ERGONOMICS AND VIBRATION GUIDELINE
TNCL-OHS-GDL-0005

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1. INTRODUCTION

To provide a guideline for the Management of risks related to ergonomics, vibration and manual handling to ensure that all risks are minimised, and the operation is conducted in a safe and effective manner to achieve our goal of ZERO HARM.

2. DEFINITION AND ACRONYMS

Terms	Definition
ART	Assessment of Repetitive Task Tool
HSE	Health and Safety Executive
MAC	Manual Assessment Chart
OHS	Occupational Health and Safety
RAPP	Risk Assessment for Pushing and Pulling
TNCL	Tembo Nickel Corporation Ltd
V-MAC	Variable Manual Assessment Chart

3. RESPONSIBILITIES

Supervisors and Department Managers are responsible for:

- Ensuring that workers have knowledge and understand the requirements of this procedure.
- Ensuring adequate provisions are available in the event of an emergency.

4. GUIDELINE

4.1 Background:

Musculoskeletal disorders (MSD) are injuries or disorders of the muscles, nerves, tendons, joints, cartilage, and spinal discs. Work-related musculoskeletal disorders (WMSD) are conditions in which the work environment and performance of work contribute significantly to the condition, and/or the condition is made worse or persists longer due to work conditions.

The most common musculoskeletal disorders reported include pain in the neck, back, shoulders, elbows, and wrists, repetitive strain disorders, nerve injuries and chronic pain disorders. It can result in reduced performance, poor quality of life and significant disability.

The musculoskeletal disorders are divided into two main groups: Upper limb musculoskeletal

disorders and Lower back pain. The commonest work-related musculoskeletal disorders include hand-arm vibration syndrome, carpal tunnel syndrome, de quervain's tenosynovitis, rotator cuff syndrome, and lateral and medial epicondylitis.

Approximately 1.71 billion people have musculoskeletal conditions worldwide. Musculoskeletal conditions are the leading contributor to disability worldwide, with low back pain being the single leading cause of disability in 160 countries.

The Health and Safety Executive data reveals that the total number of cases of work-related musculoskeletal disorders in 2021/22 was 477,000, a prevalence rate of 1,430 per 100,000 workers. These comprised 175,000 cases where the upper limbs or neck was affected, 202,000 where the back was affected and 99,000 where the lower limbs were affected. In 2021/22, musculoskeletal disorders accounted for 27% of all work-related ill health cases and 24% of all working days lost due to work-related ill health.

4.2 Causes of Musculoskeletal Disorders

1. Ergonomic factors
    a. Excessive Force
    b. Repetition
    c. Awkward Posture
    d. Lifting/pushing/carrying/pulling
    e. Manual Handling activities
2. Vibration (both whole body and hand-arm vibration)
3. Personal characteristics, i.e., High BMI, smoking

Table 1: The table below from the National Institute of Occupational Safety and Health, 1997 provides evidence-based causes of musculoskeletal disorders.

Body part Risk factor	Strong evidence (+++)	Evidence (++)	Insufficient evidence (+/o)	Evidence of no effect (-)
Neck and Neck/shoulder Repetition	…	++	…	…
Force	…	++	…	…
Posture	+++	…	…	…
Vibration	…	…	+/o	…
Shoulder Posture	…	++	…	…
Force	…	…	+/o	…
Repetition	…	++	…	…
Vibration	…	…	+/o	…
Elbow Repetition	…	…	+/o	…
Force	…	++	…	…
Posture	…	…	+/o	…
Combination	+++	…	…	…
Hand/wrist Carpal tunnel syndrome				
Repetition	…	++	…	…
Force	…	++	…	…
Posture	…	…	+/o	…
Vibration	…	++	…	…
Combination	+++	…	…	…
Tendinitis Repetition	…	++	…	…
Force	…	++	…	…
Posture	…	++	…	…
Combination	+++	…	…	…
Hand-arm vibration syndrome Vibration	+++	…	…	…
Back Lifting/forceful movement	+++	…	…	…
Awkward posture	…	++	…	…
Heavy physical work	…	++	…	…
Whole body vibration	+++	…	…	…
Static work posture	…	…	+/o	…

4.3 Common symptoms of Musculoskeletal disorders

Aches and Pain	Tingling
Discomfort	Loss of strength
Fatigue	Burning
Numbness	Trouble sleeping due to pain
Stiffness	Body parts "Falling asleep"
Tenderness	Loss of joint movement
Weakness	Swelling

4.4 Management of Ergonomic Hazards

Ergonomics is a science concerned with the 'fit' between people and their work. It puts people first, taking account of their capabilities and limitations. Ergonomics aims to make sure that tasks, equipment, information and the environment fit each worker.

