A guide to Worker Health in Extractives

DECEMBER 2017

MinEx

Executive Summary

As CEO for the extractive sector's national health and safety council, I see this guide to managing Worker Health issues as perhaps the most important document we can provide to the sector.

The reason for that is simple; although our sector, like all others, focuses on reducing injuries and fatalities, the truth is that around ten times more workers across the board die from industry-associated illnesses than die at work.

As a nation, we have to address that awful reality.

This MinEx guide is a step forward, at least for the extractives sector. You will find a host of useful advice and guidance on the risks posed by airborne contaminants, noise, temperature, fatigue and a range of other potential hazards.

I would like to acknowledge the input provided to this document by WorkSafe.

That work has been crucial to bringing together this Guide to Worker Health in Extractives.

But this is only a starting point. You need to have appropriate plans and controls in place to manage the risks posed to worker health. It is not an exaggeration to say that lives may depend on this.

MinEx is funded by the extractives sector to engage with government on health and safety policy, and to provide advice to the sector about how to best meet requirements.

If after you've read a relevant section in this Guide to Worker Health in Extractives and you are still unsure about what you should be doing, I will make every effort to respond to your enquiry.

We all need to work together to protect worker health. Let's take the steps together.

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Disclaimer: This Guide to Worker Health in Extractives is provided to assist mines, quarries and alluvial mines to identify and manage risks to the health of their workforce. It is not a Code of Practice or similar document and the advice provided does not replace any obligations under the Health and Safety at Work Act 2015 or any other legislative or regulatory requirement.

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The Health and Safety at Work Act 2015 (HSWA) is the key health and safety law. It sets out the health and safety duties that must be complied with.

Health and safety regulations sit under HSWA. They expand on duties under HSWA and set standards for managing certain risks and hazards.

This document has been developed to assist duty holders with meeting their obligations. In this case under the:

- Health and Safety at Work Act 2015 (HSWA)
- Health and Safety at Work (Mining Operations and Quarrying Operations) Regulations 2016 (MOQO Regulations)
- Health and Safety at Work (General Risk and Workplace Management) Regulations 2016 (GRWM Regulations)
- Health and Safety at work (Hazardous Substances) Regulations 2017 (HSHSR)
- Health and Safety in Employment Regulations 1995 (HSE Regulations)
- Hazardous Substances and New Organisms Act 1996 (HSNO).

See WorkSafe's Special Guide: Introduction to the Health and Safety at Work Act 2015 for more information on health and safety law.

1.1 Purpose

This document sets out WorkSafe New Zealand's (WorkSafe) expectations for managing risks to worker health in the extractives industry. It applies to all mining and tunnelling operations, alluvial mines, quarries, coal and mineral exploration and industrial mineral extraction (such as the extraction of perlite) and provides information on:

- identifying and assessing risks to worker health in extractive operations
- selecting and implementing controls for risks to worker health in extractive operations
- developing a principal control plan (PCP) for worker health.

This document is for persons conducting a business or undertaking (PCBUs) operating in the extractives industry, any person in a safety critical role, the operator, and anyone else involved in managing risks to worker health in the extractives industry. This includes workers and other persons at the operation.

1.2 How does this document apply to alluvial mines and quarries?

Under HSWA all mining operations must identify, assess and control risks to health and safety. The MOQO regulations require the development of Principal Hazard Management Plans and Principal Control Plans for principal hazards. However, alluvial mines and quarries are not required to manage principal hazards in accordance with the MOQO Regulations.

There are a number of hazards to worker health. Whether these are principal hazards or not, alluvial mines and quarries must manage risks to health and safety arising from them under HSWA's primary duty of care.

The practices detailed in this document for assessing, selecting, and implementing controls for risks to worker health apply to:

- mining and tunnelling operations
- alluvial mines and quarries.

The requirements for health and safety management systems (HSMS), principal hazard management plans (PHMP) and principal control plans (PCP) do not apply to alluvial mines and quarries. However, WorkSafe recommends that alluvial mine and quarry operators follow this systematic approach to managing risks to health and safety.

The nature of the risks associated with worker health mean that exposure monitoring and health monitoring may be required to fulfill the duties under HSWA and the MOQO regulations.

1.3 How to use this document

1.3.1 Interpreting this document

The following terms are used to set out requirements in this document.

Table 1: Terms and meanings

Term	Meaning
Must	legal requirement that has to be complied with
Needs to, or content written as a specific direction, eg "Make sure the…"	WorkSafe's expected method for complying with the legislation (alternative methods may be used as long as they meet the requirements of the legislation)
Should	recommended practice or approach, not mandatory to comply with HSWA or this document
May	permissible practice approach, not mandatory to comply with HSWA or this document or the only way to comply with the document

1.3.2 Legislation

At the start of each chapter, the legislation that applies is listed. For the full text, see the applicable legislation at www.legislation.govt.nz.

1.3.3 Terms used in this document

The term 'duty holder' used in this document refers to a PCBU, SSE, a mine, alluvial mine, or quarry operator, or other safety critical role, as appropriate.

The term 'extractives operation' refers to a mining operation, alluvial mining operation and quarrying operation. 'Extractives operator' has a corresponding meaning.

This document uses the term 'mining and tunnelling operations' even though the definition of 'mining operation' in HSWA includes a tunnelling operation. This is to emphasise that parts of the document apply to both mining and tunnelling.

1.3.4 Standards

Use the most recent version of any standards referred to in this document, unless otherwise specified.

Where applicable, and provided it does not contradict the legislation or requirements of this document, see BS 6164 Document of Practice for Health and Safety in Tunnelling in the Construction Industry for good practices in the construction of tunnels.

1.3.5 Structure of the document

Sections 1 and 2 introduce the document and WorkSafe's expectations for:

- hazard identification
- risk assessment
- selection of controls.

Sections 3 to 18 address specific hazards and contain similar information:

- Key health risks associated with the hazard.
- High exposure areas or situations, these are not exhaustive and provide some direction for identifying risks on site.
- Applicable exposure guidance that sets out WorkSafe's expectation (or a legislative limit) below which most people are unlikely to have adverse health effects.
- Workplace exposure assessment methods, because of nature of risks to worker health specialist advice and assistance may be needed to get a sufficiently robust measurement.
- WorkSafe's expectations for the selection and implementation of controls.

Not all hazards will require the amount of detail given above, or be managed in the same way (eg psychosocial hazards) and the layout may be different to reflect this.

Due to the wide range of topics covered it is not possible for this guidance to cover each topic in detail. References are provided for more detailed guidance to use when addressing the topic.

1.4 Roles and responsibilities

HSWA defines the roles and responsibilities of different duty holders. These include persons controlling a business or undertaking (PCBUs), officers, workers and other persons at workplaces. See WorkSafe's Special Guide: Introduction to the Health and Safety at Work Act 2015.

Schedule 3 of HSWA and Part 2 of the MOQO Regulations set out the specific mining sector-related roles including mine operator, mine worker, site senior executive (SSE) and other safety critical roles, and industry health and safety representative.

All mine or tunnel operators must appoint an SSE and a mine manager. The SSE is responsible for the health and safety management system, and the mine manager is responsible for the daily running of the mine or tunnel operation. Depending on the type of mining operation and the particular principal hazards, other safety critical roles are required.

Quarrying and alluvial mining operators must appoint a quarrying or alluvial mine manager, as appropriate. The Certificate of Competance that they require depends upon the size and type of operation. More information is available on the WorkSafe website.

1.5 Worker engagement, participation and representation

All extractives operators must, so far as is reasonably practicable, engage with workers. They must also have effective worker participation practices, regardless of the size, location, hours of operation, or method of extraction.

Under HSWA, an extractives operator must:

- engage with its workers on issues which will or are likely to affect health and safety, and
- have practices that provide reasonable opportunities for its workers to participate effectively in improving health and safety.

Worker engagement and worker participation practices can be direct (eg by individual workers talking directly to the PCBU) or through representation (eg using formal or informal representatives). Sections 3-5 of the good practice guidelines Worker Engagement, Participation and Representation provide information about worker engagement, worker participation practices and worker representation. The interpretive guidelines Worker Representation through Health and Safety Representatives and Health and Safety Committees, outline the rules for Health and Safety Representatives (HSRs) and Health and Safety Committees (HSCs).

A safe workplace is more easily achieved when everyone involved in the work:

- communicates with each other to identify hazards and assess risks
- talks about any health and safety concerns
- works together to find solutions.

The best ways to engage with workers and ensure their participation on an ongoing basis will depend on the views and needs of workers, the business or undertaking's size, and how, when and where work is carried out. A PCBU's commitment to improving health and safety is an essential first step.

Act in Good Faith

Employers, unions and employees are expected to act in good faith. This is a requirement of the Employment Relations Act 2000 (ERA). When workers and PCBUs interact with each other honestly, openly and with mutual respect this reduces the risk of conflict and problems.

1.5.1 Duties under HSWA and the MOQO Regulations

All PCBUs have worker engagement and participation duties under HSWA. Mine and tunnel operators have extra duties under the MOQO Regulations, as follows:

- The SSE must engage with workers and health and safety representatives (HSRs) when preparing and reviewing the health and safety management system (HSMS), including principal control plans (PCPs) and principal hazard management plans (PHMPs).
- Mine and tunnel operators must document worker participation practices.
- If a worker reports the existence of a hazard, the mine or tunnel operator must:
  - make sure the report is investigated
  - promptly advise the worker of the result of the investigation.

1.5.2 Further information about worker engagement, participation and representation

For more information on worker engagement, participation and representation see:

WorkSafe's website and the:

- Good Practice Guidelines Worker Engagement, Participation and Representation
- interpretive guide Worker Representation through Health and Safety Representatives and Health and Safety Committees.

When reading the Guidelines as a mine operator replace the following terms with the extractive industry terms:

- replace 'PCBU' with 'mine operator'
- replace 'work group' or 'members of a work group' with 'a group of mine workers who are represented by a health and safety representative' or 'mine workers in a mining or tunnelling operation'
- replace 'business or undertaking' with 'mining operation'.

1.6 Health and safety management system

All mining and tunnelling operations must have a health and safety management system (HSMS). It is part of the mine or tunnelling operation's overall management system. While it is not a requirement under MOQO, WorkSafe recommends alluvial mines and quarries have a HSMS. The principal control plan for worker health (Worker Health Plan) is an essential part of the HSMS.

The duty holder must:

- develop, document, implement and maintain the HSMS
- make sure the HSMS is easily understood and used by all mine workers
- engage with mine workers when preparing and reviewing the HSMS.

1.7 Hazards and risks

A PCBU must eliminate risks to health and safety, so far as reasonably practicable. If it is not reasonably practicable to eliminate risks, they must be minimised as far as is reasonably practicable.

There needs to be a system in place to:

- identify hazards (appraise risks) at the mining operation
- assess the risks of injury or illness to mine workers from the hazards
- identify the controls required to manage that risk.

The duty holder is responsible for ensuring that this system is put in place for operations that are subject to the MOQO regulations.

The risk appraisal and risk assessment could identify principal hazards; these are hazards that can create a risk of multiple fatalities in a single accident, or a series of recurring accidents, at the mining or tunnelling operation.

Unless hazards are identified and risks assessed properly, no amount of risk management will ensure a safe place and system of work. Unidentified hazards and risks can lead to serious consequences.

More information on identification and assessment is provided in Section 2.

1.8 Principal control plan for worker health

If the hazard identifiction and risk assessment identifies one or more principal hazards that may have long term effects on the health of mine workers a principal control plan for worker health (Worker Health Plan) must be developed by the duty holder. Duty holders are to provide sufficient resources to implement the Worker Health Plan and ensure the associated equipment is in operational condition and regularly inspected.

Alluvial mines and quarries are not currently required to produce a Worker Health Plan under MOQO. However, WorkSafe recommends that they do, as it will enable them to fulfill their duties under HSWA and the GRWM Regulations.

The Worker Health Plan outlines the risks to worker health, and all of the controls used to manage them. It sets out the processes for managing risks to worker health from:

- noise
- vibration
- dust, including asbestos dust, coal dust, silica dust, or mixed dust (being dust that contains mixtures of more than one different kind of dust)
- diesel particulates
- fumes, including exhaust fumes, welding fumes and other fumes arising from metallic sources
- temperature, including extreme hot and cold temperatures, and humidity
- changes in atmospheric pressure
- manual handling and lifting
- hours of work and fatigue
- psychosocial hazards
- ultraviolet radiation
- ionising radiation
- biological hazards
- any other hazard that may adversely affect the health of mine workers who work at the mining operation, such as:
    - hazardous substances (eg solvents, processing chemicals)
    - hazardous fauna (eg wasps)
    - heavy metals
    - pressure injection injuries.

The Worker Health Plan must also:

- provide for the development of strategies to deal with fatigue or consumption of drugs/alcohol. These strategies must be proportionate to the hazards or risk and the potential impact on worker safety or the safety of others at the mining operation.
- set out a detailed process for obtaining urgent medical treatment for mine workers who suffer serious harm at the mining operation, taking into account the nature of the terrain where the mining operation is located and the remoteness of the mining operation from the nearest hospital or other place where medical assistance may be provided.

The requirements for medical treatment and transport should be included in the Emergency Management Principal Control Plan, and a reference made, instead of recreating the information in detail. See *Emergency Preparedness in Mining and Tunnelling Operations* for more information.

Workers must always be engaged with when preparing and reviewing the Worker Health Plan. Workers can help identify hazards, risks to worker health and the controls needed.

2 Risk assessment, exposure and health monitoring, and controls

The legislation that applies in this section is:

HSWA
Section 30 Management of risks
Section 36 Primary duty of care
Section 58 Duty to engage with workers

MOQO Regulations
Regulation 54 Risk appraisal
Regulation 55 Risk assessment
Regulation 127 Mine worker health monitoring
Regulation 128 Mine workers to be given results of monitoring

Risks to worker health arise from people being exposed to hazards (anything that can cause harm). Hazards and risks to worker health vary depending on the type and size of the operation and the work activities carried out. PCBUs must, so far as reasonably practicable:

- eliminate risks to health and safety, or
- minimise risks that cannot be eliminated.

At operations covered by the MOQO regulations, the duty holder must ensure there is a process in place to:

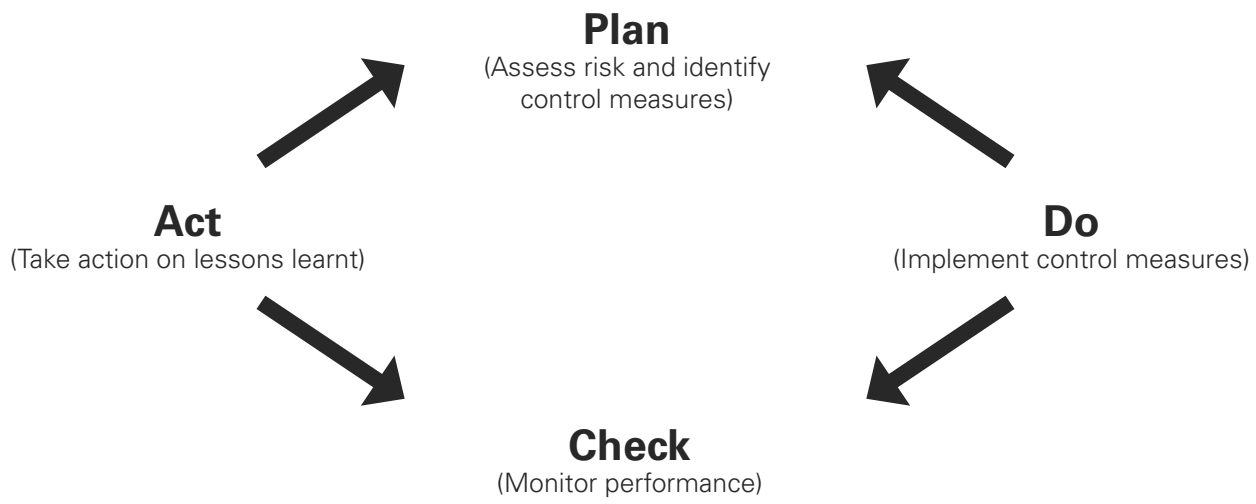
- identify hazards
- assess the risks of injury or illness to mine workers from the hazards identified
- identify the controls required to manage risks.

WorkSafe recommends that alluvial mine and quarry operators follow this systematic approach to managing risks to worker health.

The hazards and risks identified in this document are not exhaustive. Duty holders are to consider what other hazards and risks to worker health may be present in the workplace.

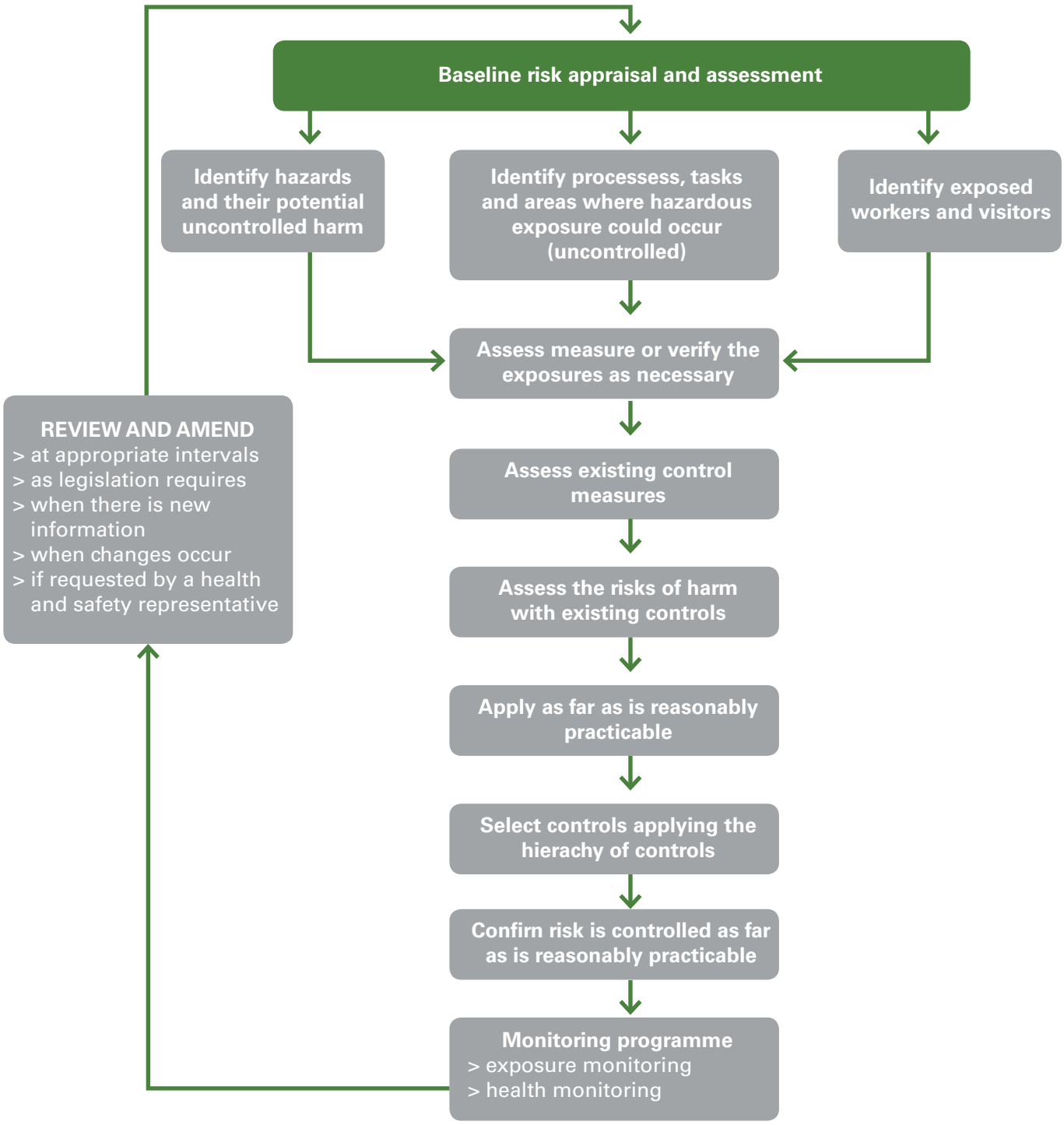
One way to manage risks is to use the plan, do, check, act system.

Figure 1: Plan, Do, Check, Act system



This iterative system splits risk management into four parts.

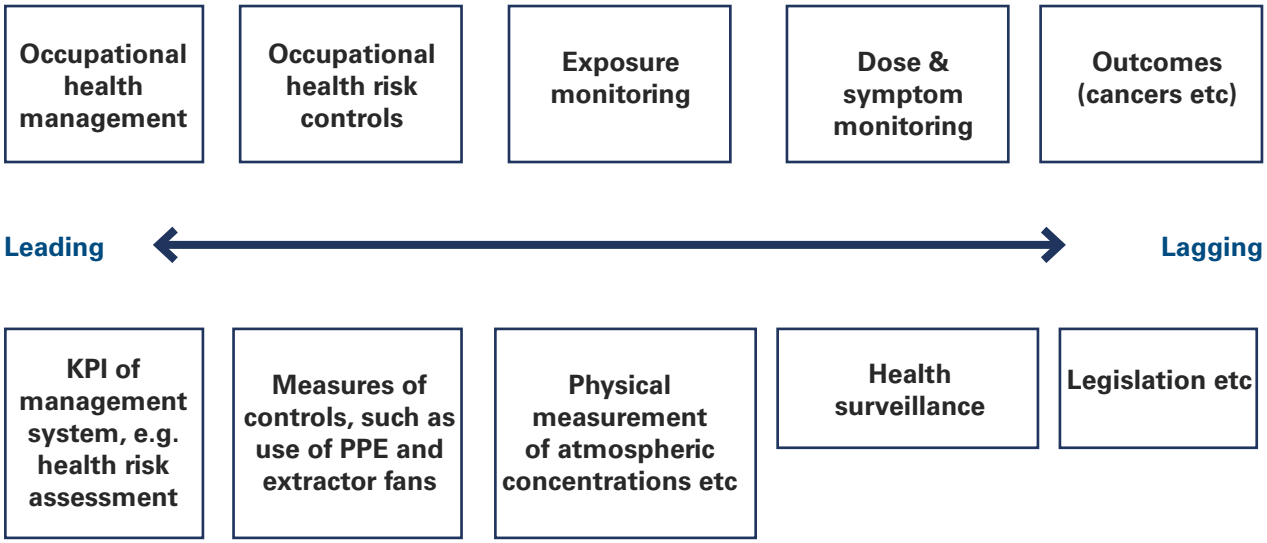
Figure 2: Baseline risk appraisal and assessment



More information on occupational health risk assessment in mining can be found in the International Council on Mining and Metal's *Good Practice Guidance on Occupational Health Risk Assessment.*

Operations should be judging the effectiveness of their systems by how well the risk is being managed rather than reports of injury or ill health. These leading and lagging indicators are shown in Figure 3 which follows.

Figure 3: Leading and lagging indicators



2.1 Hazard identification and Risk assessment

Hazard identification and risk assessment is about getting an understanding of what hazards and risks exist, and their nature. It does not have to be unduly complicated, or require a lot of paperwork, but if done poorly, unsafe situations reliably follow.

Hazard means something that can cause harm (eg bullying, fatigue, vibration, noise, radiation etc).

Risk is the chance, that somebody could be harmed by the hazard, together with how serious the harm could be. This is whether or not the risk has been realised in the workplace, and is based on how possible it is for this to occur.

Figure 4: Example risk matrix

			Consequence				
			Insignificant	Minor	Moderate	Major	Catastrophic
			1	2	3	4	5
Likelihood	Very likely	5	5	10	15 N	20	25
	Likely	4	4	8 V	12 MH	16	20
	Possible	3	3	6 STF	9	12	15 AC
	Unlikely	2	2	4	6	8	10
	Highly unlikely	1	1	2	3	4	5

Manual handling (MH) for example; a strained back from lifting a heavy item
Vibration (V) for example "white finger" (HAVS) from use of compactor
Noise (N) for example, long term hearing loss from repeated exposure to high levels of noise
Airborne contaminants (AC) for example diesel particulates (carcinogens)
Slips trips and falls (STF)

The severity and likelihood of risk will vary between instances, but Figure 4 illustrates the concept.

Hazard identification and risk assessment for worker health is no different than any other risk assessment; except the assessor is looking for damage over time, rather than immediate harm.

2.2 Identify worker health hazards

Duty holders are to identify hazards at the extractives operation. Duty holders are to look at the whole of the operation at a high-level and identify hazards. Duty holders are to consider the effects of work on worker health and effects of worker health on work (see 2.3.2 below).

Duty holders are to make sure that a team of workers with a range of experiences and expertise, including health and safety representatives, work on identifying hazards. They need to follow a systematic approach to identify all potential hazards. Examples of identification methods include:

- consulting workers
- inspecting the workplace
- reviewing available information (eg from the HSMS)
- asking "What could potentially harm a worker's health in this workplace or through the work they do?".

2.3 Assess worker health risks

From the hazards identified, duty holders are to assess the hazards to determine their risks to worker health. This is the risk assessment. Consider:

- effects of work on workers' health
- effects of worker health on work
- how serious the effects could be
- how likely the effects are to occur
- the level of exposure
- exposure route (eg skin contact vs inhaling)
- the people exposed
- combined effects
- the circumstances of exposure.

Duty holders are to identify methods to control the risks so they can be, so far as reasonably practicable, eliminated or minimised if they cannot be eliminated.

Risks to worker health may not be immediately obvious, for example, the long-term effects of exposure to noise or hazardous dust. Duty holders are to include the risks discussed in this document in the risk assessment, as a minimum.

Some risks can only be fully assessed using exposure assessment, which may require a specialist. See Appendix A for more information about exposure assessment.

Further information on risk assessment for specific hazards is provided in sections 3 to 18.

2.3.1 Doing an assessment

There are a number of ways to do an assessment, but WorkSafe expect that you, at least:

- Walk the floor
  - Visit each part of the workplace and methodically check it for hazards and risks.
- Engage with workers
  - Talk with workers about the hazards and risks inherent to the work, and workplace. Unless the assessor is doing the same job as the workers on the floor, they will not have the same depth of experience that they have.
  - Use your worker participation systems. Health and Safety Representatives and Committees (for example) can help you to engage with the workforce on the hazards and risks. There is no substitute for talking to workers, however.
- Review the record
  - Check the record of notifiable events for any red flags.
- Review the guidance available
  - WorkSafe, MinEx and other associations, publish guidance about common hazards and risks. Use this to help you understand hazards and risks at your workplace and eliminate or control them.
  - Original equipment manufacturer's guidelines can also be a good source of information.
- Get expert help if you need it
  - Some risks are complex and will require a bit more of an involved approach, or special equipment to substantiate (eg noise). Bring in expertise if it is not available in-house.

Forms are available from WorkSafe and/or MinEx to assist with the assessment.

They is useful in providing a practical introduction to the risk being assessed, but there is no substitute for thinking about and engaging with workers on the assessment. They do give you a starting point, however.

Once you've got an understanding of the hazards and the risks involved it is time to select the appropriate controls. You should be able to identify controls when assessing risks, or by using guidance. If not, do the risk assessment again, concentrating on the missing controls. Apply the hierarchy of controls when selecting the appropriate control.

2.3.2 Effects of work on health and of health on work

Work can affect health and health can affect work. Workers can become unwell or develop poor health from their work environment and activities. Poor health or physical impairment can reduce a worker's ability to work safely and productively.

Emphasis should be placed on exposure assessment by the extractives operator to ensure workers are not being adversely affected by workplace exposure to substances and phenomenon.

Include both effects during hazard identification and risk assessment. Figures 5 and 6 summarise the effects of work on health and health on work.

