

Participative Ergonomics for Manual Tasks (PERforM) Handbook

Reducing the risk of musculoskeletal injury through worker participation.

Workplace Health and Safety Queensland
www.worksafe.qld.gov.au



Background

This handbook provides guidance to industry on preventing musculoskeletal injuries from hazardous manual tasks. It is based on the Participative Ergonomics for Manual Tasks (PERforM) program.

PERforM was initially designed for general industry as part of a manual tasks research project undertaken by Workplace Health and Safety Queensland (WHSQ), now a division of the Department of Justice and Attorney-General, in collaboration with the University of Queensland and the Curtin University of Technology.¹

The PERforM program was subsequently modified for use in the surface and underground coal mining industries.² As a result of the successful implementation of PERforM in the coal mining industry,³ the program was modified for use in the civil construction industry. This project was known as PECivCon and was funded by WHSQ. A specific Participative ergonomics in civil construction handbook was developed as part of this project and is available on the WHSQ website, www.worksafe.qld.gov.au.

Acknowledgments

This handbook is based on the participative ergonomics for manual tasks (PERforM) handbook developed for civil construction which was written by Gary Dennis (PhD) and Robin Burgess-Limerick (PhD) from the University of Queensland. It has been modified for general industry.

This edition of the PERforM handbook was produced in 2013.

¹ This research was funded by the National Health and Medical Research Council and WorkCover Queensland (QComp), (Burgess-Limerick, 2004; Straker *et al.*, 2004).

² This research was funded by the Australian Coal Association Research Program (Burgess-Limerick *et al.*, 2004) and Coal Services Health and Safety Trust (Burgess-Limerick *et al.*, 2006; in press).

³ Burgess-Limerick, R., Straker, L., Pollock, C., Dennis, G., Leveritt, S., and Johnson, S. (2007) Participative ergonomics for manual tasks in coal mining *International Journal of Industrial Ergonomics* 37, 145-155.
Straker, L., Burgess-Limerick, R., Egeskov, R. and Pollock, C. (2004) A randomised and controlled trial of a participative ergonomics program (PERforM) *Ergonomics*, 47, 166-188.

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Introduction

Purpose

This handbook provides guidance on how to implement a participative ergonomics program for reducing musculoskeletal injuries resulting from hazardous manual tasks, specifically the PErforM program (Participative Ergonomics for Manual Tasks). It provides specific information on the identification, assessment and control of hazardous manual tasks risk factors, as well as case studies designed to illustrate how PErforM can be used.

Objectives

After reading this handbook users should:

- have an understanding of the hazardous manual tasks risk factors
- be able to perform a hazardous manual tasks risk assessment using PErforM
- have an understanding of the hierarchy of controls, in particular design and administrative controls
- be able to participate in managing hazardous manual tasks risks through the development and implementation of effective controls.

This handbook can be used by managers, occupational health and safety staff and workers.

Managers can use the handbook to further understand the benefits of using a participative approach that obtains input from all areas of the workforce when managing hazardous manual tasks risks.

Occupational health and safety staff, and anyone responsible for managing health and safety issues, can use the handbook to systematically assess hazardous manual tasks, develop and implement controls, and train workers and contractors in the risk assessment process.

Workers will benefit from participating in the PErforM program by being able to identify risk factors and assist in developing controls that will allow the worker to play an essential role in reducing the risk of injury.

Hazardous manual tasks and musculoskeletal injuries

Hazardous manual tasks

As per the *Work Health and Safety Regulation 2011*, specifically Part 4.2, hazardous manual tasks are defined as:

A task that requires a person to lift, lower, push, pull, carry or otherwise move, hold or restrain any person, animal or thing that involves one or more of the following:

- a. repetitive or sustained force
- b. high or sudden force
- c. repetitive movement
- d. sustained or awkward posture
- e. exposure to vibration.⁴

Hazardous manual tasks cover a wide range of activities, for example:

- operating mobile plant
- putting stock on shelves
- changing a truck tyre
- mopping a floor
- lifting a wheelchair out of a car.

Musculoskeletal injuries

Hazardous manual tasks are a significant issue for Queensland industry. Each year musculoskeletal disorders account for around 65 per cent of non-fatal workers' compensation claims. Of these, approximately two-thirds are a result of hazardous manual tasks. Most of these serious injuries could have been prevented.

Hazardous manual tasks can contribute to a number of musculoskeletal injuries including:

- muscle strains and sprains
- ligament or tendon rupture
- prolapsed intervertebral discs
- tendonitis of the shoulders and elbows
- carpal tunnel syndrome.

Musculoskeletal injuries can result in permanent injuries that can have a significant impact on a person's working ability and quality of life, as well as impacting on the productivity and economic performance of the company.

Mechanisms of injury

Musculoskeletal injuries are usually the result of repeated exposure to a variety of risk factors. Although a musculoskeletal injury can occur as the result of a single, one-off exposure, this is quite rare.

⁴ Source: *Hazardous Manual Tasks Code of Practice 2011*.

Injury occurs when the load applied to the musculoskeletal tissues is greater than the capacity of the tissues to withstand the force. The musculoskeletal structure can become overloaded and sustain an injury. Fatigue of the musculoskeletal structures can also contribute to damage and failure, or in the case of the body, a musculoskeletal injury.

PERforM hazardous manual tasks risk factors

The hazardous manual tasks risk factors outlined in the legislation are simplified within the PERforM program. They include:

- forceful exertions
- awkward and static postures
- vibration
- repetition
- duration.

Forceful exertions

Forceful exertions place high loads on soft body tissue such as muscles, tendons, ligaments, joints and discs. Muscles fatigue with increased exertion and need more time to recover. If soft tissue does not have time to recover, injury is likely to develop over a period of time. If the exertions are forceful enough, body tissues may be damaged immediately.

Forceful exertions include:

- forces exerted by muscles, such as when lifting items
- carrying loads
- holding one position for a period of time, or
- using a forceful grip.

Exposure to forces also occurs as a result of external forces applied to the body, such as the weight of a load being carried, hammering, or when jumping down when getting out of mobile plant.

It should be noted that it is the amount of force relative to the capability of the tissue which is important. For example, the small tissues of the hand may be injured by relatively low forces.