4.4.1 Assessment of Ergonomic Hazards

To assess the fit between a person and their work, you have to consider a range of factors, including:

4.4.1.1 The job/task being done:

1. The demands on the worker (activities, workload, work pacing, shiftwork, and fatigue).
2. The equipment used (its design in terms of size, shape, controls, displays, and how appropriate it is for the task).
3. The information used (how it is presented, accessed, and changed).
4. The physical environment (temperature, humidity, lighting, noise, vibration)

4.4.1.2 The individual's physical and psychological characteristics:

1. Body size and shape.
2. Fitness and strength.
3. Posture.
4. The senses, especially vision, hearing and touch.
5. Mental abilities.
6. Personality.
7. Knowledge.
8. Training.

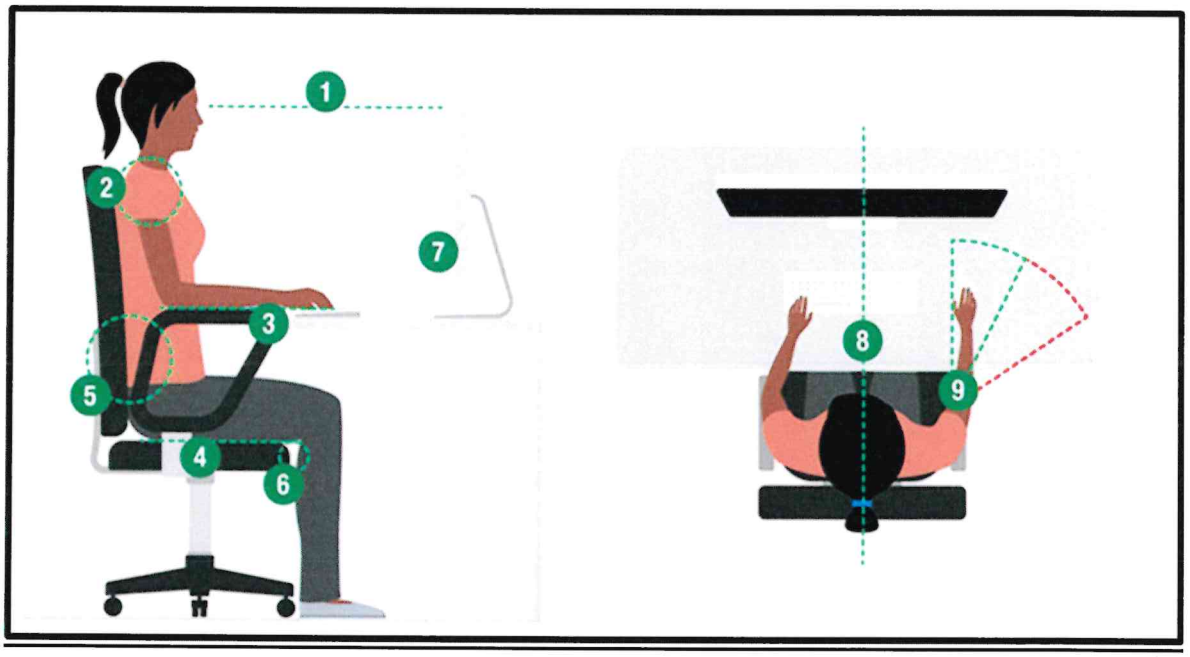
4.4.1.2 The organisation and social environment:

1. Teamwork and team structure.
2. Supervision and leadership.
3. Supportive management.
4. Communications.
5. Resources.

4.4.1.3 Tools that will be adopted for assessing and management.

For sitting working stations: The HSE Display Screen Equipment (DSE) Checklist will be used.

