring.

The Australasian Faculty of Occupational and Environmental Medicine's brochure entitled *Guidelines for Health Assessment at Work* may also be of assistance in determining appropriate health monitoring methods.

1.4 Why is it necessary to undertake health monitoring?

Protecting the health of workers and other persons at the mine and associated workplaces is a legal requirement as well as a community expectation that makes good business sense. This can be achieved by detecting as early as possible any adverse changes in health, which may be caused by exposure to the hazardous chemicals or activities and help evaluate the efficacy of control measures used to prevent or minimise exposure to the substance. Health monitoring provides information on identifying where further steps are required and provides a valuable opportunity for feedback from workers and a chance to reinforce health and safety messages to them.

Health monitoring is therefore part of an integrated range of measures directed at monitoring health of workers who may be exposed to certain hazardous chemicals at work to ensure their health and safety.

1.5 When does health monitoring occur?

Health monitoring must:

- commence before the worker starts work at the mine, and
- be carried out immediately before the worker ceases carrying out work that exposes the worker to risks associated with mining operations.

1.6 Who carries out the health monitoring?

Health monitoring must be carried out:

- under the supervision of a registered medical practitioner with the relevant competencies
- only in relation to the worker's work at the mine, and
- at a frequency determined by the mine operator in consultation with a medical practitioner and the timing of the monitoring.

1.7 Who pays for health monitoring?

The cost of undertaking health monitoring is borne by the mine operator, not the worker. This includes doctors' fees, testing and analysis costs (for example, testing blood or urine samples), as well as other costs of attending the doctor such as travelling time & expenses and, in some cases, time off work.

2. WHEN IS HEALTH MONITORING IN MINING NEEDED?

2.1 Health monitoring for workers exposed to significant levels of hazardous chemicals

Health monitoring should occur when:

- an assessment of risk suggests a significant level of residual risk to worker's health after elimination and then minimisation of risk, because the worker in the course of their work:
    - use hazardous chemicals listed in Schedule 14 of the WHS Regulations
    - use other chemicals not listed in Schedule 14 of the WHS Regulations and there are valid techniques to detect health effects or a valid biological monitoring procedure available, or
    - have work activities that might give rise to adverse health effects *and* the mine operator believes that voluntarily health monitoring would be appropriate

Therefore, control measures must be implemented. When doing this, the mine operator must consult with workers and set up an appropriate health monitoring system that:

- performs all assessments under the supervision of a registered medical practitioner and provides for adequate resourcing
- performs individual assessments before any work commences and is at an agreed frequency of work thereafter and is completed before the last work ceases, and
- obtains summaries of all health monitoring undertaken and provides for information to the individual and stores all records as confidential.

Health monitoring must be carried out when a written risk assessment identifies that a person who is usually exposed to significant levels of hazardous chemicals or potentially hazardous activities, and that exposure to the substance or activity presents a significant risk to worker's health.

If the risk assessment identifies a significant risk to workers, control measures must be put in place in order to minimise the level of risk to the workers. The implementation and proper maintenance of control measures in the workplace do not replace the need for health monitoring.

Information regarding timelines and content of health monitoring to undertake on all workers at a mine site (including workers involved in mining operations for the purposes of health monitoring) is detailed in Appendix A.

Additional health monitoring must be carried out for the following activities or chemicals that may be present at the mine site:

- Antimony
- Arsenic (inorganic) – Refer to the Code of Practice: Health Monitoring
- Naturally Occurring Asbestos – Refer to the Code of Practice: How to Manage and Control Asbestos in the Workplace
- Beryllium
- Cadmium – Refer to the Code of Practice: Health Monitoring
- Chromium (inorganic) – Refer to the Code of Practice: Health Monitoring

- Coal dust – See Appendix C
- Cobalt – Refer to Appendix B and the Code of Practice: Health Monitoring
- Crystalline silica (respirable) – Refer to Appendix D the Code of Practice: Health Monitoring
- Lead – Refer to the Code of Practice: Health Monitoring
- Mercury – Refer to the Code of Practice: Health Monitoring
- Nickel
- Thallium – Refer to the Safe Work Australia Health Monitoring Guidelines [underdevelopment]
- Other defined hazardous chemicals requiring health monitoring but not normally encountered in mining– Refer to the Code of Practice: Health Monitoring
- Dermatitis
- Heat Stress
- Noise
- Vibration.

2.2 Health monitoring for specific hazardous chemicals listed

If a chemical listed in Schedule 14 of the WHS Regulations is used and it presents a significant risk to worker's health, health monitoring must be undertaken. Some of these chemicals may occur in those that are not included in Schedule 14 for example in ore, such as nickel, or be present in discrete processes or procedures, for example, used in laboratories. In such situations, this Code must be used in combination with the *Code of Practice: Health Monitoring* which is aimed at giving information in relation to hazardous chemicals in the general (rather than mining) workplace.

The *Code of Practice: Health Monitoring* also details what to do when:

- criteria is needed to determine if a substance not listed in the above table and present on a mine site requires health monitoring
- the competencies of medical personnel for health monitoring are to be gauged, and,
- Wish to obtain some template respiratory questionnaires.

The WHS Regulations require that no worker is exposed to a chemical above its exposure standard. If a chemical is used that has an exposure standard, atmospheric monitoring may be required.

If the risk assessment identifies a significant risk to workers, the mine operator must put in place any control measures that are reasonably practicable in order to minimise the level of risk to the workers.

If there is still a significant risk to workers, health monitoring is required.

Methods for detecting health effects and biological levels for chemicals not listed in Schedule 14

Determine whether there are current techniques or test methods available that can detect health effects from exposure to chemicals used at the workplace. Techniques and tests need to be practical, accurate and safe. Health monitoring must show that ill health is beginning or is likely to occur.

Examples of appropriate test methods include use of a spirometry (lung function) test to assess exposure to a chemical that affects the respiratory system, or urine analysis to detect exposure to heavy metals.

Researching and understanding the known health effects of a chemical and the known symptoms of exposure can help the mine operator to make informed decisions about what an appropriate test method might be. The safety data sheet must contain detailed information about symptoms of exposure to the chemical. However, the mine operator may need to seek professional assistance, such as from an occupational physician or occupational hygienist for this task.

