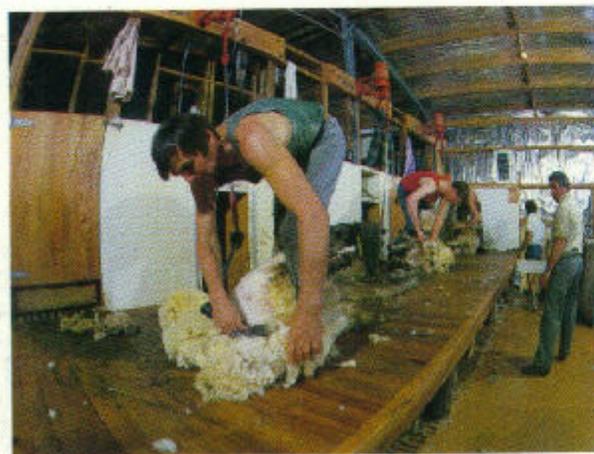
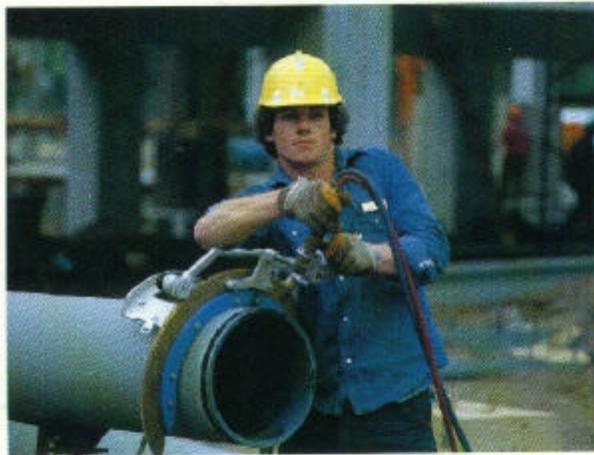
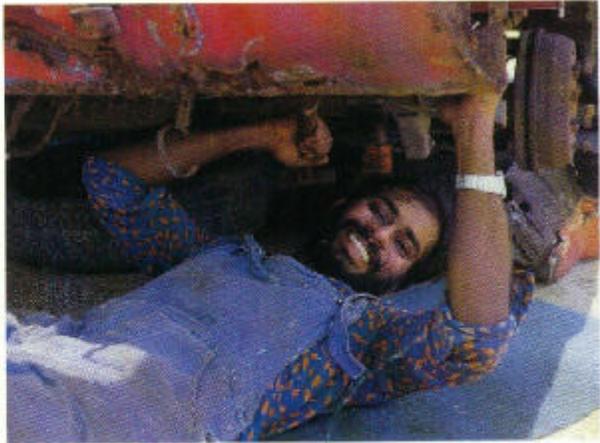


# •Manual Handling

## •GUIDELINES FOR THE WORKPLACE



# OSH

OCCUPATIONAL SAFETY  
& HEALTH SERVICES

DEPARTMENT OF  
|L|A|B|O|U|R|  
TE TARI MAHI

Published by the Occupational Safety and Health Service  
of the Department of Labour, Wellington, New Zealand.

First edition: July 1991

ISBN 0-477-03487-X

\$9.95 incl. GST

**Acknowledgement**

*The Occupational Safety and Health Service acknowledges the assistance provided by the Occupational Safety and Health Division of the Victorian Department of Labour, and Worksafe Australia in the development of this document. Considerable material has been directly sourced from these organisations.*

P197/5,000/1991

# ●CONTENTS

4.9 WORK ENVIRONMENT	15
4.10 SKILLS AND EXPERIENCE	15
4.11 AGE	15
4.12 CLOTHING	16
4.13 SPECIAL NEEDS	16

## **Part 1: Introduction**

**5**

1.1 PURPOSE	5
1.2 COMPLIANCE	5
1.3 DEFINITIONS	5
1.4 RESPONSIBILITIES	5
1.5 INTERPRETATION	5

## **Part 2: General principles**

**6**

2.1 CONSULTATION	6
2.2 DESIGN	6
2.3 REVIEW AND EVALUATION	7
2.4 RECORD KEEPING	7
2.5 TRAINING	7
2.6 RISK IDENTIFICATION, ASSESSMENT AND CONTROL	8

## **Part 3: Risk identification**

**9**

3.1 ANALYSIS OF WORKPLACE INJURY RECORDS	9
3.2 CONSULTATION WITH EMPLOYEES	9
3.3 DIRECT OBSERVATION	9

## **Part 4: Risk assessment**

**10**

4.1 ACTIONS AND MOVEMENTS	10
4.2 WORKPLACE AND WORKSTATION DESIGN OR LAYOUT	10
4.3 WORKING POSTURE AND POSITION	11
4.4 DURATION AND FREQUENCY OF MANUAL HANDLING	12
4.5 LOCATION OF LOADS AND DISTANCES MOVED	12
4.6 LOADS AND FORCES	12
4.7 CHARACTERISTICS OF LOADS AND EQUIPMENT	13
4.8 WORK ORGANISATION	14

## **Part 5: Risk Control**

**17**

5.1 JOB REDESIGN	17
5.2 MECHANICAL HANDLING EQUIPMENT	22
5.3 TEAM LIFTING	22
5.4 TRAINING	23
5.5 OTHER RISK CONTROLS	24

## **Appendix A: Risk Identification Checklist 25**

## **Appendix B: Risk Assessment Worksheet 27**

## **Appendix C: Risk Control Worksheets 29**

## **Appendix D: Risk Assessment and Control Options 31**

## **Appendix E: Extracts from the Legislation 32**

## **Appendix F: Sources of Further Information 33**

## **Appendix G: Brief Bibliography 34**

# ●PART 1: INTRODUCTION

## 1.1 Purpose

The purpose of this publication is to provide practical guidance for the identification, assessment, prevention and control of the hazards and risks associated with manual handling in the workplace.

## 1.2 Compliance

Following these guidelines can be regarded as a means of compliance with the relevant sections of the Factories and Commercial Premises Act 1981 and the Construction Act 1959.

## 1.3 Definitions

Manual handling is defined as any activity requiring a person to lift, lower, push, pull, carry, move, hold or restrain any animate or inanimate object.