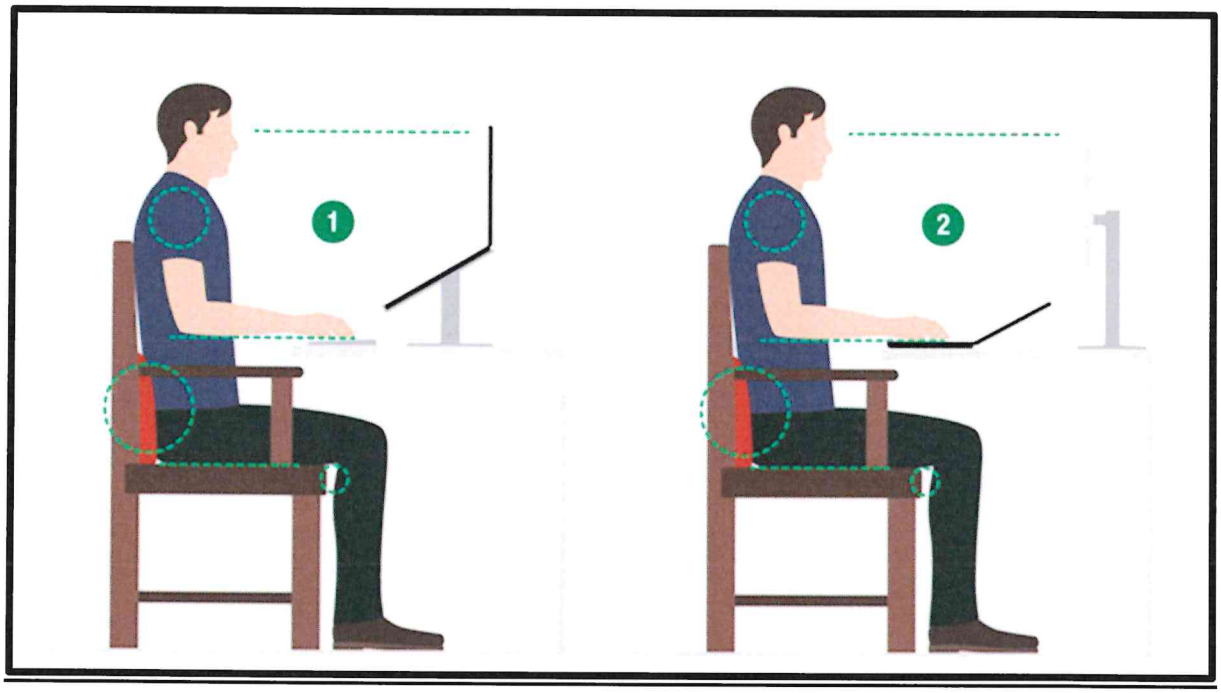
Figure 1: Standard Workstation Setup



1. Top of screen level with eyes about an arm's length away
2. Relax your shoulders - try to position yourself high enough so you don't need to shrug your shoulders.
3. Keyboard just below elbow height.
4. Seat height equally supports the front and back of thighs (or use a cushion to raise the seated position)
5. The back of the seat provides good lower back support (or use a cushion to provide additional back support)

6. The gap of 2-3 cm between the front of the seat bottom and the back of the knee
7. Computer and screen directly in front of you on a desk or another surface
8. Screen and keyboard central - don't twist your back.
9. Mouse in line with elbow

Figure 2: For Laptop Users



1. The keyboard and mouse are separate from the laptop, so the screen can be elevated on a laptop riser or similar.
2. Display screens separate from the laptop.

4.4.1.3.1 Manual handling activities

The HSE tools will be used for assessing the manual handling activities; depending on the task, the following tools will be used:

1. Using the Manual Assessment Chart (**MAC)** tool will help you assess the most common risk factors in lifting (and lowering), carrying and team handling operations.

2. Repetitive task operations use **ART** (Assessment of Repetitive Task Tool)
3. The Variable MAC tool (V-MAC) with the MAC tool for lifting operations where load weights or handling frequencies vary, such as when loading a lorry with a range of items of different weights.
4. The Risk Assessment for Pushing and Pulling (RAPP) tool will help you assess pushing and pulling operations.
5. The full Risk assessment HSE tool will be used for a full assessment.
6. The maximum lifting weight, as per NIOH recommendations, will be 23 kg.

Pushing, pulling, lifting, and carrying should always deploy mechanical assistance as far as reasonably practicable. These can be found in the **HSE manual handling operations Regulations**

4.4.1.4 Activities that involve working in assembly lines, conveyor belts, warehouses and workshops.

For the above-mentioned activities, the full risk assessment and management will follow the Ergonomics Check Points Second Edition Guide by the International Labour Organization.

4.4.1.5 Organisational factors

The TNCL management will ensure the roster for the employees will ensure the working environment supports teamwork and good communication. The work design and purchasing of ergonomically friendly equipment and furniture will always follow OHS recommendations.

4.4.1.6 Personal factors

Through the clinic communicable diseases programs, health education will be given regarding the importance of physical exercises and the health effects of smoking, alcohol and obesity. In a wide aspect, lifestyle modification will be encouraged for all employees and contractors.

4.5 Management of Vibration

Vibration is the rapid reciprocating motion of a solid surface. The energy from vibration can be absorbed into the human body, causing injury. Workers in a wide variety of industry sectors may encounter equipment, machinery and tools which generate and transmit vibration. It is convenient to recognize two types of vibration as they affect the human body: Hand-Arm Vibration (HAV) and Whole-body vibrations (WBV).

The commonest diseases that can be caused by hand-arm vibration are Hand-arm vibration syndrome and carpal tunnel syndrome. The commonest diseases that can be caused by whole-body vibration are degenerative disc disease, mechanical lower back pain syndrome, and disc prolapse.

4.5.1 Management of vibration at the workplace.

The main questions to be asked are:

1. Are my employees at risk from vibration?
2. How can I assess the risk?
3. How can I estimate the daily vibration exposure?
4. How can I plan to manage the risk?

TNCL managers and contractors must make a "suitable and sufficient" assessment of the risks to their workforce and then take action to manage any risk found.

4.5.1.1 Risk assessment

The risk assessment can be made in a number of steps and will include the following:

1. Identifying employees at risk.
2. Making a soundly based estimate of the employees' vibration exposures and comparing these with the Exposure Action (EAV) and Limit Values (ELV),
3. Determining relevant options for controlling risks.
4. Taking the required steps to control and monitor those risks.
5. Keeping records.

As a starting point, consider the industry you are working in, the processes involved, and the tools and equipment used. Typical industries where vibration risks are likely to occur are:

1. General and heavy engineering, fabrication, and metalworking.
2. Forestry.
3. Landscape gardening and maintenance.
4. Foundries.