The level of muscular effort needed to do a job may be increased by factors such as:

- awkward or fixed working postures
- heavy, bulky, unstable or difficult to grip loads
- fast, sudden or jerky movements
- working with a grip that does not allow a large area of the hand to contact the load
- using vibrating tools that need more effort to grip
- wearing gloves
- using poorly designed hand tools
- the way loads are handled (e.g. physically lifting, pushing, pulling or carrying)
- poorly maintained tools and equipment.

Often it is a number of factors that will increase the risk of injury from forceful exertions.

Examples of tasks requiring forceful exertions



Pushing shopping trolleys



Assembling wheelchair



Cutting concrete pipe with hammer



Lifting side of cane bin

Awkward and static postures

The term awkward postures refers to any posture where the body parts are away from their comfortable, neutral position (e.g. a bent back, a bent wrist or arms raised above the head). Awkward postures result in stretching or shortening of the connective and nervous tissues. As a result, the functional capacity of muscles can be reduced and the tissues are at greater risk of injury. Awkward postures are not always harmful—it is only when they are repeated frequently or performed for a long time.

The term fixed or static postures refer to postures where part of or the whole body is kept in the same position for a long period of time (e.g. standing in one position with no movement). Static postures quickly fatigue muscles because blood flow is more restricted due to the lack of muscle movement. This can lead to blood pooling and a lack of blood supply to some areas of the body and increase the risk of injury.

Awkward or static postures can be caused by:

- the work area design (e.g. working at ground level or overhead)
- handling bulky, heavy or large loads
- using poorly designed hand tools
- pushing, pulling, or carrying loads which block the worker's view
- performing tasks which require loads or body parts to be supported or held for some time.

Examples of tasks involving awkward and static postures



Sorting tomatoes



Maintaining car engine



Concrete screeding



Reaching for electrical socket

Vibration

Workers can be exposed to vibration from a variety of sources including:

- while driving trucks
- operating mobile plant (e.g. excavators, forklifts)
- using jackhammers and power tools.

The two main types of vibration that can lead to musculoskeletal injuries are:

- whole body vibration
- hand/arm vibration.

Whole body vibration

Exposure to whole body vibration occurs when the body or parts of the body come in contact with a vibrating surface, such as the seat, pedal or floor of heavy vehicles or machinery. Whole body vibration exposure has been shown to be a strong contributor to lower back injuries.

Examples of exposure to whole body vibration



Driving truck



Driving forklift

Hand/arm vibration

Exposure to hand/arm vibration occurs when working with air-operated, pneumatic, electric, or petrol-powered tools. Exposure to hand/arm vibration primarily damages blood vessels and nerve tissue, typically of the hand and fingers. Prolonged exposure can eventually result in a disease known as hand arm vibration syndrome, previously known as vibration white finger syndrome. If exposure to the vibration is over months and years, the damage can be permanent.

When the body or limbs are exposed to vibration, the force of this movement is absorbed by the body's skin and the musculoskeletal system. Intermittent exposure to vibration may allow sufficient time for the soft tissues to recover between periods of exposure. However, long duration or frequent vibration exposure will significantly increase the risk of musculoskeletal injury.

Examples of exposure to hand/arm vibration



Operating petrol-powered jack hammer



Operating power drill

Repetition

Repetition means making the same type of movements over and over (e.g. laying bricks). The work cycle is the time taken to perform the task once without interruption (e.g. the time to lay one brick). Tasks involving short cycle times (less than 30 seconds) and performed for more than 30 minutes at a time, or for two hours over a whole shift, are considered to be a risk because the same muscles and other soft tissues are being used continuously. This contributes to their fatigue and risk of injury. Tasks involving longer cycle times and shorter task duration will have a lower risk of injury.

Examples of repetitive tasks with short cycle times



Laying paving blocks



Removing muffins



Sorting tomatoes



Sorting timber

Duration

Duration is the time taken to perform the task once, or perform the task repeatedly without a break. The longer a task takes, the greater the cumulative load on the musculoskeletal tissues. If the same musculoskeletal tissues are loaded without a break for extended periods, then the mechanical properties of those tissues begin to change, decreasing their functional capacity and increasing the likelihood of injury. Duration may be considered as a significant risk factor when a task is performed continuously for 30 minutes or longer or for two hours over a whole shift.

Examples of tasks involving long durations



Steel fixing



Working in flower beds

Hazardous manual tasks risk management

A person conducting a business or undertaking (PCBU) must manage risks to health and safety relating to musculoskeletal disorders that are associated with a hazardous manual task (section 60, *Work Health and Safety Regulation 2011*).

To manage risk under the *WHS Regulation 2011*, a duty holder must:

- identify hazards that could give rise to the risk
- eliminate the risk so far as is reasonably practicable
- if not reasonably practicable to eliminate the risk, minimise the risk by implementing control measures in accordance with the hierarchy of control
- maintain the control measure so that it remains effective
- review risk control measures (sections 34–38, *Work Health and Safety Regulation 2011*).

Identifying hazardous manual tasks

Not all manual tasks are harmful, but those that could be should be identified. Hazardous manual tasks can be identified in the following ways:

- Ask your workers what tasks are the most physically difficult, tiring, awkward, dangerous or uncomfortable to perform.
- **After an incident has happened**—investigate all new incidents and look for trends in past records.
- **When there are indicators something could be wrong**—observe work processes and talk to workers. Increased error or decreased productivity may be indicators that something is wrong.
- **When making a change**—consider the effects on workers when buying new tools or equipment, starting or changing work processes or work schedules.

Make a list of hazardous manual tasks in your workplace and prioritise them for further assessment.

Assessing the risk

Assessing the risk includes analysing the task to find out what risk factors are causing the problem.

Prepare

- Look at the task during normal working conditions.
- Find out about the work process, method of work, tools, equipment and work area layout.

Consult

- Talk to workers doing the job, their supervisors and others who may be able to provide information.
- Ask them if they have any ideas about what the problems are and how the task could be done differently.

Identifying the risk factors

Hazardous manual tasks usually include a variety of risk factors that can interact together to create a risk. It is important to be able to identify all of the risk factors and what is causing them so that appropriate controls can be developed. Video or photos can assist in observing how the task is performed and can help identify what parts of the task are a problem.

Which risk factors can you identify in the kerb removal task below?