Practicable as used in these guidelines means having regard to:

- The severity of the hazard and risks arising from that hazard;
- The state of technical knowledge about the hazard

and risk and any ways of removing or mitigating that hazard or risk;

- The availability and suitability of ways to remove or reduce that hazard or risk;
- The costs of removing or mitigating the hazard or risk; and
- Any other relevant factors and circumstances.

## 1.4 Responsibilities

An employer has a general duty to provide and maintain reasonable working conditions to prevent injury and ill health affecting employees and others lawfully on the premises.

Where a manual handling task exposes an employee to such a risk the employer should ensure that the task is identified and assessed, and must ensure that it is controlled. (Refer to section 18(1) of the Factories and Commercial Premises Act 1981 and section 22 of the Construction Act 1959.)

An employee must take all reasonable and necessary precautions for his or her own health and safety when carrying out manual handling tasks. (Refer to section 18 of the Factories and Commercial Premises Act 1981 and section 23 of the Construction Act 1959.)

## 1.5 Interpretation

While this publication aims to provide detailed guidance, it is not possible to deal with every situation which may be found in the workplace. Therefore, discretion and judgement will be needed in applying the guidelines.

# ●PART 2: GENERAL PRINCIPLES

## 2.1 Consultation

The identification, assessment and control of manual handling tasks should be carried out by employers in consultation with employees who are required to carry out the tasks and the health and safety committee/representative(s) -- if appointed on site. (Refer to the voluntary *Code of Practice for Health and Safety Committees and Representatives* for advice.) Such consultation should occur:

- As early as possible in planning for the introduction of new or modified manual handling tasks, the review of existing tasks, or when work organisation is being reviewed (as set out in section 4.8 below ) -
  - to allow for changes arising from the consultation to be incorporated;
- While the employer is identifying the problem areas in order to establish priorities for assessment;
- When determining the approach and methods to be used in assessing the manual handling tasks;
- When decisions are being taken on control measures to reduce risk factors; and
- When the effectiveness of implemented control measures is being reviewed.

In some cases it may be necessary to seek expert assistance in applying these guidelines. Potential sources of further information are listed in appendix F.

## 2.2 Design

An employer should take all reasonable precautions to ensure that:

**Plant and equipment** used in the workplace are designed, constructed and maintained to be, as far as practicable, safe and without risk to health and safety when manually handled or used for manual handling;

**Work practices** involving manual handling are designed to be, as far as practicable, safe and without risk to health and safety; and

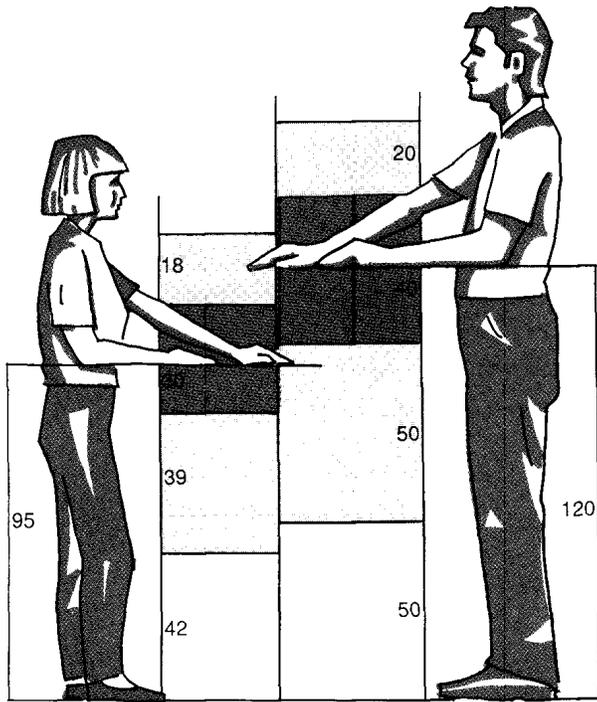
The **working environment** is designed to be, as far as practicable, consistent with safe manual handling practices.

(Refer to section 18(1) of the Factories and Commercial Premises Act 1981 and section 11, of the Construction Act 1959.)

**Additional costs are incurred in redesigning or modifying plant or processes once they are being used in the workplace. It is therefore not only more practical but also more cost-effective to reduce risk factors at the design stage.**

Purchasing specifications should specify the uses or functions of the plant and equipment, and, where possible, the general performance characteristics required to reduce the risk to health and safety.

The design of plant, equipment and workplaces needs to follow ergonomic principles, and the design must accommodate the range of physical characteristics of the workforce. Information concerning human dimensions, limitations and capabilities should be taken into account to provide an optimum match between people and plant, equipment and the working environment.



**Fig 1 Workplaces should incorporate adjustable features to accommodate people who are not of average size**

Equipment and furniture should be 'designed so that they can be used safely. It is also desirable to design activities and tasks to suit the capacity of the widest possible range of the workforce to avoid discrimination against particular groups. That is, the employer is required to take account of the safety of each employee, and not simply design a system which might be safe for an "average" person in the workforce.

Some general principles for reducing risks associated with manual handling, which should be incorporated into the design of workspaces, plant and equipment are:

- Minimise the lifting and lowering forces exerted;
- Avoid the need for bending, twisting and reaching movements; and
- Reduce pushing, pulling, carrying and holding.

Aspects to consider at the design stage include:

- Size, surface characteristics, stability and weight of objects;
- Vertical and horizontal movements involved;
- Workplace layout and general environment; and

- Work postures and space requirements.

These aspects should be considered in relation to the following stages of the handling process:

- Transportation and reception;
- Handling at the workplace; and
- Storage and distribution.

## 2.3 Review and Evaluation

The implementation of this risk control approach, as with any successful systematic process, does not end with the implementation of some change. The effectiveness of the new control measures needs to be reviewed regularly to ensure that the objectives are being met and that there are no unforeseen problems.

## 2.4 Record Keeping

Records associated with the implementation of these guidelines should be maintained in a central location and will make the task of review and evaluation easier. These records should be available to employees and their safety and health representatives.

The records may include information on:

Manual handling injury prevention programmes;

- Risk assessment reports;
- Design modifications to, and specifications for, plant and work processes;
- Risk control measures implemented; or
- Training and education activities.