5. Shipbuilding and ship repairs.
6. Construction and civil engineering.
7. Woodworking and joinery.
8. Road and railway construction and maintenance.
9. Mines and quarries.
10. Motor vehicle manufacture and repair.
11. Utilities - gas, electricity, water, telecommunications, etc.
12. Typical high-risk jobs and processes within these (and other) industries include:
13. Drilling and breaking of rock, concrete, and other materials.
14. Consolidating and compacting sand, concrete, and aggregate.
15. Riveting, caulking, hammering, clinching, flanging and hammer swaging.
16. Preparing and dressing welds.
17. Surface preparation, including scabbling, de-scaling, and paint removal.
18. Cutting metal, wood, grass, stone, bone, etc.
19. Holding or supporting items being worked on by machines (e.g., pedestal grinders).
20. Component or product assembly.
21. The use of impact or percussive (hammer-action) tools for more than about 15 minutes per day.
22. The use of rotary-action tools (e.g., grinders, sanders) for more than about 1 hour per day.
23. Where the manufacturer of a tool or machine warns of a vibration risk.
24. Any jobs where one or more employees have been affected by vibration (numbness and tingling)

4.5.1.2 Identify the people at risk.

Identifying the employees at risk from vibration is usually a simple task. Those who use vibratory tools/equipment the most are the most at risk. Those whose vibration exposure is regularly above the Exposure Action Value are most at risk, but even low levels of vibration exposure, when spread over a long enough time, may cause vibration injury.

4.5.1.3 Evaluate the risks

- Determine vibration exposure.

- The risk to employers from vibration should include the determination of the employees' vibration exposure. This may be done on an individual basis or in terms of occupational groups. An occupational group in this context is a group of people who are estimated or measured as having the same or similar exposure to vibration. People's job titles may or may not be a guide to this; an occupational group may be only part of a group with the same job title, or it may include people with several different job titles.
- The methods for determining vibration exposures are detailed in the Health and Safety Executive, control of vibration at work Regulations, L40.
- The exposure action value for hand-arm vibration is 2.5m/s2, and for whole-body vibration is 0.5m/s^2.
- The exposure limit value for hand-arm vibration is 5m/s2, and for whole-body vibration is 1.7m/s^2.
- The measurements must be conducted by the Registered Occupational Hygienist every two years or at shorter intervals as per the operational requirements.

Other factors affecting the risk of vibration.

Other factors which could influence the degree of risk should also be considered. These may include:

1. Ergonomic factors (weight, grip tightness on the handles, posture, etc);
2. Temperature of the tool and the air;
3. Humidity and wetness of the hands, including that from rain if working outdoors.

4.5.1.4 Producing an action plan to manage the risk.

The Action Plan

While assessing the vibration exposures and the work processes which cause them, one should at the same time be considering how best to reduce or eliminate the exposures. The process of risk assessment leads to the identification of reasonably practicable controls and is not complete until the action plan for risk control has been completed.

The stages in producing the Action Plan can include the following:

1. Identify the sources of vibration.
2. Prioritise them in terms of their contribution to the risk (exposure).
3. Identify solutions and evaluate them in terms of practicability and cost.

4. Plan the introduction of reasonably practicable controls with timescales.
5. Plan the introduction of health surveillance if exposures are still likely to exceed the action value.
6. Define management responsibilities and allocate adequate resources to implement controls, evaluate them and monitor progress.

4.5.1.5 Methods for reducing exposure and risk.
In approximate order of effectiveness, the basic methods for reducing vibration exposure, and hence risk, include:

1. **Eliminate** the use of vibrating tools or equipment by introducing mechanisation. This includes a good purchasing policy in which the OHS team will be involved before the procurement of machines/equipment.
2. **substitute** with alternative, vibration-free processes.
3. **Modify** the existing process to reduce vibration exposures.
4. **Replace** older tools with modern, vibration-reduced designs through an effective purchasing policy.
5. Use **correct consumables** (grinding discs, etc.) and replace them when required.

    - Provide **information, instruction, and training** on the safe use of tools and equipment.
    - Ensure adequate **supervision** of operators of vibrating tools.
    - Carry out frequent **maintenance** of tools as recommended by the manufacturer.
    - Minimise the **forces** needed to operate and control tools and
    - Reduce the exposure time through, e.g., **job rotation**.

Where no alternative tools or methods of vibration exposure reduction are available that result in a lowering of the exposure below the ELV, the exposures must be reduced to the lowest level reasonably practicable. This would be a case for increased frequency of health surveillance.

4.5.1.6 Record the findings and the action plan.

Record the findings of the assessment.
Under the Regulations, a record must be kept of the significant findings of the assessments and actions to be carried out to control the risk. Suitable types of information to record include:

1. The employees, operations and processes.
2. Description of the workplace, tools, working methods, etc;
3. Any vibration control measures already in place.
4. Likely vibration magnitudes and the source of this information.
5. Work patterns and exposure time assessments.
6. Those whose exposures are likely to exceed the EAV or the ELV.
7. Immediate measures were taken to reduce exposures below these values.
8. Identification of requirements for risk reduction, health surveillance, instruction, training, etc.
9. Identification of suitable measures to reduce vibration exposure and the resources which would be required.
10. Any other information is necessary to aid compliance with the duty to reduce exposure and control risk.
11. The date of the assessment and who made it.