Figure 5: Effects of work on health and health on work

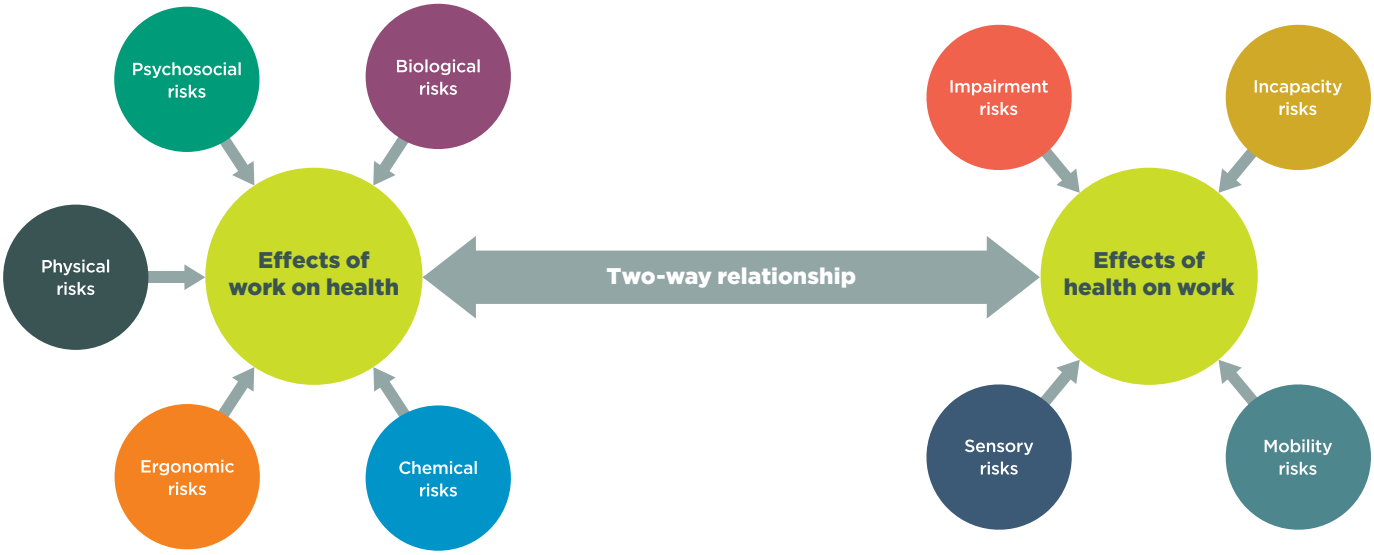


Figure 6: Examples of the effects of work on health and health on work

WORK RELATED HEALTH RISKS ('effects of work on health')					HEALTH RELATED SAFETY RISKS* ('effects of health on work')			
Chemical risks	Biological risks	Psychosocial risks	Ergonomic risks	Physical risks	Sensory risks	Judgement or impairment risks	Physical Mobility risks	Incapacity risks
> Asbestos > Silica > Mercury > Diesel > engine emissions > Limestone dust > Coal dust	> Blood borne viruses > Animal viruses > Bacterial infection	> Bullying > Excessive workload > Lack of autonomy	> Manual handling > Shift work > Job design	> Noise > Vibration > Radiation	> Colour vision deficiency > Reduced visual acuity > Reduced hearing capability	> Fatigue > Stress or mental distraction > Drugs/alcohol consumption	> Physical frailty > Bone and/ or joint conditions > Severe obesity	> Diabetes > Heart disease > High blood pressure
*Health-related safety risks are specific to the tasks, situation and work environment that they exist within and are not a risk in all circumstances.								

Source: WorkSafe work-related health strategy

WorkSafe's focus is on the efforts of duty holders to protect the health of workers in the workplace. WorkSafe expects duty holders to put steps in place to do this before they look at activities that promote the general health and wellbeing of workers.

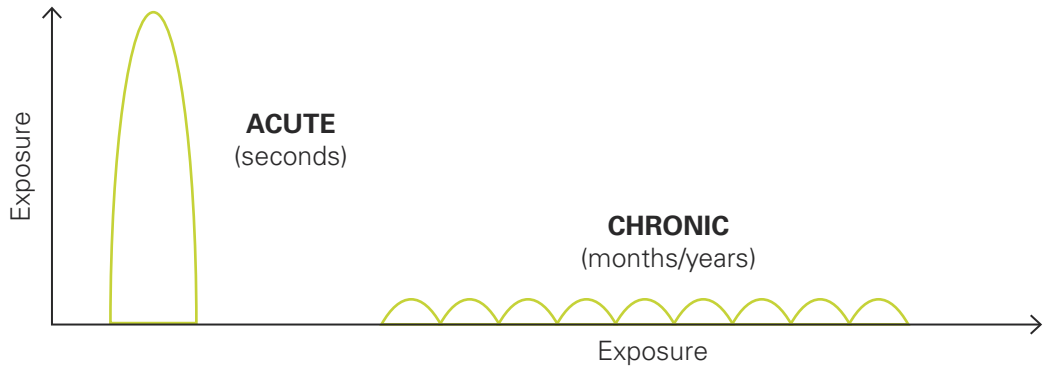
Yet, WorkSafe recognizes that duty holders and workers will benefit from promoting that broader approach.

To get these benefits, a workplace may:

- help workers to get and stay fit
- promote healthy living
- promote stop smoking programmes.

2.3.3 Acute and chronic exposure and health effects

Figure 7: Acute vs chronic exposure



Acute exposure is short-term exposure to a hazard that affects worker health. Acute health effects happen quickly, are usually identified easily and can be serious in nature. Chronic exposure is long-term exposure, usually over several years, which can cause long-term health effects.

Many health risks are different depending on whether exposure is acute or chronic. Identify, assess and control risks from both chronic and acute exposure. Controls for acute and chronic exposure are generally similar.

Specialist help may be needed to identify chronic exposure and health effects, as they are often difficult to detect. For example, the early stages of silicosis – see section 5.

2.4 Monitoring workers' health and assessing their exposure

Health monitoring is the monitoring of a worker's health to determine whether they have been affected by any health risks. It includes:

- hearing testing
- respiratory function testing
- testing for the effects of solvents.

Exposure assessment is the measurement and evaluation of exposure to a health hazard experienced by a person. It includes measuring exposure to:

- substances hazardous to health in the air
- noise
- vibration
- dust and other particulates.

Exposure assessment might include measuring levels of a substance in air, levels of noise, heat, vibration, or levels of substances in the blood or urine.

Both health monitoring and exposure assessment may be necessary to assess if a risk is being appropriately managed.

Duty holders are to use exposure assessment in preference to health monitoring. This is because health monitoring detects how much harm a worker has suffered, and does not provide information on the risks to worker health. The information from exposure monitoring can be used to minimise health effects on workers. However, depending on the hazards and risks, health monitoring may be required.

Health monitoring and exposure assessment are not controls. They can provide information on the effect the risk is having, or the risk itself, respectively, but they do nothing to prevent harm to workers. Evidence that they are being used to control a risk will not be accepted.

Duty holders are also to carry out exposure assessment if there is a change in the workplace (eg new plant or different process) that could affect the risk presented or the effectiveness of controls.

The results of exposure and health monitoring must be provided to mine workers, either as a group or individually (whether this is undertaken under HSWA or its associated regulations, or not). This must identify or disclose anything about any individual mine worker.

Pre-employment/fitness for work monitoring is to ensure that the person is capable of performing the requirements of the job. It must not be used as a basis to discriminate against employees.

Ongoing monitoring is to detect any effects on their health that the job is having.

Exit medicals are to provide a record of the effect that the job had on a worker's health at the time that they leave.

2.4.1 Health monitoring

All extractives operations

Duty holders should develop a questionnaire to identify workers' pre-existing conditions that could affect their ability to work safely or be aggravated by workplace exposures. An example questionnaire for operational employees is provided in Appendix K. The questionnaire needs to reflect the hazards and risks present at the site.

If there is a risk that workers could be exposed to harmful levels of respirable dust, or other airborne contaminants, duty holders are to carry out health monitoring to the standard described in section 5.

If a detailed noise assessment shows that noise levels are above the exposure limits, or for any reason it is thought noise levels are above the exposure limits, duty holders are to offer audiometric testing (screening) to workers. Duty holders are to do so, whether workers wear hearing protection, or not. See section 3 for more information.

Early reporting of pain, discomfort and injury is paramount for managing manual handling risks. Workers should be encouraged to do so on a 'no fault' basis.

Health monitoring methods and standards for specific risks are provided in the relevant sections of this document.

Alluvial mines and quarries should offer medical examinations as described below.

Mining and tunnelling operations
A mine or tunnel operator must offer medical examinations to workers:

- immediately before they start working at the operation
- immediately before they stop working at the operation, if there has not been an examination in the last 12 months
- at least every five years throughout the worker's employment.

Medical examinations aim to establish and monitor the health of mine workers throughout their employment. If mine workers choose to be examined, a medical practitioner or nurse must do so at the mine or tunnel operator's expense.

The results of any health monitoring must be provided to mine workers, either as a group or individually (whether this is undertaken under HSWA or its associated regulations, or not).

If workers are to be required to take medical examinations this should be included in the contractual arrangement.

If a mining operation carries out monitoring to the requirements of Regulation 128 of the MOQO Regulations they are not also required to undertake monitoring under the GRWM Regulations.

2.4.2 Exposure assessment
A competent person needs to monitor and assess exposure, or supervise another person doing the work. Duty holders are to use professional assistance, if it is not available in house, such as a suitably competent occupational hygienist. Professional associations can be a good source for competent persons (eg HASANZ, NZOHS, NZOHNA, HFESNZ).

The competent person needs to have sufficient knowledge and experience in the appropriate techniques and procedures, including:

- the risk assessment process
- the tasks, processes or exposures being assessed
- development of sampling strategy
- selection and use of sampling equipment and sampling media
- sampling methods
- data interpretation
- the criteria WES or other standards are based on
- the relevance and application of statistical analysis of exposure data.

Reports, results and recommendations should be presented in a style and format that is easily understood by PCBUs and workers.

It is important that the assessor is aware of the limitations of their competencies and when to seek help from other assessors, or alert the duty holder to their limitations as appropriate.

If a mining operation carries out monitoring to the requirements of Regulation 128 of the MOQO Regulations they are not also required to undertake monitoring under the Health and Safety (General Risk and Workplace Management) (GRWM) Regulations.

See Appendix A for more information on exposure monitoring and assessment.

2.4.3 Exposure monitoring, and health monitoring – GRWM Regulations
There are specific requirements to carry out exposure monitoring and health monitoring for substances hazardous to health under the GRWM Regulations. Whether specifically required under the GRWM Regulations, or not, so far as is reasonably practicable, exposure monitoring and health monitoring are requirements of the primary duty of care in HSWA.

A substance hazardous to health is defined as a substance, or product containing a substance, that is known or suspected to cause harm to health, and includes a substance:

- classified as having toxic or corrosive properties under the Health and Safety at Work (Hazardous Substances) Regulations 2017
- for which a prescribed exposure standard exists
- specified in a safe work instrument (SWI) as requiring health monitoring.

Under the GRWM Regulations:

- exposure monitoring is required where a PCBU is not certain on reasonable grounds whether the concentration of a substance hazardous to health at the workplace exceeds the relevant prescribed exposure standard
- health monitoring is required when a worker is carrying out ongoing work involving a substance hazardous to health that is specified in a safe work instrument as requiring health monitoring.

A prescribed exposure standard is a workplace exposure standard or a biological exposure index that has the purpose of protecting persons in a workplace from harm to health, and that is prescribed in:

- regulations
- a SWI
- an approval or a reassessment in accordance with section 77B of the Hazardous Substances and New Organisms Act 1996
- a group standard approval issued under section 96B of the Hazardous Substances and New Organisms Act 1996.

To find out if a substance has a prescribed exposure standard, you can:

> go to the controls database on the Environmental Protection Authority website: www.epa.govt.nz to see if your substance has an exposure standard prescribed in a hazardous substances approval, a group standard approval or a reassessment (if this applies).

Note: there are currently no substances that have exposure standards prescribed in regulations or SWIs. These will be issued by WorkSafe as they are developed.

Refer to WorkSafe's website for more information on SWIs.

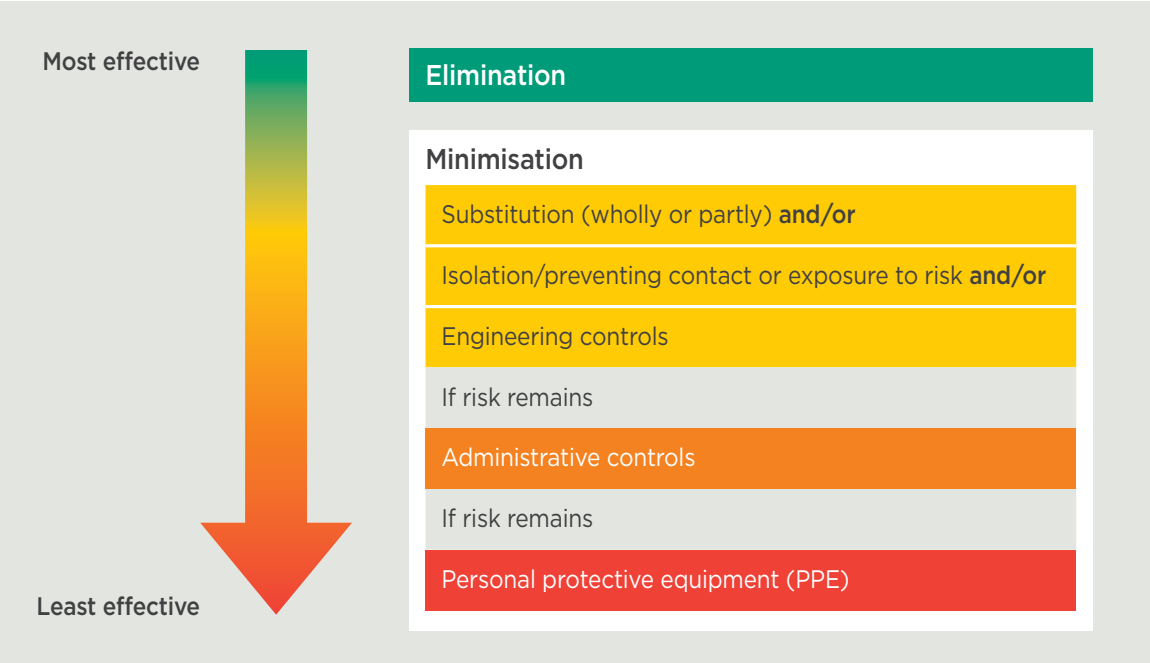
See the Exposure Monitoring under the Health and Safety at Work (General Risk and Workplace Management) Regulations 2016 fact sheet for more information on exposure monitoring requirements under the GRWM Regulations.

See the Health Monitoring under the Health and Safety at Work (General Risk and Workplace Management) Regulations 2016 fact sheet for more information on health monitoring requirements under the GRWM Regulations.

2.5 Hierarchy of controls

Duty holders need to apply the hierarchy of controls as set out in the GRWM Regulations. The duty holder needs to try to eliminate risks so far as is reasonably practicable. If elimination is not reasonably practicable, the risk needs to be minimized, so far as is reasonably practicable. The hierarchy is shown in figure 8.

Figure 8: Hierarchy of controls



The most effective control measures are used where possible. More than one type of control measure at a time can be used. The control measures used should be proportionate to the risk. Control measures include equipment, processes, procedures or behaviour to minimise risk.

In the hierarchy, duty holders need to minimise risks to health and safety, so far as is reasonably practicable, by first taking one or more of the following actions that is the most appropriate and effective taking into account the nature of the risk:

- substituting with a lower risk activity
- isolating people from the hazard/preventing people being exposed to the risk
- applying engineering control measures.

If a risk then remains, the duty holder needs to minimise the remaining risk, so far as is reasonably practicable, by putting in place administrative control measures.

Finally, if a risk still remains, the duty holder needs to minimise the remaining risk by ensuring the provision and use of suitable personal protective equipment (PPE). PPE is only used when other control measures alone cannot adequately manage the risk.

Table 2 explains the different types of control measures.

Table 2: Control measures

Action		What is this?
Elimination		Removing the sources of harm (eg equipment, substances or work processes).
Minimisation	Substitution	Substituting (wholly or partly) the hazard giving rise to the risk with something that gives rise to a lesser risk (eg using a less hazardous thing, substance or work practice).
	Isolation	Isolating the hazard giving rise to the risk to prevent any person coming into contact with it (eg by separating people from the hazard/preventing people being exposed to the hazard). Isolation focuses on boxing in the hazard or removing people away from the hazard.
	Use engineering control measures	Using physical control measures including mechanical devices or processes (eg local exhaust ventilation).
	Use administrative control measures	Using safe methods of work, processes or procedures designed to minimise risk (eg work rotation). Does not include an engineering control; or the wearing or use of personal protective equipment.
	Use personal protective equipment (PPE)	Using safety equipment to protect against harm. PPE acts by reducing exposure to, or contact with the hazard. For information on PPE requirements, see the Interpretive Guidelines Requirements for workplaces and facilities, training and supervision, personal protection equipment, monitoring, first aid, emergency plans and young people.

3 Noise

The legislation that applies in this section is:

MOQO Regulations

Part 3 Health and safety management system

Regulation 108 Worker health control plan

Part 7 Worker health monitoring

Noise induced hearing loss (NIHL) is permanent and has a large impact on a worker's life. People with NIHL can lose their jobs, spend more time away from work, perform less well than others, miss out on promotions or other jobs, and have difficult social and family relationships.

Hearing aids can help with communication, but they do not replace lost hearing.

Noise has been assessed as one of the most significant health hazards in the extractives industry. Noise and hearing impairment can also contribute to other injuries.

3.1 High exposure areas

In the extractives industry, sources of high noise exposure that are commonly at or over the noise exposure limits include:

- Blasting – sirens, pumping, stemming, mixing, transporting
- Drilling – exploration, blast holes, secondary blast holes, rock bolting, cable bolting
- Compressors or compressed air
- Fixed plant – crushers, screens, conveyors, elevators, generators, dryers, mills, pumps, transmissions, motors, loading, processing
- Hand tools – angle grinders, drills, power hammers
- Mobile machinery – trucks, excavators, bulldozers, graders, continuous miners, road headers, tunnel boring machines (TBM), front-end loader, jumbos, shotcreting
- Ventilation devices – main fans, auxiliary fans, jet fans, booster fans
- Any area where voices have to be raised to be heard by someone one metre away.

3.2 Exposure guidance

Every PCBU must ensure, so far as reasonably practicable, that no worker is exposed to noise above the following levels:

- a noise exposure level, LAeq,8h, of 85 dB(A); and
- a peak noise level, Lpeak, of 140 dB (unweighted).

The noise exposure level of 85dB(A) needs to be adjusted for longer than eight hours (which is common in the extractives industry). See Appendix A for more information.

3.3 Assessing noise exposure

There are two types of noise assessment; a preliminary noise assessment and a detailed noise assessment. A preliminary noise assessment helps to identify noise risks. They usually do not require sophisticated equipment or specially trained personnel. They are used as an initial assessment tool for identifying noise.

Information on how to conduct a preliminary noise assessment is available in the *Approved Document of Practice for the Management of Noise in the Workplace.*

See Appendix B for a preliminary noise survey checklist.

The duty holder is to undertake a noise assessment:

- if any of the above high exposure areas are present
- if there is a change in work arrangements that may increase noise levels (eg new plant)
- otherwise, if it has not occurred more frequently, every 5 years.

Duty holders need to have an initial noise assessment conducted in the workplace.

Duty holders are to conduct a detailed noise assessment at least once every five years, and at the times specified in the Approved Document of Practice for the Management of Noise in the Workplace.

A detailed noise assessment provides a more in depth analysis of the noise levels in the workplace and needs to be conducted in most extractive operations. They need to be completed by a competent person. It should include dosimetry as part of the assessment. Consider noise octave bands as part of the detailed assessment.

The duty holder is to undertake a detailed assessment:

- if a noise level may be above the exposure standards

- if any of the above high exposure areas listed above are present
- if there is a change in work arrangements that may increase noise levels and risk. This might include new plant or processes or increased periods of exposure
- at least every five years after the most recent assessment
- if engagement with workers regarding noisy situations in the workplace indicates further assessment is needed.

See Appendix C for information about how to conduct a detailed noise assessment, and who can do it.

3.4 Noise controls

The type of noise control required is dependent upon the circumstances. Controls may include:

- eliminating noise exposure
- isolating noise from workers, or workers from noise
- fitting silencers (eg mufflers or enclosures)
- providing acoustic barriers
- performing regular maintenance to reduce noise from friction
- moving workers further away from noise sources.

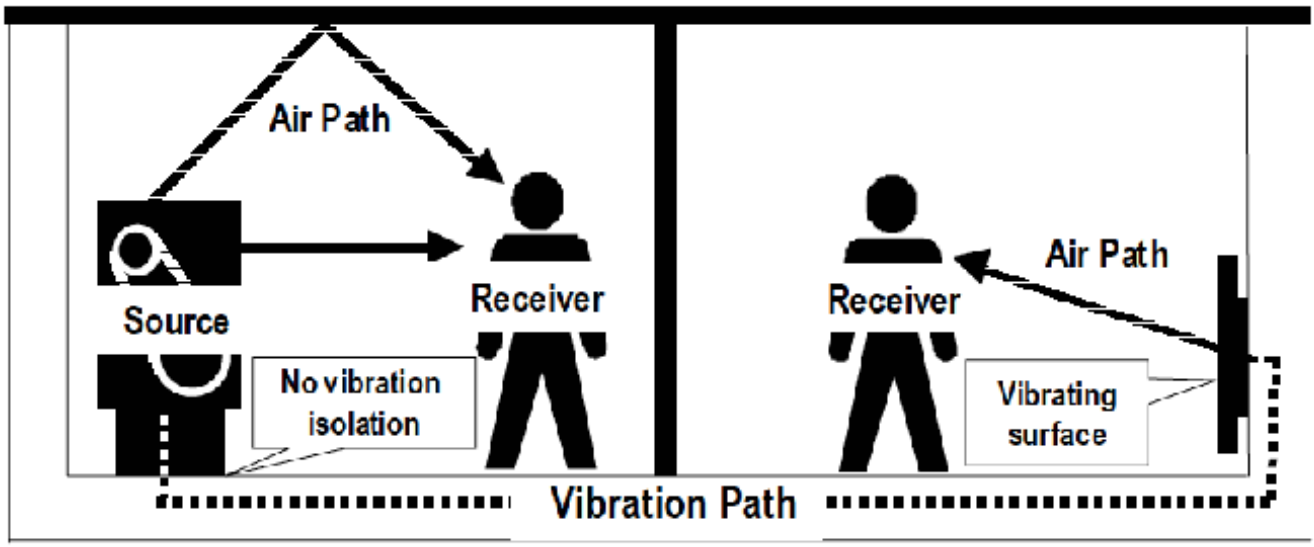
Noise controls need to follow the hierarchy of controls and not jump to hearing protection. If hearing protection is being used as the primary control the duty holder needs to be able to show that the most effective controls have been considered first, as per the hierarchy above, and the hierarchy of controls in section 2.6 and that it is not reasonably practicable to eliminate noise, or to control higher up the hierarchy.

Every noise risk has 3 elements:

- **Source** – where noise originates and radiates
- **Path** – the route noise travels along, for example, through the air, or along or through an object such as a wall or pipe
- **Receiver** – the ears of the person hearing the sound, or who is at risk from noise.

Control at the source is preferred, but controls may also be focused on the receiver and pathway.

Figure 9: Noise source, path and receiver



Duty holders are to consider the effect of noise when purchasing, designing or installing machinery (buy quiet). Plant that is designed to operate quietly is generally the best choice. Consider replacing plant with quieter versions. If it is impracticable to do this, duty holders are to buy quieter plant when replacing plant when it is due for replacement.

If plant is not replaced and noise levels need to be addressed, duty holders are to consider using silencers. A silencer is any measure that reduces the noise that is produced or prevents it from leaving the source. Silencers include, but are not limited to:

- rubber stops that prevent two pieces of metal from contacting
- mufflers that dissipate sound
- enclosures that contain sound.

If control at the source is not practicable, duty holders are to consider using acoustic barriers on the path. These could be a wall that separates workers from noisy plant (eg in a workshop), or a barrier between the operator and the noise source (eg in an underground mine).

All operations need to perform regular plant maintenance. This is an effective control as corroded, poorly lubricated or adjusted plant creates more noise than properly maintained plant.

Locating workers further away from noise sources can assist with reducing the noise they are exposed to and the risk of hearing damage.

Hearing protection to reduce noise exposure is the final option. Duty holders are not to use hearing protection without implementing controls at the source or path. Any operation using hearing protection as their primary risk management tool needs to be able show evidence that they have considered the elimination, isolation, and other noise reduction controls first, and that they are not reasonably practicable.

Workers are to be trained in the proper fitting and use of hearing protectors. Workers should be given the option to choose from a range of different types of hearing protection.

3.5 Health monitoring

Where a detailed noise assessment shows that noise levels are above the exposure limits, or for any reason it is assumed that noise levels are above the exposure limits, duty holders are to offer pure tone audiometric testing to workers every year. This needs to be done whether workers wear hearing protection or not.
The testing needs to include a hearing conservation programme with the following components:

- monitoring programme
- audiometic testing programme (including baseline testing)
- hearing protection devices (HPDs)
- employee training and education
- record keeping.

Testing is to be conducted to the requirements of AS/NZS 1269 series. If testing is conducted on site, duty holders are to provide testing facilities that meet the maximum permissible ambient noise limit, as outlined in the standard.

See the Approved Document of Practice for the *Management of Noise in the Workplace* for more information.

3.6 Further information

For more information refer to:

- *WorkSafe's Approved Document of Practice for the Management of Noise in the Workplace*
- *WorkSafe's Good Practice Guidelines on the Selection and Use of Hearing Protectors*
- ACC's website fact sheet Noise induced hearing loss
- Queensland Department of Natural Resources and Mines QGN 22 - *Guidance Note for Management of Noise in Mines*
- Safe Work Australia's *Managing Noise and Preventing Hearing Loss at Work.*

4 Vibration

The legislation that applies in this section is:

MOQO Regulations

Regulation 108 Worker health control plan

In the extractives industry vibration is seen as having a high potential to damage worker health. A vibration assessment will be required at most sites. Damage caused by vibration is often permanent and can result in serious, life changing injuries.

There are two types of vibration:

- whole body vibration
- hand-arm vibration.

Whole body vibration is vibration that is transmitted to the whole body by the surface supporting it, for example a seat. It can cause lower back pain and long-term exposure can cause:

- neck and shoulder problems
- herniated discs
- early spine degeneration.

Exposure to whole body vibration may contribute to other health effects including:

- cardiovascular, respiratory, neurological, endocrine and metabolic changes
- digestive problems
- reproductive organ damage
- impairment of vision, balance or both.

Hand-arm vibration is vibration that is transmitted to the hand and arm, for example from using power tools. It can cause:

- vibration white finger
- carpal tunnel syndrome
- damage to muscles, tendons, nerves, joints, bones and circulation.

4.1 Potential high exposure situations

4.1.1 Whole body vibration

Common high exposure situations include:

- excavators less than ~25 tonnes
- rigid dumpers
- front end loaders used in stock areas
- telescopic handlers
- front end loaders used at the face
- articulated dumpers working on roadways with substantially flat surfaces
- graders
- underground loaders >25 tonnes
- dozers – especially ripping
- articulated dumpers working on surfaces causing body roll and creating high roll in the cab
- scrapers.

Duty holders need to ensure a vibration assessment is carried out for any of the work activities above.

4.1.2 Hand-arm vibration

Operations need to ensure a vibration assessment is carried out in the following situations where a high level of hand-arm vibration is common:

When using powered hand tools, such as:

- impact drills or tools (eg sledgehammer, breakers)
- rock drills and chipping or scaling hammers
- grinders
- hand held grinders
- air-leg rock drills.

When undertaking maintenance tasks with:

- chainsaws (stripping operations)
- pedestrian controlled equipment (eg mowers)
- hand-held saws for concrete, metal and other materials
- hand-held grinders.