## 2.5 Training

Each employee should receive adequate training before beginning any new manual handling task. The training should include instruction in the correct method for performing the task, the risks involved with the task, and the reporting procedures should injury occur.

An employer should ensure that no employee undertakes any work unless that person has sufficient knowledge and skills to carry out those tasks safely. An employer must provide training or supervision where an employee's knowledge and/or skills are insufficient. (Refer to section 20 of the Factories and Commercial Premises Act 1981 and section 11 of the Construction Act 1959. Further information is also given in section 4.10 of these guidelines.)

Specific groups requiring training in manual handling are:

- Supervisors and managers of employees involved in manual handling tasks;
- Employees working at manual handling tasks; and
- Staff responsible for work process design and purchasing.

Objectives should be established and should include:

- The reduction of manual handling injuries by an approach that emphasises primary prevention through work processes, workstation and task design;
- The recognition and promotion of the understanding of the multifaceted nature of manual handling problems; and
- The promotion of safe manual handling techniques.

## **2.6 Risk Identification, Assessment and Control**

This publication provides guidance in the following three key stages in the process of reducing manual handling injuries.

1. **Risk identification** of factors in the workplace likely to cause manual handling injuries (see part 3 following).
2. **Risk assessment** in detailed assessment of particular risk factors (see part 4).
3. **Risk control** -- measures that can be applied to eliminate or reduce risk (see part 5).

# ●PART 3: RISK IDENTIFICATION

Before manual handling tasks that are likely to be a risk to health and safety can be assessed and controlled, it is important that they are fully identified. Risk identification should therefore be undertaken on a regular basis.

The purpose of risk identification is to:

- Identify; and
- Place in priority order.

There are three basic steps to risk identification:

- 1 Analysis of workplace injury records;
- 2 Consultation with employee; and
- 3 Direct observation or inspection of the task or work area.

If any of the three steps indicate the need for assessment, part 4 of this publication provides advice on that assessment.

## 3.1 Analysis of Workplace Injury Records

Records of accidents and incidents should be examined to identify where, and in what jobs, manual handling injuries have occurred.

Indicators to consider include:

- The area of the workplace where the injury occurred;
- The occupation, or job/task of the injured person;

- The part of the body injured, for example, back, neck or shoulder;
- The nature of the injury, for example, strain, sprain, laceration or fracture; and
- The type of incident, for example, over-exertion and physical stress in lifting objects, or slips and falls while handling objects.

It is often useful to examine injury records to find out the frequency and severity of injuries and compare them to the number of employees or hours worked to determine the incidence rate. Comparisons can also be made between locations, occupations or tasks.

## 3.2 Consultation with Employees

It is important to consult with employees performing the tasks, as they are likely to be aware of the risk of manual handling injuries associated with their jobs.

Consultation during the risk identification process -- with employees carrying out the tasks and with their representatives on health and safety issues -- may also provide information about associated risk factors.

There should also be consultation when setting priorities for risk assessment. Employees may be able to indicate tasks or movements which are particularly fatiguing, strenuous or difficult to perform.

## 3.3 Direct Observation

The direct observation of work areas and of the task being performed will assist in identifying risk. Workplace inspections, audits and walk-through surveys, and the use of checklists can assist in the risk identification process. It is best if these direct observation tools are tailored to the specific characteristics of the organisation or industry concerned. A general risk identification checklist, and guidance on its use, is included as appendix A.

# I PART 4: RISK ASSESSMENT

When manual handling tasks have identifiable risks, detailed assessments should be carried out. Risk assessment is particularly critical whenever:

- An injury has arisen from a work process and/or practice; or
- A work process and/or practice is introduced or modified.

Employees should be advised of the results of the assessment and if they feel their health and safety is at risk, be given the right to refuse the task.

A general risk assessment worksheet is included as appendix B.

## GENERAL GUIDELINES

In assessing a job or a task, all risk factors need to be considered, and in determining appropriate control measures, the interaction of all the following factors should be taken into account:

**Actions and movements;**

**Workplace and workstation layout;**

**Working posture and position;**

**Duration and frequency of manual handling;**

**Location of loads and distances moved;**

**Loads and forces;**

**Characteristics of loads and equipment;**

**Work organisation;**

**Work environment;**

**Skills and experience;**

**Age;**

**Clothing, footwear; and**

**Special needs (temporary or permanent).**

Any other factors considered relevant by the employer, employees (or their representative(s) on health and safety issues) also need to be considered.

## 4.1 Actions and Movements

Actions and movements should not cause discomfort or pain. Actions should be performed smoothly and with control, avoiding sudden or jerky movements. Manual handling should be performed in a balanced and comfortable posture.

Extreme ranges of joint movement should be avoided, especially when this is prolonged or repetitive. Repetitive bending, twisting and overreaching movements are among those liable to increase the risk of manual handling injuries.

Mechanical aids should be employed when appropriate.

Variation from the above and/or answering YES to any of the following questions indicates an increased risk:

- Is the load shared unevenly between both hands, or lifted by one hand only?
- Is the object pushed or pulled across the front of the body?
- Is there a need to bend over to one side to lift an object or exert a force?
- Are two actions performed at the same time when one action is holding an unsupported fixed position?
- Are several tasks performed in the one position where some are best done in a seated position and the others are best done in a standing position?

## 4.2 Workplace and Workstation Design or Layout

The positioning of plant and its controls, equipment, tools and other materials in relation to each other and to the employee is important. It affects the working posture, working height, manual handling technique, duration, frequency

and other work actions and movements that are adopted by the employee.

The layout should permit the employee(s):

- To adopt an upright and forward-facing posture;
- To have good visibility of the task; and
- To perform the majority of tasks at about waist height and within easy reach.

Answering YES to any of the following questions indicates an increased risk:

- Is the layout inappropriate for the manual handling task and the size and capabilities of the employee(s) performing the task?
- Is there inadequate space for all movements involved in the manual handling task?
- Are appropriate mechanical handling aids unavailable for the task?
- Are the working heights non-adjustable or mismatched to the size of the employees and the tasks?
- Is there inadequate clear space for moving legs and feet?
- Is excessive movement required?

### 4.3 Working Posture and Position

Work activities should permit the employees to adopt several different, but equally healthy and safe working postures. No single posture should be maintained for long periods without the opportunity to change posture through a variation of activity or rest.