4.5.1.7 Review the assessment.

The risk assessment must be regarded as a 'live' document which needs to be reviewed at regular intervals, say every 2-3 years. A review will also need to be carried out when there are changes in the workplace affecting exposure levels and risk. These would include the introduction of new machinery and processes, changes in working methods or patterns, and if any vibration controls are put in place.

Table 2: Elements of Risk Assessment of Hand Arm Vibration

When assessing the Hand-Arm Vibration, the following elements must be included:

Contributing factor	Required to be considered in the assessment
Vibration characteristics	Magnitude (rms, peak) Frequency (dominant frequencies) Direction (x-, y-, z-axes)
Tools or processes	Tool design (portable, fixed, remote) Tool type (percussive, rotary, rotating percussive) Tool condition and maintenance Operation (circumstances of use) Material being worked (concrete, metal, wood)
Exposure conditions	Duration (daily, yearly exposures) Pattern (continuous, intermittent, rest periods) Cumulative exposure duration
Individual characteristics	Method of working (grip force, push force, posture) – ergonomic factors Health (of the individual) Smoking and drugs (medicines) Information, instruction and training Skill (in the use of tools) Use of gloves (of benefit in cold weather) Individual susceptibility to injury
Other factors and environmental conditions	Ambient temperature Airspeed Humidity Noise levels Dynamic response of the finger-hand-arm system Mechanical impedance Vibration transmissibility Absorbed energy. Design of tool

4.6 Manual Handling Operations

That means human effort is involved rather than mechanical handling by devices such as cranes or lift trucks. Using a mechanical aid, such as a sack truck or a powered hoist, may reduce but not eliminate manual handling as human effort is still required to move the mechanical aid or to steady or position the load on the aid.

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Manual handling includes both transporting a load and supporting a load in an astatic posture. The load may be moved or supported by the hands or any other part of the body, for example, the shoulder. Manual handling also includes the deliberate dropping or throwing of a load, whether into a container or from one
person to another.

The Labour Force Survey (LFS) estimates that work-related MSDs, including those caused by manual handling, account for around 40% of all work-related ill health in the UK. There is evidence that manual handling, heavy manual labour, awkward postures and a recent or existing injury are all risk factors in the
development of work-related MSDs.

Management of Manual Handling Operations.

TNCL management recommends the following:

1. Avoid the need for hazardous manual handling 'so far as is reasonably practicable';
2. Assess the risk of injury from any hazardous manual handling that can't be avoided.
3. Reduce the risk of injury from hazardous manual handling 'so far as is reasonably practicable.

4.6.1 Risk Assessment.

The specific tools for risk assessment are mentioned in the ergonomic sections above. However, factors that must be taken into consideration when conducting risk assessments are:

Table 3: Elements of Manual Material Handling Risk Assessment

FACTORS	QUESTIONS
The tasks	1. Holding or manipulating loads at a distance from the trunk?
	2. Unsatisfactory bodily movement or posture, especially:
	a) Twisting the trunk?
	b) Stooping?
	c) Reaching upwards?
	d) Excessive movement of loads, especially:
	e) Excessive lifting or lowering distances?
	f) Excessive carrying distances?
	g) Excessive pushing or pulling of loads?
	h) Risk of sudden movement of loads?
	i) Frequent or prolonged physical effort?
	j) Insufficient rest or recovery periods?
	k) A rate of work imposed by a process?
The loads	1. Heavy?
	2. Bulky or unwieldy?
	3. Difficult to grasp?
	4. Unstable, or with contents likely to shift?
	5. Sharp, hot, or otherwise potentially damaging?
The working environment there:	1. Are space constraints preventing good posture?
	2. Uneven, slippery, or unstable floors?
	3. Variations in the level of floors or work surfaces?
	4. Extremes of temperature or humidity?
	5. Conditions causing ventilation problems or gusts of wind?
	6. Poor lighting conditions?
Individual capability	**Does the job:**
	1. Require unusual strength, height, etc?
	2. Create a hazard to those who might reasonably be considered to be pregnant or to have a health problem.
	3. Do you require special information or training for its safe performance?
Other factors	Is movement or posture hindered by personal? Protective equipment or clothing?

4.6.2 Hierarchy of Controls

Elimination will be the best method of handling manual handling activities. If not practicable, the substitution method is highly recommended.

Should both of the above methods be not practicable, Engineering controls are highly recommended.

Automation and/or mechanisation measures should be implemented. Automated is when the duty will not involve human interphase for the mechanisation measures when the human efforts will be minimised.