4.2 Exposure guidance

WorkSafe has adopted the exposure guidance in the European Union Directive 2002/44/EC (2002) on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (vibration) for addressing vibration.

As shown in Table 3 there is:

- a maximum daily exposure limit
- an action level, which if reached or exceeded requires an employer to take specific actions to reduce exposure.

Table 3: Vibration exposure values

	Daily exposure limit	Daily action level
Hand-arm vibration	5 m/s^2 A(8)	2.5 m/s^2 A(8)
Whole body vibration	1.15 m/s^2 A(8) 21 $m/s^{1.75}$	0.5 m/s^2 A(8) or 9.1 $m/s^{1.75}$

A(8) refers to the amount of vibration a worker is exposed to during a working day, normalised to an eight hour period of reference.

Table 4 shows measured hand-arm vibration levels at one mine site for some common hand tools used. At this site, workers using the engraver are able to work for one and a half hours, for each eight hour shift, before they reach the action level (as shown in the time to action level column). After this level of exposure, steps are needed to reduce exposure. If they work for more than 5 hours they are in breach of the exposure limit (as shown in the time to exposure limit column). The right side of the table shows the estimated daily exposure time that is actually occurring on site, and the estimated daily vibration exposure from that.

Table 4: Hand-arm vibration values for common hand held tools

Tool	Vibration Level (m/s^2)	Time to Action Level	Time to Exposure Limit	Estimated Daily Exposure Time	Average Daily Exposure Level (m/s^2)
Angle grinder metal plate	2.5	8.5 hr	>24 hr	4 hr	1.7
Jack hammer on asphalt	9.9	30 min	2 hr	1 hr	3.5
Rattle gun	13.7	16 min	1 hr	1 hr	4.8
Rattle gun on track	19.9	8 min	30 min	1 hr	7
Needle gun on track	17.9	9 min	37 min	1 hr	6.3
Engraver	6.2	1.5 hr	5 hr	30 min	1.6

4.3 Assessing vibration

Vibration, of either kind, needs to be assessed by a competent person with specialist training and experience, see section 2.5.2. This could be an ergonomist/human factors professional.

Duty holders are to ensure vibration is assessed to the requirements of:

- AS 2670.1 Evaluation of human exposure to whole-body vibration – General requirements
- AS ISO 5349.1 Mechanical vibration – Measurement and evaluation of human exposure to hand-transmitted vibration - General requirements
- AS ISO 5349.2 Mechanical vibration – Measurement and evaluation of human exposure to hand-transmitted vibration - Practical guidance for measurement at the workplace
- ISO/TR 25398 Earth-moving machinery – Guidelines for assessment of exposure to whole-body vibration of ride-on machines.

Duty holders are to ensure an assessment for vibration is carried out if a worker may be exposed to vibration above the daily action level or daily exposure limit.

When carrying out an assessment with a competent person, duty holders are to ensure workers are consulted about their experiences with vibration to assess potentially damaging vibration. As shown in Figure 10, perceived ride roughness corresponds well with the actual vibration, when measured. An example questionnaire for worker engagement on whole body vibration (WBV) is provided in Appendix D.

Figure 10: Perceived ride roughness vs measured vibration

Any worker that experiences tingling or numbness during or after vibration exposure may be being exposed to harmful levels. Workers reporting this are to have a vibration assessment for their work.

4.4 Vibration controls

Some example vibration controls are provided below; however this is not an exhaustive list. The hierarchy in which these are applied is safety by design (engineering controls, isolation, substitution), good maintenance, and then training (including speed limits or any other control that relies upon a person's action or inaction).

4.4.1 Whole body vibration

Vehicle and seat design

- Vehicle suspension appropriate for loads – no bottoming out
- Good seat design and suspension ('air ride' suspended seats), to the standards of ISO 7096. Ensure it is correctly adjusted to the operator's weight (accounting for possible changes)
- Cabs suitable for the size and reach of the operator (otherwise the seat will not be able to be correctly adjusted)
- Improved visibility from cab, especially at night (headlights)
- Forward facing passenger seating
- Fully adjustable seating
- Use vehicles that are the right size and type for the task
- Use vehicles that have the right type of tyres, at the correct pressure for the task.

Road maintenance

- Planned, systematic road maintenance programmes
- Dedicated vehicles and drivers for road maintenance
- Use the smoothest site routes practicable
- Effective communication of road conditions (eg signposting, markers)
- Prompt repair of poor road conditions.

Vehicle maintenance

- Planned maintenance of vehicle and seat suspensions
- Specialist maintenance for vehicle and seating suspension systems.

Speed

- Fit speed limiters
- Enforce speed limits
- Set the speed limit at the manufacturer's recommended speed, if there is one
- Appoint competent, safe drivers.

Operator training and awareness

- Raise awareness of harmful effects of vibration and the requirement to have regular breaks out of cab
- Driver competency training is undertaken, where appropriate
- Ensure truck load limits are followed (to avoid pressure on suspension)
- Avoid bending and lifting immediately after exposure to reduce likelihood of injury.

Miscellaneous

- Use operator change out (to reduce exposure times)
- Ensure adequate shot firing standards
- Equipment exposure limits are set and workers trained in these
- Equipment change out and swap arrangements are in place (as required).

4.4.2 Hand-arm vibration

- Use methods that do not require using hand tools (eg tools operated by remote)
- Buy tools that produce less vibration
- Use methods of work that produce less vibration (eg abrasive blasting instead of needle guns, hydraulic rather than compressed air wrenches, using a cut off saw instead of an angle grinder)
- Organise work and design workstations to avoid uncomfortable postures and the need for high manual effort to handle equipment
- Maintain tools regularly
- Limit the time workers are exposed to vibration (job rotation)
- Keep workers warm (eg. gloves) and provide appropriate PPE.

4.5 Further information

For further information see:

- *Bad Vibrations - A Handbook on Whole-Body Vibration Exposure in Mining*
- *Safe Work Australia's:*
  - Guide to measuring and assessing hand-arm vibration
  - Guide to measuring and assessing whole body vibration
- *European Union Directive 2002/44/EC (2002) on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (vibration)*
- *AS 2670.1 Evaluation of human exposure to whole-body vibration - General requirements*
- *AS ISO 5349.1 Mechanical vibration - Measurement and evaluation of human exposure to hand-transmitted vibration - General requirements*
- *AS ISO 5349.2 Mechanical vibration - Measurement and evaluation of human exposure to hand-transmitted vibration - Practical guidance for measurement at the workplace*
- *ISO/TR 25398 Earth-moving machinery – Guidelines for assessment of exposure to whole-body vibration of ride-on machines.*

5 Airborne contaminants

The legislation that applies in this section is:

MOQO Regulations

Regulation 84 Principal hazard management plans for air quality

Regulation 108 Worker health control plan

Part 7 Worker health monitoring

GRWM Regulations

Part 3 Duties relating to exposure monitoring and health monitoring

Airborne contaminants include dusts, gases, vapours, vehicle emissions and fumes. These are briefly discussed below. Duty holders need to ensure airborne contaminants are identified, a risk assessment carried out, and controls applied (as appropriate).

For more information on assessing exposure and selecting and implementing controls for respiratory health risks see WorkSafe's Approved Document of Practice on Air Quality in Extractives.

Airborne contaminants include, for example:

- asbestos
- blasting fumes
- carbon monoxide
- coal dust
- diesel engine emissions
- gases
- lead
- legionella containing mists or dusts
- man-made vitreous fibres (MMVFs)
- metal dust
- respirable crystalline silica (RCS)
- vapours and mists
- welding fumes.

Table 5: Common airborne contaminants and their effects

AIRBORNE CONTAMINANT	HEALTH EFFECTS
Asbestos	Health effects associated with asbestos exposure include respiratory diseases, such as asbestosis (lung fibrosis), lung cancer and mesothelioma (cancer of the mesothelium).
Blasting fumes	Exposure to the fumes in a blast plume is usually very brief – seconds to minutes. For most people, any health effects from exposure to a blast plume are short lived. Symptoms from high levels of exposure might include: > eye, nose and throat irritation and coughing > dizziness and headache > shortness of breath > wheezing or exacerbation of asthma. Serious lung inflammation has been known to develop several hours after exposure to very high levels of nitrogen dioxide.
Coal dust	Inhalation of respirable coal dust can lead to serious respiratory disease including coal mine workers' pneumoconiosis and progressive fibrosis. These diseases can take many years to develop, but in the shorter term a reduction in lung function can also occur due to chronic obstructive pulmonary disease (COPD).
Diesel exhaust emissions	Short-term acute symptoms include headaches, dizziness, lightheadedness, nausea, coughing, difficult or laboured breathing, tightness of chest, and irritation of the eyes and nose and throat. Long-term exposures can lead to chronic, more serious health problems such as cardiovascular disease, cardiopulmonary disease, and lung cancer.

AIRBORNE CONTAMINANT	HEALTH EFFECTS
Gases	Contaminant gases can present an acute or chronic health risk, or both. Acute health effects can include irritation and asphyxiation. Irritation can be mild to severe (eg mild irritation of the eyes, nose and throat, to severe damage to the lungs). Asphyxiation can occur either by the displacement of oxygen from the air (called simple asphyxiants such as carbon dioxide and nitrogen), or by interference with the body's ability to transport oxygen (called chemical asphyxiants, such as carbon monoxide and hydrogen cyanide). Chronic health effects from exposure to gases and vapours can include target organ effects (eg cardiac and central nervous system effects). Due to the radioactive properties of radon gas, it can have long term health effects on people after exposure. They release alpha radiation, or alpha particles, into the atmosphere. When radon daughters are inhaled, they can damage the lungs, and lead to lung cancer.
Legionella	Inhalation of mists containing the bacteria can cause Legionnaires disease, a potentially fatal respiratory disease, or the less severe Pontiac fever. In mining, the main risk areas for the growth of and exposure to Legionella bacteria are cooling towers or water treatment plants.
Man-made vitreous fibres (MMVFs)	Health effects from working with MMVFs include skin, eye and upper respiratory tract irritation. Ceramic fibres can possibly cause cancer; however, glass fibre, rock wool and slag wool are not classified as carcinogenic to humans.
Metal dust	Different metals give rise to different health effects, but can include: lung disease, such as pneumoconiosis (eg siderosis from iron exposure); chronic obstructive pulmonary disease; occupational asthma; cancer; target organ toxic effects (eg on the liver or kidney); or adverse skin effects (eg allergic contact dermatitis from skin contact with nickel metal).
Respirable crystalline silica (RCS)	Exposure to respirable crystalline silica can cause: > lung cancer > chronic obstructive pulmonary disease (COPD), also known as chronic bronchitis or emphysema > kidney disease > silicosis (a condition due to scarring of the lung). Workers may get some of these health conditions at relatively low levels of exposure, including levels below the workplace exposure standard (WES). Initially, workers with a health condition caused by exposure might have no symptoms. Recognisable early signs of COPD, lung cancer and silicosis are: > shortness of breath > severe cough > weakness. These symptoms can worsen over time and lead to death.

AIRBORNE CONTAMINANT	HEALTH EFFECTS
Vapours and mists	Health effects of vapours vary depending on the substance. Organic solvents are associated with central nervous system effects, some of which can target specific organs. > Mercury poisoning can result from both acute and chronic exposures. High mercury vapour concentrations can cause upper respiratory tract irritation and severe lung damage. At low vapour concentrations over a long time, neurological disturbances, memory problems, skin rash, and kidney abnormalities can occur. > Xanthates can liberate carbon disulphide, which is flammable and can cause peripheral and central nervous system effects, and inflammation of the optic nerve. > Di-isocyanates, such as TDI, MDI and HDI, are potent respiratory sensitizers causing occupational asthma and reduced lung function. > Some vapours and mists can also cause adverse skin reactions due to irritation, corrosion or allergy. Safety data sheets should be consulted for information on health risks. Read product safety data sheets for information on health risks.
Welding fumes	The health effects of welding fumes and gases depend on their composition. They can include metal fume fever (a short-term painful ailment with symptoms of fever and chills), chronic obstructive lung disease, pneumoconiosis (lung disease due to accumulation of mineral or metallic particles), occupational asthma, and irritation of the eyes and respiratory tract.

5.1 Dust

Airborne dust is present in most extractives sites. An assessment for dust will be needed for most sites. Risks to worker health from dusts must be managed, including:

- asbestos dust
- coal dust
- silica dust
- metal dust
- other hazardous/respirable dusts.

Respirable dust is dust that penetrates to the unciliated airways when inhaled.

5.1.1 Silica

Prolonged exposure to respirable silica can cause silicosis. This is due to fine particles deposited in the lungs causing thickening and scarring of the lung tissue. Depending on the concentrations of silica dust and the duration of exposure; as the disease progresses symptoms include shortness of breath, severe cough and weakness. The symptoms can worsen over time and lead to death.

Crystalline silica exposure is also a cause of lung cancer and kidney disease.

When managing risks from crystalline silica, duty holders are to apply the Approved Document of Practice for Air Quality in Extractives

5.1.2 Asbestos

Asbestos is not commonly found, or mined in its natural state in New Zealand. Common risks from asbestos arise when it is present in the fabric of buildings and from insulation and brake pads.

When managing risks from asbestos, duty holders are to apply the Approved Document of Practice for the Management and Removal of Asbestos.

5.2 Diesel emissions

Short-term acute symptoms include headaches, dizziness, light-headedness, nausea, coughing, difficult or laboured breathing, tightness of chest, and irritation of the eyes, nose and throat. Long-term exposures can lead to chronic, more serious health problems such as cardiovascular disease, cardiopulmonary disease, and lung cancer.

5.3 Fumes, including welding fumes

The health effects of welding fumes and gases depend on their composition. They can include metal fume fever (a short-term painful ailment with symptoms of fever and chills), chronic obstructive lung disease, pneumoconiosis (lung disease due to accumulation of mineral or metallic particles), occupational asthma, and irritation of the eyes and respiratory tract.

5.4 Mercury

Mercury can be present in precious and base metal ore and may be produced as a by-product of gold and silver processing. Mercury is a very toxic cumulative poison which can affect the brain, the central nervous system and the reproductive system. It can be absorbed by inhalation, ingestion and through the skin.

Mercury poisoning can result from both acute and chronic exposures. It is critical to recognise that exposure to mercury can be without warning and workers may not know the extent to which they have been contaminated.

Exposure and health monitoring is to be completed by a competent person, to determine the exposure hazard and evaluate symptoms, as necessary. See Workplace Exposure Standards and Biological Indices for more information.

Provide information, training, and supervision to workers about the risks of mercury and the controls to be applied at the site.

For more detailed information see:

- Safety Data Sheets for precautions and other hazardous substance information
- WorkSafe's Workplace Exposure Standards and Biological Indices
- USA Department of Labor Mine Safety and Health Administration (MSHA) 'Best Practices' section of the Controlling Mercury Hazards in Gold Mining: A best practices toolbox for hazard controls.

5.5 Assessing workers' exposure

Duty holders need to ensure that workers' exposure to airborne dust and other contaminants is assessed.

Exposure assessment must be carried out or supervised by a competent person.

The design of the assessment strategy depends on the size and type of extractives operation, and the activities carried out. A good assessment requires:

- a robust sampling strategy
- appropriate measuring and monitoring
- appropriate interpretation of results.

Most exposure monitoring will be occasional and workers will not wear monitoring equipment all the time, with some exceptions, such as underground mining gas detectors (eg for early warning of spontaneous combustion).

Exposure needs to be compared against Workplace Exposure Standards and Biological Exposure Indices.

Results of exposure monitoring should be made available to workers. This information is not to contain any information that identifies, or discloses anything about, an individual worker.

5.6 Respiratory health monitoring

If workers may be at risk from exposure to airborne contaminants, after controls have been applied, duty holders are to ensure health monitoring is carried out to the appropriate standard. Spirometry is to be conducted to the prescribed standards and the medical officer carrying it out is to be either an:

- occupational health physician or nurse
- respiratory physician
- GP who has completed a postgraduate course in spirometry.

Health monitoring is to include the use of the respiratory health questionnaire provided in Appendix L.

Offer respiratory health monitoring on the schedule outlined below.

5.6.1 Initial Medical

Offer an initial medical examination emphasising the respiratory system to workers. This includes:

- full work history
- medical examination
- lung function tests (FEV1 and FVC).

5.6.2 Ongoing Monitoring

If workers may be at risk from exposure to airborne contaminants, after controls have been applied, duty holders are to offer annual monitoring that consists of:

- Medical examination emphasising the respiratory system
- lung function tests (FEV1 and FVC).

5.6.3 Other health monitoring

This may be appropriate depending on the exposure (eg neuro testing for solvent exposure) Health monitoring may be appropriate following accidental exposures (eg to gases). Take advice of a competent occupational health practitioner.

5.7 Further information

For further information see:

- WorkSafe's *Workplace Exposure Standards and Biological Exposure Indices* Special Guide
- WorkSafe's *Management and Removal of Asbestos Approved* Document of Practice
- WorkSafe's *Air Quality in Extractives* Approved Document of Practice.

6 Manual handling

The legislation that applies in this section is:

MOQO Regulations

Regulation 108 Worker health control plan

Manual handling is defined as: "any activity requiring a person to lift, lower, push, pull, carry, throw, move, restrain, hold or otherwise handle any animate, or inanimate, object". This hazard needs to be assessed on every extractives site.

Risks from manual handling include:

- serious back injuries
- musculoskeletal disorders - including occupational overuse syndromes
- acute injuries such as sprains and strains of muscles or tendons
- injuries sustained through slips, trips and falls.

There is some evidence that manual handling is one of many inter-related risk factors for acute low back pain.

6.1 High exposure situations

Situations prone to causing manual handling injuries include:

- repetitive tasks (eg rockbolting)
- handling over barriers (eg loading onto a vehicle)
- handling when not in an upright position (eg vehicle maintenance from underneath the vehicle)
- lifting heavy loads (eg vehicle maintenance)
- handling shifting loads (eg liquids)
- handling awkward loads (eg cable bolts)
- operating a tunnel boring machine (TBM).

For any of these situations, duty holders need to ensure a manual handling assessment is conducted, as set out below.

Manual handling is also affected by temperature, as well as non-work factors such as:

- rheumatoid arthritis
- hormonal disorders
- obesity
- pregnancy
- age
- gender
- physical fitness
- current or previous injuries
- diabetes
- non-work activities.

For any other situation where a worker may be harmed by manual handling, duty holders are to ensure a manual handling risk assessment is conducted. See the exposure guidance given below.

6.2 Exposure guidance

So far as is reasonably practicable keep all manual handling tasks within the exposure guidance provided below.

Carry out an assessment for any manual handling that does not fall within the exposure guidance given below. Engage with workers when assessing manual handling risks. Duty holders will be expected to be able to show that they have properly assessed the risks.

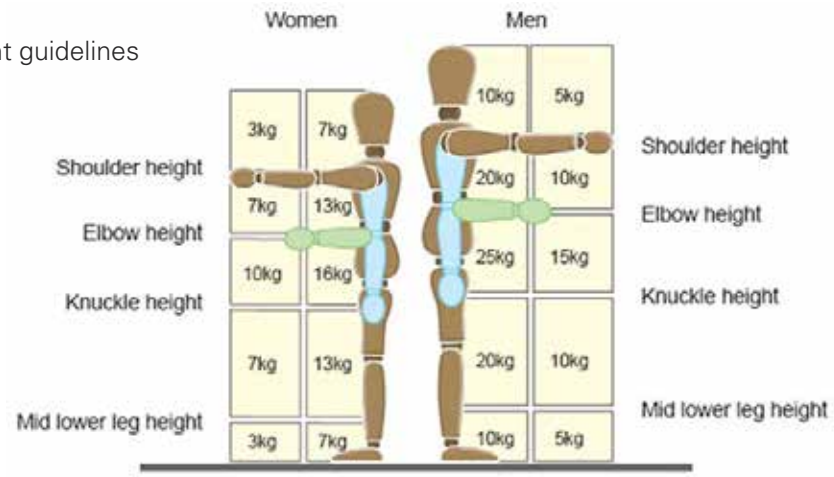
There is no such thing as a completely 'safe' manual handling operation. But working within the following guidelines will cut down the risk and reduce the need for a more detailed assessment.

Early reporting of pain, discomfort and injury is paramount. Workers should be encouraged to do so on a 'no fault' basis.

6.2.1 Lifting/lowering tasks

Any individual task that involves lifting or lowering is to be within the limits set out in Figure 11 below. This is for manual handling task less frequent than one per minute, with two hands directly in front of the body.

Figure 11: Lifting and lowering weight guidelines



The boxes represent the applicable weight for manual handling in that area. Working within these will provide a reasonable level of protection to most workers. However, workers that are at an increased risk can still be injured, and are to have a full assessment, for example workers that are:

- pregnant
- older
- recently injured
- at a diminished capacity, otherwise.

If the load moves through more than one box, use the smallest weight. Use an in between weight if the hands are close to a boundary between boxes.

Frequent lifting/lowering task
Reduce the weights as follows for more frequent lifting tasks:

- 1 – 5 times per minute = 70% of the values
- 5 – 10 times per minute = 50% of the values
- >10 times per minute = 20% of the values.

Awkward posture while lifting/lowering
Reduce the weights as follows when the body is rotated or twisted way from facing the front:

- 15° – 45° = 90% of the values
- 45° – 90° = 80% of the values
- >90° = 60% of the values.

Team lifting/lowering
All team lifting and lowering tasks shall be designed to ensure equal weight distribution to each lifter. Also keep weights and locations of the lift/lower within 133% of the values stated in Figure 11 when a task is performed by 2 people.

Do not design or conduct team lifting with 3 or more people.

One-handed lifting/lowering
All one-handed lifting and lowering tasks shall be designed to keep weights and locations of the lift/lower within 50% of the values stated in Figure 11.

6.2.2 Pushing and pulling

Two-handed pushing/pulling
All individual pushing and pulling tasks shall be designed to keep forces within the limits set out in Table 6. These limits apply to pushing/pulling with two hands directly in front of the body.

Table 6: Pushing/pulling guidelines

	FEMALE		MALE	
Distance	Once per Minute	Once per Shift	Once per Minute	Once per Shift
2 m	17 kg	22 kg	25 kg	31 kg
15.2 m	14 kg	17 kg	19 kg	25 kg
30.5 m	12 kg	15 kg	15 kg	23 kg

One-handed pushing/pulling
All one-handed pushing and pulling tasks shall be designed to keep forces within 50% of the values stated in Table 6.

6.2.3 Carrying

Two-handed carrying
All individual carrying tasks shall be designed to keep forces within the limits set out in Table 7. These limits apply to carrying with two hands directly in front of the body.

Table 7: Carrying guidelines

	FEMALE		MALE	
Distance	Once per Minute	Once per Shift	Once per Minute	Once per Shift
2.1 m	13 kg	16 kg	17 kg	25 kg
8.5 m	10 kg	12 kg	13 kg	20 kg

One-handed carrying
All one-handed carrying tasks shall be designed to keep forces within 50% of the values stated in Table 7.

6.3 Assessing manual handling

There are three main types of assessment tools for manual handling, those for:

- Lifting/lowering tasks
- Pushing/pulling tasks
- Upper limb disorders.

These have been included as Appendices E, F and G.

There is also an assessment tool for variable lifting and lowering tasks, available from the Health and Safety Executive.

A task may fall into more than one category and require assessment against multiple criteria (eg maintenance tasks).

The task may also need to be assessed against the vibration criteria, or other worker health assessment criteria. See section 4 for more information.

The exposure guidance is given as a way of narrowing the field of hazardous tasks for assessment. It is not an assurance against harm. If there is any doubt whether a task is hazardous, carry out an assessment. Ideally, all manual handling tasks will be fully assessed.

6.4 Manual handling controls

There is no one-size-fits-all control for hazardous manual handling tasks. The most appropriate controls depend on:

- the task
- the environment
- what is reasonably practicable.

However, the general principle is that the hazardous manual handling task needs to be as easy as possible. Injuries occur as because of strain on the body, especially strain on the lower back. Easier tasks strain the body less.

General principles for reducing strain include:

- use mechanical assist devices
- reduce weight being handled
- handle objects close to the body
- ensure work is performed in an upright position
- use good lifting techniques
- ensure manual handling area is uncluttered.

6.4.1 Components

All components between 10 kg and 100 kg that could be removed or replaced during operation or maintenance are to have their weight marked on the component. This is to assist people in understanding the risks associated with lifting the object.

Any component that cannot be easily and safely lifted in accordance with the previously stated guidelines is to either:

1. be fitted with lifting lugs and accessible by lifting equipment when installed. All lifting lugs will be positioned on equipment, components and assemblies such that the lifting equipment hoist cable or chain will be directly over the centre of gravity of the item during lifting; or
2. incorporate an integrated lifting device in the design; or
3. be provided with special lifting gear attachments (eg grabs, holders, spreader bars) along with the equipment (see Figures 12-15).

All lifting equipment should be tested and certified as fit for purpose every 6 months.

Figure 12: Permanent jib for removing hatch cover

Figure 13: A slide for return rollers which forgoes heavy manual lifting

Figure 14: Hoisting components

6.4.2 Consumables

All consumables (eg grease, oil, filters) between 10 kg and 100 kg that are required during operation or maintenance will have their weight marked on the component. This assists in understanding the risks associated with lifting the object.

Any consumable that cannot be easily and safely lifted in accordance with the previously stated guidelines will either:

1. be able to be lifted into the appropriate location by lifting equipment. Special lifting gear attachments (eg grabs, holders) will be procured and provided along with the equipment; or
2. be designed to allow the consumable to be transported or pumped into location from a remote bulk storage location; or
3. be designed to enable operation and maintenance activities to occur using smaller consumable containers (eg 10 kg grease rather than 20 kg grease).

Figure 15: Hoisting equipment

6.4.3 Specific tasks

The following specific requirements will also be incorporated into the design:

1. all manually operated valve handles will be in the height range of 900 – 1500 mm above walkway level and a maximum of 400 mm horizontally displaced in front of the person operating the valve
2. split system air conditioners will be used rather than Room Air-Conditioned (RACs) to reduce lifting requirements during installation and maintenance
3. unbogging of haul trucks has to be considered. Tow hooks/attachment points should be on the front of the bumper (not underneath) to facilitate sling attachments.
2. Each identified task will be subject to ergonomic analysis and solutions devised and equipment sourced.
3. Jacking/fixed support equipment for all items of heavy equipment will be provided.
4. Specialised items of workshop equipment will be sourced to support maintenance and inspection tasks associated with elevated maintenance and inspection work on, at least:
   a. dozers (tracks, bonnets, and ripper frames)
   b. loaders (boom, bucket assemblies)
   c. haul truck decks, air filter replacement and so on
   d. lowered Drill masts
   e. digger and Shovel booms/buckets.

Workshop Support Equipment

1. All manual tasks requiring > 25 kg (one person lift) and > 35 kg (two person lift) will be identified.

Examples of equipment sought are given. Figure 16 illustrates a platform for air filter removal on haul trucks.