During manual handling, bending and/or twisting of the spine should be avoided, especially when this is prolonged or repetitive.

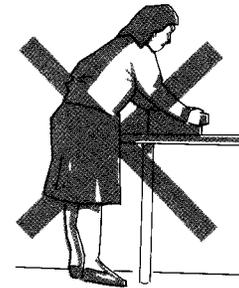
Answering YES to either of the following questions indicates an increased risk:

- Is the object presented to the employee in a position which makes it difficult to reach or grasp?
- During manual handling, is there frequent or prolonged movement of the types shown in fig 2.

(i) Reaching above the shoulder?



(ii) Bending forward?



(iii) Twisting the back?



(iv) Bending sideways?

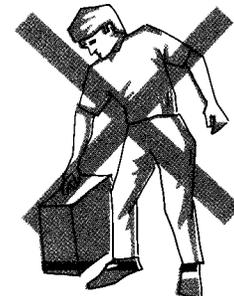


Fig 2 Working posture and position

## 4.4 Duration and Frequency of Manual Handling

The risk of injury rises with the increasing frequency, repetition and duration of manual handling in a work period.

Problems with frequency and duration are not restricted to lifting or lowering of loads. Pushing, pulling, carrying and holding can also be a problem if performed frequently or for prolonged periods.

The same manual handling task repeated over long periods of time may induce feelings of monotony and boredom. The resulting reduction in alertness may have an important effect on safety.

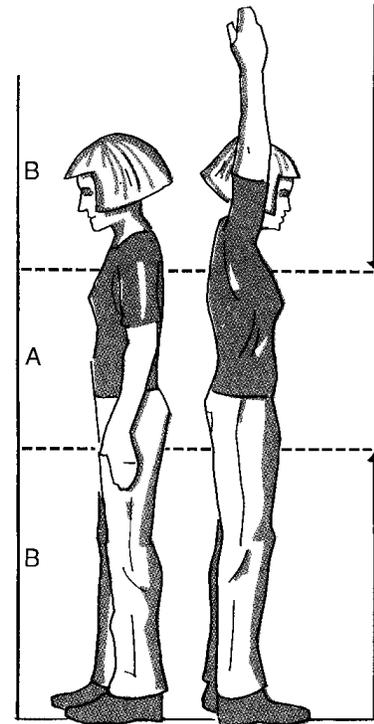
There are several factors which influence a person's ability to continue prolonged exertion. These include available energy reserves, the employee's physical fitness and the relative workload -- that is, the proportion of the employee's physical capacity engaged by the task.

Manual handling operations involving the use of smaller muscle groups, such as hands, (and whether in sustained or repetitive static activity) should not be overlooked in assessing risks. This is because these muscles fatigue quickly when overloaded.

## 4.5 Location of Loads and Distances Moved

Distances over which loads are manually handled should be as short as possible. The longer the distance the lighter the load that can be carried without increased risk.

If the load is located above the employee's shoulder height or below mid-thigh height, or otherwise requires extended reach, then the risk of injury is increased. An increased risk also occurs where the load requires precise manoeuvring into position.



**Fig 3 The best height range for handling loads is around waist level with lifting between the knuckle and the shoulder being acceptable. Frequently used objects should be stored in the "A" zone. Seldom-used objects should be stored as close as possible to the edge of the pallet, shelf or other support.**

## 4.6 Loads and Forces

Any load should be considered in relation to other key risk factors. These include, in particular:

- Frequency and duration;
- Position of load relative to the body;
- Distance moved; and
- Characteristics of the load.

Where heavier objects are handled, more care is needed in the assessment of risk and in the application of appropriate control measures.

It is not possible to specify a maximum load that an employee can be required to lift, lower, carry or hold. The determination of such a limit is dependent on the combination of risk factors found during the risk assessment. In addition, personal factors such as size, sex, age, health and level of fitness of the employee should be taken into account.

**Research has shown that the risk of injury increases when loads of more than 4.5 kg sitting and 16 kg standing are handled.**

These figures should not be regarded as fine lines between "safe" and "unsafe", but should be used as a guide when assessing the overall risk of any manual handling task.

Apart from lifting, lowering and carrying objects, many tasks in industry involve the use of force to push, pull, hold or restrain objects. Sometimes, as when holding or restraining, the force used does not actually result in movement. In other cases -- such as pushing levers, or pulling or sliding objects -- the amount of force used is not necessarily related to the movement. For example, considerable force may be required to move a lever a short distance.

The posture required and the working conditions affect the risk associated with applying a force to push, pull or restrain an object.

Figure 4 illustrates the application of force in two circumstances.

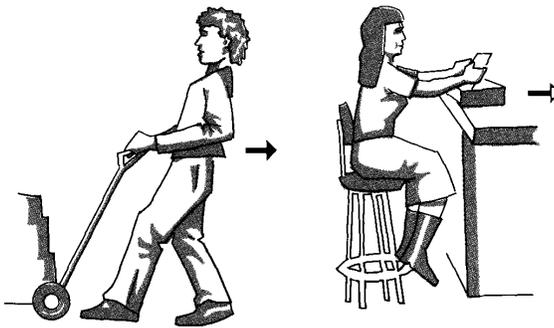


Fig 4

Answering YES to any of the following questions indicates an increased risk:

- When sliding, pulling or pushing an object, is it difficult to move?
- Is the employee required to exert a large force while seated?
- Is the employee required to push or pull while seated without having good seating and solid foot support?

## 4.7 Characteristics of Loads and Equipment

Characteristics of loads and equipment to consider when assessing risk -- in addition to weights and forces -- include:

- Dimensions; Stability;
- Rigidity; Predictability;
- Surface texture and temperature; and
- Grips and handles.

The need for gloves or similar personal protective equipment should also be assessed in relation to manual handling risks. Gloves may protect against hand injuries, such as abrasions and burns, but they will affect grip stability, dexterity and strength. The size, shape, structure and material of the load can also affect the risk of injury.

The handling of live animals or people (as hospital patients for example) increases the difficulty of assessing the risk, and limits the availability of some of the common controls which are used for inanimate objects. This is because the person or animal being handled can hinder (or assist) by moving independently of the people performing the handling. This may require the handlers to apply additional force to restrain the person or animal, or to exert sudden force in response to unexpected movements.