Table of risk factors involved in the kerb removal task

Risk factor	Task observations
Forceful exertions	The worker is using relatively high muscle force to hold and push the jackhammer to break away the concrete.
Awkward/static postures	The worker holding the jackhammer is maintaining a static bent-over body position, whilst the person removing the concrete stoops over to lift the concrete and carry it to the dump truck.
Vibration	The jackhammer is a significant source of hand/arm vibration.
Repetition	The person lifting out the concrete is performing a repetitive ‘stoop – lift – carry – dump’ task over a short cycle time.
Duration	This task took over an hour to break away the required amount of concrete.

Who should participate in the risk assessment?

Workers who perform the hazardous manual task, their supervisors and others who can provide information or may be affected by the changes to the design or process (e.g. maintenance staff, cleaners), should be involved in the risk assessment, including developing and implementing controls. This will ensure that:

- hazardous manual tasks risks are not passed on to other workers
- all issues are considered
- acceptance of the controls and changes that may be made to the task increase.

For example, operational staff may be included in the design of a new work area, but the cleaning of this new area may become a problem if cleaners have not been consulted at the initial design stage.

PERforM risk assessment tool

The PERforM risk assessment tool will assist you in:

- recording relevant information about the task
- identifying the manual tasks risk factors
- assessing the degree of exposure
- developing suitable controls
- prioritising the tasks which are creating the highest risk to your workers.

Completing the risk assessment form provides a record of the risk assessment and should be kept on file.

The PERforM risk assessment tool and instructions for completing it are provided in Appendix 1.

Controlling the risk

Reducing risk requires implementing effective controls which are suggested and accepted by workers and do not introduce new risk factors into the workplace. Consider the following three elements when planning a control strategy:

1. The effectiveness of the new controls.
2. The successful implementation of new controls.
3. Managing potential new risk factors.

Encouraging work teams to participate throughout the control strategy process should ensure these elements are considered. Worker participation is critical to the overall success of the control strategy.

1. Effective controls

To be effective, controls should:

- target the risk factors present in the task
- meet the needs of all workers who will undertake the task.

2. Successful implementation

A number of people will play a role in the control of hazardous manual tasks. All people who are likely to have some responsibility at the implementation stage need to participate. Involving workers right from the beginning and listening to their input and ideas will give them a sense of ownership over the proposed controls.

Successful implementation can be facilitated by:

Management commitment – The success of PERforM depends on commitment from managers and supervisors, especially when there may be perceived competing priorities such as production and safety. It is important to gain this commitment before commencing the PERforM program, otherwise adequate resources may not be provided and the program could fail.

Integration into management systems – PERforM is best implemented as part of an organisation's health and safety management system, for example, attached to incident reports, used when developing a job safety analysis (JSA).

A site champion – A skilled and trained coordinator plays a critical role in promoting and 'driving' the program, including ensuring that the necessary communication occurs at all levels of the organisation and that essential activities are undertaken.

A communication plan – Ongoing communication between management, workers and other relevant parties is critical. For example, when designing new or modifying existing controls, engineers should consult with workers throughout the process to ensure the end product will suit the workers' requirements. Existing communication channels, including noticeboards, toolbox talks or emails, can be used to keep everyone informed, including shift workers.

Achievable goals – Initially focus on a few simple tasks and easily implemented controls to gain confidence with the process and to demonstrate that it can work. Have a positive attitude and be realistic. It may not be possible to find a solution to every problem, but remember that there are always small changes that can be made, and make a significant difference to reducing the overall level of risk.

3. Managing potential new risk factors

To reduce the likelihood of creating new risks, ensure that:

- relevant workers, including experienced workers who have the ability to provide critical feedback based on their experience, are included in the design and development stages
- controls consider all stages of the operational lifespan (e.g. long term maintenance requirements as well as day-to-day activities)
- controls are monitored and reviewed.

Other things to consider

Other issues that need to be addressed as part of the overall risk management plan include:

- **Design**—when purchasing materials, tools, equipment and plant, it is important to consider the impacts on the workers and the manual tasks performed.
- **Consultation**—talk to workers before changes are made to work processes or new equipment is purchased.
- **Keeping records**—of tasks assessed, specifications of plant and work processes, incident reports, actions taken, maintenance records and training activities.

Ways to minimise risk

As part of a hazardous manual task risk assessment you need to determine what the source of the risk is. This helps to direct resources to the appropriate areas for eliminating or minimising the risk of injury.

In accordance with the Work Health and Safety Regulation 2011, the employer must consider the following:

- The 'work area design and layout', which includes the furniture, fittings and equipment used by the workers to perform the task. The positioning and relationship of the different elements in a work area are important because of the effect on working postures.
- The 'nature, size weight or number of persons, animals or things involved', is about the loads required to be handled and the muscular effort needed to handle them.
- 'Tool design' which includes the design of the tool being used. Poor design may cause vibration, forceful exertions, awkward and static postures.
- 'Systems of work' includes issues such as the length of the shift, how often the task is performed, the number of workers assigned to the task and the pace of work.

The 'workplace environment' is potentially a source of risk in the work being performed. For example:

- Cold environments can lower body and hand temperature and make handling and gripping more difficult.

- Hot environment can also make handling and gripping items more difficult.
- Humidity can cause discomfort and fatigue, and wind can increase the force required to handle items.
- Floor surfaces should be considered (e.g. friction in pushing trolleys on carpet).

Hierarchy of controls

Control options are ranked according to the hierarchy of controls. For clarity, the PERforM risk assessment tool differentiates between design controls (that are more effective) and administrative controls (that are less effective).

Design controls

Design controls involve redesigning the task, workplace or tools to eliminate or reduce the risk. Design controls included on the PERforM risk assessment tool include elimination, substitution and engineering controls. Some general examples of design controls are discussed below.

- **Elimination**
 - Eliminate the problem task completely (e.g. automate a complete job process or aspects of a particular task).
- **Substitution**
 - Replace heavy items with lighter, smaller and/or easier to handle items (e.g. items with handles). This may involve discussions with manufacturers, suppliers and/or delivery providers.
 - Substitute a cotton mop-head with one made of microfibre.
 - Use of polypropylene wheelbarrow instead of steel.
- **Engineering**
 - Provide work benches or store items between knee and shoulder height to reduce awkward postures and increased force.
 - Use mechanical lifting aids such as cranes, forklifts, pallet jacks and trolleys to move items.
 - Cover tool handles with dampening materials to absorb vibration. Use dampening materials in floors and around vibrating machinery to reduce worker exposure to vibration.