3. WHAT TO DO WHEN HEALTH MONITORING IN MINING IS REQUIRED

3.1 Consultation with the worker and their health and safety representative

Before a worker is exposed to a hazardous substance or activity triggering health monitoring, they must have been appropriately trained and informed of the health monitoring requirements. Consultation with the worker and their health and safety representative must occur to devise and implement an effective program of health monitoring well before it is undertaken. Health monitoring may not be successful if workers do not know what it involves and why it is occurring.

Involve the worker and their health and safety representative early to ease fears and build trust. Workers need to understand their role and responsibilities in the health monitoring programme. They need to be sure there are safeguards to protect their jobs if evidence of ill-health is found. Health and safety representatives can often be a source of useful, common-sense advice about how best to manage change to workplace practices.

When speaking with the worker, the mine operator should discuss:

- what is involved in the health monitoring program, for example the frequency of testing and which tests (eg blood tests, respiratory tests) may be needed
- what a program of health monitoring will achieve, how the worker will benefit and that it is in their interest to report symptoms
- whether it is a legal requirement
- alternative measures to manage risks to the worker
- who pays for the health monitoring – all health monitoring expenses must be paid by the person conducting a business or undertaking.
- what are possible health effects from exposure
- any requirements for the worker to see and doctor or specialist
- how a medical practitioner is chosen and the qualifications that they need
- that information about the results of health monitoring will be provided to the person conducting a business or undertaking as well as the worker.
- if and how monitoring results may affect the worker's employment arrangements
- the record keeping requirements, and the confidentiality of information, and
- that the worker's written consent is required for health monitoring results to be disclosed to someone else, other than the regulator.

3.2 Obtain services of a registered medical practitioner

The WHS Regulations require health monitoring to be carried out under the supervision of a registered medical practitioner. The mine operator must engage or use the services of a registered medical practitioner after consulting with the worker about the choice of medical practitioner. The registered medical practitioner should devise a program of health monitoring and either carry out the health monitoring program themselves or supervise the program when carried out by another suitably qualified person, such as an occupational health nurse.

Not all medical practitioners have adequate competencies to devise and / or implement health monitoring programs. The medical practitioner chosen for the health monitoring program should have the competencies describes in *Safe Work Australia Guidance: Competencies for Health Monitoring [under development]*. The registered medical practitioner has the overall responsibility for health monitoring but may need to seek advice about the conduct of health monitoring, for example, from an occupational physician and may need to consult with other workplace health and safety professionals.

The mine operator must provide the following information to the registered medical practitioner when undertaking health monitoring of workers:

- their name and address
- the name and date of birth of the worker
- the work the worker is, or will be, carrying out that has triggered the requirement for health monitoring, and
- if the worker has started work – how long the worker has carried out the work.

For scheduled chemicals and asbestos, certain information needs to be collected for health monitoring including demographic data, occupational history and relevant medical history. Proformas for each scheduled chemical and asbestos are provided in the *Guidelines for Health Monitoring*. Enter the relevant information on the proforma and give it to the registered medical practitioner.

The mine operator should also:

- provide the medical practitioner with a list of the hazardous chemicals that the worker is exposed to and for which the health monitoring is required. A copy of the relevant information, e.g. safety data sheets should also be provided to the medical practitioner.
- permit the medical practitioner to have access to any relevant risk assessment reports undertaken at the workplace. This information may be critical in allowing the medical practitioner to understand all of the situations where workplace exposure could occur.
- make acceptable arrangements for workers to participate in the health monitoring program

The medical practitioner responsible for health monitoring should be familiar with the regulatory requirements for health monitoring in the WHS Regulations and have an understanding of the workers' work activities.

3.3 Decide what health monitoring procedure to use

Depending on the chemical involved, specific monitoring methods are needed. Appendix A provides a summary of the type of health monitoring that, in most cases, should be used for the hazardous chemicals listed. Other monitoring tests and methods may be used instead for those chemicals in some circumstances, for example where new technology or equipment becomes available. Any alternate monitoring method chosen for use must be equal or superior to the type listed in Appendix A and should be recommended by the registered medical practitioner supervising the health monitoring.
Specific information, including detailed information on the health monitoring tests and procedures on scheduled chemicals and the information required for the preparation of a health monitoring program can be found in the Safe Work Australia *Guidelines for Health Monitoring*

{underdevelopment] for hazardous chemicals. The information may also be useful to workers and the registered medical practitioner supervising the health monitoring program.

For chemicals not in ***Appendix A*** that require a health monitoring program, the mine operator should determine the most appropriate tests to use and testing schedule in consultation with the registered medical practitioner.

All testing and health monitoring schedules should be practical, accurate and safe for the worker.

3.4 Quality Assurance

Those providing health monitoring need to ensure the quality of the program through acceptable quality assurance practices, such as those set out in Standards Australia, Standard New Zealand and International Organisation for Standardisation AS/NZS ISO 9001:2008 Quality Management Systems – Requirements.

Where there are any specific tests required, the analytical laboratory providing the test service must be accredited for the procedure with the National Association of Testing Authorities (www.nata.asn.au).

3.5 Sample collection

In those cases where the collection of biological samples is required, the instructions of the analytical laboratory providing the test service with regards to the collection, storage and transport of the samples should be strictly adhered to in order to ensure that the results are accurate and medically significant.

3.6 Health monitoring summary and keeping records

The mine operator needs to discuss the progress of the health monitoring with the medical practitioner from time to time to ensure that the health monitoring program is progressing correctly. By doing so, any issues or concerns can be identified early and rectified where necessary.

The mine operator must obtain a summary of results of the health monitoring from the supervising medical practitioner as soon as reasonably practicable after the completion of the monitoring program. This is a health monitoring summary.

What is in the health monitoring summary?
A health monitoring summary must contain:

- name and date of birth of the worker for identification purposes
- name and registration number of the registered medical practitioner, to ensure validity of the summary
- the name and address of the mine operator
- the date of health monitoring
- any advice that the test results indicate a disease, injury or illness that is likely to be related to exposure to the hazardous chemical in the workplace that triggered the requirement for health monitoring

- any recommendation that recommend remedial measures to ensure that the worker is not exposed to the hazardous chemical for any period. This includes whether the worker can continue working with the chemical, and
- whether medical counselling is required for the worker because of risks to health from handling the hazardous chemical.