The nature or state of the person or animal may place additional demands on the handlers or limit the way the handling may be performed. Two examples are:

- Hospital patients require extreme care in handling, often while attached to fragile medical equipment.
- Disturbed animals (or even people) may require restraint in addition to the force needed to move them.

Answering YES to any of the following questions indicates an increased risk:

Is the object more than 500 mm wide (measured in direction across the body)?

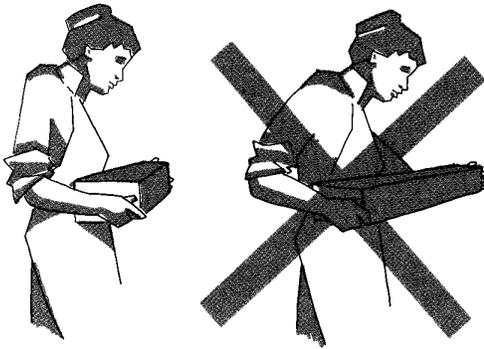


Fig 5

Is the object more than 300 mm long (measured away from the body)?

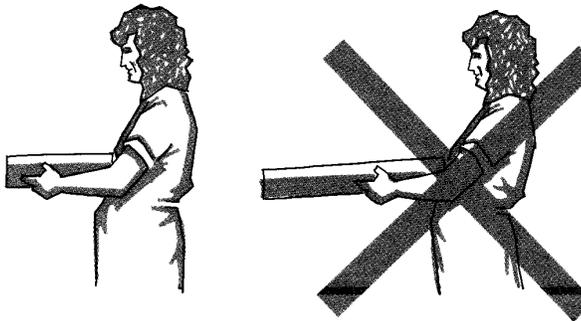


Fig 6

Are any two of the object's dimensions more than 750 mm?

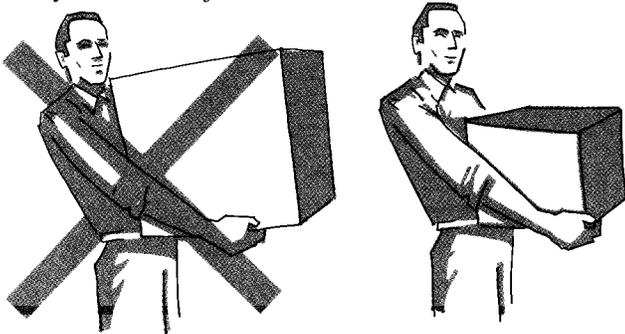


Fig 7

Does the person or animal need to be moved in a special way to ensure their health or safety?

Is the person or animal disturbed, excited or moving vigorously?

- Is the object an awkward shape to carry in a balanced posture?
- Is the object difficult to grasp or hold?
- Is the object unstable or unbalanced, or does it have contents that may move suddenly?
- Is the object smooth, slippery, greasy or wet?
- Does the object have sharp edges or protrusions?
- Is the object very hot or very cold?
- Does the object block the view of the employee when being handled?
- Does one person handle sheet material or other bulky loads without straps, special holders or a second person to assist?

## 4.8 Work Organisation

Work organisation may influence risk levels by interacting with other manual handling factors. Factors include staffing levels, availability of equipment, work schedules, shift work, work pace, task variety, rest breaks and recovery time and work procedures.

Answering YES to any of the following questions indicates an increased risk:

- Is the work frequency affected by bottlenecks, or sudden changes or delays to the flow of materials?
- Is the work affected by the unavailability of people to complete tasks to a deadline?
- Is team lifting not provided and/or safely organised when required?
- Are there insufficient numbers of employees to carry out the work -- including where peak workloads occur?
- Is there no effective maintenance programme for tools, plant and equipment used for manual handling?
- Are procedures for reporting and fixing unsafe equipment or environmental conditions adequate?

- Is the work flow disjointed?
- Is there a lack of effective selection/ purchasing, instruction and maintenance programmes for loads, equipment and mechanical handling devices?
- Is the work monotonous and without variation?
- Do employees have to work without adequate rest breaks?

## 4.9 Work Environment

Factors in the work environment that influence risk include:

- Climate; Lighting; Space; and
- Floors and other surfaces underfoot.

Housekeeping and footwear are associated factors that are of particular relevance in avoiding the risk of slips and falls while handling loads.

Answering YES to any of the following questions indicates an increased risk:

- Are the floors and surfaces underfoot uneven or slippery?
- Are there different floor levels in the workplace?
- Is the workplace untidy with a lack of attention to housekeeping details?
- Are there extremes of heat, cold, wind or humidity?
- Are there high levels of fumes, dusts, gases or vapours?
- Is there excessive vibration?
- Is the task performed in a confined space?
- Is the lighting below the levels recommended in NZS 6703:1984 *Code of practice for interior lighting design*?

## 4.10 Skills and Experience

Employees must have the knowledge and ability required to perform the task. A mismatch can cause an increased risk of injury. (Refer also to section 2.5.)

Answering NO to any of the following questions indicates an increased risk:

- Has the employee received appropriate training/education in manual handling hazards and/or techniques?
- Has the employee received appropriate training in recognising risk and evaluating tasks in order to select and apply appropriate handling techniques?
- Has training, appropriate to the tasks, been provided which relates to manual handling?
- Has the employee been properly inducted into the work practices and safety requirements in the workplace?
- For heavy handling tasks, has the employee had previous experience with heavy manual handling?
- Are the demands of the task within the physical capacity of the employee?

## 4.11 Age

Young workers -- those under the age of 18 -- are at greater risk of manual handling injuries than adult workers because they are still developing physically.

An increased level of care is needed in the assessment of risk and the application of appropriate control measures for young workers. As a guide, the younger the worker, the more care that needs to be taken.

Workers under 18 years of age should not be required to lift, lower or carry objects weighing more than 16kg without mechanical or other assistance. This assistance may include team lifting

and/or particular training for the task.

For older workers, increasing age may be associated with decreasing physical capacity. However, age alone is not sufficient for assessing risk, as older workers may be able to compensate any physical loss by their experience and skill at the task. All relevant risk factors need to be taken into account.

## **4.12 Clothing**

The type of clothing an individual wears at work may hinder safe manual handling, for example, tight clothing which restricts movements will adversely affect manual handling technique. When specialist clothing is required, such as a uniform or personal protective equipment, its effect on risk needs to be assessed. (Refer also to section 5.1.)