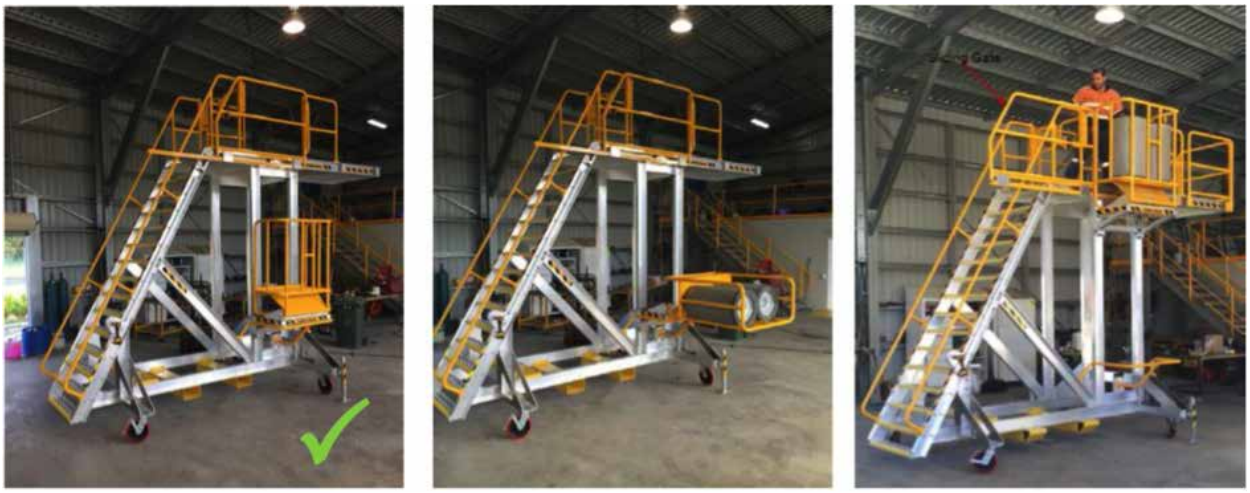


Figure 16: An air filter replacement platform – hoist capacity 300 kg (all 3 photos)

Figure 17: Suspended 797F OHT body

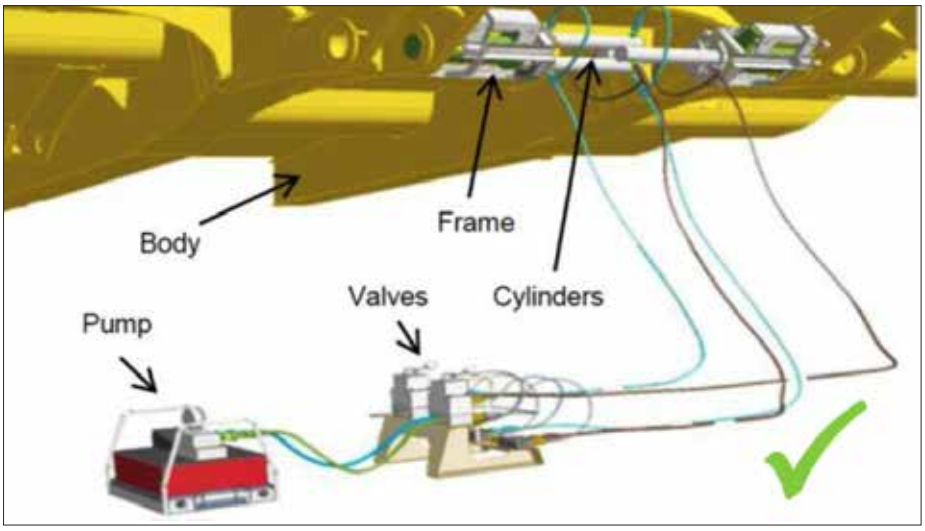
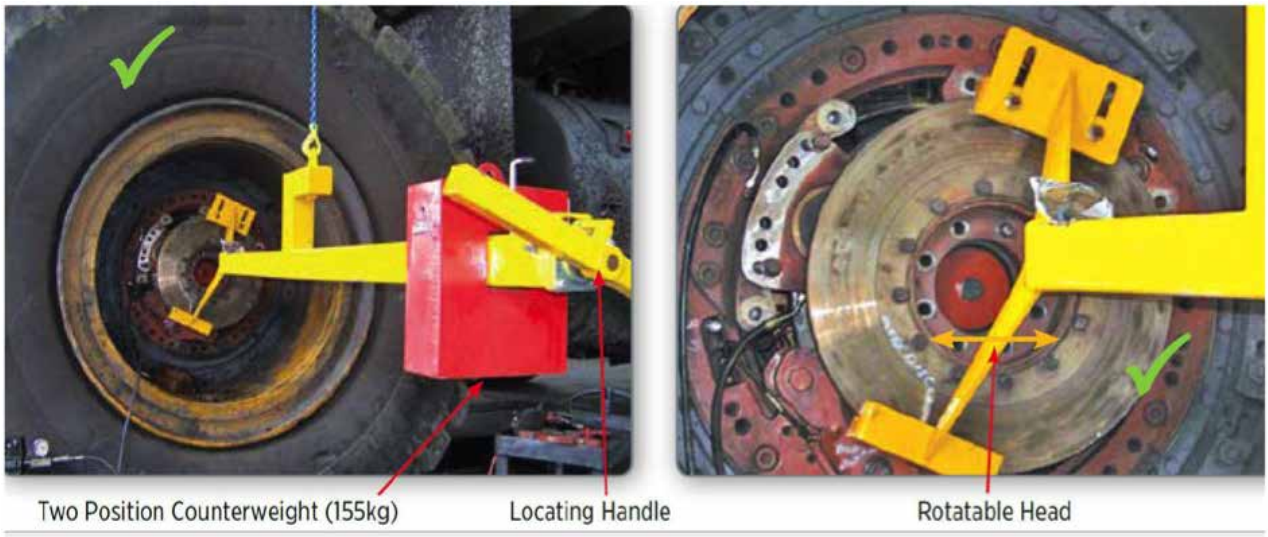


Figure 18: Body pin installation/removal tool

(from left) Figure 19 and Figure 20: GET removal tool

Figure 21: Jig for starter motor removal

Figure 22: Belly pan hoist for dozer scrapers



(from left) Figure 23 and Figure 24: Brake disc removal tool

Figure 25: Wheel chock lowering device for haul trucks

6.5 Further information

- Health and Safety Executive's:
  - Manual Handling at Work: A brief Guide
  - Upper Limb Disorders in the Workplace
  - Manual Handling Assessment Charts (MAC) Tool
  - Variable Manual Handling Assessment Chart (V-MAC) Tool
  - Assessment of Repetitive Tasks (ART) Tool
  - Risk Assessment of Prushing and Pulling (RAPP) Tool
- WorkSafe's Document of Practice for Manual Handling
- ACC's Preventing and Managing Discomfort, Pain and Injury

7 Slips, trips and falls

The legislation that applies in this section is:

MOQO Regulations

Regulation 108 Worker health control plan

Slips, trips and falls are common in the extractives industry, and are the cause of many injuries, especially back injuries.

Slipping involves loss of grip as the heel of the leading foot strikes the surface (Figure 26). A slip of the foot by more than 100mm is often unrecoverable.

Tripping involves loss of balance as the boot toe of the trailing foot catches on an object and the person falls forward (Figure 26).

Ankle roll involves the foot contacting an edge or obstruction (Figure 26).

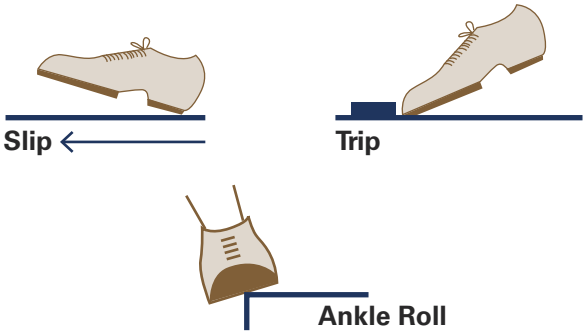


Figure 26: Slips, trips and ankle rolls
A person has a greater ability to recover if a trip is involved. Whether they fall, or not, injuries can still result.

Many slips, trips and falls are caused by failure to plan ahead. Start by planning a safe approach.

7.1 High exposure situations

Slips, trips and falls are risks in any operation and can occur particularly when:

- accessing or egressing mobile plant
- undertaking maintenance and pre start checks for mobile plant
- access to structures, or general access ways, has not been properly designed
- there is not enough in-built grip, or it has worn away
- material has built up (eg mud, oil)
- working on or accessing the flatbed of a semitrailer
- objects are left or stored in access ways.

In surface operations, slipping is most common. In underground mining, ankle roll is most common.

The workforce has a tremendous store of knowledge about poor underfoot conditions and this is to be part of the engagement and participation process with workers.

7.2 Controlling for slips trips and falls

7.2.1 Level platforms/walkways

Trips and falls occur where there is a lack of surface continuity, contaminants and/or the presence of edges.

Slips and falls usually occur where there is low grip underfoot or on a contaminated smooth surface (eg muddy plate walkways).

This is often where the level of grip changes unexpectedly and/or a contaminant (eg mud) is not taken into account. Instructing workers to 'be careful' is not an effective control for this.

Flooring materials should not have a preferential grip direction (eg not expanded metal). There are readily available anti-slip coatings that can be applied to improve grip.

No area accessible by a worker should be smooth, painted steel (eg access areas for mobile plant), unless the area is less than 100mm x 100mm in size.

Checker plate should not be used on any working area (including stairway treads/nosings) unless treated with grip enhancing materials (eg anti slip coating).

For underground operations, a road standard needs to be in place, and enforced.

Lighting needs to be provided in operational areas.

7.2.2 Stairways and fixed ladders

Tread nosings shall be visually distinct against the tread surface.

See Figure 27 for an example of good stairway access, with good, visually distinct tread nosings with good grip.

Every flight of stairs needs a handrail. Spiral stairs should not to be used as these present other problems.

Stairways are an access system and one hand needs to be free at all times when ascending and descending. Consider how tools, equipment and other items are transported between levels, and design accordingly.

7.2.3 Lighting

Good visibility is critical to navigating the environment, preventing slips, trips and falls and recognizing hazards in the workplace.

Man-made lighting is the key lighting factor for underground operations, work indoors and work at night.

LED lighting should be used for all lighting, so far as is reasonably practicable, with a minimum 30,000 hours of operating time.

Internal

Duty holders are to have lighting designed and installed to meet or exceed the requirements outlined in **Table 8** and **Table 9** for all internal areas.

Figure 27: Example of good stairway access

Table 8: Internal lighting requirements

Internal Locations	Minimum Maintained Illuminance
Assembly, fabrication, manufacture or maintenance areas • Rough work (eg frame assembly) • Medium work (eg machined parts, engine assembly) • Fine work (eg small parts, electronic equipment) • Extra-fine work (eg very small or intricate parts, precision mechanisms, instruments)	 240 lux 400 lux 600 lux* 1200 lux*
Laboratories	400 lux
Office Environments • Meeting Rooms • Desk and computer areas • Remaining office area (other than desks) • Waiting rooms and foyers	 320 lux 320 lux 160 lux 160 lux
Food preparation areas	240 lux
Control rooms	240 lux
Crib rooms and eating areas	160 lux
Electrical areas (eg substations)	160 lux
Other general working areas (not offices)	160 lux
Warehouse and storage areas	80 lux
Stairways and ramps	80 lux
Toilets and changerooms	80 lux
Plant rooms (not electrical)	80 lux
Walkways and access areas (corridors & passageways)	40 lux

*The use of localised light is recommended

Table 9: Recommended maintenance illuminance levels for different applications

Type of Task or Interior	Maintenance Illumination (lx)
ENTRANCES	
Entrance halls	160
Enquiry desks	400
Entrance gates and control	40
Gatehouses	80
Loading bays	80
CIRCULATION AREAS	
Corridors, passageways	40
Stairs	40
Lifts	40
Escalators, moving walks	80
STAFF RESTAURANTS	
Canteens, cafeteria, dining rooms —	
General	160
Counters	240
KITCHENS	
General	160
Food preparation, cooking, wash up	240
STAFF ROOMS	
Changing rooms, locker rooms	80
Cleaner's room	80
Cloakrooms	80
Restrooms	40
FIRST AID CENTRES	
Restrooms	40
Treatment rooms	400
TOILETS	80
STOREROOMS	
Rough bulky material —	
• Dead storage	40
• Live storage	80
Medium of fine material requiring care —	
• Dead storage	80
• Live storage	160
Packing and dispatch, wrapping, labeling, filling and stamping	160
Counters	160
PLANT ROOMS	
General	80
Control Panels, switchboards	160
Place luminaires outside direct view of resting occupants Additional local light may be required for maintenance purposes.	

External
Duty holders are to have lighting designed and installed to meet the requirements outlined in Table 10 for all external areas.

Table 10: External lighting requirements

External Locations	Minimum Maintained Illuminance
Crushers & screens	160 lux
Assembly, fabrication, manufacture or maintenance areas	80 lux
Stairways, ramps and mobile equipment access	40 lux
Loading and unloading areas (forklift or manual)	40 lux
Refuelling areas	40 lux
Conveyors and gantries (including accessways)	40 lux
General storage areas requiring pedestrian access – with vehicle movements	20 lux
Walkways and access areas on fixed plant	20 lux
Carparking areas	15 lux
Walkways and access areas between buildings/plant	10 lux
Vehicle intersections • With pedestrian movements • No pedestrians	 10 lux 5 lux

7.2.4 Mobile plant
Duty holders need to ensure the need to access heavy vehicles for maintenance, is eliminated where practicable (eg remote monitoring, different work methods, remote greasing points).

Checks and service functions of mobile plant should be conducted from the ground.

Figure 28: Ground access for checks and maintenance

There should be no requirement to climb to check and fill oil/fluid compartment.

Always apply the 'three points of contact rule' when using, ladders or steps or climbing for any reason.

Access to, and egress from, heavy vehicles should be by a well-constructed ladder or steps. Ladders or steps should be well built, properly maintained and securely fixed. Where steps or ladders extend to the ground, use interlock systems to prevent the vehicle moving or starting until the ladder or step has been correctly stowed.

Avoid using suspended steps wherever practicable. If they cannot be avoided, use rubber or cable suspension ladders, not ladders made of chains. Ladders and steps should slope inward towards the top if this is reasonably practicable. They should not slope outwards towards the top.

Duty holders are to ensure rungs or steps on vehicles:

- are level and comfortable to use
- have a slip-resistant surface
- do not allow a dangerous build-up of mud, grease, oil, or other substances (eg a grating could be used to allow things to pass through a step).

The first rung or step needs to be close enough to the ground to be easily reached – ideally about 40 cm and not more than 70 cm.

Duty holders are to ensure ladders or steps are placed as close as possible to the part of the vehicle requiring access. See *AS/NZS 1892.5 Portable ladders - Selection, safe use and care* for more information on the requirements for portable ladders.

Opening (and holding open) a cab door on a vehicle should not force a driver to break the 'three points of contact' rule or to move to an unsafe position.

Vehicle owners should consider retrofitting safer access ways to eliminate the risk of falling, see Figures 30 and 31.

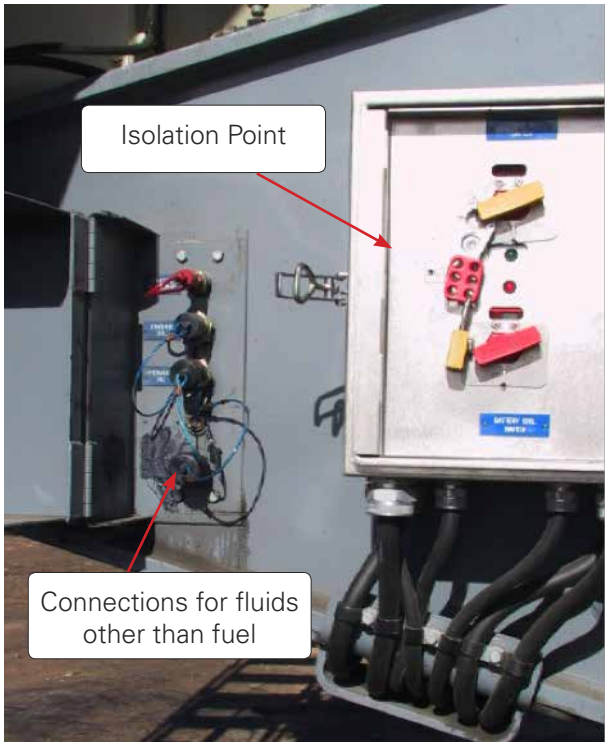


Figure 29: Ground access for oil

Figure 30: Retrofitted stairway and platform

Figure 31: Example of access system

7.2.5 Fixed structures

Where a structure is a building under the Building Act 2004, reasonable and adequate access to enable safe and easy movement of people must be provided.

Access routes must, among other things:

- have adequate activity space
- be free from dangerous obstructions and from any projections likely to cause an obstruction
- have a safe cross fall, and safe slope in the direction of travel
- have adequate slip-resistant walking surfaces under all conditions of normal use
- include stairs to allow access to upper floors
- not have isolated steps (ie single steps).

Have landings of appropriate dimensions where a door opens from or onto a stair, ramp or ladder so that the door does not create a hazard.

Access routes must also have stair treads and ladders which:

- provide adequate footing
- have uniform rise within each flight and for consecutive flights
- have stair treads with a leading edge that can be easily seen.

Access routes must also have handrails which are:

- smooth, reachable and graspable so they provide support and to assist with movement along a stair or ladder
- are adequately strong and rigid, as required by Clause B1 "Structure" of the MBIE Building Programme Compliance Document for New Zealand Building.

Even if your machinery is not classified as a building under the Building Act, WorkSafe recommends you follow the requirements of the Building Act.

7.3 Further information

See the MBIE Building Programme Compliance Document for New Zealand Building

Clause D1 – Access Routes and Compliance Document for New Zealand Building

Clause F4 Safety from Falling for more information about access routes, including:

- detailed diagrams of dimensions
- construction requirements for
  - stairs
  - ladders ramps
  - barriers
  - access ways.

See *NZS/AS 1657 Fixed platforms, walkways, stairways and ladders - design, construction and installation* for more information.

See *ISO 2867 - Earth-moving machinery - Access systems* for more information on access systems for earth moving machinery.

8 Fatigue

The legislation that applies in this section is:

MOQO Regulations

Regulation 108 Worker health control plan

Fatigue is an issue in the extractives industry with the introduction of 24 hour operations and 12 hour shifts. With more focus on commuting accidents and fatalities, there is growing concern about the effect of fatigue on mine workers and on general road users.

The need to sleep is a requirement of the human body. As the need for sleep builds up mental and physical impairment can result, leading to errors in decision making and safety. Micro-sleeps, where the person falls asleep briefly, are potentially deadly if they occur at the wrong time.

Aside from the amount of sleep a person has had, the drive to sleep gradually builds up over time that a person has been awake.

8.1 Exposure guidance

There is not a prescribed exposure standard for fatigue. Extractives operators and workers both need to manage fatigue. The minimum requirements for managing fatigue are:

- make sure there is an optimal shift schedule that allows adequate time for recovery sleep (workers require at least 2 full nights sleep to recover from fatigue)
- minimise extended duration shifts
- for rotating shift schedules, have forward rotation of shifts where possible – from day to afternoon to night
- ensure, so far as far reasonably practicable, workers have at least 7 hours of sleep per 24 hours
- screen for sleep disorders or health issues (eg using pre-employment questionnaire).

While a worker can experience fatigue at any time of day, peak injury times are 12 midnight, 3am and 5am.

Long shift hours both increase worker exposure and decrease recovery time. Thus they have a cumulative impact on risks to worker health.

Methods of managing fatigue include:

- avoid exposure to bright light after a night shift (eg wear sunglasses or stay indoors)
- avoid alcohol and caffeine before sleeping; they can disrupt subsequent sleep
- keep the bedroom dark, quiet and cool to facilitate sleep
- begin recovery sleep as soon as practically possible after a night shift
- take a 30 minute to 2 hour nap before a night shift to supplement the main sleep period
- use appropriate measures to help maintain alertness, for example have a 20 to 30 minute nap and/or caffeine to help maintain alertness – particularly for high risk tasks such as driving.

There is no substitute for getting enough good quality sleep at the right time of day.

8.2 Making a plan

Establish a fatigue management plan if fatigue is a hazard. 24 hour operations will have fatigue as a hazard, as they operate at night. Mine operators must establish a fatigue plan as part of the Worker Health Plan.

The plan needs to specify, at least:

- minimum hours of sleep opportunity between shift:
  - at least 2 full nights to recover from fatigue
- maximum shift length, considering:
  - time of day
  - type of work
  - underground or surface based work
- maximum travel time before and after a shift
- maximum hours to be worked in a week
- maximum hours to be worked in a month
- procedures for detecting, reporting and addressing fatigue, if it occurs.

8.3 Further information

Tools for assessing fatigue:

- HSE's Fatigue and Risk Index
- SCIRT's Fatigue Scorecard
- NSW's Fatigue Risk Management Chart.

Additional guidance on fatigue is available on WorkSafe's website.

NSW Department of Industry Resources and Energy's *Fatigue Management Plan - A practical guide to developing and implementing a fatigue management plan for the NSW mining and extractives industry.*

SWA's Fatigue management - a worker's guide.

9 Drugs and alcohol

The legislation that applies in this section is:

MOQO Regulations

Regulation 108 Worker health control plan

Workers impaired by drugs and alcohol are a health and safety risk to themselves, others, and workplace assets.

Drug and alcohol abuse or dependency can be a serious risk for the workplace and needs to be addressed with care. A clear drug and alcohol plan assists with this.

9.1 Making a plan

Alluvial mine and quarry operators should establish a drug and alcohol plan, in doing so the document given below needs to be applied.

Duty holders must ensure strategies to deal with drug and alcohol are provided in the Worker Health Plan, in consultation with workers and their representatives (where reasonably practicable).

The plan (strategy) is to specify that if workers are impaired by a prescription drug they are to inform the extractives operator. Workers may perform work while taking prescription medication if a medical practitioner has cleared them to do so.

The drug and alcohol plan needs to contain, at least:

- the tasks that are not to be performed under the influence of drugs or alcohol (high risk work)
- the position on the consumption of alcohol on site
- that workers are not to be under the influence of illegal drugs
- when drug/alcohol tests may be performed. This might include:
  - random testing
  - post incident testing
  - reasonable cause testing.

The best tool is education to change the culture. Wherever a plan is in force, this is to be reflected in the employment agreement or contract for service. Directing employees to take drug and/or alcohol tests without prior agreement can be in breach of statutory law.

Workers are to be trained on the drug and alcohol plan, including the requirements for drug/alcohol testing.

Drug testing is to be performed to *AS/ NZS 4308 Procedures for specimen collection and the detection and quantitation of drugs of abuse.*

10 Psychosocial (Stress, bullying, harassment and violence)

The legislation that applies in this section is:

MOQO Regulations

Regulation 108 Worker health control plan

Psychosocial risks can have a serious effect on the workers and workplace health and safety. They can affect workers physically and mentally and cause:

- increased stress levels
- decreased emotional wellbeing
- reduced coping strategies and lower work performance.

Psychosocial effects can reduce productivity and disrupt workplaces through:

- impaired performance
- increased absence
- low morale
- more mistakes and accidents
- loss of company reputation
- resignations and difficulty recruiting
- poor customer service/product quality.

Psychosocial risks are factors with the potential to cause harm, which arise from the design and management of work, and its social and organisational context. These factors include the design, content, scheduling, and control of work, and interpersonal relationships.

Creating a healthy workplace is the best way to prevent psychosocial hazards.

10.1 Bullying, harassment and violence

PCBUs need to react appropriately to workplace bullying, harassment and violence. They have a duty to manage risks to health and safety, including from inappropriate behaviour by people. Do not allow bullying, harassment or violence in the workplace. A plan assists with this.

It is important to distinguish between bullying, harassment, and violence. While one plan can cover all of these, they require different approaches. See Table 11 below for their definitions.

Table 11: Definitions of bullying, harassment and violence

Bullying	Workplace bullying is repeated and unreasonable behaviour directed towards a worker or a group of workers that creates a risk to health and safety. • Repeated behaviour is persistent and can involve a range of actions over time. • Unreasonable behaviour means actions that a reasonable person in the same circumstances would see as unreasonable. It includes victimising, humiliating, intimidating or threatening a person. A single incident of unreasonable behaviour is not considered workplace bullying, but it could escalate and should not be ignored.
Harassment	Under the Harassment Act 1997 (HA), harassment takes place when someone directs one or more specified acts at another person (including watching, loitering, following, accosting, interfering with another person's property or acting in ways that causes the person to fear for their safety) at least twice in a 12-month period. Harassment has the potential to cause humiliation, offence or intimidation. It's usually repeated behaviour but even one instance may cause reasonable concern.
Violence	Acts of violence towards a person can be verbal (verbal abuse, threats, shouting, swearing) or physical (stalking, throwing objects, hitting, damage to property). Workplace violence is illegal, can be referred to the police, and charges can be laid under criminal law.

Every extractives operator must have a bullying, harassment and violence plan as part of their Worker Health Plan.

Creating an environment that builds good relationships prevents bullying. This is much easier than dealing with bullying once it occurs. If staff have a clear picture of what a business wants to achieve, they're more likely to engage with the common goal.

Likewise, clear guidelines for expected behaviour, work culture and values means unreasonable behaviour is less likely to thrive.

10.1.1 Making a plan

The plan must be made in consultation with workers.
The plan is to set out:

- the operator's position on bullying and violence
- how to report instances of bullying and violence
- the steps the operator will take to address bullying and violence
- the problem resolution process included in workers' employment agreements.

Education to change the culture is an effective tool, and should be used by duty holders.

Duty holders are to ensure workers are aware of the steps set out in the Worker Health Plan, the plan, and the problem resolution process in their employment agreement.

The plan needs to outline the process for investigating and resolving complaints of bullying.

There is detailed information, including example problem solving processes in WorkSafe's *Preventing and responding to workplace bullying.*

10.2 Stress

Stress is a well understood concept, but is difficult to quantify in a workplace. There is no exposure standard as such. Extractives operators need to address stress in their Worker Health Plan.

Indicators of excessive stress include increases in:

- sick leave
- absenteeism (being absent without leave)
- tiredness
- irritability
- errors.

Creating an environment that promotes good psychosocial health prevents stress related illness. More information on what makes a healthy place of work can be found in WorkSafe's *Morale, distress and healthy work*.

10.2.1 Making a plan

The plan must be made in consultation with the workers.

The plan needs to set out:

- the operator's position on stress
- how to report instances of stress
- the steps the operator will take to address stress.

10.3 Further information

For further information on bullying and violence see WorkSafe's Preventing and responding to workplace bullying.

WorkSafe's *Morale, distress and healthy work*. Additional guidance on psychosocial hazards is available on WorkSafe's website.

Canadian Centre for Occupational Health and Safety:

- *Mental Health - Psychosocial Risk Factors in the Workplace*
- *Guarding Minds at Work Survey.*

11 Temperature

The legislation that applies in this section is:

MOQO Regulations

Regulation 108 Worker health control plan

Exposure to extreme temperatures can be a serious cause of harm to people. Exposure to low temperatures can cause hypothermia, frostbite, loss of extremities and death. High temperatures can cause heat strain and the rapidly fatal heat stroke.

Heat strain is the term used to describe the effects that occur in the body as a result of heat stress.

The physical effects of heat strain can vary from less serious disorders such as skin rashes and fainting, to serious life-threatening situations where sweating stops and heat stroke develops.

Heat stroke is the least common but most severe degree of heat strain. It has a high mortality rate, especially if effective treatment is not given immediately. It causes a major disruption of the central nervous system, and is characterised by the following symptoms:

- convulsions
- mania or coma
- dilated pupils
- a core body temperatures of 41°C or above
- usually a hot dry skin.

Heat stroke may happen suddenly, or there may be warning signs such as irritability, dizziness or mental confusion.

11.1 High exposure areas

Extremes of temperature can be a risk to worker health in some of the following conditions:

Table 12: Conditions of risk for extremes of temperature

High temperatures	Low temperatures
• in humid environments • in areas of poor air circulation • where a lot of physical activity is occurring • where warm or heavy clothing is being worn • near to a source of radiant heat (eg heavy machinery or a generator). Wearing negative pressure respiratory protective equipment or heavy/impervious clothing can prevent heat leaving the body.	• in wet conditions (eg rain, in standing or flowing water) • at night • in high wind conditions (natural or mechanical) • in alpine regions • outdoors • in open vehicles.

11.1.1 Individual susceptibility

Individual susceptibility to heat or cold is variable and can be affected by:

- age
- gender
- weight
- level of fitness
- medication
- fatigue
- circulatory disease
- alcohol
- smoking
- lack of acclimatization
- recent illness.

11.1.2 Confined space

Confined spaces are inherently hazardous. In addition to the other considerations for confined space entry, they can also have a temperature hazard.