Administrative controls

Administrative controls are less effective than design controls and generally require ongoing supervision to ensure they are followed. They may be forgotten under stressful conditions, such as when trying to meet deadlines, or when there are fewer staff available to do the work. Rather than controlling the risk directly, administrative controls reduce the time that workers are exposed to the risk.

Administrative controls focus on implementing policies and procedures such as Standard Operating Procedures (SOPs) and typically include:

- maintenance programs to ensure plant, tools and equipment are maintained on a regular basis
- work organisation, such as job rotation, to ensure adequate staff numbers are available to meet work demands and reduce shift length

- task-specific training to ensure workers are trained in their specific work, such as using tools and mechanical aids
- use of personal protective equipment (PPE), such as anti-vibration gloves, to reduce the exposure to vibration, or shock absorbent shoes for work on hard (concrete) floors^{5 6}; and
- return to work programs appropriate to individual fitness levels after extended periods of leave.

Administrative controls are best used as **part** of a comprehensive control strategy, or in the interim while longer term design controls are being developed.

Training

Training is an important administrative control and workers should be trained in safe methods of work and use of mechanical aids. To implement an effective manual task risk management program, workers must be able to identify hazardous manual tasks and be aware of the aspects of manual tasks that increase injury risks.

The evidence shows that lifting technique training is not an effective risk control strategy and should never be relied on for management of hazardous manual tasks. Research across a range of industries demonstrates that lifting technique training is not effective in changing uninjured workers long-term behaviour.

Appropriate training

The training should include information about:

- safe methods of work (e.g. provide all workers with training following the implementation of new safe operating procedures)
- manual task risk management, including the characteristics of hazardous manual tasks
- specific manual task risks at the workplace and the measures in place to control them
- how to perform manual tasks safely, including the use of mechanical aids, tools, equipment and safe work procedures
- how to report a problem or maintenance issues.

Further information on controls can be obtained from the Queensland *Hazardous Manual Tasks Code of Practice 2011*.

Case studies

The case studies in Appendix 2 of this handbook demonstrate the application of the PERforM risk assessment tool. While the case studies may not represent the wide range of high risk manual tasks performed in industry, it will assist in illustrating how PERforM can be used. Case study 1—*Vibrating needle sub-grade compaction* was provided by Civdec Construction as part of the PECivCon project.

⁵ Lifting belts worn when manually handling heavy loads are not considered effective PPE as they have not been shown to offer protection against the risk of back injury.

⁶ If PPE is used, especially gloves and respiratory protection, consideration must be given to the fact that PPE can adversely impact on the task demands by increasing the muscular effort to hold items or result in awkward postures due to restricted head/neck movement or vision.

Appendix 1: PErforM risk assessment tool

Worksheet 1 – Manual tasks risk assessment form

PErforM – Participative ergonomics for manual tasks

Manual tasks risk assessment form

Date and workplace

Date:

Workplace:

Risk assessors

Work unit/team:

Positions:

Names:

Task description

Name of task:

Why was this task selected:

Location where task occurs:

Who performs the task:

General description:

Postures:

Forceful / muscular exertions:

Repetition and duration:

Tools or equipment used:

Work/task organisation and environment:



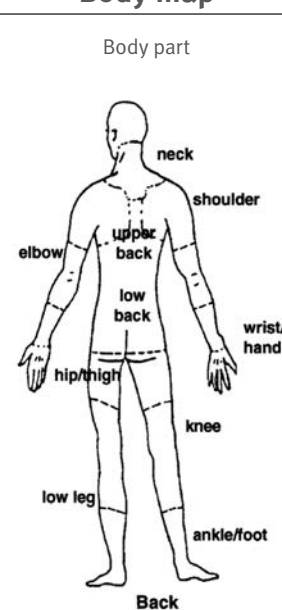
Worksheet 2 – Risk factor assessment

1. Indicate on the body chart which area(s) of the body you feel are affected by the task.
2. If more than one body part is affected, you may shade the different body parts in different colours. If so, use the matching colour when scoring the risk factors (e.g. red for arms on the body and score sheet, blue for low back on the body and score sheet).
3. Give each risk factor a score out of five. One (1) is when the risk factor is not present and five (5) is when the risk factor is the most severe level they have experienced.

Risk factors

Exertion				
1 No effort	2	3 Moderate force and speed	4	5 Maximum force or speed
Awkward posture				
1 All postures neutral	2	3 Moderately uncomfortable	4	5 Very uncomfortable
Vibration				
1 None	2	3 Moderate	4	5 Extreme
Duration				
1 < 10 minutes	2 10–30 min	3 30 min–1 hr	4 1–2 hrs	5 > 2 hrs
Repetition				
1 No repetition	2	3 cycle time < 30 s	4	5 cycle time < 10 s

Body map



Risk controls

Design control options:

(eliminate, substitute, engineer)

Administrative control options:

Completing the PERforM risk assessment tool

Worksheet 1 – Manual tasks risk assessment form

The first stage of the risk assessment tool involves thinking about the task and breaking it down to identify any significant risk factors. It is also useful for recording brief notes on particular aspects of the task as described in the table below:

Task description	
Name of task:	
Why was this task selected:	Workers report something is wrong, after an incident or injury, making a change to process.
Location where task occurs:	
Who performs the task:	
General description:	This does not need to be a workplace procedure. It is intended to be a general overview.
Postures:	Consider each joint in the body and how far it is from a neutral comfortable position. It is the joints that are at extreme positions that need particular focus. Static/fixed postures also need to be considered.
Forceful/muscular exertions:	Remember the force is relative to the body part, i.e. small muscle groups in the hand are able to handle a smaller force compared to large trunk and shoulder muscles. Note the effect the task has on people performing it; Are they bracing their bodies or is their breathing affected? These signs may suggest over exertion. Jarring and hammering type tasks are considered in this section and should not be confused with mechanical vibration.
Repetition and duration:	Repetition means making the same type of movements over and over. The work cycle is the time taken to perform the task once without interruption. Duration is the exposure to the task without a break. Note the cycle times and durations. Greater than 30 minutes exposure to risk factors, such as awkward postures or vibration without a break, is considered to have increased risk. Note whether the tasks performed before and after the task place similar demands on the muscles and joints, or whether the postures are different.
Tools or equipment used:	Note the tools and equipment handled, including; weights, equipment specifications and maintenance/condition of tools and grips. Are tools designed for the job? Is vibration present?
Work/task organisation and environment:	Some examples to consider: <ul style="list-style-type: none">• Does the layout impact on the worker's posture? i.e. location of equipment and heights, distances of furniture/materials, etc.• Are staffing levels adequate? consider factors such as; schedules, pace, availability of assistive equipment; housekeeping and the comfort of the work environment.