The summary should also contain:

- the name of the chemical to be monitored
- the type of work being carried out
- how long the worker has been working with the chemical
- if blood and urine samples are taken, the date of sampling
- results of biological monitoring and other tests carried out
- name of pathology service used to carry out testing
- an interpretation of the results
- medical opinion on whether the worker is suitable for work/is fit to return to work if removed/if fit to return to normal duties if transferred, and
- registered medical practitioner's registration number and signature.

Note: There are specific requirements for asbestos and lead in the WHS Regulations. For example some of the above recommended requirements are mandatory for lead. Refer to WHS Regulations Part 7.2 or the Guidelines for health monitoring for inorganic lead and for asbestos to WHS Regulations Part 7.3 or the Guidelines for health monitoring for asbestos.

Identify summary as a record

Identify health monitoring results for a worker as a record for that worker. Clearly identify them from other information obtained for other purposes, such as records of examinations that are not connected with health monitoring.

Confidentiality

Keep this record as a confidential record. For example, do not discuss the contents of the summary or provide the summary to anyone except the worker without first getting written permission from the worker. Permission is not required where the person the record is disclosed to is required to keep the record confidential under a duty of professional confidentiality.

Similarly, any blood or tissue samples, X-rays, questionnaires or other materials taken for health monitoring must not be used for any purpose other than health monitoring (health monitoring includes longer-term epidemiological studies) without the express consent of the worker.

How long to keep the record

Health monitoring records for all workers must be kept for at least 30 years, even if the worker no longer works at the workplace.

4. HEALTH MONITORING SUMMARY IN MINING – WHAT TO DO NEXT

Once the mine operator has the health monitoring summary from the medical practitioner, they need to consider these results and any recommendations and advice contained in it.

As soon as is reasonably practicable, the mine operator must provide a copy of the health monitoring results to the worker and explain what the results mean. The mine operator should explain whether the worker's health is being harmed and what will be done to resolve any issues.

Where an abnormality is observed and the medical practitioner has made recommendations and advice, the mine operator must take the appropriate action to address the risks to the worker.

- The mine operator must provide a copy of the advice and / or recommendation to the regulator as soon as is reasonably practicable.
- If the summary recommends corrective action be taken, review the risk assessment and control measures for the hazardous chemical. If necessary revise the control measures in order to eliminate the risk or minimise it so far as is reasonably practicable.
- If the summary recommends that a worker should not be exposed to a hazardous substance or chemical for a specified period of time or should only work under conditions specified by the medical practitioner, the mine operator must follow these recommendations. For example, assign the worker to alternative work or another location at which exposure to the hazardous chemical will not occur. This should be done in consultation with the worker and the medical practitioner.
- Review training programs.
- Provide workers who have been removed from work with hazardous chemicals information concerning the results of workplace assessment and their health status.

If biological monitoring has been undertaken for routine exposure screening and measured biological levels reach or exceed recommended action levels, a suitable and sufficient health assessment by a competent person is indicated. Best practice also incorporates such an assessment as part of an annual health review for workers at risk of significant exposure.

5. CHECKLIST - WHAT TO DO WHEN HEALTH MONITORING IS REQUIRED

- Inform worker of health monitoring requirements before the worker carries out any work with the chemical. Consult with the worker or their health and safety representative.
- Engage a registered medical practitioner with the relevant competencies to supervise the health monitoring program.
- Decide the type of health monitoring to use according to the WHS Regulations and in consultation with the registered medical practitioner.
- Registered medical practitioner conducts or supervises health monitoring.
- Obtain the health monitoring summary, identify the record as a confidential record in relation to the worker and keep the record at least 30 years after the record is made.
- Provide a copy of the health monitoring summary to the worker.
- Provide a copy of the health monitoring summary to all other persons conducting businesses or undertakings who have a duty to provide health monitoring for the worker.
- Provide a copy of the health monitoring summary to the regulator if the summary has test results indicating the worker has been exposed to the chemical in excess of the exposure standard, advises the worker is suffering a disease, injury or illness as a result of exposure or recommends remedial action to be taken.
- Take appropriate action where the health monitoring summary has test results indicating the worker has been exposed to the chemical in excess of the exposure standard, advises the worker is suffering a disease, injury or illness as a result of exposure or recommends remedial action to be taken.

6. INDUCTION, INFORMATION, TRAINING AND SUPERVISION IN MINING

The WHS regulations require workers to be given adequate induction and training in tasks they undertake and any risks they may be exposed to during work. As part of training and induction procedures, make sure that workers are given information about any health monitoring procedures that may be required if they are at risk from the use of hazardous chemicals.

APPENDIX A - CONTENT AND TIMELINES: HEALTH MONITORING FOR WORKERS

1 - Pre-employment health checks (for all workers at the mine site) should include at least:

- a summary of their work history;
- a questionnaire, re: known allergens to the individual, e.g. Nickel, and,

a respiratory questionnaire.

2 - An initial health assessment conducted on workers involved in mining operations for the purposes of health monitoring (see note 1 below) should include as a minimum:

- a lung function test; and,
- an audiometric (hearing) test (in line with Noise ACoP).

For workers involved in mining operations for the purposes of health monitoring (see note 1 below), it is usually necessary for employers to perform the initial health assessment *with* the pre-employment check in order to gauge the individual's overall suitability for the proposed role and gauge whether some, none or all the duties proposed are indeed appropriate for the person.

3 - Periodic health assessments for workers involved in mining operations for the purposes of health monitoring should consist of at least:

- a revised summary of their work history since the last summary was made;
- a new questionnaire, re: known allergens to the individual;
- a new respiratory questionnaire;
- a new lung function test; and,
- an new audiometric (hearing) test (in line with Noise ACoP).