## **4.13 Special Needs**

In some instances, employees may have special needs that require consideration in the risk assessment process. These needs may be permanent or temporary, for example, returning to work from an illness or extended leave of absence, pregnancy, a specific disability, etc.

# ●PART 5: RISK CONTROL

Risk control is the process of eliminating or reducing manual handling problems that have been identified and assessed in the workplace.

Where a manual handling task has been assessed as a risk the employer should firstly, where practicable, redesign the task to eliminate or reduce manual handling.

If a manual handling problem cannot be eliminated or reduced by such redesign of the work process, the employer should, where practicable, provide suitable mechanised handling equipment.

Where mechanical handling equipment is provided, all parties should work to ensure that it is used properly and for the purpose intended.

If job redesign and/or the provision of mechanical handling equipment is not practicable, employers must ensure employee(s) are trained in the correct manual handling techniques to be applied.

Where job redesign is carried out and/or mechanised handling equipment is provided, care must be taken to ensure that other types of health and safety hazards are not introduced into the workplace.

Risk control worksheets are provided as appendix C.

## 5.1 Job Redesign

### MODIFY OBJECT

The object being handled may be modified or repackaged into a larger or smaller weight or a different size or shape.

Modifications suggested by the following questions may help to reduce the risk:

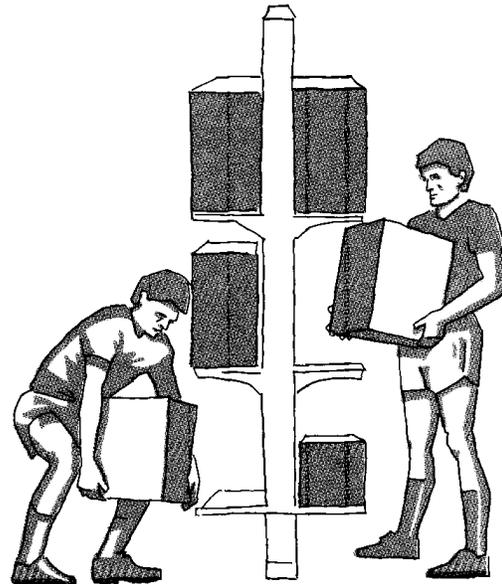
- Can the object be made lighter?
- Can the object be packaged in smaller containers?

- Can the object be made less bulky, so that it can be handled closer to the employee's centre of gravity?
- Can the shape or surface texture of the object be changed to make it easier to grip?
- Could the surface be cleaner or cooler, or the edges less sharp, so the employee can hold the object against the body?
- Can handles be provided, or some type of sling used to move the object?
- Is the object designed, or the material packaged, so that it will not shift unexpectedly while it is being used?
- Can the object be packaged to suit mechanical handling?

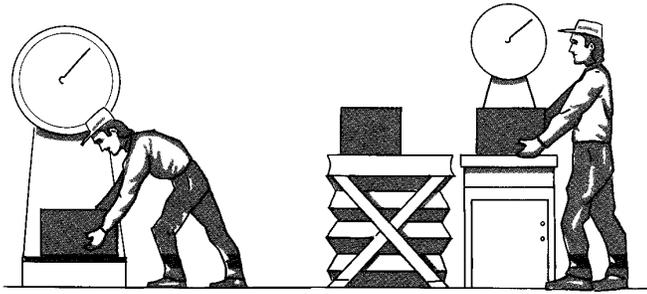
### MODIFY WORKPLACE DESIGN

The design of the plant, equipment and furniture may be modified or rearranged. This may include workstation, tool, implement or control design, or increased attention to housekeeping and maintenance.

Examples of the modification of workplace design or layout are given in figures 8 and 9.



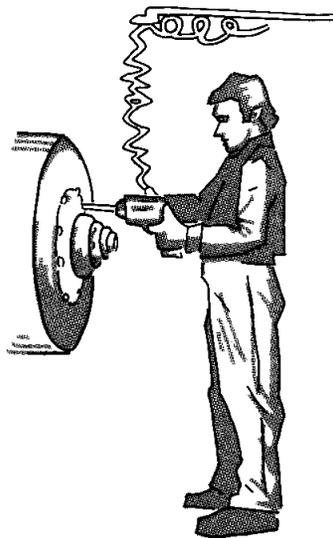
**Fig 8 Store heavier and frequently used objects at waist level**



**Fig 9 Adjustable work heights**

**The design of tools, implements and controls** has an influence on work postures, movements and physical stress. Some principles of good design are:

- Tools should be as light as their function will permit, that is, heavy tools fitted with devices to save the employee from having to support an unnecessary weight, and designed for two-handed use.



**Fig 10 Suspended tools avoid unnecessary loads**

- Tools should be well balanced. The angle between handle and working parts needs to be designed to avoid unnatural bending of the hands and arms;
- The handle design should suit the grip and force required, and preferably allow the user to change his or her grip.

- The grip surface should not conduct heat or cold easily, and should be textured to prevent hands from slipping. There should be no sharp or projecting parts to impose any uneven or unnecessarily heavy surface pressure on the hand;
- The positioning, resistance, direction of movement, and length of travel of controls needs to be suitable for the employees and the job;
- Tools should have insulation against vibration as necessary; and
- Tools should be suitable for both right-handed and left-handed employees and for different sized hands.

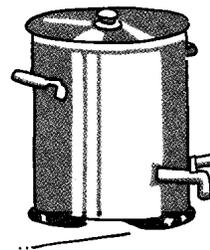
**Hand-operated controls** are often preferable for precision or speed of operation, while foot controls are generally best if greater force has to be applied. Pedals are most conveniently and safely operated from a seated position. If the employee has to stand up, the pedal needs to be designed and positioned in such a way that the employee can support the foot on the pedal at the heel. This will make it easier to keep balance.

### REARRANGE MATERIALS FLOW

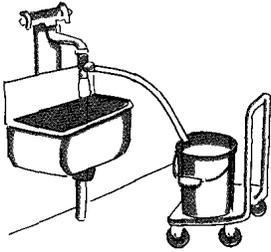
The schedule or timing, and path(s) of materials flow may be modified.