Worksheet 2 – Risk factor assessment

The second stage of the risk assessment tool involves:

- identifying the body areas affected by the task
- assessing the risk factors
- recording recommendations for risk controls.

Body map

The body map prompts the assessor to think about any areas of the body that may be affected by the tasks (e.g. those areas that become tired, sore or uncomfortable).

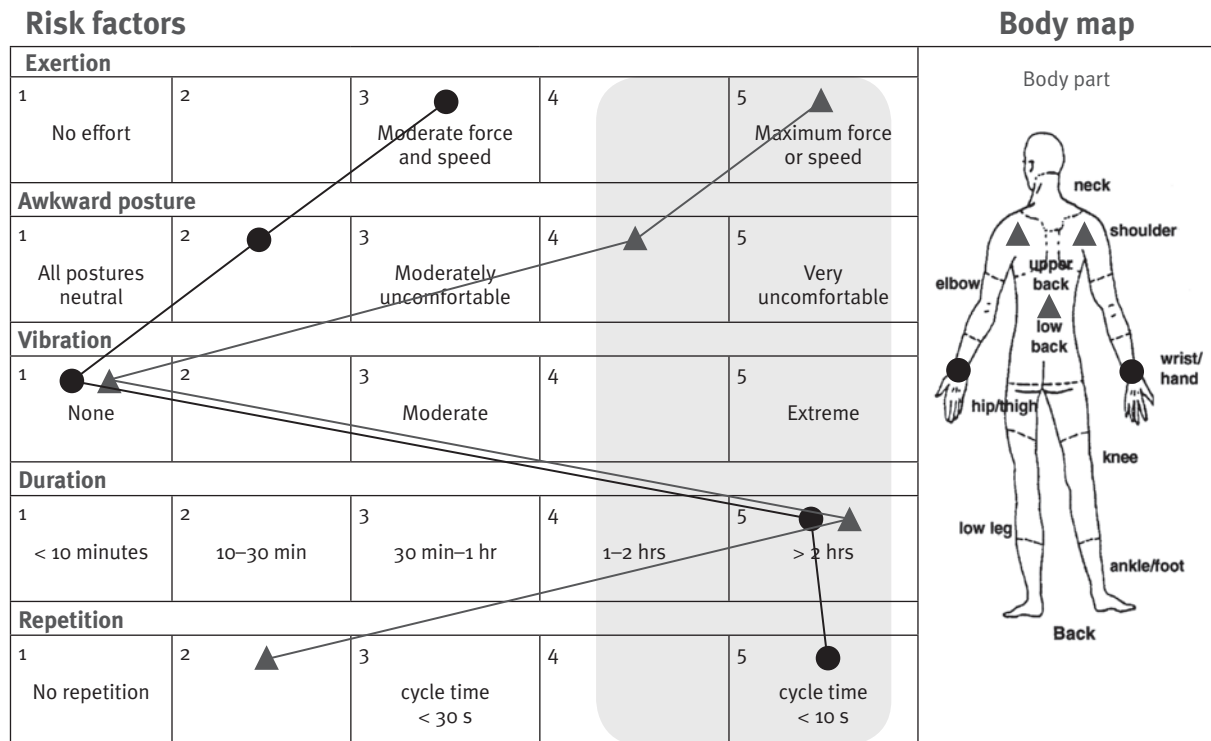
Risk factor assessment

The risk factor section located to the left of the body map requires the group to rate the level of severity of each risk factor for each affected body region on a 1 to 5 scale. A score of 1 is given when the risk factor is not present, and a score of 5 is given when the risk factor is the most severe it could be. The selected rankings should be circled to provide a clear profile of the task. The most significant risk factors can then be easily identified.

When assessing each risk factor, the group should consider the following:

- **Exertion**—Whether the task requires the worker to use maximum force. If the worker is able to continue working at the same level once the task is completed, then they have probably not been exerting maximum force. However, if the worker is left exhausted and has a significantly reduced capacity to exert any force after completing the task, it is quite possible that the worker exerted maximum force during the task.
- **Posture**—Observe the worker's posture and give a ranking out of five for comfort of posture. The group may also consider whether there are postures that could be even more extreme or uncomfortable.
- **Vibration**—When assessing vibration, the group should consider how extreme the vibration is. Whole body vibration contributes to increased injury, particularly in the back, neck and legs. Hand/arm vibration is primarily a risk factor for the arms, hands and shoulders.
- **Duration**—The typical length of time that the task is performed repeatedly without any rest break or substantial interruption by any other task. Consider whether the task is performed for more than 30 minutes at a time, or more than two hours over a whole shift.
- **Repetition**—Rated 1 if a task is performed once only without repetition it scores a one (no repetition). Tasks performed repetitively are then ranked according to the length of the cycle time.

Example body map and risk factor assessment



In the example above, the grey triangles have been used to indicate the level of risk on each of the five risk factors for the **lower back and shoulders**. The black dots indicate the risk of musculoskeletal injury to the **wrists**. By joining these dots, the risk profile of each body part assessed can be seen clearly.

All dots within the shaded green section are factors that need new control strategies to lower risk. In this example, control measures should particularly focus on:

- the duration of the task
- the force and posture associated with the back and shoulders
- the repetitive actions of the wrist.

The PERforM risk assessment tool can also be used after the controls have been implemented to determine if the level of risk has been decreased for the relevant risk factors and if the new control measures have been effective.

Risk controls

Recommendations for controls should be recorded in the final section of Worksheet 2. Consider both design and administrative controls.

Appendix 2: Case studies

The following case studies demonstrate the application of the PERforM risk assessment tool. While the case studies may not represent the wide range of high risk manual tasks performed in industry, it is hoped that they will assist in illustrating how PERforM can be used. Case study 1—*Vibrating needle sub-grade compaction* was provided by Civdec as part of the PECivCon project.