Confined space hazards include:

- an oxygen-deficient atmosphere
- restricted access and escape
- limited movement
- close proximity to hot or cold surfaces
- the increased potential for a build-up of atmospheric contaminants from welding or other processes.

These may mean that protective clothing options need to be considered sooner for temperature hazards than would normally be the case.

For more information on confined space entry see the *Confined spaces: Planning entry and working safely in a confined space* fact sheet.

11.2 Exposure guidance

There are many factors that affect how hot or cold a person is or feels, in addition to the air temperature.

11.3 Assessing heat stress risk

Duty holders are to use Basic Effective Temperature (BET) when addressing extremes of temperature. Duty holders are to ensure the BET is calculated using Appendix H, and the results in Table 13 are applied.

Duty holders are to manage the risks to worker health from work being undertaken in extremes of temperature. Duty holders are to establish a temperature plan.

The Australian Institute of Occupational Health (AIOH) Heat Stress Standard requires a more detailed assessment than BET in some situations. BET has limitations above 31°C. If work must be completed under these conditions another measurement may need to be used. Duty holders are to seek advice from a competent person in these situations.

11.4 Low temperature and wind chill

The human body's core temperature is 37OC, which is maintained by the body's normal regulatory mechanisms. In cold environments, without protective clothing, these mechanisms do not work effectively. Hypothermia, a potentially fatal condition, occurs if the core temperature drops to 33°C or less.

Often the first signs of this are a sensation of cold, followed by pain in exposed parts of the body. Because water is a much better conductor of heat than air, both to and from the body, the most dangerous situations occur when the body is immersed in cold water.

As the exposure time increases, or the temperature continues to drop, increasing numbness develops, and the sense of pain decreases. The next symptoms to develop are weakness and drowsiness, which usually occur when the core temperature drops below 33°C. This condition is called "hypothermia". Additional symptoms of hypothermia include a cessation of shivering, diminished consciousness and dilated pupils. When the temperature reaches approximately 26-27°C, unconsciousness occurs.

See Table 14 for likely effects and symptoms of cold exposure. Train workers to recognise the symptoms of cold exposure – especially hypothermia.

Table 13: Controls for high temperature and humidity

Temperature	Action
Wet bulb > 25°C	An air velocity of not less than 0.5 metres per second should be provided.
BET > 28°C	Manage the health of persons by meeting the requirements of the Australian Institute of Occupational Hygienists (AIOH) A guide to managing heat stress.
BET >30°C	Ensure persons do not work in the mine unless carrying out work in an emergency situation to a Standard Operating Procedure.

Table 14: Likely effects and symptoms of cold exposure

Core Temperature (ºC)	Clinical Symptom
37.5	Normal core (rectal) temperature.
37	Normal core temperature.
36	Metabolic rate increase in an attempt to compensate for heat loss.
35	Maximum shivering.
34	Victim conscious and responsive, with normal blood pressure.
33	Severe hypothermia below this temperature.
31-32	Consciousness clouded, blood pressure becomes difficult to obtain, pupils dilated.
30-29	Progressive loss of consciousness, muscular rigidity increases, pulse and blood pressure difficult to obtain, respiratory rate decreases.
28	Ventricular fibrillation possible with myocardialirritability.
27	Voluntary motion ceases, pupils non-reactive to light, deep tendon and superficial reflexes absent.
26	Victim seldom conscious.
25	Ventricular fibrillation may occur spontaneously.
24	Pulmonary oedema.
22-21	Maximum risk of ventricular fibrillation.
20	Cardiac standstill.
18	Lowest accidental hypothermia victim to recover.
17	Isoelectric electroencephalogram.
9	Lowest artificially cooled hypothermia patient torecover.

At any temperature, a person feels colder as air movement increases. The combined effect of air movement and temperature is called the "equivalent chill temperature" (ECT), or the "wind-chill temperature". Duty holders are to consider the ECT when assessing the hazard of exposure to cold. Appendix H is an example of a chart used to calculate the ECT from temperature and wind speed. Duty holders are to consider physical activity, including the reduction in core temperature when people stop working, especially if they have been sweating.

Duty holders are to monitor workers' temperature to determine whether controls are working.

- A suitable thermometer should be used where the air temperature may drop below 16°C, to monitor any further temperature changes.
- In workplaces where the temperature is below freezing (0°CECT), and/or the speed of air movement is higher than 2 m/sec, the temperature should be monitored at least every 4 hours.

If a worker cannot be adequately protected from the effects of cold, duty holders are to suspend work or modify work regimes to remove the risk of harm.

Table 15: The effect of wind chill

	Ambient Air Temperature (°C)								
	4	-1	-7	-12	-18	-23	-29	-34	-40

Wind Speed km/h	Equivalent Temperature in Still Air °C)								
0	4	-1	-7	-12	-18	-23	-29	-30	-40
8	3	-3	-9	-14	-21	-26	-32	-38	-44
16	-2	-9	-16	-23	-30	-35	-43	-50	-57
24	-6	-13	-20	-28	-36	-43	-50	-58	-65
32	-8	-16	-23	-32	-39	-47	-55	-63	-71
40	-9	-18	-26	-34	-42	-51	-59	-67	-76
48	-10	-19	-27	-36	-44	-53	-62	-70	-78
56	-11	-20	-29	-37	-46	-55	-63	-72	-81
64	-12	-21	-29	-38	-47	-56	-65	-73	-82
(Wind speeds greater than 64 km/h have little additional effect)	LITTLE DANGER In <1 hr with dry skin. Maximum danger of false sense of security.			INCREASING DANGER Danger from freezing of exposed flesh within 1 minute			GREAT DANGER		
	Ensure dry clothing worn			Continuous work not permitted					

11.5 Managing thermal risk

Methods for managing thermal risk are shown in Table 16.

Table 16: Managing thermal risk

High temperatures	Low temperatures
o Identify and manage susceptible individuals o plan for acclimatization o Use physiological monitoring where appropriate (eg heart rate) o provide adequate ventilation o provide breaks for employees o conduct work away from heavy machinery and generators o provide wholesome drinking water o provide ice jackets o train workers to recognise heat related symptoms.	o plan work for times of the year or day when cold is not a problem o manage tasks efficiently to minimize time in a cold environment o provide shielding in the work area to reduce the cooling effects of air o provide PPE such as thermals, head covering, insulated boots and gloves o for continuous work in cold temperatures cold, heated warming shelters, such as cabins and rest rooms, should be provided.

11.6 Further information

For more information see:

- WorkSafe's Guidelines for work in extremes of temperature
- Australian Institute of Occupational Health *A guide to managing heat stress: developed for use in the Australian environment*
- Department of Mines and Petroleum Heat Stress toolbox presentation.

12 Hazardous substances

The legislation that applies in this section is:

HSHSR Regulations
Part 2 Labelling, signage, safety data sheets and packaging
Part 3 General duties relating to risk assessment
Part 5 Emergency management

MOQO Regulations
Regulation 86 Explosives
Regulation 108 Worker health control plan
Part 5 subpart 4 Emergency management

GRWM Regulations
Regulation 28 Managing risks associated with substances hazardous to health
Regulation 29 Ensuring prescribed exposure standards for substances hazardous to health are not exceeded
Regulation 30 When exposure monitoring required
Regulation 31 When health monitoring required

Hazardous substances cover a wide range of substances, with an equally wide range of effects. These substances could be hazardous to inhale or touch, acidic, affect reproductive health, or may be highly flammable or explosive.

Many chemicals and fuels used in extractives operations are hazardous and are controlled under the Health and Safety at Work (Hazardous Substances) Regulations 2017 (HSHSR) and the Hazardous Substances and New Organisms Act 1996 (HSNO). The steps used to control exposure to hazardous substances are detailed in the relevant Safety Data Sheet (SDS) for the substance. Duty holders are to use the information on the SDS as a part of their risk assessment and control selection.

Hazardous substances used in the extractives industry include:

- explosives and detonators
- compressed gases
- cyanide
- lead
- mercury
- acids
- resins (eg polyurethane resins)
- paints and solvents
- petrol, diesel and liquefied petroleum gas (LPG).

Every extractives site should have a hazardous substance register together with the quantities and the type of storage vessel. Once this is established in accordance with HSHSR and HSNO the required controls are to be put in place.

Compliance with Workplace Exposure Standards when using hazardous substances in the vworkplace is mandatory.

12.1 Person in charge

HSHSR and HSNO require a person in charge at any workplace, to manage hazardous substances. They must make sure that the mining operation complies with all the HSHSR and HSNO controls. Duties to maintain a safe and healthy workplace continue to apply to other duty holders.

12.2 Further information

The Hazardous Substances Toolbox provides information on hazardous substances, controls and the HSNO calculator. The calculator will help to work out what key HSNO controls you need to have in place based on the hazardous substances you use and store at your workplace.

The Environmental Protection Authority's website contains information about hazardous substance approvals.

More information on Workplace Exposure Standards is available in WorkSafe's *Workplace Exposure Standards and Biological Exposure Indices: 8th Edition* Special Guide.

13 Skin contaminations

The legislation that applies in this section is:

MOQO Regulations

Regulation 108 Worker health control plan

Some substances can affect the skin when in contact, or can be absorbed into the body via the skin. Occupational skin diseases are common and can occur in several forms including irritant dermatitis, allergic dermatitis, skin infection and skin injuries.

Some substances eg many solvents can penetrate the skin in their liquid form, and in some cases in vapour form. Absorption may result in a higher substance uptake than would have been expected from inhalation only. Where significant uptake occurs via the skin, respiratory protection will give a false sense of security. This is particularly important where skin absorption of the vapour occurs, as there may be no obvious contact between the skin and the substance. Biological monitoring for exposure may be a useful supplement to air sampling in these situations.

The extent of absorption of a chemical into the body via the skin depends on:

- skin integrity (damaged vs intact)
- part of the body in contact with the chemical
- skin temperature
- physical and chemical properties of the hazardous substance
- concentration of a chemical on the skin surface
- duration of exposure
- the surface area of skin exposed to a hazardous substance.

13.1 Exposure guidance

The methods for assessing the effects of skin contaminants are complex and generally require specialist assistance to apply. Extractives operators should consider seeking advice from a competent person if skin contaminants are a risk in the workplace.

13.2 Controls for skin contaminants

Make sure that potential skin contaminants are considered in the risk assessment. The controls needed depend on the:

- substances used
- physical properties of the substances
- working methods
- exposure time
- availability of PPE.

Duty holders need to apply the manufacturer's instructions, as well as the relevant HSHSR and HSNO controls to skin contaminants. Consider breakthrough times and degradation of PPE when selecting PPE used to protect against chemical hazards, including solvents. Workers need to be trained in these limitations.

13.3 Further information

For more detailed information see:

- product labels
- Safety Data Sheets
- The WorkSafe website for HSHSR controls
- The EPA website for HSNO controls.

14 Biological hazards

The legislation that applies in this section is:

MOQO Regulations

Regulation 108 Worker health control plan

Biological hazards include bacteria, fungi, viruses, plant and animal particles. They can cause a range of adverse health effects including infectious disease, respiratory diseases and cancer.

Less serious effects can cause sickness and sick leave and has a detrimental effect on productivity and morale.

Sources of biological hazards in mining can include human waste, food and food waste, contaminated water, compost, animal urine and faeces, and water sources.

14.1 Legionella

Legionella is a bacterium than can exist in water and soil, and, if it gets inhaled, can cause fever and severe respiratory infection.

Mining and quarrying is not necessarily at a greater risk of legionella than other industries. However, the high quantity of water used in many operations does present a risk of legionella.

Potential water sources at risk of supporting the presence of Legionella bacteria include:

- water used for spraying on extracted material by fogging cannons or directional misting units
- water used for spraying on product for wet suppression of dust at transfer or discharge points
- water used for spraying on roads for wet suppression of dust using water bowsers or fixed sprays
- hoses to clean areas of hard stand around processing plant and site buildings
- water used for spraying from vehicle or wheel washers
- water used as part of the production process eg barrel washers, wet scrubbers, cooling of cutting blades on saws
- water curtains for dust control (eg for dimensional stone cutting and processing)
- water in emergency showers.

14.2 Controlling the risks

14.2.1 Legionella

The primary control is limiting conditions that present favourable conditions for legionella to grow, including:

- controlling water temperature below 20, or above 45°C
- minimising build-up of nutrients such as scale, dirt, process solids, leaves, vermin, insects, soil
- eliminating production of aerosols
- water treatment with bactericides
- preventing stagnation by eliminating dead pipes, and regularly flushing emergency showers
- testing water temperature
- testing water for bacteria, and specifically Legionella.

Management of cooling towers, water systems and air handling units should be carried out in accordance with NZS 3666 Air-handling and water systems of buildings - Microbial control.

14.2.2 Other biological risks

PCBUs must ensure, so far as is reasonably practicable, adequate facilities are provided for workers at a workplace. Facilities include:

- toilets
- drinking water
- hand-washing facilities
- eating and break facilities
- facilities for unwell workers to rest – if it is not reasonable for workers to leave the workplace if they become unwell.

PCBUS can be required to provide other facilities. For more information on the requirements for providing facilities see the *General Risk and Workplace Management – Part 1* interpretive guidelines.

When managing risks from other biological hazards, duty holders should:

- apply the hierarchy of controls, starting with elimination.
- ensure waste does not accumulate and is suitably contained
- ensure vermin are controlled
- practice good personal hygiene (washing hands, covering mouth when sneezing or coughing, cleaning cuts and scratches)
- practice good housekeeping (regularly clean washrooms, toilets, food preparation/storage areas and break rooms)
- prevent water accumulation in indoor areas, and remove or treat water damaged building materials
- wear suitable protective equipment if removing any materials or waste contaminated with bacteria or fungi.

14.3 Further Information

For more information see:

- Ministry of Health's website for advice on preventing communicable diseases
- *NZS 3666 Air-handling and water systems of buildings - Microbial control series*
- WorkSafe's *General Risk and Workplace Management – Part 1* interpretive guidelines
- World Health Organisation *Guidelines for Indoor Air Quality – Dampness and Mould.*

15 Atmospheric pressure

The legislation that applies in this section is:

MOQO Regulations

Regulation 108 Worker health control plan

Working in compressed air in tunnels, shafts and caissons can present health risks to workers. Caissons are structures below ground that workers enter through a lock into a compressed air atmosphere. They are usually used to keep groundwater from seeping into the tunnel.

Decompression sickness (also known as divers' disease, the bends or caisson disease) is a condition arising from dissolved gases coming out of solution into bubbles inside the body on depressurisation.

Bubbles can form in or migrate to any part of the body. The symptoms and effects of decompression sickness vary from joint pain and rashes to paralysis and death. Individual susceptibility can vary from day to day. Different individuals can be affected differently or not at all under the same conditions.

Differences in atmospheric pressure can cause seals in underground mines to leak into active areas. For surface operations, it can be nearby underground workings that release oxygen depleted air, particularly when there is a low pressure weather cell or temperature inversion on a cold morning.

15.1 Exposure guidance

Duty holders are not to expose people to pressures exceeding 3.5 bar unless in an unforeseen emergency.

Duty holders are to ensure atmospheric pressure is measured using the methods in AS 4774.1.

15.2 Controls

Duty holders are to follow a safe system of work in compressed air that is based on:

- *AS 4774.1 Work in compressed air and hyperbaric facilities - Work in tunnels, shafts and caissons*
- *Work in Compressed Air Regulations 1996* (UK)
- *Workplace Safety and Health (Construction) Regulations 2007* (Singapore).

Specialist advice from a competent person may be needed to manage risks from atmospheric pressure.

Duty holders are to ensure workers are trained on entering or working in compressed air and follow AS 4774.1 when developing and carrying out the training.

Duty holders are to ensure that decompression chambers meet the requirements of *Rules for Classification and Construction VI – Other Operations and Systems Part 4 - Chamber Systems for Tunnelling.*

15.3 Health monitoring

Health surveillance is to be provided to workers by the duty holder based on the advice of a competent medical advisor.

15.4 Further Information

For more information see:

- *AS 4774.1 Work in compressed air and hyperbaric facilities - Work in tunnels, shafts and caissons*
- *Work in Compressed Air Regulations 1996* (UK)
- *Workplace Safety and Health (Construction) Regulations 2007* (Singapore)
- *Rules for Classification and Construction VI – Other Operations and Systems Part 4 - Chamber Systems for Tunnelling.*

16 Ionising radiation

The legislation that applies in this section is:

MOQO Regulations

Regulation 108 Worker health control plan

Ionising radiation sources in mines include:

- naturally occurring radioactive material (NORM) such as radon gas and its decay products
- artificial radiation sources such as radiation gauges used for analysing mineral content, measuring density and moisture content, which are encapsulated and called sealed sources.

Ionising radiation is extremely harmful, and can cause debilitating or fatal conditions including:

- cancer
- acute radiation syndrome
- chronic radiation syndrome
- radiation-induced thyroiditis.

The Approved Document of Practice for *Ventilation in Underground Mines and Tunnels* (Ventilation ACOP) provides guidance on monitoring and controlling radon.

Radon gas is odourless, tasteless, and colourless (invisible). It emits ionising radiation in the form of alpha particles. Alpha particles are a hazard when taken internally, by inhalation of radon gas, or inhalation or ingestion of dust containing alpha particle emitting substances.

16.1 High exposure sources

Common high exposure sources for ionising radiation (including radon) are:

Table 17: High exposure sources for ionising radiation

Natural sources	Manufactured sources
Naturally occurring radioactive material (eg granite (uranium content), ore body (metal mines), limestone (thallium), mineral sand (thorium)	Introduced through processing plant (eg pulp density meter, ash analyser)
In situ ionising radiation in coal (associated with burning coal vs digging it out)	Penetrometers (soil density testing)
	Exploration (down hole geophysics)
	X-rays in labs

16.2 Exposure guidance

An initial assessment needs to be conducted to assess the risk of naturally occurring radioactive materials. This should include information derived from:

- core samples
- soil samples
- geological data from site sampling
- historical sources.

An assessment also needs to be carried out where:

- the rock type changes from the initial assessment
- an area that was not previously assessed is being developed
- conditions are encountered not addressed by the risk assessment.

Any area where the radioactivity exceeds 1000 Bq/m^3 is a controlled area that requires a controlled area work procedure. This is irrespective of whether the source is natural, man-made, or a combination of the two.

If radon is present at the site radon monitoring arrangements need to be in place.

Duty holders are to use short-term passive dosimeters when monitoring for radon. These are to be positioned at specific locations for set periods (usually one month). At the end of the set period, the dosimeter is to be sent to an independent testing facility for analysis.

If radon is detected, the duty holder needs to ensure that arrangements are in place to monitor the levels of radon using short-term passive dosimeters or air sampling monitors.

16.3 Controls

Monitoring and control of artificial sources are covered by the Radiation Safety Act 2016, the Radiation Protection Act 1965 and the Radiation Protection Regulations 1982. The Ministry of Health's Office of Radiation Safety (ORS) administers this Act and regulation.

Where radon levels exceed the reference level, apply the control guidance given in the Ventilation ACOP and in the International Atomic Energy Agency Safety Standards.

If radon is present, duty holders are to manage it in the same way as other gases, including:

- dilution of the gas by permanently increasing ventilation quantity
- directing the ventilation in the area where radon is being generated to a return airway
- sealing the area where radon is being generated
- if the radon is desorbed from water, contain the water in pipes, direct the water to returns, or prevent turbulence of the water until it can be contained in pipes.

Duty holders should seek geological advice on the potential for natural radioactive sources in the extractives permit area.

16.4 Further Information

For further information see:

- Safe Work Australia's Draft Document of Practice for *Managing Naturally Occurring Radioactive Materials in Mining* for more information
- WorkSafe's *Ventilation in Underground Mines and Tunnels* Approved Document of Practice
- Radiation Safety Act 2016
- Radiation Protection Act 1965
- Radiation Protection Regulations 1982
- International Atomic Energy Agency safety standard *Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards General Safety Requirements Part 3.*

17 Non-ionising radiation

The legislation that applies in this section is:

MOQO Regulations

Regulation 108 Worker health control plan

Non-ionising radiation includes ultraviolet radiation and infra-red radiation.

Exposure to ultraviolet radiation is most commonly by exposure to the sun. Exposure can also occur during welding or plasma cutting. Exposure can cause sunburn and lead to skin cancer in later life, and damage the eye. All skin types can become sunburnt. The sun in New Zealand is particularly intense, due to relatively lower levels of ozone, so ultraviolet radiation can easily cause permanent damage.

Sources of infrared radiation include furnaces, molten metals and welding. It can damage the eyes and skin.

PCBUs must manage risks of exposure, so far as is reasonably practicable.

17.1 High sun exposure times

Ultraviolet rays are most intense from September to April between 10am and 4pm, in winter months at high altitude, and in snow.

Workers can get sunburnt at any time, regardless of the time of year or day. Cloud cover does not mean that there is a lower risk of sunburn.

17.2 UV exposure controls

Duty holders are to control exposure to UV radiation by ensuring:

- workers cover skin and eyes (eg overalls, sunglasses and sunhat)
- work is conducted in shade
- uncovered outside work is conducted outside of 10am to 4pm, wherever practicable
- workers use sunscreen
- the use of appropriate eye protection when welding, cutting, or working with molten metals.

Eye filtration when welding cutting or working with molten metals is to be as set out in *AS/NZS 1338 filters for eye protectors.*

Controls for radiation from welding are addressed in WorkSafe's *Health and Safety in Welding* good practice guideline.

17.3 Further information

Further information on UV radiation is available through these sources:

- WorkSafe's *Guidance notes for the protection of workers from solar UV radiation*
- *AS/NZS 1338 Filters for eye protectors* series
- Safe Work Australia's *Guide on Exposure to Solar Ultraviolet Radiation (UVR)*
- New Zealand Cancer Society website.

18 Pressure injection injuries

The legislation that applies in this section is:

MOQO Regulations

Regulation 108 Worker health control plan

Pressure injection injuries are innocuous appearing injuries caused by the high pressure injection of fluid such as oil or hydraulic fluid under the skin. Their minor appearance belays how much damage has occurred; aside from the toxicity of the fluid injected, the forced injection of fluid can cause permanent nerve damage and gangrene, leading to loss of limb.

The most crucial aspect of pressure injection injuries is that they are treated as a serious surgical emergency.

18.1 High risk situations

During the operation, maintenance and inspection of high-pressure equipment such as:

- hydraulic lines
- high-pressure grease guns
- high-pressure fuel injection systems.

Pressure injection injuries often happen when checking for leaks in a pressurised system. The leak is only apparent due to the presence of fluid nearby, and the worker runs a hand along the line to find it. When they reach the pinhole fluid is injected as if from a needle.

Fluid in this type of equipment is under pressure ranging from 600-12,000psi.

Skin penetration can occur at pressures as low as 100psi.

The velocity of fluid forced through a pinhole break in a hydraulic hose can be in excess of 250 metres per second (600ft/s). This is close to the muzzle velocity of a rifle, and is sufficient to drive fluids through protective clothing, including protective gloves.

Skin penetration can occur up to 100mm away from the fluid source.

18.2 Controls

The best way to address pressure injection injuries is to ensure they do not happen, but, if they do, treat them as a surgical emergency and seek medical assistance immediately.

Get the injured person to the nearest hospital Accident & Emergency (A&E) unit immediately.

Tell the hospital staff that the injury is a fluid injection injury, or you suspect it to be so. The nature of the injury may not be apparent to medical staff from its appearance and it could be misdiagnosed.

Most equipment does not need to be pressurised to find a leak. Lock out and de-energising should be part of the SOP for the equipment. Refer to the OEM manual for more information.

If the system has to be pressurized to find a leak, stand well away from the line, and used a piece of cardboard or wood to locate the leak. Do not use your hand. Wear appropriate PPE.

18.3 Further information

For more information refer to:
High Pressure Injection Injuries safequarry.com

Queensland Department of Natural Resources and Mines *Risk management of high pressure fluids and gases*

19 Review and audit

The legislation that applies in this section is:

MOQO Regulations

Regulation 58 Periodic review of health and safety management system

Regulation 94 Review and revision of principal control plan

Regulation 95 Audit of principal control plan

Regulation 108 Worker health control plan

19.1 Reviewing the plan

Extractives operations that are not mining operations should review their risk management plan for risks to worker health as described below.

The duty holder must review the Worker Health Plan at least once every two years after it was made. The review determines whether the controls continue to be suitable and effective in managing the risks to worker health.

The Worker Health Plan must also be reviewed after:

- an accident involving any hazard managed by the Worker Health Plan
- a material change in the management structure that may affect the Worker Health Plan
- a material change in plant used or installed that may affect the Worker Health Plan
- the occurrence of any event specified in the Worker Health Plan requiring its review.

The Worker Health Plan should also be reviewed after:

- a notifiable incident that persons have been exposed
- each audit of the Worker Health Plan and other PCPs or PHMPs, if they identify non-conformance that affects the Worker Health Plan
- an improvement or prohibition notice is served that affects the Worker Health Plan.

When reviewing the Worker Health Plan, also review the risk assessment used at the start of the process. Existing risks could have changed or there could be new risks, so controls may need to be changed or added.

During the review, the duty holder should take into account any relevant information gathered in:

- routine risk appraisals and risk assessments
- monitoring and inspections by the mining operator or WorkSafe
- review of TARPs and incidents or near misses
- input from mine workers and in the case of underground coal mining operations, industry health and safety representatives.

The Worker Health Plan and any supporting documents may need to be revised and re-issued after the review. Mine workers must be engaged with when reviewing the Worker Health Plan (as it is part of the HSMS). Tell mine workers about any updated documents, and train or re-train them if necessary.

19.2 Auditing the plan

The mine operator may carry out internal audits of the Worker Health Plan, from time to time. If this is carried out develop a structured internal audit programme that reviews how mine workers comply with relevant operational procedures and support plans. This can be done through inspection, spot checks and documentation review.

The mine operator must ensure that an independent external party audits the Worker Health Plan at least once every three years from the date it was made.

The final audit report is to include details of the audit, recommendations for corrective action, review mechanisms, and outline who is responsible for making these changes.

Keep records of the audit, and associated risk appraisals, for at least 12 months from the date the mining operation is abandoned. Ensure details of audits and the risk appraisals are available to WorkSafe, a health and safety representative or an industry health and safety representative.

20 Glossary

Term	Definition
Acute exposure	Acute exposure is short-term exposure to a hazard that affects worker health. Acute health effects happen quickly, are usually identified easily and can be serious in nature.
Bar	Unit of measurement regarding atmospheric pressure.
index (BEI)	Guidance values for assessing biological monitoring results. It indicates a concentration below which nearly all workers should not experience adverse health effects from exposure to a particular substance.
Carcinogenic	Something that causes cancer, or contributes to its development.
Competent person	A person who has the relevant knowledge, experience, and skills to carry out a task and has a relevant qualification evidencing the person's possession of that knowledge, experience, and skill. Competent medical practitioner has a corresponding meaning.
Chronic exposure	Chronic exposure is long-term exposure, usually over several years, which can cause long-term health effects.
dB (A)	The logarithmic unit of measure used for noise, where an increase of one indicates noise is ten times greater. For example 110 dB (A) is 10 times greater than 109 dB(A). A weight indicates it has been put through a special filter to assess how hazardous the noise is for individuals.
Duty holder	In the context of this document, a Duty holder is a PCBU; SSE; a mine, alluvial mine or quarry operator; or other safety critical role.
Employer	A person employing any employee or employees; and includes a person engaging or employing a homeworker
Exposure assessment	Mean exposure monitoring, including risk assessment and selection of controls as a result of the exposure monitoring.
Exposure levels	The measure magnitude of exposure that a person is being subjected to. Taken as part of monitoring to carry out exposure assessment or compare to an applicable WES.
Exposure guidance	WorkSafe's expectation for the level of exposure a worker will have.
Exposure monitoring	Has the meaning given in the GRWM Regulations: exposure monitoring— (a) means the measurement and evaluation of exposure to a health hazard experienced by a person; and (b) includes— (i) monitoring of the conditions at the workplace; and (ii) biological monitoring of people.
Extractives operation	In the context of this document, means: a mining operation, alluvial mining operation and quarrying operation. Includes coal and mineral exploration and industrial mineral extraction (such as the extraction of perlite). Extractives operator has a corresponding meaning.
FEV1	FEV1 is the volume of air that can forcibly be blown out in one second, after full inspiration.