4.6.2.1 Mechanical assistance

Mechanical assistance involves the use of handling aids – some manual handling is retained, but bodily forces are applied more efficiently, reducing the riskof injury. There are many examples:

1. A simple lever can reduce the risk of injury by decreasing the bodily force required to move a load or by removing fingers from a potentially damagingtrap.
2. A hoist, either powered or hand-operated, can support the weight of a loadand leave the handler free to control its position.
3. A trolley, sack truck or roller conveyor can greatly reduce the effort required tomove a load horizontally.
4. Chutes and flow racking are convenient ways of using gravity to move loadsfrom one place to another.
5. Handling devices such as hand-held hooks or suction pads can simplify theproblem of handling a load that is difficult to grasp.
6. Hand pallet trucks and roll cages are ways of moving bulky loads manually.
7. Turntables, inverters and drum rotators can be used to manipulate bulkyloads.
8. Powered lift trucks can be used to move items such as pallets into position formanual handling of individual items on the pallet.

Figure 3: Small hand-powered hydraulic hoist

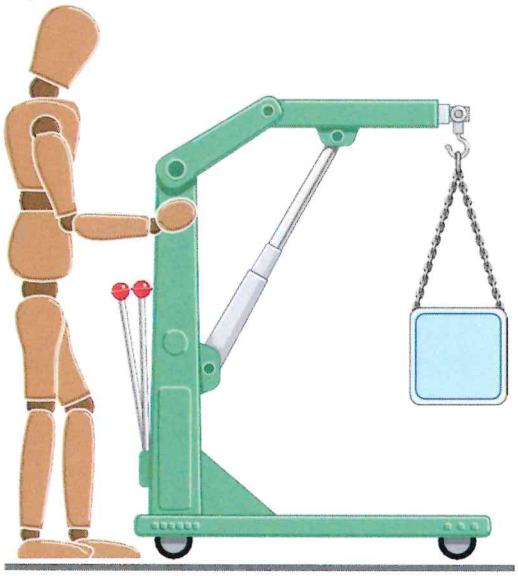


Figure 4: Roller conveyors.

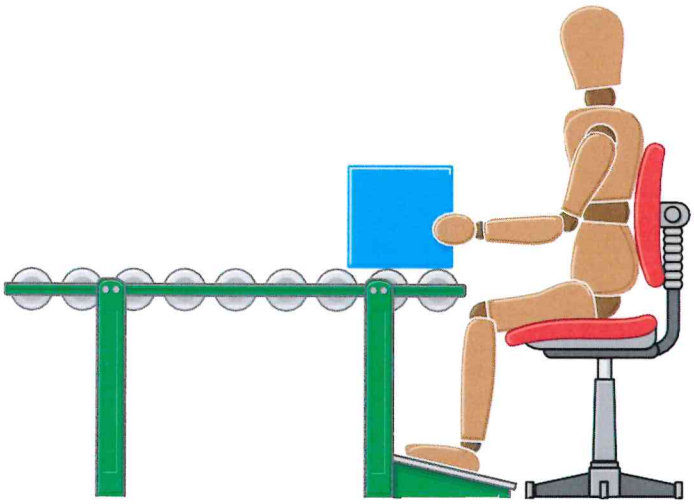


Figure 5: Moving large sheet material.

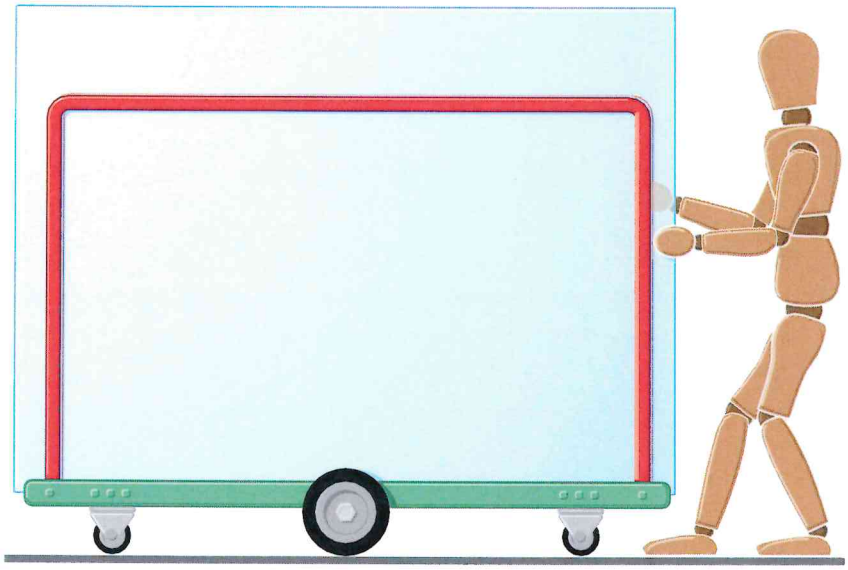


Figure 6: Small hydraulic lorry loading crane.