Case study 1 – Vibrating needle sub-grade compaction

PERforM—Participative Ergonomics for Manual Tasks

Manual tasks risk assessment form

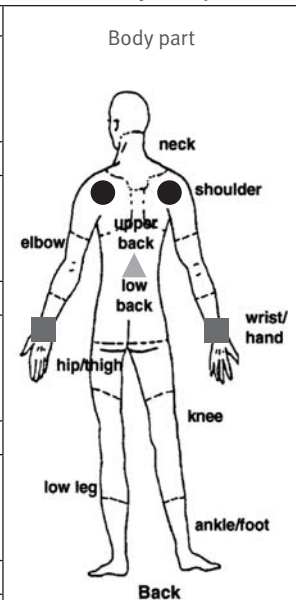
Date and workplace	
Date: 14/10/05	Workplace: Civdec (Port of Brisbane)
Risk assessors	
Work unit/team:	Earthworks crew
Positions:	Labourers, leading hands
Names:	
Task description	
Name of task:	Sand sub-grade compaction of trenches and manholes with vibrating needle.
Why was this task selected:	The natural material at the Port of Brisbane is white sand, which therefore requires particular attention to achieve the required density and compaction for the construction of pavements. In particular, the compaction of the sand sub-grade within trenches or around manholes is an important part of ensuring the integrity of pavements. To achieve the required compaction, the sand is required to be flooded and vibrated. The current method to achieve this is to use a needle vibrator, which is a slow and labour intensive task. This task is very demanding on the body, in particular the back, hands and forearms.
Location where task occurs:	Sand sub-grade compaction.
Who performs the task:	Earthworks/pavements construction labourers.
General description:	Once sand has been backfilled within trenches or around manholes within a pavement, it is flooded with water to become liquefied. At this point a vibrating needle (commonly used to compact concrete) is placed into the sand and retrieved. This process removes any voids within the sand and compacts it accordingly. The process of placing the vibrating needle and retrieving it is usually required about three to five times per square metre. The sand is also usually compacted in 0.5m thick layers.
Postures:	Due to the process of constantly retrieving the vibrating needle from the sand, the lower back and shoulders take a lot of strain. The back is required to be bent over numerous times during the process, and the shoulders are used to physically retrieve the needle.
Forceful exertions:	A strong grip is required to retrieve the needle from the sand. Also the vibrations caused from the vibrating needle are carried through the hands, wrists and forearms each time the needle is retrieved. This results in muscular fatigue setting in reasonably quickly within these body parts.
Repetition and duration:	Needle retrieving approximately 1 in 30 seconds, duration of task is approximately 1 hour depending on size of area to be compacted.
Tools or equipment used:	Labourer, vibrating needle, drive motor, water.
Work/task organisation and environment:	Conditions that make this task awkward and uncomfortable are the wet sand, the vibration of the needle, and the repetitiveness and physical effort needed to retrieve the needle from the sand.

Risk factor assessment

Risk factors

Exertion				
1 No effort	2	3 Moderate force and speed	4	5 Maximum force or speed
Awkward posture				
1 All postures neutral	2	3 Moderately uncomfortable	4	5 Very uncomfortable
Vibration				
1 None	2	3 Moderate	4	5 Extreme
Duration				
1 < 10 minutes	2 10–30 min	3 30 min–1 hr	4 1–2 hrs	5 > 2 hrs
Repetition				
1 No repetition	2	3 cycle time < 30 s	4	5 cycle time < 10 s

Body map



Risk controls

Design control options:

- Look into the manufacture of a series of vibrating needles on a beam that can be hitched to a backhoe. This will allow the backhoe to compact the sand (with the use of the vibrating needles) using mechanical power, not physical power. Additionally, this would also improve efficiency by speeding up the time taken to perform the sub-grade compaction.

Administrative control options:

- Provide more vibration equipment for additional labourers to perform the task, which would therefore reduce the duration of the task if only one labourer performed the task.
- Minimise number of trenches by 'trench sharing of conduits'.
- Train additional labourers to perform the task and allow job rotation.

Supporting photo



Vibrating needles

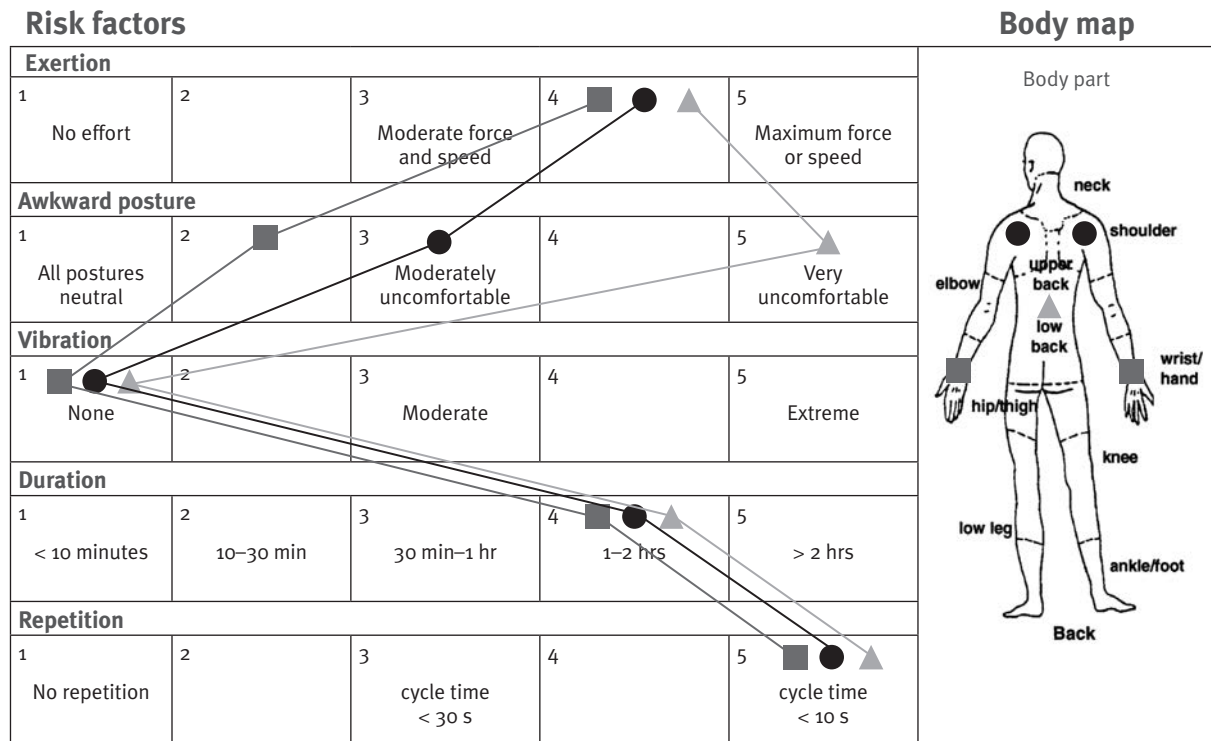
Case study 2 – Stacking pallets for customer orders