These are to be conducted at intervals not exceeding five years. However, the actual frequency of any periodic health assessment for any individual will be determined by a registered medical practitioner after considering any relevant suitable and sufficient assessment of risk performed by a competent person. For example, where total enclosure segregates a worker from airborne contamination, five years may be considered appropriate, whereas any worker who relies on respiratory protection equipment may be considered at higher risk of exposure and may be periodically health assessed annually.

Notes:

1 - There may be exemptions from applying the initial and periodic health assessments (but not the pre-employment health check) to certain classes of mine workers, who are considered - after application of a rigorous assessment of risk process - to not be usually exposed to

significant levels of hazardous chemicals, *i.e.* they are not considered workers involved in mining operations for the purposes of health monitoring.

2 - A chest x-ray is not a routinely required component of any pre-employment health check or of any initial or periodic health assessment. However, there is provision for the registered medical practitioner to request a chest x-ray as a component of these health checks or assessments should it be considered clinically necessary or desirable by the registered medical practitioner.

3 - For workers not considered as involved in mining operations for the purposes of health monitoring, the written risk assessment needs to take account of the nature of the chemicals, the type of exposure, the extent of exposure and assessment of current scientific knowledge to assess whether an identifiable disease or adverse effect that can develop from the exposure, by virtue of available epidemiology, information on human exposure, human and animal toxicological data and extrapolation from information about similar chemicals or situations.

4 – Employers must:

- organise health assessments and consult with the worker re: a reasonable time for & place of attendance; and,
- pay for the expenses (including travel time) associated with these tests; and

5 – Workers must:

- have a pre-employment health check and (if applicable) an initial health assessment irrespective of previous similar tests within the last five years to ensure their suitability for work at the mine site; and
- attend health assessments at places specified by their employers as agreed after consultation.

6 - Medical practitioners must:

- ensure that they are competent to undertake health monitoring work; and,
- complete any the relevant health assessment forms & summaries in accordance with this Code.

APPENDIX B - RESPIRABLE CRYSTALLINE SILICA

Crystalline silica, in the form of the mineral quartz, is found in many different materials, with some sandstone being almost pure quartz. Exposure to respirable crystalline silica ('RCS') in the mining and extractive mining and processing industries is governed by many factors, especially:

- the proportion of silica in the material;
- the mechanical work involving breaking up and / or processing the material; and,
- work patterns influencing when and how individuals may become exposed.

It is important to note that we are interested in the *respirable* fraction of the silica dust. This is the portion of the dust that reaches the deepest parts of the lungs, and is normally 10-20% of the total inhalable dust, though this proportion can vary considerably.

The amount of free silica in the respirable dust does not necessarily have any relationship to the proportion in the parent material. Correct assessment of exposure therefore depends on suitable methods of sampling and analysis of the respirable dust.

In parts of the industry where the silica content of the material is low, exposure levels to respirable crystalline silica may well be below the exposure standard. Even so, where there is evidence of hazards to health below these levels, exposure must be controlled accordingly.

Silicosis

Silicosis is a major disease risk from RCS dust. It causes small hard nodules of scar tissue to develop in the lungs that are seen on a chest X-ray. Silicosis usually takes some years to develop. There is also an acute form of silicosis that occurs at very high exposures. This can start within a short time and can kill within a few months of first exposure.

The main symptoms are cough and difficulty in breathing. Workers with silicosis are at increased risk of tuberculosis and lung cancer and may also develop kidney disease and arthritis (and related diseases). Those who work with silica may be at increased risk of some of those diseases even if they do not develop silicosis.

The early detection of breathing problems or lung damage is vital to protect workers' health by reducing future exposure to dust.

Where there is a reasonable likelihood of silicosis developing, health monitoring will be necessary. The mine operator should consider, in discussion with a health professional, the risk of silicosis or tuberculosis developing due to RCS and decide what detailed health monitoring scheme is appropriate.

A baseline X-ray is normally appropriate where there is a residual risk of silicosis. Discuss the need for a chest X-ray at the start of employment, with the health professional. Furthermore, if a health professional recommends an X ray as part of a clinical investigation of an individual, who reports new or worsening respiratory or other symptoms, the mine operator must comply with request.

Symptom enquiry is also needed where there is a risk of tuberculosis.

The health professional must explain the test results to the individual, and report to the mine operator on the worker's fitness to work.

The health professional also needs to interpret the result trends for groups and individuals and identify any need to revise the risk assessment.

The mine operator should keep a health record, and encourage workers to keep a copy of their results in case they change jobs.

Keep health records and the results of lung function tests for 40 years.

The mine operator should keep simple attendance records to identify any patterns to sickness absence.

Chronic obstructive pulmonary disease (COPD)
Exposure to RCS may also cause chronic obstructive pulmonary disease ('COPD'). This disease interferes with air movement in and out of the lungs and causes breathlessness, often with a chronic cough and sputum (phlegm). It is not certain about the risk of developing COPD from RCS exposure, but it is good practice to monitor all workers exposed to RCS for signs of COPD. RCS can cause irreversible lung damage before any symptoms develop. The illness it causes may continue to worsen even after exposure stops.

Health monitoring is never an alternative to the proper control of exposure. It is not the same as health screening or health promotion.

Risk assessment
Where exposure to respirable crystalline silica may arise, an assessment must be made of the risks to workers' health. The assessment will determine what control measures are likely to be needed and any other steps – including the need for appropriate health monitoring - necessary to comply with the regulations.

In the risk assessment, the mine operator must distinguish those who have continuous exposure at a consistent level from those whose exposure is largely due to short-term work in dusty conditions. For some workers, the exposure might follow a complicated pattern. The risk assessment is the key to ensuring workers' exposure is minimised to the lowest levels achievable, and is the essential first step towards control and therefore determining the type and frequency of health monitoring.

In preparing the risk assessment, for each job or range of tasks being reviewed the mine operator must include the following:

- potential for exposure – examine all tasks, not forgetting non-routine work (emergency breakdowns etc)
- examination of existing controls
- effectiveness of existing controls, where applicable using dust survey information, use of dust lamp etc
- whether further engineering controls are necessary (i.e. what needs to be done to achieve and sustain adequate control)

- use of respiratory protective equipment, of an approved type, at any particular location or task
- maintenance, examination and testing of engineering controls
- monitoring
- existing health monitoring data, and
- information, instruction and training of workers.