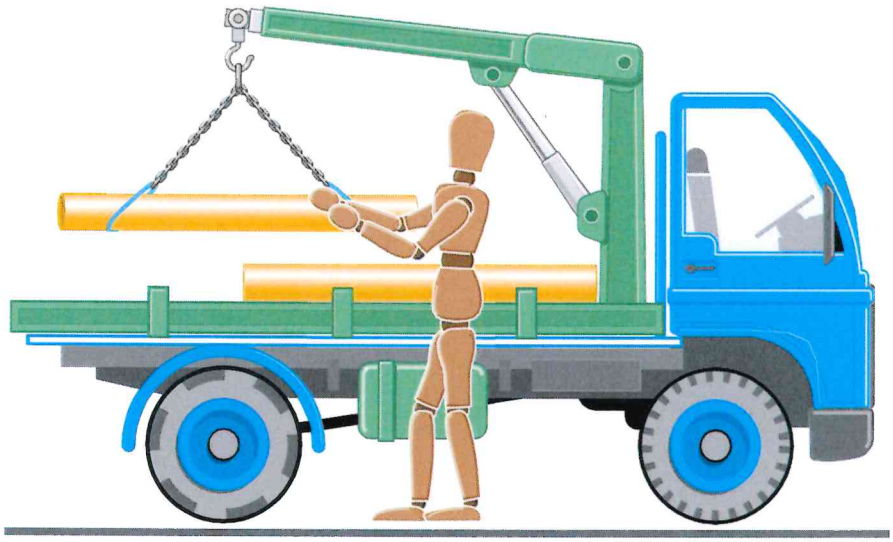


Figure 7: Patient standing hoist.

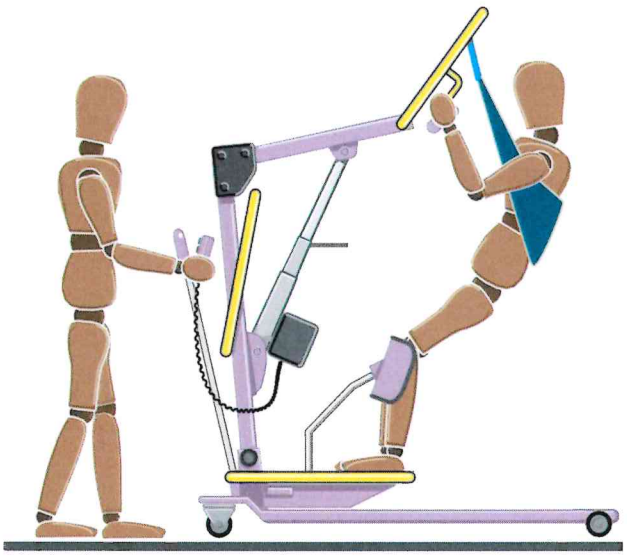


Figure 8: The simple, low-tech sack trolley.

Figure 9: Powered vacuum lifter.

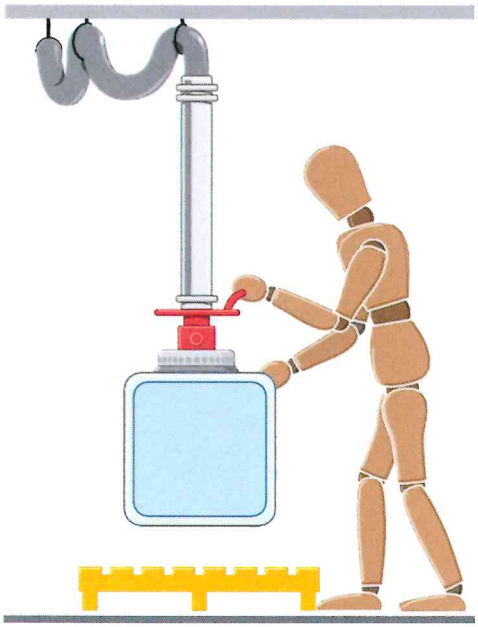
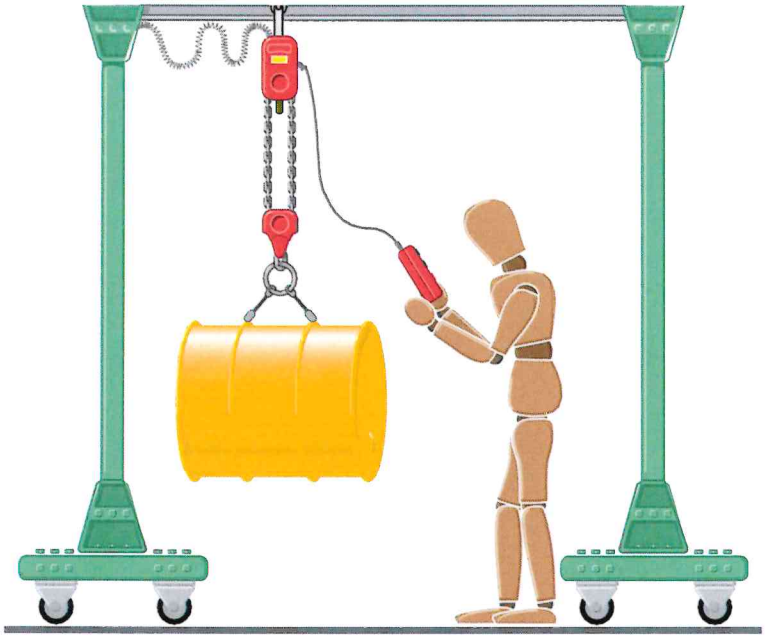
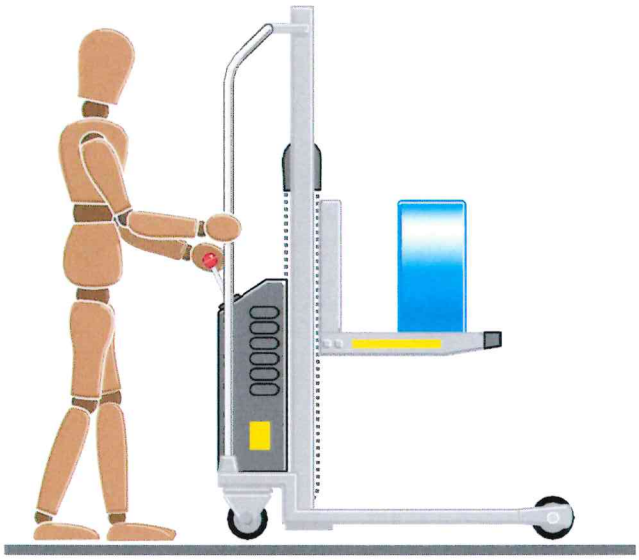