PERforM – Participative ergonomics for manual tasks

Manual tasks risk assessment form

Date and workplace	
Date: 17/02/09	Workplace: Packing shed
Risk assessors	
Work Unit/team:	Packers
Positions:	Labourers, supervisors
Names:	
Task description	
Name of task:	Stacking pallets with boxes of tomatoes for customer orders.
Why was this task selected:	Workers cited this task as difficult and complain of discomfort to back, elbows and hands. It is performed most days and often involves four hours per shift.
Location where task occurs:	Next to the load out area.
Who performs the task:	Usually 2 male workers. The task is considered by management to be too heavy for female workers and they are too short in stature to reach the top layers of the pallet.
General description:	The worker has to complete customer orders from various pallets of different types of tomatoes. This involves carrying the boxed tomatoes from one pallet and stacking them on another pallet. Pallets are moved with an electric pallet jack. The worker has to work around the pallets, starting at ankle level and working up to shoulder height.
Postures:	Bending over while putting the boxes down on the pallet. Twisting when carrying boxes around obstructions such as empty and full pallets.
Forceful/muscular exertions:	Forceful exertion by the back and upper body while carrying full boxes weighing 12 kg each. Gripping force by the wrist and force on the forearm muscles when carrying boxes.
Repetition and duration:	This task is usually performed in the morning for one or two hours. Pace is dictated by the number of orders to complete for the day. It could be described as slow to medium paced work. Workers do have time to take short breaks whilst waiting for pallets to be replaced.
Tools or equipment used:	Nil.
Work task organisation and environment:	<p>It usually takes 20 minutes to stack/sort each pallet before moving onto the next one. The workers commence at 7:00 AM and arrange the paper work for the orders before commencing stacking/sorting at 7:30 AM. They work till morning tea and then move to other tasks such as forklift work and field work.</p> <p>The packing shed has some ceiling insulation and fans but workers still complain of the heat in summer.</p>

Risk factor assessment



Risk controls

Design control options:

- Investigate automating the task.
- Install spring-loaded pallet turntable to allow the stacking task to be done at waist height and turn the pallet to stack from one direction.
- Investigate recessing a height adjustable pallet turntable into the floor to keep the task at waist height.
- Plan the layout of this area and give consideration to issues such as space, handling of product, access to pallets.
- Use a platform structure around the pallet with a pallet on a mechanical lifting system (e.g. a forklift).
- Negotiate with clients and/or transport companies regarding the configuration of pallets (e.g. to reduce the height, do half/split pallets).

Administrative control options:

- Implement a good housekeeping policy (i.e. clear walkways, maintain floor surfaces, remove produce and other items from floors and clean up spills immediately).
- Rotate the job among workers.
- Allow frequent rest breaks e.g. five minutes each hour.

Supporting photo:



Stacking boxes of tomatoes.