Examples of this are:

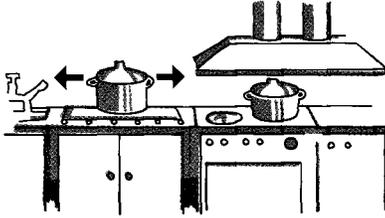
- Rearranging the containers and the way materials are moved around the workplace and between different parts of the work process.
- Placing loads to be handled in an optimum location will also reduce the risk. The best height range for handling loads is around waist level -- with lifting between the mid thigh and the shoulder being acceptable.



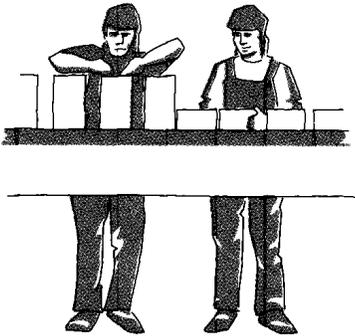
**Fig 11 Tap avoids lifting to empty**



**Fig 12 Hose avoids lifting**



**Fig 13 Rollers avoid carrying**



**Fig 14 Tilt objects to reduce work height**



**Fig 15 Adjustable work heights**

## DIFFERENT ACTIONS, MOVEMENTS, FORCES

With or without workplace modifications, a task may be carried out in different ways, using different actions and forces.

Bending movements can be reduced by:

- Using lift tables, work dispensers and similar mechanical aids;
- Raising the work level;

- Keeping materials at the working level, for example, avoiding lowering objects that will be lifted later; and
- Eliminating extended horizontal reaching.

Twisting movements can be reduced by:

- Positioning all tools and materials in front of employees;
- Using conveyors, chutes, slides or turntables to change the direction of flow of materials;
- Providing adjustable swivel chairs;
- Providing sufficient workspace for the employee's whole body to turn; and
- Improving the layout of the work area.

Reaching motions can be reduced by:

- Positioning tools and machine controls close to the employee;
- Positioning materials, workpieces and other heavy objects as near to the employee as possible;
- Enabling the object handled to be kept close to the body;
- Reducing load or container size; and
- Enabling the employee to walk around the load or to rotate it.

Static muscle load can be reduced by:

- Varying the task of the employee; Providing regular rest breaks;
- Ensuring repetitive tasks are designed to require a minimum of precision in gripping the objects, and that it can be done with either arm, or either leg without adjustment to equipment;
- Positioning all materials at working height;
- Positioning the work level so that tasks are performed with the joints at about the mid-point of their range of movement; and
- Creating a work environment that allows the employee to adopt several different, but equally healthy and safe, postures without reducing their capability to do the work.

Lifting and lowering forces can be reduced by:

- Eliminating the need for manual handling by using aids such as lift tables, forklifts, cranes, hoists, balancers, drum and barrel dumpers, work dispensers, elevating conveyors; raising the work level; lowering the position of the employee; or using gravity dumps or chutes;
- Reducing object weight by reducing the contents of the package or container (may involve specifying to suppliers), reducing the capacity and/or the weight of the container, or reducing the number of objects lifted or lowered at one time;
- Increasing the object weight so that it needs to be handled mechanically by using a unitised or bulk load concept, such as palletised handling;
- Reducing the need to hold the object away from the body by changing object shape, providing suitable grips or handles, providing greater access to the load; or improving workplace layout; or
- Converting to pushing or pulling.

Pushing and pulling forces can be reduced by:

- Eliminating the need to push or pull by using powered conveyors, powered trucks or movers, or using slides, rollers or chutes;
- Reducing the required forces by reducing the load weight; using non-powered conveyors, air bearings, ball castor tables, monorails or similar aids; using four-wheel hand trucks, hand trolleys (with good bearings and large diameter wheels or castors appropriate to the particular surfaces) providing good maintenance of equipment and floor surfaces; or using mechanical pushers or pullers; or
- Reducing the distance of push or pull by improving work area layout, relocating the production or storage

area, or similar system changes.

Carrying tasks can be reduced by:

- Converting to pushing or pulling by use of conveyors, air bearings, ball castor tables, monorails, slides, chutes and similar aids; using forklifts, two or four-wheel hand trucks, trolleys or similar;
- Reducing object weight by either reducing the size of the object, reducing the capacity, weight or load of each container, or reducing the number of objects carried at one time; or
- Reducing the distance objects need to be carried by improving work area layout, relocating storage or production areas, or similar system changes.

Holding forces can be reduced by:

- Reducing object weight, as above; Reducing object size;
- Reducing holding time; Eliminating holding by using, for example, jigs and fixtures; or
- Using mechanical loading and unloading.

Basic principles involved in minimising the risk of injury when applying manual handling forces include:

- Pushing or pulling is more efficient if applied at or around waist level;
- Pushing in/pulling out is stronger than left/right (across the body);
- For manual handling, significantly higher push/pull forces are possible when standing than when seated, and the use of body weight in pushing/ pulling is preferred;
- Facing the direction of movement when pushing/pulling is most effective; or
- Provide for clear vision (or advice on progress) when carrying.

## MODIFY TASK - MECHANICAL ASSISTANCE

The risk associated with a task can be reduced by mechanical assistance, minor rearrangement of plant and equipment and an improved (or effective) maintenance programme.

Examples of portable mechanical aids and some potential hazards which may be encountered in their use are given below. Section 5.2, on the other hand, briefly describes some larger-scale mechanical equipment which can be used to eliminate the need for manual handling in workplaces.

**Hooks** can be useful in handling bulk materials, e.g., sheet materials or wool bales, etc. The employee should be trained in the use of hand or packing hooks so that they will not glance off hard objects. If the hook is carried in a belt, the point must be covered.