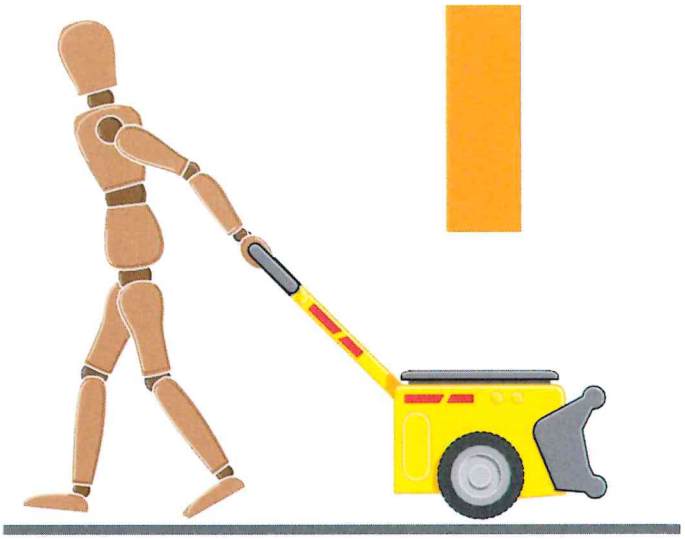
Figure 10: Electric hoist on the mobile gantry.





Truck with powered lifting mechanism

Figure 11: Mobile welding set.



4.6.3 Administrative controls:

Training in good lifting techniques, job rotation, weightlifting limits and assessment of physical capacity through medical surveillance will be conducted.

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5. SYSTEM EVALUATION

This guideline shall be reviewed at least two years by members of the OHS department and presented to the Standard Committee for approval or when organisational changes take place or are required as part of internal and external audits. The TNCL Document Controller will monitor compliance with the document control system on an ongoing basis.

6. DISTRIBUTION

List physical locations which require a controlled copy of this document.

Copy	Controlled Document Folder Location
Master	Controlled Documents Central Filing System

7. CONTRAVENTION

Any breach of this guideline shall be regarded as refusal/failure to carry out a lawful instruction and will be dealt with as per the disciplinary procedure.

8. DOCUMENT CHANGE PROCESS

The process of document change starts when the document custodian identifies there is a need to make changes within the document. The document custodian/ owner shall complete the document change request form, sign it off and submit it to the Document Controller.

The Document controller shall issue the controlled word copy of the document to the respective document custodian/owner so that changes may be made. The document custodian/owner shall resubmit the updated document to the document controller so that the document can be controlled and updated within the Filing system, ready for use by the end users.

8.1 Reason for Change

A	As a result of incidents	F	Change in training requirements
B	As a result of the audit findings	G	Results of risk assessments
C	New / changes in governance documents	H	Change due to spelling or grammatical error
D	Changes in legislation	I	New document format
E	Changes in technology	J	To integrate special instruction into the document control system

8.2 History of Change

Date of Change	Revision No	Revised Item (paragraph Number reference if required)	Reason Code	Name of Reviewer

9. RECORD CONTROL

Document Title:	Document ID:	Responsible for Maintenance:	Responsible for Filling:	Location of Storage:	Retention Period:	Method of Disposal:
ERGONOMICS AND VIBRATION GUIDELINE	TNCL-OHS-GDL-0005	Document Controller	Document Controller	OHS Department	Hard Copy two Years	Hard copy shared file electronic

10. DECLARATION

I hereby declare that I have taken part in the discussion of this guideline, and I understand its contents and do commit that I shall ensure compliance hereto:

	Name and Surname	Company Number	Designation / Role	Signature	Date Signed
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