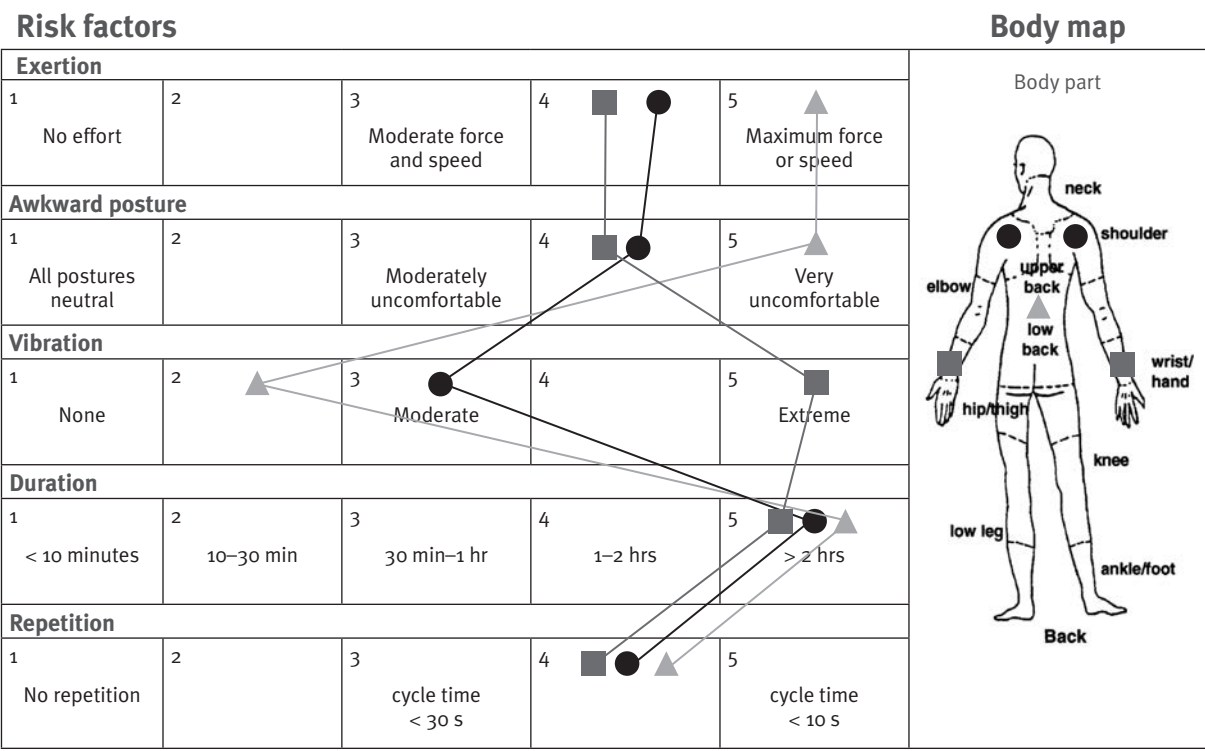
Case study 3 – Fettling of furnace

PERforM – Participative Ergonomics for Manual Tasks

Manual tasks risk assessment form

Date and workplace	
Date: 23/06/2010	Workplace: Bradken
Risk assessors	
Work unit/team:	Melting
Positions:	Furnace Operators, Melters, Labourers, Furnace Fettler
Names:	As per attendance sheet
Task description	
Name of task:	Maintenance of furnace internal lining ('Fettling furnaces')
Why was this task selected?	Workers felt this task had a high potential for manual task injuries. Four musculoskeletal injuries had been attributed to this task within a 12 month period; two injuries were lost time injuries. Workers report that the job is uncomfortable and they feel discomfort primarily in the back and hands.
Location where task occurs:	Main foundry bay.
Who performs the task:	Usually 2 male labourers.
General description:	The task involves workers manually removing large clumps of metal slag and brick (up to 30kg) from the inside of several fettling furnaces. The workers also use jack hammers, crow bars and other tools to remove the slag.
Postures:	Bending and twisting of the back, reaching forward.
Forceful/muscular exertions:	Forceful exertion of the back and upper body while lifting heavy waste material (slag). Sustained and repeated gripping and pulling at slag material as well as forceful gripping of the jack hammer.
Repetition and duration:	This task is usually performed for up to 2 hours at a time for a full 8hr shift. It has repeated movements of the back and shoulders involving the upper limb, and the wrists and hands.
Tools or equipment used:	Jackhammers, crowbars, sledgehammer, shovels (these tools estimated to be ~10kg), ladder and overhead crane.
Work/task organisation and environment:	The environment is dusty and noisy with uneven footing. There are some sharp edges on slag material and various sizes of waste is removed. Workers do this task for two 8hr days approximately twice a week.

Risk factor assessment



Risk controls

Design control options:

- Use of a mini-excavator to eliminate manual task.
- Investigate a cargo style net to collect bricks/slag and remove this with overhead crane.
- Investigate different styles of : chisels, jackhammers, reduce exertion and awkward postures.

Administrative control options:

- Rotate the job to other workers.
- Allow frequent rest breaks.
- Use anti-vibration gloves.
- Training in safe work procedures.

Supporting photo:



Figure 1: Worker using jackhammer to break up slag inside furnace



Figure 2: Remote controlled excavator

References and further reading

- Burgess-Limerick, R. (2004). Ron Cumming Memorial Lecture 2004. A tale of two acronyms: PERforM and ManTRA. *Ergonomics Australia*, 18(4), 10–13.
- Burgess-Limerick, R., Joy, J. and Straker, L. (2004). *Reducing Musculoskeletal Risk in Open-cut Coal Mining*. Australian Coal Association Research Program final report. (ergonomics.uq.edu.au/download/C11058.pdf)
- Burgess-Limerick, R., Joy, J., Straker, L., Pollock, C. and Cliff, D. (2006) *Implementation of an Ergonomics Program Intervention to Prevent Musculoskeletal Injuries Caused by Manual Tasks*. Coal Services Health and Safety Trust Research Grant Final Report Jan 2006
- Burgess-Limerick, R., Straker, L., Pollock, C., Dennis, G., Leveritt, S. and Johnson, S. (in press). Participative ergonomics for manual tasks in coal mining. *International Journal of Industrial Ergonomics*.
- Chaffin, D.B., Galloway, L.S., Wolley, L.B. and Kuciamba, S.R. (1986) An evaluation of the effect of a training program on worker lifting postures. *International Journal of Industrial Ergonomics*, 1, 127–136.
- Daltroy, L.H., Iversen, M.D., Larson, M.G., Lew, R., Wright, E., Ryan, J., Zwerling, C., Fossel and Liang, M.H. (1997) A controlled trial of an educational program to prevent low back injuries. *New England Journal of Medicine*, 337, 322–328.
- McGill, S.M. (1997) The biomechanics of lower back injury: implications on current practice in industry and the clinic. *Journal of Biomechanics*, 30(5), 465–475.
- McPhee, B., Foster, G. and Long, A. (2001) *Bad Vibrations*. Joint Coal Board Health and Safety Trust.
- Queensland Government Department of Justice and Attorney-General. *Hazardous Manual Tasks Code of Practice 2011*.
- Queensland Government Department of Justice and Attorney-General. *Workplace Health and Safety Regulation 2011, Chapter 4, Hazardous Work*.
- Scholey, M. (1983) Back stress: The effect of training nurses to lift patients in a clinical situation. *International Journal of Nursing Studies*, 20, 1–13.
- Silverstein, B. and Clark, R. (2004) Interventions to reduce work-related musculoskeletal disorders. *Journal of Electromyography and Kinesiology*, 14, 135–152.
- Snook, S.H., Campanelli, R.A. and Hart, J.W. (1978) A study of three preventive approaches to low back injury. *Journal of Occupational Medicine*, 20, 478–481.
- Straker, L., Burgess-Limerick, R., Egeskov, R. and Pollock, C. (2004) A randomised and controlled trial of a participative ergonomics program (PERforM). *Ergonomics*, 47, 166–188.
- St. Vincent, M., Tellier, C. and Lotie, M. (1989) Training in handling: An evaluative study. *Ergonomics*, 32, 191–210.
- Supplementary document *Reducing Musculoskeletal Risk in Open Cut Coal Mining*.
- Videman, T., Rauhalta, H., Asp, S., Lindstrom, K., Cedercreutz, G., Kamppi, M., Tola, S. and Troup, J.D.G. (1989) Patient-handling skill, back injuries and back pain: An intervention study in nursing. *Spine*, 14, 148–156.
- Workcover New South Wales (1998) *Guidance note on preventing slips, trips and falls*.

Further information

For general information on manual tasks, please contact
Workplace Health and Safety Queensland:

Telephone 1300 369 915

Website www.worksafe.qld.gov.au

Telephone interpreter service 13 14 50

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