Tailor the risk assessment to the exact circumstances, working practices and patterns in the workplace, and present both the assessment and resulting systems of work in a way those who are affected can understand. A risk assessment is not a static document and the mine operator will need to review it regularly, for example:

- when the original assessment is no longer valid
- when significant changes in work occur, e.g. volume of production, plant, materials, process, control methods
- if ill-health related to work is reported
- when new evidence about hazards of respirable crystalline silica become known
- if monitoring or health monitoring results show loss of control, and
- if new or improved techniques of control become available.

The risk assessment must also include contingency plans for handling dust emitted during breakdown conditions. Laboratory workers also need to be considered during the preparation of an assessment.

Monitoring

Since exposure levels to RCS in mixed dusts cannot be predicted on the basis of the silica content in the parent material, the assessment will depend upon a suitable sampling strategy. In general, the use of personal sampling (that is, with the sampling instrument attached to the worker) rather than fixed-point sampling (sampling at a particular location) is the only method likely to give an accurate picture of the level of exposure suffered by the individual. A sampling survey in itself does not constitute a risk assessment.

The exposure of workers to respirable crystalline silica should be eliminated or - if this is not reasonably practicable - adequately controlled. The prevention of exposure to airborne crystalline silica must be the main objective. The mine operator can achieve a great deal through the careful design of equipment, particularly chutes and transfer points, and by changes in working practices. Respiratory protective equipment (RPE) can only be used to secure adequate control when all other reasonably practicable measures have been taken, but have still not achieved adequate control.

Ultimately, if the risk assessment determines that there is a residual risk of silicosis, a baseline X-ray assessment is normally appropriate. Discuss the need for a chest x-ray at the start of employment with the worker and with the health professional. *Please note*: There may be a State jurisdictional requirement to report any defined respiratory illnesses to the local Mines Inspectorate on a prescribed form.

APPENDIX C - COAL DUST

Similar to Respirable crystalline silica, coal dust can cause a multitude of respiratory illnesses. In particular, pneumoconiosis or 'black lung' is associated with coal dust.

Pneumoconiosis
This is caused by very fine coal dust particles, which reach the depths of lungs and become lodged on the lung wall. The body reacts to such particles by forming layers of scar tissue over the affected area and these can be seen as small, round shadows on chest X-rays.

The lesser degrees of pneumoconiosis do not usually cause any symptoms or disability. A chest X-ray may show fine dust shadows or nodules, but the individual may have little or no breathing problems. With more advanced pneumoconiosis, there is shortness of breath and an increasing overall lung disability. It can eventually become grossly disabling and is often complicated by other lung diseases, especially those caused by smoking cigarettes, which is actively discouraged.

Currently, there is insufficient evidence to classify coal dust as a carcinogen. Research is continually being undertaken by dedicated coal, mining and quarrying boards around Australia, and any possible adverse affect on health should be detected at an early stage and appropriate action recommended.

Risk assessment
Where exposure to coal dust may arise, an assessment must be made of the risks to workers' health. The assessment will determine what control measures are likely to be needed and any other steps – including the need for appropriate health monitoring - necessary to comply with the regulations.

In the risk assessment, the mine operator must distinguish those who have continuous exposure at a consistent level from those whose exposure is largely due to short-term work in dusty conditions. For some workers, the exposure might follow a complicated pattern. The risk assessment is the key to ensuring workers' exposure is minimised to the lowest levels achievable, and is the essential first step towards control and therefore determining the type and frequency of health monitoring.

In preparing the risk assessment, for each job or range of tasks being reviewed the mine operator must include the following:

- potential for exposure – examine all tasks, not forgetting non-routine work (emergency breakdowns etc)
- examination of existing controls
- effectiveness of existing controls, where applicable using dust survey information, use of dust lamp etc
- whether further engineering controls are necessary (i.e. what needs to be done to achieve and sustain adequate control)
- use of respiratory protective equipment, of an approved type, at any particular location or task
- maintenance, examination and testing of engineering controls

- monitoring
- existing health monitoring data, and
- information, instruction and training of workers.

Tailor the risk assessment to the exact circumstances, working practices and patterns in the workplace, and present both the assessment and resulting systems of work in a way that those who are affected can understand. A risk assessment is not a static document and the mine operator will need to review it regularly, for example:

- when the original assessment is no longer valid
- when significant changes in work occur, e.g. volume of production, plant, materials, process, control methods
- if ill-health related to work is reported
- when new evidence about hazards of coal dust become known
- if monitoring or health monitoring results show loss of control, and
- if new or improved techniques of control become available.

The risk assessment must also include contingency plans for handling dust emitted during breakdown conditions. Laboratory workers also need to be considered during the preparation of an assessment.

Monitoring

The assessment will depend upon a suitable sampling strategy. In general, the use of personal sampling (that is, with the sampling instrument attached to the worker) rather than fixed-point sampling (sampling at a particular location) is the only method likely to give an accurate picture of the level of exposure suffered by the individual. A sampling survey in itself does not constitute a risk assessment.

The exposure of workers to coal dust should be eliminated or - if this is not reasonably practicable - adequately controlled. The prevention of exposure to airborne coal dust must be the main objective. The mine operator can achieve a great deal through the careful design of equipment, particularly chutes and transfer points, and by changes in working practices. Respiratory protective equipment (RPE) can only be used to secure adequate control when all other reasonably practicable measures have been taken, but have still not achieved adequate control.

Ultimately, if the risk assessment determines that there is a residual risk of pneumoconiosis, a baseline X-ray assessment is normally appropriate. Discuss the need for a chest x-ray at the start of employment with the worker and with the health professional. *Please note*: There may be a State jurisdictional requirement to report any defined respiratory illnesses to the local Mines Inspectorate on a prescribed form.

APPENDIX D - DERMATITIS

Occupational dermatitis is a skin disease that is related to work. Common symptoms include:

- skin redness or soreness
- itching
- rash, and
- cracking or peeling.