Fume	Very small airborne solid particulates with diameters generally less than 10 micron. They may be formed by thermal mechanisms (eg condensation of volatilised solids, or incomplete combustion) or chemical processes (eg vapour phase reactions). Agglomeration of fume particles may occur, resulting in the formation of much larger particles.
FVC	Forced vital capacity is the volume of air that can forcibly be blown out after full inspiration.
GRWM	Health and Safety at Work (General Risk and Workplace Management) Regulations 2016.
HAV	Hand-arm vibration.
Health monitoring	In relation to an individual, means monitoring of the individual to identify any changes in his or her health status because of exposure to certain health hazards.
High exposure areas	An area or situation where high exposure to a substance or phenomenon hazards to worker health is likely.
HSMS	Health and safety management system.
HSNO	Hazardous Substances and New Organisms Act 1996.
HSHSR	Health and Safety at Work (Hazardous Substances) Regulations 2017.
Inhalable dust	Portion of airborne dust that is taken in through the mouth and nose.
Manual handling	Any activity requiring a person to lift, lower, push, pull, carry, throw, move, restrain, hold or otherwise handle any animate, or inanimate, object.
Mining operation	Has the meaning given in HSWA, Schedule 3, Part 1, Clause 2.
Mine operator	Has the meaning given in HSWA, Schedule 3, Part 1, Clause 1.
MOQO	Health and Safety at Work (Mining Operations and Quarrying Operations) Regulations 2016.
OEM manual	Original equipment manufacturer manual.
PCBU	'A person conducting a business or an undertaking'. A broad concept used throughout the HSWA to describe all types of modern working arrangements, which are commonly referred to as businesses.
PHMP	Principal hazard management plan.
PPE	Personal protective equipment.
Principal control plan (PCP)	A plan required under MOQO Regulation 92. The plan documents systems and processes in place at the mining or tunnelling operation to manage hazards at the operation, and the measures that are necessary to manage principal hazards at the mining or tunnelling operation. See MOQO Regulation 93.

Principal hazard	Any hazard arising at any mining operation (including a tunnelling operation) that could create a risk of multiple fatalities in a single accident or a series of recurring accidents at the mining operation in relation to any of the following: i. ground or strata instability ii. inundation and inrush of any substance iii. mine shafts and winding systems iv. roads and other vehicle operating areas v. tips, ponds, and voids vi. air quality vii. fire or explosion viii. explosives ix. gas outbursts x. spontaneous combustion in underground coal mining operations. It also includes any other hazard at the mining operation (including a tunnelling operation) that has been identified by the site senior executive under MOQO Regulation 66 as a hazard that could create a risk of multiple fatalities in a single accident, or a series of recurring accidents at the mining operation. See MOQO Regulation 65.
Safety data sheet (SDS)	Safety Data Sheets (SDSs) are designed to protect the health and safety of people in the workplace by providing information on the hazards of substances and how they should be safely used, stored, transported and disposed of. SDSs also describe emergency procedures, such as what to do in the event of a spill or fire.
Standard operating procedures (SOPs)	Documented standard operating procedures for installation, maintenance, removal and quality control.
SWI	Safe work instrument.
TARPs	Triggered action response plan. TARPs specify the actions to be taken when changes occur.
Tunnel boring machine (TBM)	Machine used to excavate tunnels with a circular cross section through a variety of soil and rock.
Tunnel operator	In this document has the same meaning as Mine operator.
Unciliated airways	In the upper respiratory tract, fine hair-like projections from cells (cilia) 'sweep' in unison to remove or clear fluids and particles. In the unciliated airways, of the lower respiratory tract (the alveolar region) there are no cilia.
WBV	Whole body vibration.
WES (Workplace exposure standard)	Workplace exposure standards are a value that refers to the airborne concentration of substances, at which it is believed that nearly all workers can be repeatedly exposed to day after day without coming to harm. The values are normally calculated on work schedules of five shifts of eight hours duration over a 40 hour work week.

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Document of Practice for Manual Handling Approved Document of Practice

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Guidelines for the Medical Surveillance of Lead Workers

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Health and Safety at Opencast Mines, Alluvial Mines and Quarries Good Practice Guidelines

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www.minex.org.nz

Accident Compensation Corporation
www.acc.co.nz

Environmental Protection Agency
www.epa.govt.nz
www.hazardoussubstances.govt.nz

Ministry of Health
www.health.govt.nz

WorkSafe New Zealand
www.worksafe.govt.nz

Health and Safety Association New Zealand
http://www.hasanz.org.nz/

New Zealand Occupational Hygiene Society
http://www.nzohs.org.nz/

New Zealand Institute of Safety Management
http://www.nzism.co.nz/

American Conference of Governmental Industrial Hygienists
http://www.acgih.org/

22 Appendix A: Exposure assessment

22.1 Sampling strategy

Sampling strategy will usually include identifying groups of workers for whom risk and exposure profiles are similar. These groups are called SEGs (similar exposure groups). Choosing a representative unbiased subsample of the SEG should be sufficient for assessing exposure and risk for the whole SEG.

Most worker exposure monitoring will be occasional in that the workers will not wear monitoring equipment all the time (with some exceptions eg explosive gas meters, which are usually used for safety risk management rather than health risk). The regularity of worker exposure monitoring will depend on the objectives and outcomes of the risk identification and analysis. For example, if the risk identification or analysis indicates that exposure can vary considerably from day to day, then monitoring may need to occur on a more regular basis than an exposure that does not change considerably over time, or an exposure that is well managed.

Monitoring should occur when there are any changes in processes or activities that result in, or may result in, a change to exposure, or if it is not certain whether or not the airborne concentration exceeds the Workplace Exposure Standard (WES) or presents a health risk.

22.2 Variation in exposure

Exposure levels are commonly variable even in work that is regular and consistent. Variation in worker exposure arises from variation in work activities, control methods and environmental conditions (called "random variation") and systemic error eg sampling and analytical error.

Due to this variation, exposure measured on a single day may not reflect exposure on other days. Even samples from multiple days may not reflect the true variation in exposure that may occur over the long term. With this in mind, the monitoring strategy must be designed to provide sufficient measurements to reflect the risk to the worker from the variation in exposure.

It is very rare for all exposures for a worker to be measured all the time. Frequently only one or two shifts will be sampled and this data will be used to make judgements about exposures over many months or years. If the worker is exposed every day for five years, and their exposure is assessed once a year, then five days of data is being used to make judgements about 1250 days of exposure.

Various methods are available for determining an appropriate number of samples to account for variation, and it is recommended these methods are consulted when developing the sampling strategy. Methods include:

- NIOSH Occupational exposure sampling strategy manual (1977)
- at least one employee in five from a properly selected SEG (UK Health and Safety Executive HSG173 (2006)
- a calculated number of samples based on previous data, using t-statistics and co-efficient of variation (source W501 OH Learning, *Measurement of Hazardous Substances*, 2009)
- methods of Rappaport, Selvin and Roach (1987) based on the number of samples needed to test the mean exposure of a lognormal distribution of exposures against an exposure standard (source W501 OH Learning, *Measurement of Hazardous Substances,* 2009)
- South African Mines Occupational Hygiene Programme – sample 5% of workers in an SEG
- American Industrial Hygiene Association suggests 6-10 samples are sufficient to give a picture of an exposure profile. In respect to the minimum number of samples to be collected, fewer than six samples in any one SEG leaves a great deal of uncertainty about the exposure profile (AIHA 2006) (source W501 OH Learning, *Measurement of Hazardous Substances,* 2009).

22.3 Statistical analysis of sampling results

Multiple samples generally allow for better understanding of the variation in exposure, and thus provide more detailed information for the risk assessment.

Where multiple samples are taken, application of appropriate statistical analysis to sampling results can be valuable in:

- assessing confidence that the results represent the 'true' exposure profile (the profile you would see if you were to measure the exposure every shift, and you were to measure all workers in the SEG)
- interpreting whether WES are complied with
- managing uncertainties in exposure assessment and health risk assessment.

Application of appropriate statistical analysis to sampling results is important in order to assess how closely the results represent the "true" exposure profile and can be used to assess compliance with WES and assess risk. For example,

the mean (average) exposure calculated may be below a WES, but random variation, sampling and analytical error will introduce some uncertainty around that average. This uncertainty can be described as confidence limits around the average. If the upper confidence limit exceeds the WES, it indicates less certainty around whether the average exposures truly fall below the WES. If the upper confidence limit gives us 95% confidence that the "true" average falls comfortably below the WES, then that provides a high level of certainty that exposures comply with the WES.

A useful tool for statistical analysis of occupational hygiene samples is the "IHStats" spreadsheet developed by the American Industrial Hygiene Association.

22.4 Which statistics to use for comparison to WES

Average (mean) exposure level is the appropriate parameter for evaluating cumulative exposure for substances that present a long term health risk. In this case the WES-TWA is the appropriate criteria for comparison. The average exposure will usually be calculated as a geometric mean rather than an arithmetic mean, as occupational hygiene exposures are usually log-normally distributed rather than normally (bell curve) distributed. It is necessary to assess the type of distribution so that the correct statistical parameters are used. Confidence limits around the mean should be considered when comparing the result to the WES.

The 95% upper confidence limit (UCL), and the upper tolerance limit (UTL) ie the 95% UCL of the 95 percentile of the results) are the appropriate parameters for evaluating exposure to substances that present an acute health risk. In this case the WES-STEL, WES-Ceiling or WES-GEL are the appropriate criteria for comparison.

22.5 Workplace exposure standards (WES)

Monitoring workers exposure will involve comparison of results against Workplace Exposure Standards and Biological Exposure Indices.

Workplace exposure standards (WES) are values that refer to the airborne concentration of substances at which it is believed that nearly all workers can be repeatedly exposed day after day without coming to harm. The values are normally calculated on work schedules of five shifts of eight hours duration over a 40-hour work week.

In all instances, workplace exposure standards relate to exposure that has been measured by personal monitoring using procedures that gather air samples in the worker's breathing zone. The breathing zone is defined as a hemisphere of 300mm radius extending in front of the face and measured from the midpoint of an imaginary line joining the ears.

Defining an exposure level that will achieve freedom from adverse health effects is the major consideration for assigning WES. However, compliance with the designated WES does not guarantee that all workers are protected from discomfort or ill health. The range of individual susceptibility to hazardous and toxic substances is wide, and it is possible that some workers will experience discomfort or develop occupational illness from exposure to substances at levels below the WES. As such, WES must not be used to differentiate between safe and inherently hazardous exposure levels.

Substances with multiple WES (for different periods of exposure) will require monitoring for those specific periods. For example if a substance has a WES-TWA (time weighted average) then exposure for the whole shift needs to be assessed. This does not necessarily mean exposure has to be measured over the whole shift, but if exposure will vary, full shift sampling will provide the most useful data for the risk assessment. If the substance also has a WES-STEL (short term exposure limit), exposure for 15-minute periods needs to be assessed. It is important to ensure results are measured and calculated over appropriate time frames when comparing to a specific WES, and that WES are adjusted accordingly for extended workshifts.

The numerical value of two or more WES must not be used to directly compare the relative toxicity of different substances. Apart from any inconsistency that may result from the information that was available at the time each WES was set, the biological basis for assigning the WES varies. Some WES are designed to prevent the development of ill health after long-term exposure (WES-TWA), others to reduce the possibility of acute effects (WES-Ceiling, WES- GEL, WES-STEL).

Compliance with WES

When evaluating exposure in relation to a WES, the following points must be considered:

- How representative is the sampling programme in regard to variation in exposure,

and how do the results represent the "true" exposure profile?

- Variability of exposure means that occasional high results can occur even where the exposure is generally well controlled.
- The criteria for setting a specific WES may be for a different health outcome than the risk being assessed. For example the WES may be based on reducing risk of irritation, however risk of more serious adverse effects may be the focus of the health risk assessment, therefore the WES may not be a stringent enough guideline to use in this case.
- Compliance with the designated WES level does not guarantee that all workers are protected from discomfort or ill health due to individual susceptibility.

The above considerations show that assessing compliance with WES isn't necessarily a straight forward process of comparing a sample result, or an average, to a WES.

Various organisations have developed guidelines to address this issue of how to assess WES compliance and whether further control of exposure needs to occur. Organisations that have developed guidance include the British and Netherlands Occupational Hygiene Societies (BOHS/NOHS), the American Industrial Hygiene Society (AIHA), the International Council on Mining and Metals (ICMM), and Utrecht University. A summary of their approaches is given below, but for more detail their documents should be referred to:

- BOHS/NOHS - Assumes a WES may be regarded as complied with if, with 70% confidence, <5% of the exposures in the SEG exceed the WES. An individual worker's exposure complies if there is <20% probability that >5% of their exposure exceeds the WES.
- AIHA – Has a rating scheme that categorises exposures as trivial (very low), highly controlled, well controlled, controlled, poorly controlled based on the estimated 95th percentile of the exposure distribution.
- ICMM provides guidance on rating exposures e.g. if a result is less than 50% of the WES, exposures are well controlled below the WES. Results between 50% to 100% of the WES indicate there is potential for breaches of the WES.
- The Utrecht University, Institute for Risk Assessment Sciences SPEED (statistical program for the evaluation of exposure data) Excel application assesses whether the within-worker and between-worker exposures are acceptable in relation to the WES. It provides a stepwise approach to the sampling and statistical analysis of data.

22.6 Mixed exposures

If two or more hazardous substances have similar toxicological effects on the same target organ or system, their combined effect should be considered. In this case the combined exposures need to be compared against the TLV of the mixture, as well as each individual substance against its specific WES.

22.7 Substances without a WES

In many cases well-documented data exist to help determine WES. But for some substances, the available toxicological and industrial hygiene information is insufficient to enable highly reliable standard-setting. As such some substances do not have WES. If a substance doesn't have a WES, this should not be taken to mean that it is safe under all conditions, and that no restriction should be placed on their use. Regardless of the substance, it is important to take all practicable steps to eliminate or minimise the concentration of airborne substances as far as reasonably practicable.

22.8 Adjustment of WES for extended work-shifts

Workplace Exposure Standard Time Weighted Averages (WES-TWA) are derived on an eight hour work day and 40 hour work week. When shifts are longer than this, either over a day or a week, the WES-TWA needs to be adjusted to account for the longer period of exposure and shorter recovery time.

Various models are available to make the adjustment and each may result in a different adjusted WES.

The selection of an appropriate model is dependent on various factors such as: ease of use; availability of an adjustment model for a specific WES; and the availability of relevant toxicology and pharmacokinetics data for pharmacokinetic models. A useful document for discussion on adjustment models is the Australian Institute of Occupational Hygienists Position Paper on "Adjustment of Workplace Exposure Standards for Extended Workshifts" (December 2010).

23 Appendix B: Preliminary noise survey checklist

Preliminary Noise Survey Checklist

Date: ___ / ___ / ___

Assessed by: . . . . . Position: . . . . . .

Location of assessment: . . . . . .

NOTE

- The existence of any one of the following key factors indicates the need for further asssessment (see Part 4 of this code).
- Some employers may not have enough information to answer questions 7 and 8.

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1 Is there difficulty in communication between two people at 1 metre distance? (Difficulty means that the speaker must raise his/her voice, or that the listener may not understand what is said.)

Yes ❑ No ❑

2 Do employees in the area notice a reduction in hearing over the course of the day? (This reduction might not be noticed until after work.)

Yes ❑ No ❑

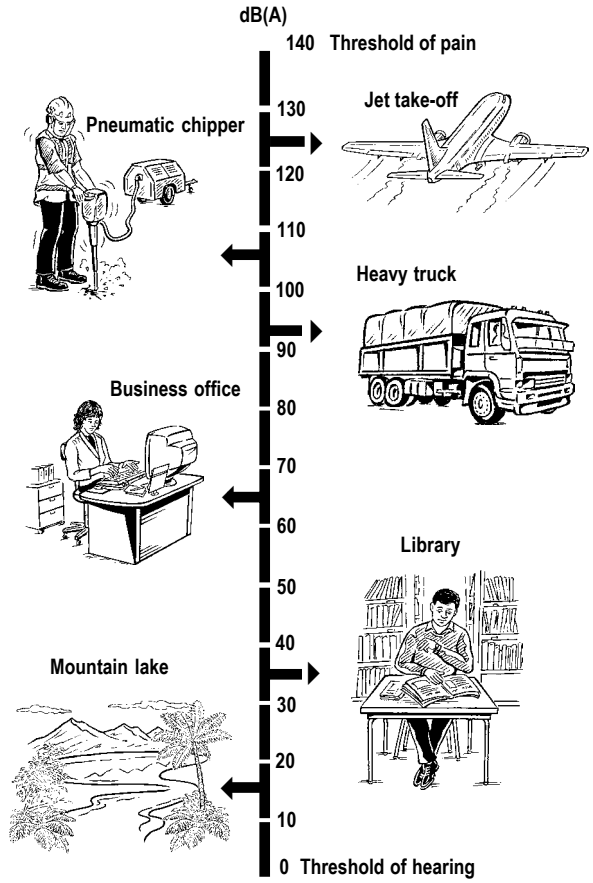
3 Do employees experience ringing in the ears (tinnitus) or blurred/dull hearing?

Yes ❑ No ❑

4 Are hearing protectors being used?

Yes ❑ No ❑

Figure 2: Decibel levels of common sound



5 Are signs posted at the entrance to or in the work area indicating that hearing protectors should be worn?

Yes ❑ No ❑

6 Does noise in any part of the workplace sound as loud as or louder than 85 dB(A) using the scale in Figure 2 below.

Yes ❑ No ❑

7 Do results of past noise measurements or assessments indicate noise levels equal or greater than any of the following?:

(a) 85 dB(A) "Slow" or Fast" response

Yes ❑ No ❑

(b) 85 dB(A) $L_{Aeq,T}$ (See Note 1) (or L_{eq})

Yes ❑ No ❑

(c) 80 dB(A) Sound Power Level

Yes ❑ No ❑

8 Does any equipment have noise information including labels that indicate noise levels equal to or greater than any of the following?

(a) 80 dB(A) L_{Aeq},T (or L_{eq})

Yes ❑ No ❑

(b) 130 dB Peak (unweighted)

Yes ❑ No ❑

(c) 80 dB(A) Sound Power level (See Note 2)

Yes ❑ No ❑

9 Do the results of the audiometry indicate that any past or present employees have a hearing loss due to noise?

Yes ❑ No ❑

10 Have there been any industrial deafness claims?

Yes ❑ No ❑

Notes:

1. For a variety of reasons, the $L_{Aeq,T}$ quoted may underestimate noise levels that actually result.
2. Sound Power Level is not a noise level. For example, under some circumstances equipment generating a sound power level of 80 dB(A) may result in a noise level of 85 dB(A) or higher.

24 Appendix C: Conducting a detailed noise assessment

Detailed noise assessments must be carried out by a competent person. The knowledge and skills that a competent person should have acquired to perform noise assessments are described in Appendix B of the Approved Document of Practice for the Management of Noise in the Workplace.

The competent person carrying out the assessment should have a thorough understanding of the:

- objectives of the assessment
- correct way to use noise measuring instruments
- limitations of noise measuring instruments
- limitations of the noise exposure assessment strategy
- interpretation of the results
- recording of the results
- HSWA, AS/NZS 1269.1 and this document.

The methods of how measurements and assessments must be undertaken are detailed in AS/NZS 1269: Part 1 Measurement and assessment of noise immission and exposure. The Regulation 11 of the Health and Safety in Employment Regulations require that measurements of noise levels and exposure be carried out in accordance with this standard.

The type of instruments selected to carry out the work depends on the circumstances and purpose of the noise assessment, and must meet the standards specified in AS 1269. Type 1 meters are preferred, although type 2 meters can be used except in marginal cases. Type 3 meters can only be used for preliminary assessments.

All sound level meters used must comply with the requirements of AS 1259.1 (IEC 60651) and/or AS 1259.2 (IEC 60804). Sound exposure meters must comply with the requirements of IEC 601252. Reference sound sources (calibrators) must comply with Class 2 specifications of IEC 60942.

The procedures for determining the levels of noise and the noise exposures from the results of the levels measured during the detailed assessment are stated in Appendix E of AS/NZS 1269.1. These procedures should be followed.

Table 18: Hearing protection classes

Hearing Protection Class	LAeq,8h (dBA)
1	Less than 90
2	90 to less than 95
3	95 to less than 100
4	100 to less than 105
5	105 to less than 110

Hearing protection has a class assigned to them based on their performance being tested to AS/NZS 1270. This is the band of noise that the hearing protection will offer protection. Provide the correct class of hearing protection. The level of protection offered can be affected by the frequency of noise. Use the octave band method when assessing this.

Refer to AS/NZS1269.3 Occupational Noise Management - Hearing Protection Programme for more information regarding the selection of hearing protection as well as the octave band method for selecting these devices.

25 Appendix D: Example ride roughness questionnaire

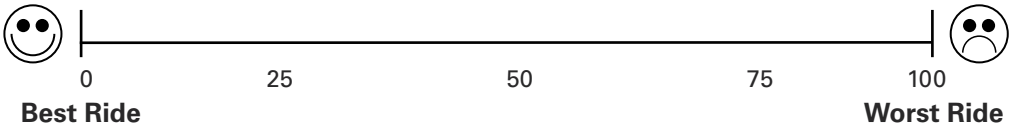
Survey Forms for rating individual rides, vehicles and tasks for roughness

Option 1-

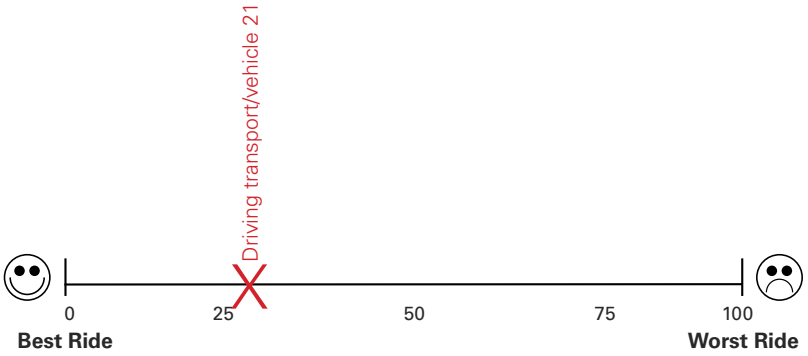
Compare this ride to all other rides you have ever experienced

Instruction to Driver/Operator:
You have just finished driving/operating a vehicle/machine.

Please place a X mark on the black line to indicate where you believe that your last ride ranks in terms of roughness in comparison with the roughest and smoothest rides that you can remember.



Example:

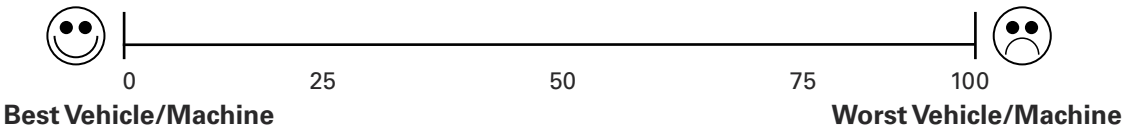


Comments

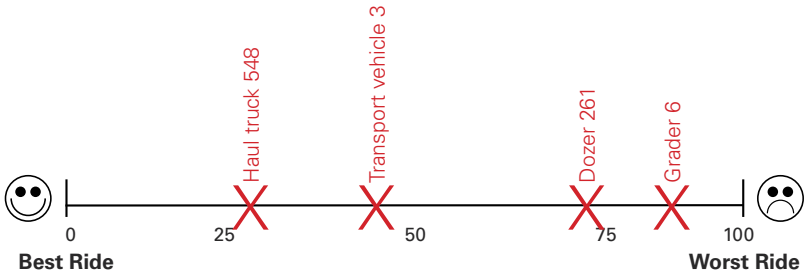
Option 2-

Compare vehicles that you operate regularly with each other (use the vehicle name, types and/or numbers to identify each vehicle or machine e.g. dozer 261, haul truck 548, grade 6, transport vehcile 3)

Instruction to interviewee:
Please place a X mark on the black line where you believe that the ride in this vehicle ranks in terms of roughness compared with other rides that you have experienced at work in the last week. Rank all the rides on this line.



Example:

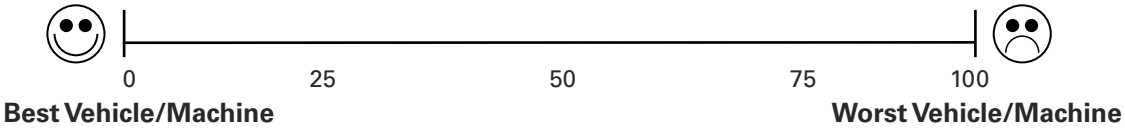


Comments

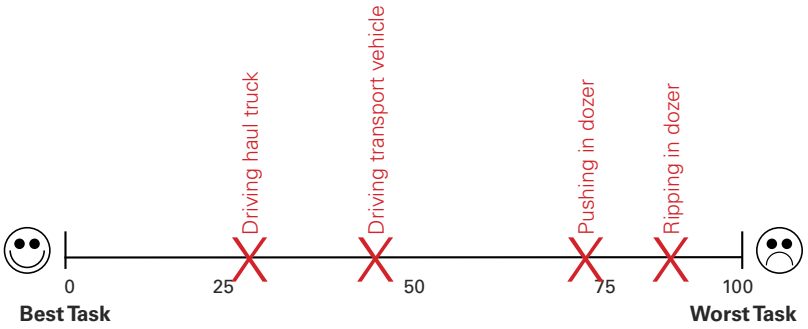
Option 3-

Compare jobs that you do regularly (eg ripping, pushing, road making, light vehicle driving, haul truck driving)

Instruction to interviewee:
Please place a X mark on the black line where you believe that each driving, operating or riding taskthat you do ranks in terms of roughness compared with other tasks that you have done at work in the last week. Rank all the tasks on this line.



Example:



Comments

26 Appendix E: Lifting/lowering risk assessment

Assessment checklist for lifting and carrying

Health and Safety Executive

Section A: Preliminary

Task name: Task description: Load weight: Frequency of lift: Carry distances (if applicable): Are other manual handling tasks carried out by these operators? Assessment discussed with employees/safety representatives:	Is an assessment needed? (An assessment will be needed if there is a potential risk of injury, eg if the task falls outside the guidelines in the L23 Appendix.) Yes/No* **If 'Yes' continue. If 'No' the assessment need go no further**. *Circle as appropriate

Operations covered by this assessment (detailed description): Locations: Personnel involved: Date of assessment:	Diagrams (other information including existing control measures):

Overall assessment of the risk of injury? *Circle as appropriate Make your overall assessment **after** you have completed Section B**.**	Low/Medium/High*

Section B: Lifting and carrying – More detailed assessment, where necessary

Questions to consider:	If 'Yes', tick appropriate level of risk				Problems occurring from the task. (Make rough notes in this column in preparation for the possible remedial action to be taken.)	Possible remedial action, eg changes that need to be made to the task, load, working environment etc. Who needs to be involved in implementing the changes?
	Low	Med	High	N/A		
Do **the tasks** involve:						
■ holding loads away from torso?						
■ twisting?						
■ stooping?						
■ reaching upwards?						
■ large vertical movement?						
■ long carrying distances?						
■ strenuous pushing or pulling?						
■ unpredictable movement of loads?						
■ repetitive handling?						
■ insufficient rest or recovery?						
■ a work rate imposed by a process?						
Are **the loads:**						
■ heavy?						
■ bulky or unwieldy?						
■ difficult to grasp?						
■ unstable or unpredictable?						
■ intrinsically harmful (eg sharp/hot)?						