Dermatitis is a common health problem. A number of chemicals used in the mining industry can cause occupational dermatitis. If dermatitis is inadequately treated, subsequent exposure to small amounts of the chemical can trigger severe reactions. If the mine operator detects the first signs of a worker's skin disease early enough and halt exposure to the substance responsible, they should minimise the consequences. Solvents on the skin make other chemicals more likely to cause skin damage.

Monitoring for dermatitis consists of:

- assessing workers' skin condition before starting work, e.g. at the pre-employment or initial health assessment
- examining the skin (usually hands and forearms) regularly, e.g. every few months
- asking workers about their skin condition, and
- keeping a record.

Note: Health screening or health promotion schemes are not health monitoring.

Record the fact that workers need monitoring for dermatitis. Note down the products that can cause dermatitis. Also record:

- the worker's name and address
- the products they work with or the process, and how often they do this work
- the protective measures used (gloves, skin creams etc), and
- the date of starting work with the products or process.

The results of health monitoring must be kept by the employer for at least 30 years from the date of the last entry made in the records.

APPENDIX E - HEAT STRESS

This section should be read in combination with the *Code of Practice: Ventilation in Mining.*

The effects of heat may be encountered during:

- work in confined workplaces without adequate ventilation;
  work where there is direct exposure to solar radiation
- work in hot and humid conditions
- work performed in the vicinity of hot sources such as furnaces, heaters and ovens
- heavy physical work in moderately hot and humid conditions (for example, such as in some underground mines)
- work situations where protective clothing has to be worn, and
- any situation where a worker has previously shown signs of heat related effects (for example, dizziness, fainting and heat cramps).

Working in high heat environments can put workers at risk of impaired performance, heat illnesses and heat stroke. Impaired performance may result in unsafe acts and heat may also tend to promote accidents due to sweaty palms or impairment of vision through fogging of safety glasses.

By way of further introduction this Code refers to:

- Heat Stress - which is the burden or load of heat that must be dissipated if the body is to remain in thermal equilibrium, and
- Heat Strain - is the normal physiological or abnormal pathological change resulting from heat stress.

The physiological condition referred to as heat strain is characterised by increases in deep body temperature, heat rate, blood flow to the skin and water and salt loss due to sweating.

Most adverse effects arise from a failure of the body's cooling mechanisms or as a result of overloading of the system.

Normally, several physical and physiological mechanisms assure transfer of excess body heat to the environment. Even when the body is at rest, heat is generated by normal metabolism. With exercise, the heat produced by muscle activity rises rapidly.

This generated heat is moved to the skin by the blood with the aim of transferring body heat to the environment. Heat may then be lost through convection, evaporation of sweat, radiation and conduction.

To maintain the appropriate body temperature three issues are essential:

- the metabolic heat produced must be transferred to the skin via the circulation for dissipation
- the sweat glands must be able to produce the necessary amount of sweat, and
- the sweat must be able to evaporate.

Failure in any of these mechanisms for heat transfer may cause the body core temperature to rise, leading to heat strain and subsequent heat illness.

Additionally, for the successful maintenance of the thermoregulatory system, adequate fluids must be consumed to prevent dehydration.

Heat stress factors

There are six factors influencing a person's capacity for heat exchange with the environment:

- **Air temperature (dry bulb).** Above 36°C the body can gain heat from the environment.
- **Absolute humidity (wet bulb temperature).** When the absolute humidity is high, evaporation of sweat is minimised, thereby reducing the body's opportunity to lose its heat.
- **Radiant heat from objects such as the sun, furnaces, and other hot surroundings**. The direction of heat transfer depends on the absolute temperature difference between the body and the surrounding surfaces. It is not affected by the air temperature or humidity.
- **Air movement**. This can influence both convection and evaporation and can have a marked effect on heat exchange at the exposed skin surfaces (face, arms, legs). Convective heating or cooling does depend on the air temperature. Air movement assists with the evaporation of sweat from the skin and hence cooling capacity.
- **Muscular activity**. This is the most significant as it imposes a variable heat load. Work rates may increase heat production up to ten times the resting level and can cause a rapid body heat rise if this cannot be lost to the surroundings.
- **Clothing**. This can have a major effect on the amount of heat transfer from the body. Clothing may limit convective exchange and may interfere with the body's capacity to lose heat through evaporation of sweat. However clothing can minimise the radiant heat to the body from surrounding surfaces (fire fighters, furnace operators, underground motors and machinery).

Effects of heat stress on the body

The body core temperature is significantly affected by body. The extent of any rise is related to the physical work level. Skin temperature on the other hand depends on several environmental conditions. Increased blood flow through the skin allows body core heat to be dissipated at the body surface. Evaporation of sweat cools the skin and in conjunction with increased skin blood flow assists in achieving thermal balance.

The body uses its own water reserves to generate sweat, so maintaining body temperatures within safe limits. Sweat loss, if not replaced, leads to dehydration, which puts a strain on the circulation system causing the heart to beat at a higher rate. Additionally, the sweat rate is minimised, so thereby affecting the thermoregulatory capacity and adaptation.

Repeated exposure to heat over a period (usually not less than 7 days) produces physiological changes enabling a person to respond more efficiently to the heat demands - this is acclimatisation. This increases water requirement, minimises strain, improves performance and comfort. There are reductions in core temperature and heart rate reached at the same rate of work as before, there is an increase in blood volume, the body sweats more readily and the salt content of sweat is decreased.

A description of the symptoms of the various effects is tabulated below.

Adverse Effect	Description
Skin problems (*e.g.* prickly heat)	Caused by blockage of sweat ducts and associated inflammation of the skin.
Heat strain	This is the change in pulse, body temperature and sweating. It may lead to heat illness if the heat load continues.
Heat illness	This is a feeling of weakness, dizziness and nausea. The person loses concentration. Safety awareness and performance may deteriorate.
Heat exhaustion	If there is insufficient replacement of water loss from sweating, progressive dehydration occurs. These can be pallor, profuse sweating, hypotension, rapid heart rate, alteration of consciousness, thirst and increase in body temperature. Blood pooling may cause fainting. Salt deficiency, especially following long periods of sweating may also produce a form of heat exhaustion and can cause muscle cramps.
Heat stroke	This is more severe and may be life threatening. A person may become irritable, confused and apathetic before a life threatening stage is reached. The person may also have fits. The body temperature is high (over 40°C) and the skin may be hot and dry. Heat stroke can occur if treatment is not given immediately. Any increase in body core temperature beyond that point is life threatening and must be treated accordingly.
Chronic heat disorders	These are not well documented and there is little available information.

Methods for reducing heat stress (load)
Excessive heat load can be due to radiation, convection, unsuitable clothing or, body metabolism.

Consistent with the hierarchy of control measures generally applied to health and safety hazards, the employer must ensure that exposure to heat is limited by:

- not exposing workers to heat so far as is reasonably practicable
- isolating sources of heat, so far as is practicable, through shielding, containment and remote handling techniques, if applicable
- providing engineering controls, such as ventilation, to minimise heat loads
- adopting safe work practices and appropriate administrative procedures such as job rotation, and
- if other means of controlling exposure are not practicable or adequate, by providing personal protection equipment.

The radiant heat load may be minimised by insulation (shielding) or relocation of heat sources, use of barriers or reflective screens with aprons and covering exposed parts of the body.

The convective heat load may be minimised by lowering the air temperature and increasing the air velocity (for example, fans).

For extreme conditions, (e.g. during certain confined space maintenance activities) air or ice cooled clothing may be used. In general, clothing is chosen to allow ready evaporation of sweat.

Reducing the effect of metabolism can be accomplished by reducing the physical demands of the work (for example, mechanisation, automation), sharing the work load (particularly during peak heat periods) and increasing rest time.

Evaluation of heat stress (load)
This can be complex because of the numerous indices in use with each one providing a differing assessment of heat stress. Thermal load and the body's response to it is influenced by seven important factors:

- radiant heat
- air temperature
- air movement
- humidity
- intensity of physical work
- clothing worn, and
- individual acclimatisation.

There are several heat stress indices in use, incorporating these seven factors to varying degrees:

1. **Wet Bulb Globe Temperature (WBGT).** Considered the simplest of indices to use, the index is sensitive to dry bulb, radiant and natural wet bulb temperatures, and air

velocity. It can be adjusted to take into account clothing, work rate or duration of exposure.

2. **Effective Temperature (ET) and Corrected Effective Temperature (CET)** were devised originally as a comfort scale. This index combines the effects of globe temperature (radiant and dry bulb), wet bulb and air velocity, though not under hot, humid conditions.
3. **Heat Stress Index (HSI)** is based on the physical analysis of heat exchange. The index equates the amounts of heat required to be dissipated by evaporation of sweat with the maximum possible evaporative capacity. This index tends to overestimate the environmental heat load, and is too complex for daily use.

4. **Predicted Four Hour Sweat Rate (P4SR).** This is the quantity of sweat, in litres, likely to be produced under specific thermal conditions. It takes into account the metabolic rate and to a lesser extent the clothing worn, along with dry bulb, radiant temperature, wet bulb and air velocity. This index is also complex and requires a nomogram to obtain corrected figures.
5. **The Wet-Kata Thermometer. This is the** measure of the cooling power of the environment. This index correlates well with body responses in hot, humid conditions, but is less meaningful in hot dry conditions and with unacclimatised people.
6. **The Air Cooling Power. This index is** used in South African underground mines and recognises workload, and clothing additionally to the environmental factors of wet and dry bulb temperatures, radiant temperature and wind velocity. This i**n**dex is complex and requires a short computer programme.

The American Conference of Government Industrial Hygienists (ACGIH) has recommended Threshold Limit Values (TLVs) for differing workloads using the most universally applied heat stress index, the Wet Bulb Globe Temperature (WBGT). Additionally, the ACGIH recommends accommodation to be made for unacclimatised workers and suggests a correction factor for clothing thus:

Examples of Permissible Heat Exposure Threshold Limit Values
[Values are given in °C WBGT]*

Work-Rest Regimen	**Work Load**		
	Light	**Moderate**	**Heavy**
Continuous work	30.0	26.7	25.0
75% Work / 25% Rest, each hour	30.6	28.0	25.9
50% Work / 50% Rest, each hour	31.4	29.4	27.9
25% Work / 75% Rest, each hour	32.2	31.1	30.0

* Not to be confused with normal day bulb temperature readings.
* As workload increases, the heat stress impact on an unacclimatised worker is exacerbated. For unacclimatised workers performing a moderate level of work, the permissible heat exposure TLV should be minimised by approximately 2.5°C.

TLV WBGT Correction Factors in °C for Clothing

Clothing Type	Clo Value*	WBGT Correction
Summer work uniform	0.6	0
Cotton coveralls	1.0	-2
Winter work uniform	1.4	-4
Water barrier, permeable	1.2	-6

* Clo: Insulation value of clothing. One clo unit = 5.55 kcal/m^2/hr of heat exchange by radiation and convection for each °C of temperature difference between the skin and adjusted dry-bulb temperature..

A hand held instrument for assessing WBGT is available. It is emphasised that the WBGT index was developed for workers in temperate climates and that interpretation is required when attempting to adapt it to hotter climates.

However, as stated earlier, the degree of activity or workload (metabolic rate) heavily influences body heat load. Therefore, an index that recognises this work activity may be considered more appropriate. An example of such an index is the Air Cooling Power (ACP) which accounts for the degree of work activity and the clothing worn. A small computer programme can be generated to run this index, as it is based on quantified data such as dry bulb, wet bulb and air velocity. ACP calculates the energy balance of metabolic heat production for comparison with the mechanical work done.

The environmental indices are best used as "screening tools" to assist in defining the magnitude of the problem and to determine whether further investigations are needed.

Minimising the potential for heat strain

1. Ensure appropriate water consumption. Sweat rates can be as high as 2 litres / hour for those performing heavy physical labour in the heat. Therefore, water must be readily available and should be consumed before the shift, and then subsequently at regular intervals thereafter. Thirst indicates that moderate dehydration is already established.

The water must be palatable by being cool (6-15°C) and can be flavoured for example, with weak cordial.

Proprietary carbohydrate / electrolyte beverages are not required if the diet contains the normal amount of salt.