Section B: Lifting and carrying – More detailed assessment, where necessary

Questions to consider:	If 'Yes', tick appropriate level of risk				Problems occurring from the task. (Make rough notes in this column in preparation for the possible remedial action to be taken.)	Possible remedial action, eg changes that need to be made to the task, load, working environment etc. Who needs to be involved in implementing the changes?
	Low	Med	High	N/A		
Consider **the working environment** Are there:						
■ constraints on posture?						
■ poor floors?						
■ variations in levels?						
■ hot/cold/humid conditions?						
■ strong air movements?						
■ poor lighting conditions?						
Consider **individual capability** Does the job:						
■ require unusual capability?						
■ pose a risk to those with a health problem or a physical or learning difficulty?						
■ pose a risk to those who are pregnant?						
■ pose a risk to new workers/young people?						
■ require special information/training?						

Section B: Lifting and carrying – More detailed assessment, where necessary

Questions to consider:	Yes/No	Problems occurring from the task. (Make rough notes in this column in preparation for the possible remedial action to be taken.)	Possible remedial action, eg changes that need to be made to the task, load, working environment etc. Who needs to be involved in implementing the changes?
Other factors to consider			
Protective clothing			
■ Is movement or posture hindered by clothing or personal protective equipment?	Yes/No		
■ Is there an absence of the correct/suitable PPE being worn?	Yes/No		
Work organisation (psychosocial factors)			
■ Do workers feel that there has been a lack of consideration given to the planning and scheduling of tasks/rest breaks?	Yes/No		
■ Do workers feel that there is poor communication between managers and employees (eg not involved in risk assessments or decisions on changes in workstation design)?	Yes/No		
■ Are there sudden changes in workload, or seasonal changes in volume without mechanisms for dealing with the change?	Yes/No		
■ Do workers feel they have not been given enough training and information to carry out the task successfully?	Yes/No		

Section C: Lifting and carrying – Remedial action to be taken

Remedial steps that should be taken, in order of priority:	Person responsible for implementing controls	Target implementation date	Completed Y/N
1			
2			
3			
4			
5			
6			
7			
8			
9			
Date by which actions should be completed:			
Date for review of assessment:			
Assessor's name:	Signature:		

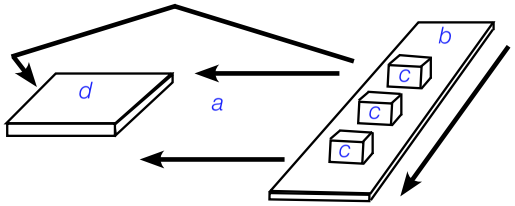
TAKE ACTION... AND CHECK THAT IT HAS THE DESIRED EFFECT

Assessment checklist for lifting and carrying – Worked example

Health and Safety Executive

Section A: Preliminary

Task name: *Conveyor/pallet loading.* Task description: *Pallet loading: boxes containing coiled wire. Remove from conveyor onto pallet.* Load weight: *45 kg* Frequency of lift: *15 lifts/hour* Carry distances (if applicable): *3 m* Are other manual handling tasks carried out by these operators? *No* Assessment discussed with employees/safety representatives: *Yes*	Is an assessment needed? (An assessment will be needed if there is a potential risk of injury, eg if the task falls outside the guidelines in the L23 Appendix.) Yes/No* **If 'Yes' continue. If 'No' the assessment need go no further.** *Circle as appropriate

Operations covered by this assessment (detailed description): *Operator lifts box, with hook grip, from conveyor, which is 50 cm above the ground, turns, walks 3 m and lowers box onto a pallet on the ground. Boxes are piled six high on pallet.* Locations: *Wire factory only* Personnel involved: *One operator* Date of assessment: *24 June 2015*	Diagrams (other information including existing control measures): *(a) Worker* *(b) Conveyor* *(c) 45 kg boxes of wire* *(d) Pallet*  *Arrows show direction of conveyor belt and worker movements between conveyor and pallet.*

Overall assessment of the risk of injury? *Circle as appropriate Make your overall assessment **after** you have completed Section B.	Low/Medium/High*

Health and Safety Executive

Section B: Lifting and carrying – More detailed assessment, where necessary

Questions to consider:	If 'Yes', tick appropriate level of risk				Problems occurring from the task. (Make rough notes in this column in preparation for the possible remedial action to be taken.)	Possible remedial action, eg changes that need to be made to the task, load, working environment etc. Who needs to be involved in implementing the changes?
	Low	Med	High	N/A		
Do **the tasks** involve:						
■ holding loads away from torso?			✓			
■ twisting?		✓			*1 Sometimes extended reaching when placing boxes on pallet.*	*Review mechanical handling equipment to eliminate manual lifting.*
■ stooping?			✓			
■ reaching upwards?	✓				*2 Twisting when putting down the box.*	*Remind operator of the need to move feet.*
■ large vertical movement?	✓				*3 Stooping when placing box on pallet and stooping when picking box up from the conveyor.*	*Adjust pallet height – Review availability of rotating, height adjusting equipment and raise height of conveyor.*
■ long carrying distances?	✓					
■ strenuous pushing or pulling?				✓		
■ unpredictable movement of loads?	✓					*Provide better information and instruction.*
■ repetitive handling?	✓					
■ insufficient rest or recovery?	✓					
■ a work rate imposed by a process?	✓					
Are **the loads:**						
■ heavy?			✓		*4 Load too heavy. Is the weight of the load a problem for customers too?*	*Review product and customer needs with a view to improving product design.*
■ bulky or unwieldy?	✓					
■ difficult to grasp?		✓			*5 Smooth cardboard boxes are difficult to grasp.*	*Provide boxes with hand grips.*
■ unstable or unpredictable?	✓					
■ intrinsically harmful (eg sharp/hot)?	✓					

Section B: Lifting and carrying – More detailed assessment, where necessary

Questions to consider:	If 'Yes', tick appropriate level of risk				Problems occurring from the task. (Make rough notes in this column in preparation for the possible remedial action to be taken.)	Possible remedial action, eg changes that need to be made to the task, load, working environment etc. Who needs to be involved in implementing the changes?
	Low	Med	High	N/A		
Consider **the working environment** Are there:						
■ constraints on posture?		✓			6 *Bad postures encouraged by obstructions when full pallets are not removed.*	*Introduce system to ensure full pallets removed promptly – Speak to Operations Manager.*
■ poor floors?	✓					
■ variations in levels?	✓					
■ hot/cold/humid conditions?	✓					
■ strong air movements?	✓					
■ poor lighting conditions?	✓					
Consider **individual capability** Does the job:						
■ require unusual capability?			✓		7 *Operator has no history of back pain problems but clear signs of sweating and straining.*	*Consider job enlargement to introduce variety and allow for recovery time. Monitor to ensure no rushing. Speak to trainer about manual handling course.*
■ pose a risk to those with a health problem or a physical or learning difficulty?			✓			
■ pose a risk to those who are pregnant?			✓			
■ pose a risk to new workers/young people?			✓			
■ require special information/training?		✓				

Section B: Lifting and carrying – More detailed assessment, where necessary

Questions to consider:	Yes/No	Problems occurring from the task. (Make rough notes in this column in preparation for the possible remedial action to be taken.)	Possible remedial action, eg changes that need to be made to the task, load, working environment etc. Who needs to be involved in implementing the changes?
Other factors to consider			
Protective clothing			
■ Is movement or posture hindered by clothing or personal protective equipment?	Yes/No		
■ Is there an absence of the correct/suitable PPE being worn?	Yes/No		
Work organisation (psychosocial factors)			
■ Do workers feel that there has been a lack of consideration given to the planning and scheduling of tasks/rest breaks?	Yes/No	*8 Boxes delivered at pre-set rate.*	*Look at varying delivery rate.*
■ Do workers feel that there is poor communication between managers and employees (eg not involved in risk assessments or decisions on changes in workstation design)?	Yes/No	*9 Employees not directly involved in risk assessment process.*	*Discussions to be held with safety representatives and other workers during identification and when solutions are decided.*
■ Are there sudden changes in workload, or seasonal changes in volume without mechanisms for dealing with the change?	Yes/No		
■ Do workers feel they have not been given enough training and information to carry out the task successfully?	Yes/No		

Section C: Lifting and carrying – Remedial action to be taken

Remedial steps that should be taken, in order of priority:	Person responsible for implementing controls	Target implementation date	Completed Y/N
1 *Safety representatives and employees to be involved in risk assessment process and workstation design.*	*A N Onymous*	*ASAP*	*Yes*
2 *Review product design to reduce weight of load and improve grip.*	*A N Onymous*	*July 2015*	*Yes*
3 *Review process in light of changes agreed in (1), particularly on customer requirements and transportation.*	*A N Onymous*	*Aug 2015*	*Yes*
4 *Seek funding for magnetic lifting aid to help with transfer from conveyor to pallet.*	*A N Onymous*	*Aug 2015*	*Yes*
5 *Seek funding for pallet rotating/height adjustment equipment.*	*A N Onymous*	*Aug 2015*	*Yes*
6 *Operator to attend manual handling training.*	*A N Onymous*	*Sept 2015*	*Yes*
7 *Raise conveyor height by 25 cm.*	*A N Onymous*	*Sept 2015*	*Yes*
8 *Ensure full pallets are removed by pallet truck promptly*.	*A N Onymous*	*Ongoing*	*Yes*
9 *Operations manager to ensure no rushing on this job.*	*A N Onymous*	*Ongoing*	*Yes*
Date by which actions should be completed: *30 Nov 2015*			
Date for review of assessment: *15 April 2016*			
Assessor's name: *A N Onymous*	Signature: *A N Onymous*		

TAKE ACTION – AND CHECK THAT IT HAS THE DESIRED EFFECT

27 Appendix F: Pushing and pulling risk assessment

Assessment checklist for pushing and pulling

Section A: Preliminary

Task name: Task description: Load weight: Frequency of operation: Push/pull distances: Are other push/pull tasks carried out by these operators? Assessment discussed with employees/safety representatives:	Is an assessment needed? (An assessment will be needed if there is a potential risk of injury, eg if the task falls outside the guidelines in the L23 Appendix.) Yes/No* **If 'Yes' continue. If 'No' the assessment need go no further.** *Circle as appropriate

Operations covered by this assessment (detailed description): Locations: Personnel involved: Date of assessment:	Diagrams (other information including existing control measures):

Overall assessment of the risk of injury? *Circle as appropriate Make your overall assessment **after** you have completed Section B.	Low/Medium/High*

Section B: Pushing and pulling – More detailed assessment, where necessary

Questions to consider:	If 'Yes', tick appropriate level of risk				Problems occurring from the task. (Make rough notes in this column in preparation for the possible remedial action to be taken.)	Possible remedial action, eg changes that need to be made to the task, load, working environment etc. Who needs to be involved in implementing the changes?
	Low	Med	High	N/A		
Do **the tasks** involve:						
■ high initial forces to get the load moving?						
■ high forces to keep the load in motion?						
■ sudden movements to start, stop or manoeuvre the load?						
■ twisting/manoeuvring of the load into position or around obstacles?						
■ one-handed operations?						
■ the hands below the waist or above shoulder height?						
■ movement at high speed?						
■ movement over long distances?						
■ repetitive pushing/pulling?						
The **load or object** to be moved:						
■ does it lack good handholds?						
■ is it unstable/unpredictable?						
■ is it sharp/hot?						
■ is vision over/around it restricted?						
If on wheels/castors, are they:						
■ unsuitable for the type of load?						
■ unsuitable for the floor surface/work environment?						
■ difficult to steer?						
■ easily damaged or defective?						
■ without brakes or difficult to stop?						
■ with brakes, but the brakes are poor/ineffective?						
■ without a planned inspection and maintenance regime based on a frequency that keeps them in working order?						

Section B: Pushing and pulling – More detailed assessment, where necessary

Questions to consider:	If 'Yes', tick appropriate level of risk				Problems occurring from the task. (Make rough notes in this column in preparation for the possible remedial action to be taken.)	Possible remedial action, eg changes that need to be made to the task, load, working environment etc. Who needs to be involved in implementing the changes?
	Low	Med	High	N/A		
Consider **the working environment** Are there:						
■ constraints on body posture/ positioning?						
■ confined spaces/narrow doorways?						
■ surfaces or edges to cause cuts/ abrasions/burns to hands or body?						
■ rutted/damaged/slippery floors?						
■ ramps/slopes/uneven surfaces?						
■ trapping or tripping hazards?						
■ poor lighting conditions?						
■ hot/cold/humid conditions?						
■ strong air movements?						
Consider **individual capability** Does the job:						
■ require unusual capability?						
■ pose a risk to those with a health problem or a physical or learning difficulty?						
■ pose a risk to those who are pregnant?						
■ pose a risk to new workers/young people?						
■ require special information/training?						

Section B: Pushing and pulling – More detailed assessment, where necessary

Questions to consider:	Yes/No	Problems occurring from the task. (Make rough notes in this column in preparation for the possible remedial action to be taken.)	Possible remedial action, eg changes that need to be made to the task, load, working environment etc. Who needs to be involved in implementing the changes?
Other factors to consider			
Equipment			
■ Is movement or posture hindered by clothing or personal protective equipment?	Yes/No		
■ Is there an absence of the correct/suitable PPE being worn?	Yes/No		
■ Are trolleys/carts/floor surfaces poorly maintained/cleaned/repaired?	Yes/No		
■ Is there a lack of regular maintenance procedures for the equipment?	Yes/No		
Work organisation			
■ Do workers feel that there has been a lack of consideration given to the planning and scheduling of tasks/rest breaks?	Yes/No		
■ Do workers feel that there is poor communication between users of equipment and others (eg managers, purchasers etc)?	Yes/No		
■ Are there sudden changes in workload, or seasonal changes in volume without mechanisms for dealing with the change?	Yes/No		
■ Do workers feel they have not been given enough training and information to carry out the task successfully?	Yes/No		

Section C: Pushing and pulling – Remedial action to be taken

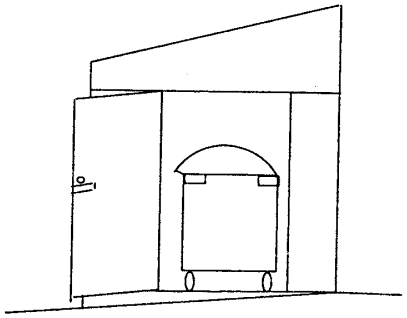
Remedial steps that should be taken, in order of priority:	Person responsible for implementing controls	Target implementation date	Completed Y/N
1			
2			
3			
4			
5			
6			
7			
8			
9			
Date by which actions should be completed:			
Date for review of assessment:			
Assessor's name:	Signature:		

TAKE ACTION... AND CHECK THAT IT HAS THE DESIRED EFFECT

Assessment checklist for pushing and pulling – Worked example

Health and Safety Executive

Section A: Preliminary

Task name: *Collecting bins* Task description: *Collecting waste paper from computer company using industrial refuse bins* Load weight: *Can exceed 100 kg* Frequency of operation: *1 push/pull every 5–10 mins* Push/pull distances: *Between 2–15 m depending on the location of the vehicle* Are other push/pull tasks carried out by these operators? *No* Assessment discussed with employees/safety representatives: *Yes*	Is an assessment needed? (An assessment will be needed if there is a potential risk of injury, eg if the task falls outside the guidelines in the L23 Appendix.) Yes/No* **If 'Yes' continue. If 'No' the assessment need go no further.** *Circle as appropriate
Operations covered by this assessment (detailed description): *Operator leaves vehicle and walks to bin storage area. Operator must then pull fully laden bin from storage area and push/pull load around vehicles parked in car park outside storage area. Once contents have been removed, bin is pushed/pulled back into storage area.* Locations: *Storage bin area* Personnel involved: *One operator* Date of assessment: *23 Jan 2015*	Diagrams (other information including existing control measures): 
Overall assessment of the risk of injury? *Circle as appropriate Make your overall assessment **after** you have completed Section B.	Low/Medium/High*

Section B: Pushing and pulling – More detailed assessment, where necessary

Questions to consider:	If 'Yes', tick appropriate level of risk				Problems occurring from the task. (Make rough notes in this column in preparation for the possible remedial action to be taken.)	Possible remedial action, eg changes that need to be made to the task, load, working environment etc. Who needs to be involved in implementing the changes?
	Low	Med	High	N/A		
Do **the tasks** involve:						
■ high initial forces to get the load moving?			✓		*1 Initially the wheels are often difficult to move as they may be inappropriately aligned, the refuse bin may have been unattended for some time, and debris builds up around wheels.*	*Remind operators to check position and alignment of wheels, and whether there is debris or obstructions which may inhibit their movement. Assess suitability of bin/wheels for the type of location. Inform customers.*
■ high forces to keep the load in motion?		✓				
■ sudden movements to start, stop or manoeuvre the load?			✓			
■ twisting/manoeuvring of the load into position or around obstacles?			✓			
■ one-handed operations?	✓					
■ the hands below the waist or above shoulder height?	✓				*2 Close parking of cars near refuse bins and restricted space in storage areas leads to pushing/pulling with twisted postures.*	*Remind operators of importance of clearing suitable path for bin. Review instructions and training on manual handling techniques.*
■ movement at high speed?	✓					
■ movement over long distances?			✓			
■ repetitive pushing/pulling?		✓				
The **load or object** to be moved:						
■ does it lack good handholds?		✓			*3 Difficulties of parking the collection vehicle close to refuse bins.*	*Review scheduling of collection rounds and information supplied to customers on the positioning of bins.*
■ is it unstable/unpredictable?		✓				
■ is it sharp/hot?				✓	*4 Bins are often overfilled. Compact/dense material (eg computer paper) leads to heavy loads.*	*Discuss with customers the reasons for bins being overfilled and examine feasibility of providing additional bins.*
■ is vision over/around it restricted?		✓				
If on wheels/castors, are they:						
■ unsuitable for the type of load?	✓				*5 Overfilled bins can restrict visibility.*	*Instruct operators to remove excess contents (but warn not to lift awkward or heavy objects) and/or seek assistance when moving bins.*
■ unsuitable for the floor surface/work environment?	✓					
■ difficult to steer?			✓			
■ easily damaged or defective?		✓			*6 The four swivel castors make the bin difficult to handle on sloping ground and when moving over long distances.*	*Review the suitability and practicality of fitting castors with a swivel locking mechanism. Assess design of bins/ handles/wheel brakes. Ensure handle heights are appropriate.*
■ without brakes or difficult to stop?		✓				
■ with brakes, but the brakes are poor/ineffective?				✓		
■ without a planned inspection and maintenance regime based on a frequency that keeps them in working order?		✓				

Section B: Pushing and pulling – More detailed assessment, where necessary

Questions to consider:	If 'Yes', tick appropriate level of risk				Problems occurring from the task. (Make rough notes in this column in preparation for the possible remedial action to be taken.)	Possible remedial action, eg changes that need to be made to the task, load, working environment etc. Who needs to be involved in implementing the changes?
	Low	Med	High	N/A		
Consider **the working environment** Are there:						
■ constraints on body posture/ positioning?		✓				
■ confined spaces/narrow doorways?		✓				
■ surfaces or edges to cause cuts/ abrasions/burns to hands or body?		✓				
■ rutted/damaged/slippery floors?		✓				
■ ramps/slopes/uneven surfaces?			✓			
■ trapping or tripping hazards?		✓				
■ poor lighting conditions?		✓				
■ hot/cold/humid conditions?		✓				
■ strong air movements?		✓				
Consider **individual capability** Does the job:						
■ require unusual capability?		✓				
■ pose a risk to those with a health problem or a physical or learning difficulty?			✓			
■ pose a risk to those who are pregnant?			✓			
■ pose a risk to new workers/young people?			✓			
■ require special information/training?		✓				

7 Storage areas, waste material and obstructions often inhibit the ease with which the bin can be moved.

Review storage area facilities to ensure clear access to bins during pickups.

8 A marked step between doorway frame and the ground outside the store room. Terrain uneven and noticeable camber.

Make customers aware of difficulties and seek to improve access, particularly outside the store room.

9 Variable weather conditions and hazardous terrain. Special problems during snow/ice.

Ensure operators have appropriate footwear and protective equipment/ clothing, particularly for adverse weather conditions.

10 Those suffering from musculoskeletal and respiratory complaints are likely to encounter difficulties when they carry out the work.

Review training to ensure that operators are aware of the risks. Ensure employees are given suitable induction training and appropriate systems for reporting complaints are in place. Review procedures for return to work following health problems.

Section B: Pushing and pulling – More detailed assessment, where necessary

Questions to consider:	Yes/No	Problems occurring from the task. (Make rough notes in this column in preparation for the possible remedial action to be taken.)	Possible remedial action, eg changes that need to be made to the task, load, working environment etc. Who needs to be involved in implementing the changes?
Other factors to consider			
Equipment			
■ Is movement or posture hindered by clothing or personal protective equipment?	Yes/No		
■ Is there an absence of the correct/suitable PPE being worn?	Yes/No		
■ Are trolleys/carts/floor surfaces poorly maintained/cleaned/repaired?	Yes/No	*11 Refuse collectors have a tendency not to report problems.*	*Review reporting procedures to actively encourage the reporting of breakage/failure of refuse bins.*
■ Is there a lack of regular maintenance procedures for the equipment?	Yes/No	*12 When a problem is reported, it is not always apparent that action is taken.*	*Implement a formal method to document problems and review maintenance procedures.*
Work organisation			
■ Do workers feel that there has been a lack of consideration given to the planning and scheduling of tasks/rest breaks?	Yes/No		
■ Do workers feel that there is poor communication between users of equipment and others (eg managers, purchasers etc)?	Yes/No	*13 Refuse collectors feel that they are not consulted about good features of bin design that aid handling tasks.*	*Review procedures for facilitating discussions between user and equipment purchasers.*
■ Are there sudden changes in workload, or seasonal changes in volume without mechanisms for dealing with the change?	Yes/No		
■ Do workers feel they have not been given enough training and information to carry out the task successfully?	Yes/No		

Health and Safety Executive

Section C: Pushing and pulling – Remedial action to be taken

Remedial steps that should be taken, in order of priority:	Person responsible for implementing controls	Target implementation date	Completed Y/N
1 *Discuss and agree with customers improvements to ground directly outside storage area.*	*A N Onymous*	*20 Feb 2015*	*Yes*
2 *Discuss and agree with customers appropriate steps to prevent overfilling of bins – review its effectiveness.*	*A N Onymous*	*25 Feb 2015*	*Yes*
3 *Review storage facilities to improve ease of access to bins and discuss with customers arrangements for good housekeeping practices.*	*A N Onymous*	*28 Feb 2015*	*Yes*
4 *Operator to attend relevant manual handling training course.*	*A N Onymous*	*25 March 2015*	*Yes*
5 *Instigate a reporting procedure to encourage workers to report problems. Ensure that a system of work is in place to address and monitor these problems.*	*A N Onymous*	*30 March 2015*	*Yes*
6 *Review refuse bin design to ensure that it is most suited to customer needs and handling requirements, eg size and shape in view of waste contents, wheel/castor design characteristics. Seek funding to replace/modify bin design, if required.*	*A N Onymous*	*25 April 2015*	*Yes*
7 *Ensure the provision of suitable clothing and footwear.*	*A N Onymous*	*30 April 2015*	*Yes*
8			
9			
Date by which actions should be completed: *31 May 2015*			
Date for review of assessment: *15 December 2015*			
Assessor's name: *A N Onymous*	Signature: *A N Onymous*		

TAKE ACTION... AND CHECK THAT IT HAS THE DESIRED EFFECT

28 Appendix G: Assessing upper limb disorder hazards

RISK FILTER

Task: _____
Assessor: _____
Date: _____ Location/work area: _____

IF YOU ANSWER YES TO ANY OF THE STEPS, YOU SHOULD THEN MAKE A FULL RISK ASSESSMENT OF THE TASK. REMEMBER TO CONSIDER ALL OF THE BODY PARTS OF THE UPPER LIMBS (FINGERS, HANDS, WRISTS, ARMS, SHOULDERS AND NECK). ANSWER **ALL** QUESTIONS

Step 1: Signs and symptoms			
Are there any: ☐ Medically diagnosed cases of ULDs in this work? ☐ Complaints of aches and pains? ☐ Improvised changes to work equipment, furniture or tools?	Are any of these present?	YES ☐ NO ☐	Move on to Step 2
Step 2: Repetition			
Are there repetitive elements such as: ☐ Repeating the same motions every few seconds? ☐ A sequence of movements repeated more than twice per minute? ☐ More than 50% of the cycle time involved in performing the same sequence of motions?	For more than 2 hours total per shift?	YES ☐ NO ☐	Move on to Step 3
Step 3: Working postures			
Are there any working postures such as: ☐ Large range of joint movement such as side to side or up and down? ☐ Awkward or extreme joint positions? ☐ Joints held in fixed positions? ☐ Stretching to reach items or controls? ☐ Twisting or rotating items or controls? ☐ Working overhead?	For more than 2 hours total per shift?	YES ☐ NO ☐	Move on to Step 4
Step 4: Force			
Are there any forces applied such as: ☐ Pushing, pulling, moving things (including with the fingers or thumb? ☐ Grasping/gripping? ☐ Pinch grips ie holding or grasping objects between thumb and finger? ☐ Steadying or supporting items or work pieces? ☐ Shock and/or impact being transmitted to the body from tools or equipment? ☐ Objects creating localised pressure on any part of the upper limb?	Sustained or repeated application of force for more than 2 hours total per shift?	YES ☐ NO ☐	Move on to Step 5
Step 5: Vibration			
☐ Do workers use any powered hand-held or hand-guided tools or equipment or do they hand-feed work pieces to vibrating equipment?	Regularly (ie at some point during most shifts)?	YES ☐ NO ☐	

If you answer yes to any of the steps, you should make a full risk assessment of the task.