A simple spot urine test (‘Fantus Test’) can be undertaken, which assesses the specific gravity and total urinary chloride level.

The test should be performed at the beginning of the shift and before work activity starts. The chloride content of the urine is an important sign in the early diagnosis of heat exhaustion. The test requires the collection of a spot sample of urine, assessing the specific gravity, titrating for total chloride level and reading the result from a graph.

The result will indicate whether an individual has salt depletion and, by inference water depletion. This result must only be used to confirm the suspicion of dehydration; dark yellow urine could indicate already established dehydration, as urine should be the colour of water.

2. Heat acclimatisation. Through acclimatisation, workers have the ability to increase tolerance to work in heat. Full acclimatisation takes 7-14 days with 3 hours activity per day. Acclimatisation usually increases water requirements as acclimatisation increases sweating, but minimises salt loss.

Some of the characteristics of acclimatisation to heat can be summarised as follows:

- Acclimatisation begins with the first exposure, progresses rapidly and may be well developed in about one week for some.
- Acclimatisation can be induced by short, intermittent work periods in the heat for two hours daily. Resting or inactivity in the heat produces only slight acclimatisation.
- Subjects in good physical condition acclimatise more rapidly and are capable of doing more work in the heat. Good physical condition, however, does not in itself confer acclimatisation. Also, individuals differ widely in their ability to acclimatise.
- Acclimatisation to high heat loads will enhance performance at less severe conditions, but will only provide partial benefits for more severe conditions.
- Acclimatisation to heat is well retained during periods of no exposure for about one week; thereafter, acclimatisation is lost at a rate that varies among individuals. Within about three weeks to a month, acclimatisation effects are lost and hardly any traces are to be found after a few months. Staying in good physical condition helps retain acclimatisation.

By way of example, the American National Institute of Occupational Safety and Health (NIOSH) recommends the following acclimatisation routine:

(1) Unacclimatised workers should be acclimatised over a period of 6 days. The acclimatisation schedule should begin with 50 percent of the anticipated total work load and time exposure of the first day, followed by daily 10 percent increments building up 100 percent total exposure on the sixth day.

(2) Regular acclimatised workers who return from nine or more consecutive calendar days of leave, should undergo a four-day acclimatisation period. The acclimatisation schedule begins with 50 percent of the anticipated total exposure on the first day, followed by daily 20 percent increments building up to 100 percent total exposure on the fourth day.

(3) Regular acclimatised workers who return from four consecutive days of illness should have medical permission to return to the job, and should undergo a four-day re-acclimatisation period as in (2) above.

It should be recognised that the above acclimatisation routine was developed for typical climatic conditions experienced in the USA and is provided here to highlight the need to consider suitable acclimatisation procedures for workers, who are subject to heat stress. Such procedures must be developed in consultation with workers and consider the particular shift roster schedules used and also the differences in climatic conditions between the site and the workers off-work site location The need for a suitable acclimatisation routine may be particularly

critical in situation where workers have an extended absence from site in climatic conditions which are substantially cooler than those experienced on site.

3. Good physical condition will minimise the likelihood of heat strain. Those that are more than 20% overweight are more prone to developing heat illness symptoms. Those that are fit will most readily acclimatise and have some 'protection'.

4. Clothing that is both loose fitting and made from cloth that "breathes" may be appropriate. Artificial fibre cloth such as nylon is not recommended in heat stress situations. It is important not to obstruct evaporation from the skin.
Protective covering such as hats, long sleeved shirts and shoes is recommended in situations where radiant heat is likely to be a problem, such as outdoors.

5. Scheduling of physical activity. Where practicable, adjustment of work schedules and hot jobs may need to be made. Activities in the earlier part of the day (before 10 am) and later in the day (after 3 pm) must be considered to avoid the maximum heat conditions found in the middle of the day. Consideration may need to be made to re-scheduling work according to weather conditions. In hot conditions relative humidity over 75% contributes a substantial risk to heat injury.

6. Work rates and physical activity. Sustained physical activity can cause a rapid rise in body core temperature which may exceed the body's capacity to dissipate this heat to the environment. It may be necessary to provide adequate and regular rest periods to minimise heat production, or to provide for self paced work. The provision of air conditioned retreats and cooled fluids may also assist in maintaining appropriate body temperature. Resting or performing other tasks in cool (<25°C), low to moderate humidity surroundings minimises considerably the effects of hot work. Rest areas must be located close to the hot work areas in order to encourage their use.

7. Other factors. Other issues that need to be considered include:

- Age. The older a person is, the less capacity they have for coping in heat stress.
- Obesity. This is a factor in a person’s ability to minimise body core temperature.
- Physical Fitness. The fitter a person the better they manage in heat stress conditions.
- Medical conditions and medications. These influence a person’s ability to acclimatise and cope in hot conditions. Medical conditions for consideration include, heart disease, high blood pressure on medication, asthma on medication, kidney disease. Medications for concern include the use of steroid (cortisone, prednisolone) tablets, blood pressure tablets and diuretics.

APPENDIX F - OTHER RELEVANT INFORMATION

- Guidelines for health monitoring. The guidelines set out how to meet the minimum requirements for health monitoring. Each chemical-specific health monitoring guideline contains information on the health effects of the chemical. Safety Data Sheets for particular chemicals should be consulted.
- Note: The guidelines for asbestos and inorganic lead contain information on mandatory requirements as well as guidance.
- Appendix C: Respiratory Questionnaires. These are examples for medical practitioners

Other references

- Safe Work Australia, Hazardous Substances Information System http://hsis.ascc.gov.au/Default.aspx
- National Industrial Chemicals Notification and Assessment Scheme, *Selection Procedures for Priority Existing Chemicals*, National Industrial Chemicals Notification and Assessment Scheme, Marrickville, November 2001.
- QLD to supply reference to their 'airflow' standard.
- ACoP on Air Quality and Ventilation in Mining

Further reading

Guidelines for Health Assessments for Work, Australasian Faculty of Occupational Medicine, ISBN No. 0 646 36299 2, October 1998. http://afom.racp.edu.au/page/media-and-news/publications