RISK ASSESSMENT WORKSHEETS

Worksheet Reference Number	

Date:_____ Name of assessor:_____ Task:_____ No. of employees that conduct this task_____ How long is the task typically undertaken for: a) without a break_____ b) in a typical shift (excluding breaks)_____	How frequently is the task undertaken (eg. daily, weekly):_____ Other tasks undertaken by worker that may pose risk of ULDs *(include worksheet reference numbers)*: What hand tools are used in the task:_____	Task description:

1 Repetition **For 2 consecutive hours per work day:**		Yes	No	**Describe any problem(s) and probable cause(s):** *Describe what the person is doing eg. hand operation of drill 10 times per minute. Performed 3 hours per day, five days per week.*	**Describe any risk control options you have identified**	**Control options** *(not exhaustive list)*
1.1 Does the task involve repeating the same movements every few seconds?	*A '**Cycle**' is a sequence of actions of relatively short duration that is repeated over and over, and is almost always the same. A cycle is not necessarily associated with one single joint movement, but also with complex movements of one or more parts of the body.*	☐	☐			**Reduce repetition:** ■ Mechanise or automate repetitive functions ■ Use power ratchet tools ■ Remove machine or other pacing ■ Restructure task (Job design) ■ Remove or monitor piecework schemes **Reduce duration:** ■ Implement job enlargement ■ Ensure adequate breaks ■ Implement job rotation ■ Limit/control overtime
1.2 Is there a cycle or sequence of movements that is repeated twice per minute or more **OR** More than 50% of the task involves performing a repetitive sequence of motions?		☐	☐			
1.3 Are the wrists/hands/ fingers used intensively?		☐	☐			
1.4 Is there repetitive shoulder/arm movement (ie regular arm movement with some pauses or almost continuous arm movement?)		☐	☐			
1.5 Are tools used that require **repetitive** finger or thumb action?		☐	☐			

2 Working posture **Fingers, hands and wrist**		Yes	No	**Describe any problem(s) and probable cause(s):** *Note problem postures and identify parts of the upper limb involved. eg. Static gripping posture used for up to 2 hours at a time, wrists repetitively bent sideways when drilling objects.*	**Describe any risk control options you have identified**	**Control options** *(not exhaustive list)*
2.1 Is the wrist bent **repetitively** up and/or down?	*Remember: the greater the deviation from a neutral position, the greater the risk.* 	☐	☐			**Optimise working posture:** ■ Modify operation or production method ■ Relocate equipment or items ■ Present work items differently ■ Reduce amount of manipulation required ■ Ensure equipment accounts for differences in worker size, shape and strength ■ Ensure working heights are appropriate ■ Ensure items are within reach distances ■ Provide suitable (and adjustable) seating ■ Use fixtures/jigs After tools or controls ■ Ensure tools are suitable for task ■ Ensure tools do not require awkward postures
2.2 Is the wrist **held** in a position that is bent upwards or downwards?		☐	☐			
2.3 Are the fingers gripping or used while the wrists are bent?		☐	☐			
2.4 Is the wrist bent **repetitively** to either side?		☐	☐			
2.5 Is the wrist **held** bent to either side?		☐	☐			
2.6 Are the hands **repetitively** turned or twisted so that the palm is facing up or downwards?		☐	☐			
2.7 Are the **hands** held with the palms facing up or down?		☐	☐			
2.8 is a wide finger and/ or hand span needed to grip, hold or manipulate items?		☐	☐			
2.9 Do static postures of the fingers, hand or wrist occur, for more than two consecutive hours per working day?		☐	☐			
2.10 Are there tools, equipment and/or work pieces that are poorly shaped and/or do not fit the hand comfortably?		☐	☐			
2.11 Are there any tools, hand held equipment or work pieces that are too large or small to be gripped easily?		☐	☐			
2.12 Are tools designed for right handed use only?		☐	☐			

3 Working posture **Arms and shoulders**		Yes	No	**Describe any problem(s) and probable cause(s):** *Note problem postures and identify parts of the upper limb involved. eg. Shoulder held in fixed position with elbow out to the side for up to 2 hours at a time. This is due to the work height.*	**Describe any risk control options you have identified**	**Control options** *(not exhaustive list)*
3.1 Is work performed above the head or with the elbows above the shoulders for more than 2 hours total in a working day?	*Remember: the greater the deviation from a neutral position, the greater the risk.* 	☐	☐			**Optimise working posture:** ■ Automate or mechanise ■ Modify operation or production method ■ Relocate equipment or items ■ Present work items differently ■ Reduce amount of manipulation required ■ Ensure workplaces and equipment account for differences in worker size, shape and strength ■ Ensure working heights are appropriate ■ Ensure items are within reach distances ■ Provide suitable (and adjustable) seating ■ Use fixtures/jigs Alter tools or controls ■ Ensure tools are suitable for task ■ Ensure tools do not require awkward postures ■ Provide arm support for precision work
3.2 Does the task involve **repetitively** moving the upper arms out to the side of the body?		☐	☐			
3.3 Does the task involve **holding** the upper arms out to the side of the body without support?		☐	☐			
3.4 Do static postures of the shoulder or elbow occur, for more than two consecutive hours per work day?		☐	☐			
3.5 Does the work involve any other postures such as: ☐ Awkward forward or sideways reaching? ☐ Awkward reaching behind the body? ☐ Awkward reaching across the body?	  *Workstation layout and working height can be a major influence on working postures*	☐	☐			

4 Working posture **Head and neck**		Yes	No	**Describe any problem(s) and probable cause(s):** *Note problem postures and identify parts of the upper limb involved. eg. neck held in fixed bending position to see screw holes.*	**Describe any risk control options you have identified**	**Control options** *(not exhaustive list)*
4.1 Does the task involve **repetitively** bending or twisting the neck?	*Remember: the greater the deviation from a neutral position, the greater the risk.* 	☐	☐			**Optimise working posture:** ■ Ensure visual requirements are not too demanding ■ Provide visual aids ■ Ensure lighting is suitable ■ Reposition items that workers are required to look at
4.2 Does the task involve **holding** the neck bent and/or twisted for more than 2 hours total per working day?		☐	☐			
4.3 Do the visual demands of the task require the worker to view fine details and adopt awkward positions?		☐	☐			
4.4 Do aspects of lighting such as dim light, shadow, flickering light, glare and/or reflections cause the worker to adopt awkward postures?		☐	☐			

5 Force		Yes	No	**Describe any problem(s) and probable cause(s):** *eg. Drill handle is too small resulting in increased gripping force for up to 4 hours per day. Also high force applied to screws*	**Describe any risk control options you have identified**	**Control options** *(not exhaustive list)*
5.1 Does the task require **repetitive** or **static** application of force?	*For the hand/ wrist, high-force tasks are those with estimated average individual hand force requirements of 4 kg or above.*	☐	☐			**Optimise working posture:** ■ Reduce forces necessary ■ Use power tools ■ Can the function be achieved differently? ■ Use jigs to hold items ■ Reduce weight of items ■ Present items differently ■ Increase mechanical advantage ■ After task to use stronger muscles ■ Use foot pedals ■ If gloves used check that they are appropriate ■ Maintain tools ■ Ensure tools are suitable for task ■ Improve handles ■ Use light weight tools ■ Use tool counterbalances ■ Ensure tool handles fit workers comfortably
5.2 Is it a pinch grip being used **repetitively** or **statically** for more than two hours total per work day?	*For example, pinching an unsupported object weighing 0.9 kg (2 lbs) or more per hand, or using a similar pinching force (eg holding a small binder clip open).* 	☐	☐			
5.3 Does the worker use the grip of the finger, thumb or hand as a pressing tool?		☐	☐			
5.4 Do tools require the application of pressure on a trigger or button?		☐	☐			
5.5 Does the hand apply force by twisting objects/ tools or squeezing items?		☐	☐			
5.6 Is the hand or wrist used as a hammer?		☐	☐			
5.7 Is force being applied when the wrists are bent and/or with the arms raised?		☐	☐			
5.8 Does the task require the wearing of gloves which affect gripping?		☐	☐			
5.9 Do any objects, work pieces, tools or parts of the workstation impinge or create localised pressure on any part of the body?		☐	☐			

6 Working environment		Yes	No	**Describe any problem(s) and probable cause(s):** *eg. Workers exposed to hand vibration from drill up to 4 hours per day. Workers have cold air blowing on hands from exhaust.*	**Describe any risk control options you have identified**	**Control options** *(not exhaustive list)*
6.1 Are vibration exposures likely to regularly exceed HSE's recommended action level of 2.8 m/s^2 A(8)? - impulsive tools (chipping hammmers, needle guns, hammer drills, etc) may exceed HSE's recommended action level after only a few seconds use per day and are highly likely to exceed the action level after 30 minutes use per day - Rotary tools (grinders, sanders, etc may exceed HSE's recommended action level after only a few minutes use per day and are highly likely to exceed the action level after 2 hours use per day		☐	☐			**Improve the working environment:** ■ Use alternative process(es) ■ Select alternative lower vibration equipment ■ Use balancers/ tensioners ■ Maintain equipment ■ Reduce exposure time to vibration ■ Provide information and training ■ Conduct health surveillance ■ Avoid working in cold ■ Avoid handling or insulate cold items or tools ■ Redirect blowing air ■ Use warm clothing
6.2 Do tools create or transmit jerky actions, shock or torque (twisting)?		☐	☐			
6.3 Does the task involve working in cold or in draughts, particularly with cold air blowing over the hands?		☐	☐			
6.4 Does the task involve holding cold tool handles, work items or other cold objects?		☐	☐			

7 Psychosocial factors *(These factors are best dealt with through discussion with workers. Sensitivity may be required)*		Yes	No	**Describe any problem(s) and probable cause(s):** *eg. Workers are on piecework system. Support from supervision and co-workers is low.*	**Describe any risk control options you have identified**	**Control options** *(not exhaustive list)*
7.1 Is the work placed? ie machine or team sets the pace, or the work rate is otherwise not under the worker's control?		☐	☐			**Reduce force:** ■ Reduce monotony ■ Ensure reasonable workload and deadlines ■ Ensure good communication and reporting of problems ■ Encourage teamwork ■ Monitor and control overtime and shiftwork ■ Reduce or monitor productivity relatedness of pay systems ■ Provide appropriate training
7.2 Is there a system of work, or piecework, which encourages workers to skip breaks or to finish early?		☐	☐			
7.3 Do workers find it difficult to keep up with their work?		☐	☐			
7.4 Do workers feel that there is a lack of support from supervisors or co-workers?		☐	☐			
7.5 Is there overtime/shiftwork that is unplanned, unmonitored and/or not organised to minimise risk of ULDs?		☐	☐			
7.6 Do the tasks require high levels of attention and concentration?		☐	☐			
7.7 Do the workers have little or no control over the way they do their work?		☐	☐			
7.8 Are there frequent tight deadlines to meet?		☐	☐			
7.9 Are there sudden changes in workload, or seasonal changes in volume without any mechanisms for dealing with the change		☐	☐			
7.10 Do workers feel that they have been given sufficient training and information in order to carry out their job successfully?		☐	☐			

8 Individual differences		Yes	No	**Describe any problem(s) and probable cause(s):** *eg. No system for gradual return to work*	**Describe any risk control options you have identified**	**Control options** *(not exhaustive list)*
8.1 Are any workers potentially at increased risk of ULS due to: ☐ being new employees or returning to work after a long break; ☐ differences in competence and skills; ☐ being part of vulnerable groups such as older, younger workers, new or expectant mothers; ☐ disability and health status.		☐	☐			**Improve the working environment:** ■ Allow for a gradual build up to full production speed ■ Provide suitable training to develop the skills required ■ Seek advice on special requirements

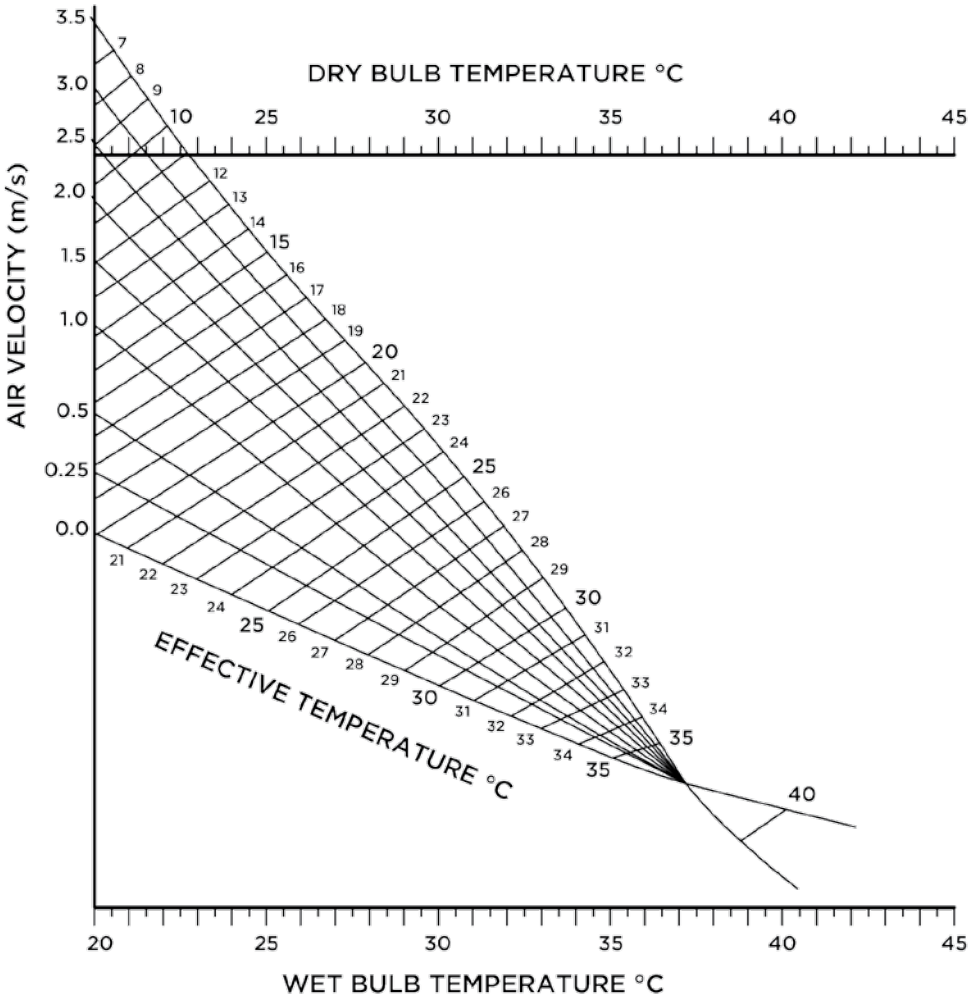
REMEMBER TO CONSIDER HOW THE RISK FACTORS INTERACT WITH EACH OTHER (eg are forces repetitively in awkward posture etc)

ACTION PLAN

Worksheet reference	Controls to be implemented	Priority	Who is responsible for implementing controls?	Target implementation date	Date of re-evaluation

29 Appendix H: Effective temperature chart

How to determine Basic Effective Temperature



The above chart represents the relationship between the wet bulb (WB) temperature, the dry bulb (DB) temperature, and air velocity. It is a useful tool for calculating basic effective temperature (ET). To determine ET, the WB, DB and air velocity figures should be known.

The DB temperature is the temperature of the air, measured with a standard thermometer.

The WB temperature is measured using a thermometer, the mercury bulb of which is surrounded by a wetted gauze. The effect of the gauze is to saturate the atmosphere locally by evaporation, so the WB temperature is reduced in proportion to the dryness of the air.

The two temperatures are usually taken simultaneously using a whirling hygrometer.

If required, the relative humidity can be calculated from the two temperatures.

The air velocity is usually measured using an anemometer and stopwatch. Air velocity produces a wind chill factor, which lowers the apparent temperature, giving a mine worker the sensation of being exposed to a lower temperature than actually being experienced.

The chart is used by drawing a straight line between the points on the upper and lower scales corresponding to the measured DB and WB temperatures. From the point at which the line intersects the curve corresponding to the measured air velocity, the ET can be read off the ET scale.

For example, the ET corresponding to 25°C WB, 29°C DB and an air velocity of 1.5 m/s is 23°C.

30 Appendix I: Welding fume control summary worksheet

PART 21: WELDING FUME CONTROL SUMMARY WORKSHEET

This worksheet can be used to obtain an idea of the level of protection required for different welding processes.

A. Select a process weighting factor

Process	Weighting
Submerged arc welding (remote operation) Laser cutting and welding Micro plasma Gas cutting (remote operation)	0
Submerged arc welding (manual) Submerged arc welding (multi arcs)	2
Brazing (manual operation) Gas tungsten arc welding (TIG) (manual operation) Gas welding and cutting (manual) Silver soldering (manual) Resistance spot welding (manual) Plasma cutting (under water table) Plasma arc welding Gas metal arc welding (MIG) (remote operation) Resistance seam welding (remote operation) Electroslag welding	4
MIG (hand-held) Manual metal arc welding (MMAW) Resistance seam welding (manual operation) Thermit welding Electrogas welding	7
Arc cutting Plasma arc gouging Air arc gouging Flux cored arc welding (manual and remote operation)	9
Plasma arc cutting	15

B. Select a fume constituent weighting

Fume group		Weighting
A	Iron, aluminium, tin, titanium – less than 5% of group B or C or less than 0.05% of group D.	0
B	Copper, magnesium, manganese, molybdenum, silver, tungsten, zinc. Flux fumes such as fluorides, rosin, phosphor acid, zinc chloride and boric acid.	10
C	Barium, chromium, cobalt, lead, nickel, ozone, vanadium, phosgene, organic fume.	20
D	Beryllium, cadmium.	55

C. Select a work location weighting

Work location	Weighting
Outdoor workspace	0
Open workspace	12
Limited workspace	16
Confined workspace	24

D. Add the three weightings you obtain at A, B and C to determine the control actions needed as below:

Sum of weighting factors	Controls
≤ 9	Natural ventilation
> 9 to 21	Mechanical ventilation
> 21 to 54	Local exhaust ventilation
> 54	Local exhaust ventilation and respiratory protection

31 Appendix J: Initial Scan Questionnaire

GuardingMinds @ WORK

GM@W Initial Scan

Please note: Your answers are anonymous and individual responses will be kept confidential.

	Strongly Agree	Agree	Disagree	Strongly Disagree
I am satisfied with the amount of involvement I have in decisions that affect my work.	☐	☐	☐	☐
I feel I am well rewarded (in terms of praise and recognition) for the level of effort I put out for my job.	☐	☐	☐	☐
In the last six months, too much time pressure at work has caused me no worry, "nerves" or stress.	☐	☐	☐	☐
In the last six months, I have experienced no worry, "nerves" or stress from mental fatigue at work.	☐	☐	☐	☐
I am satisfied with the fairness and respect I receive on the job.	☐	☐	☐	☐
My supervisor supports me in getting my work done.	☐	☐	☐	☐

32 Appendix K: Example Pre-Employment Questionnaire

Answer questions by circling the correct answer, or entering information in the space provided. Please see the job description and task analysis documentation that must accompany this form.

Identification		
Name:	Sex: M F	Date of birth:
HAV	Hand-arm vibration	
Address:	Phone number:	
GP:	Medical Centre:	
Position applied for:	Location:	
Brief description of position:		

Occupational History Since Leaving School	
Mining in New Zealand or overseas	
Employer Details:	List hazards encountered e.g. dust, noise, fumes, welding, asbestos, heavy lifting, shift-work, biological, other.
Other employment	
Employer Details:	List hazards encountered e.g. dust, noise, fumes, welding, asbestos, heavy lifting, shift-work, biological, other.

Medical History		
Are you being, or are about to be treated by any health practitioner for any illness or injury?	Yes	No
In the past 12 months have you been treated by any health practitioner for any illness or injury?	Yes	No
Are there any specific conditions or adjustments that the operation would have to accommodate in order to ensure a safe environment for yourself and others?	Yes	No
Are you taking any medications or other remedies including non prescription or herbal products?	Yes	No
Have you ever had a migraine?	Yes	No
Have you ever suffered any industrial or work related disease / condition?	Yes	No
Do you have any allergies?	Yes	No
Have you been vaccinated for tetanus?	Yes	No
Have you ever had an alcohol or drug-related illness?	Yes	No
Have you ever had a conviction for drink driving or a drug offence?	Yes	No
If you answered yes to any question, please provide details:		

Shift Work		
Do you have any reasons why you could not undertake shift work of varying patterns?	Yes	No
Do you have, or have you had, any ill-effects from shift work in the past?	Yes	No
Do you have, or have you had, any major sleep problems?	Yes	No
If you answered yes to any question, please provide details:		

Manual Handling					
Do you have any injury or medical condition that affects the use of any of the following body parts? Circle all that apply.					
Hands	Fingers	Wrists	Arms	Shoulders	Elbows
Neck	Back	Hips	Knees	Ankles	Feet
If you circled any of the above, please provide details:					
Do you have any condition that affects the following functions? Circle all that apply.					
Push	Pull	Kneel	Lift	Carry	Balance
Walking	Walking on rough terrain		Standing for long periods		
If you circled any of the above, please provide details:					

Driving / Heavy Machinery / Confined Spaces / Working At Heights / Safety Critical Work		
Have you had, or been told you have, any of the following?	Yes	No
Epilepsy or a seizure/fit, or a serious head injury?	Yes	No
Fainting, dizziness, or collapse?	Yes	No
Concussion or an episode of loss of consciousness?	Yes	No
Depression, anxiety, mental health or psychiatric disorder?	Yes	No
Fear of heights or a fear of enclosed spaces?	Yes	No
Sleep problems?	Yes	No
Diabetes?	Yes	No
Heart problems?	Yes	No
Chest pains?	Yes	No
Do you have any defect or problem with your eyesight that requires correction by using glasses or contact lenses?	Yes	No
If yes, when was the last time you were assessed by an optician? Date:		
If you answered yes to any question, please provide details:		

Noise		
Hearing History		
Have you had any hearing problems such as infection, head/ear injury, ringing, or balance difficulties?	Yes	No
Have you had any recent earache, discharge or cold symptoms?	Yes	No
Do you have any problems hearing what people say (particularly with background noise)?	Yes	No
Is there a family history of hearing loss?	Yes	No
Exposure History		
Do you have, or have you ever had any noisy hobbies, for example shooting, motorbikes, playing in an orchestra or band?	Yes	No
For how many years have you had this hobby?		
Have you worked in noisy jobs before?	Yes	No
For how many months/years were you exposed to noise?		
Did you participate in a hearing protection program?	Yes	No
If you answered yes to any question, please provide details:		

Dust Exposure		
Asthma		
Have you ever had asthma?	Yes	No
Was it diagnosed by a doctor or other health professional?	Yes	No
Do you still have it?	Yes	No
If not, at what age did your symptoms cease?		
Has a doctor ever prescribed asthma medication for you?	Yes	No
Do/did you take medication or use an inhaler for asthma?	Yes	No
Respiratory symptoms (cough)		
During the past 12 months, have you had a cough apart from colds?	Yes	No
Have you had this cough on most days for 3 months or more?	Yes	No
For how many years have you had this cough?		
Respiratory symptoms (phlegm)		
During the past 12 months, have you brought up phlegm apart from colds?	Yes	No
During the past 12 months, have you brought up phlegm from your chest on getting up or first thing in the morning?	Yes	No
Have you brought up phlegm like this on most days for three months or more during the year?	Yes	No
For how many years have you brought up phlegm like this?		

Respiratory symptoms (shortness of breath)		
Are you troubled by shortness of breath when hurrying on level ground or walking up a slight hill?	Yes	No
Do you have to walk slower than people of your age on level ground because of shortness of breath?	Yes	No
Do you ever have to stop for breath when walking at your own pace on level ground?	Yes	No
Respiratory symptoms (wheeze)		
Does your chest ever sound wheezing or whistling?	Yes	No
In the last 12 months, have you had persistent (for more than a week) wheezing or whistling in the chest when you did not have a cold?	Yes	No
Work-related symptoms		
Are there exposures or conditions at work that make your breathing worse?	Yes	No

Existing lung disease		
Have you seen your doctor for lung problems over the last few years?	Yes	No
Have you ever had any of the following lung problems?	Yes	No
Asbestosis	Yes	No
Pneumonia	Yes	No
Chronic obstructive pulmonary disease (smoking-related lung disease)	Yes	No
Tuberculosis	Yes	No
Silicosis	Yes	No
Pneumoconiosis (coal workers pneumoconiosis)	Yes	No
Lung cancer	Yes	No
Chest injury	Yes	No
Chest surgery	Yes	No
Others (describe)	Yes	No
Are you taking any treatment such as inhalers or pills for your breathing or lung problems?	Yes	No
Occupational exposure		
In any job, have you been regularly exposed to mineral dusts e.g. concrete demolition, sandblasting, drilling concrete, cutting concrete, coal dust, asbestos, silica, sand or soil?	Yes	No
Are you currently exposed to those kinds of dusts?	Yes	No
Over how many years have you been exposed?		
In any job, have you been regularly exposed to organic dusts e.g. dust from baking flour, grains, wood, cotton, compost, or other plants or animals?	Yes	No
Are you currently exposed to those kinds of dusts?	Yes	No
Over how many years have you been exposed?		
In any job, have you regularly been exposed to chemical fumes, exhaust fumes, smoke, or any other gases, vapors or fumes?	Yes	No
Are you currently exposed to those kinds of fumes?	Yes	No
Over how many years have you been exposed?		
Have you done welding on a regular basis?	Yes	No
Are you currently doing welding?	Yes	No

Dust Exposure		
Over how many years have you done welding?		
In the past, have you worked in a foundry, mine, quarry, sandblasting, cotton textile mill, mushroom farm, composting facility?	Yes	No
How many years altogether have you worked in these jobs?		
What is your current job?		
Are you currently exposed to any dust, gases or fumes at your work?	Yes	No
Do you regularly wear a respirator at work?	Yes	No
Does your workplace have a respiratory workplace safety program?	Yes	No
Do you participate in the program?	Yes	No
Cigarette smoking		
Have you ever smoked cigarettes (more than 20 packs in total)?	Yes	No
How old were you when you started smoking?		
Do you currently smoke cigarettes?	Yes	No
If no, how old where you when you quit smoking?		
How many years have you smoked?		
On average how many cigarettes have you smoked per day?		
Have you ever participated in a smoking cessation program?	Yes	No
If you answered yes to any question, please provide details:		

Vibration		
Do you have, or have you ever suffered from, tingling or numbness in your fingers?	Yes	No
Do your fingers ever go white on exposure to the cold or at any other time?	Yes	No
If you answered yes to any question, please provide details:		

Personal Protective Equipment		
If applicable to your role are you able to wear/use personal protective equipment such as hearing protection, respiratory protection, safety boots or shoes, safety goggles/masks, and breathing apparatus?	Yes	No
If you answered no, please provide details:		

Travel (please answer if you are likely to travel overseas on company business)		
Have you ever had:		
Deep vein thrombosis or pulmonary embolism (blood clots in legs or lungs)	Yes	No
Pneumothorax (collapsed lung)?	Yes	No
Sinus problems?	Yes	No
Phobias about flying or other forms of travel?	Yes	No
Sleep problems?	Yes	No
Do you have any medical problems that may require urgent medical attention?	Yes	No
Do you have any medical issues or are on medications that may affect your immune system?	Yes	No
If you answered yes to any question, please provide details:		
Please note below any current vaccinations you have had (within the last 10 years):		

Wellness Initiatives		
The following information is used to design wellness initiatives to improve the health of workers		
Do you know your cholesterol levels?	Yes	No
If so, are they normal or high?	Normal	High
Do you know your blood pressure?	Yes	No
If so, is it normal or high?	Normal	High
Do you have a family history of heart disease or strokes?	Yes	No
Do you smoke?	Yes	No
If so, do you wish to give up?	Yes	No
Do you believe you exercise enough?	Yes	No
Do you believe you have a healthy weight?	Yes	No
Do you believe you have a healthy diet?	Yes	No
If you answered yes to any question, please provide details:		

33 Appendix L: Respiratory Health Questionnaire

Personal Details of Person Investigated

1. Surname
2. Given Names
3. Home address
4. Telephone Numbers Home:
   Work:

5. Date of Birth?
6 Gender Male ☐ Female ☐
7. Ethnic Origin? European ☐
   Maori ☐
   Pacific Island ☐
   Other ☐
   If other please specify below
8. Name and Address of Family Doctor?

9. Occupational History

Current Employment

Who do you for?

How long have you worked in this industry?

How long as a minor/quarryman

If you have had previous employment as a minor/quarryman, where?

How long?

Daily Exposure - What is yuor average daily exposure?

Very little ☐ About half a day ☐ All day ☐

10. Smoking

Have you ever smoked for as long as a year? Yes ☐ No ☐

At what age did you begin smoking?

On average, how many cigarettes did you/do you smoke each day?

If you no longer smoke, how old were you when you stopped smoking?

11. Chest Symptoms

	Yes	No
Do you wheeze?	☐	☐
Does it come on at work?	☐	☐
Does it come on after work?	☐	☐
Does it improve away from work?	☐	☐
Do you have chest tightness?	☐	☐
Does it come on at work?	☐	☐
Does it come on after work?	☐	☐
Does it improve away from work?	☐	☐
Do you cough?	☐	☐
Do you bring up phlegm?	☐	☐

	Yes	No
Do you bring up phlegm for 3 months or more for 2 years?	☐	☐
Do you get short of breath?	☐	☐
Does it occur walking up hills?	☐	☐
Does it occur walking on the flat?	☐	☐
Do you wake up at night short of breath?	☐	☐
Are you an asthmatic?	☐	☐
Are you on treatment? List type of treatment: 1. 2. 3.	☐	☐

12. Past Respiratory History

	Yes	No
Have you had asthma?	☐	☐
Is there a family history of asthma?	☐	☐
Have you had hayfever?	☐	☐
Have you had eczema?	☐	☐
Have you had pleurisy?	☐	☐
Have you had any other chest condition? List other chest conditions: 1. 2. 3.	☐	☐

13. Spirometry

	Predicted	Sample 1	Sample 2	Sample 3
FEV 1				
FVC				
FEV 1%				

Date of Test

Type of Spirometer

Date Calibrated

Name of Nurse

14. The Worksite

How many miners/quarrymen are employed?

Type of quarry/mine

Any dust tests done?

When?

How many?

Are results available?

MinEx