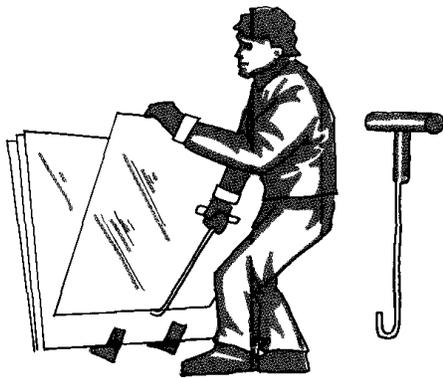


Fig 16

**Bars or levers** reduce the required force. The point or edges should have a good "bite".

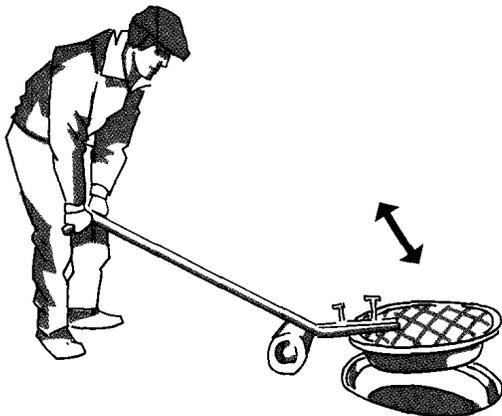


Fig 17 Levers reduce the force required

Rollers are often used to move heavy and bulky objects. A hazard they create is that fingers or toes may be pinched or crushed between a roller and the floor.



Fig 18 Rolling platform to avoid lifting

Jacks should be clearly marked with their safe working load. The surface onto which a jack is placed should be level and clean, and be sturdy enough to support the load. After the load is raised, additional support should be placed under it.

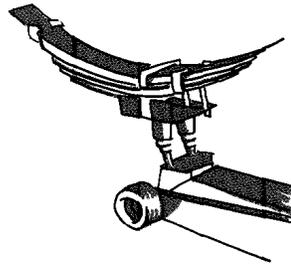


Fig 19 Support weight with jack

**Platforms** are useful for loading and unloading, provided that the load is maintained at a convenient height for lifting and handling.



Fig 20 Adjustable platform reduces stooping and reaching

## 5.2 Mechanical Handling Equipment

Mechanical handling equipment includes:

- Simple aids, for example, sliding rails, belt or roller conveyors;
- Cranes and hoists, for example, job cranes, overhead travelling cranes or mobile hoists;
- Positioning equipment, for example, lift jacks; and
- Industrial vehicles, for example, forklift trucks and two- or four-wheeled hand trucks.

Mechanical handling equipment should:

- Be easy to use and not cause an obstruction;
- Be designed to suit the load; and
- Be readily available even in emergencies.

The design, installation and use of mechanical handling equipment may be subject to other health and safety requirements e.g. the guarding of nip points or drives.

### EXAMPLES OF MECHANICAL HANDLING EQUIPMENT

Conveyors are generally useful when loads are relatively uniform, materials move continuously at a relatively steady rate, and the path to be followed is fixed. Conveyors also need to be able to bypass cross traffic.

Types of conveyors include:

- Roller conveyors;
- Belt conveyors;
- Screw conveyors;
- Chutes;
- Monorails; and
- Trolley conveyors.

Cranes and hoists are most commonly used when movement is within a fixed area, moves are intermittent, loads vary in size and weight, cross traffic will interfere with conveyors, and/or loads handled are not uniform.

Types of cranes and hoists include:

- Overhead travelling cranes;
- Gantry cranes; Job cranes;
- Hoists; and Stacker cranes.

Industrial trucks are generally used when loads are moved intermittently, movement is over varying routes, loads are uniform, and cross traffic would prohibit conveyors. They require adequate clearances and running surfaces and are most suitable when materials can be put into unit loads and manoeuvred and stacked as pallets, for example.

Types of industrial trucks include:

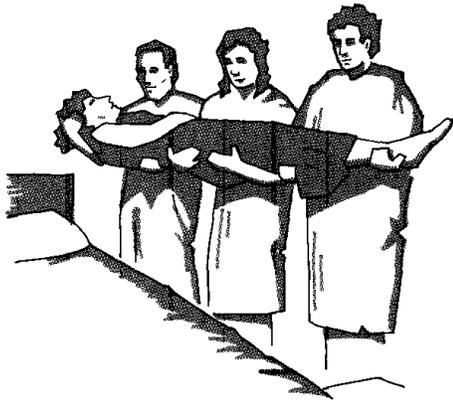
- Forklift trucks;
- Platform trucks;
- Two-wheel hand trucks;
- Tractor-trailer trains; and
- Hand stackers.

## 5.3 Team Lifting

Team lifting may be effective in reducing risk in certain manual handling tasks. However, a regular need for team lifting usually signals the need for redesign.

Whenever team lifting is used, it is essential to co-ordinate and carefully plan the lift. In organising a lift it is important to ensure that:

- There is an adequate number of people in the team;
- One person is appointed to co-ordinate the lift;
- The team members are of similar capacity and know their responsibilities during the lift;
- Appropriate training in lifting has been provided; and
- The lift has been rehearsed, including what to do in case of an emergency.



**Fig 21 Team lifting**

### **TAKE A SECURE GRIP ON THE OBJECT BEING HANDLED**

The grip helps to determine how safe the task will be. Whenever possible, a comfortable grip with the whole hand should be used - rather than with fingers only.

### **PULL THE LOAD IN CLOSE TO THE BODY**

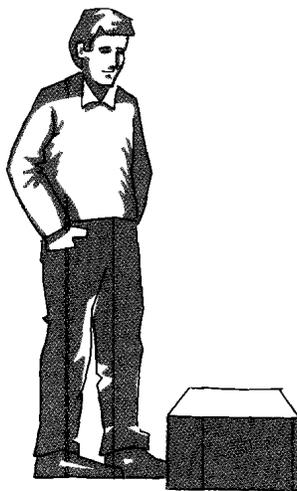
For lifting in particular, it is important to have the centre of gravity of the load close to the body to prevent excessive stress on the back and to use the strongest muscles of the arms to hold the load. It is important to minimise the effects of acceleration by lifting slowly and without jerking.

## **5.4 Training**

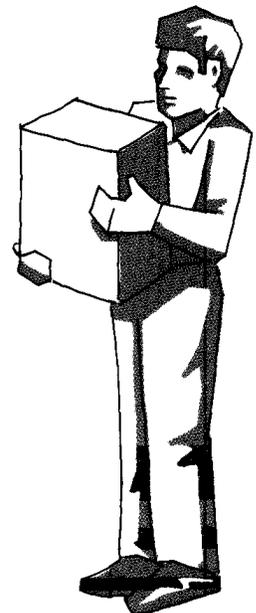
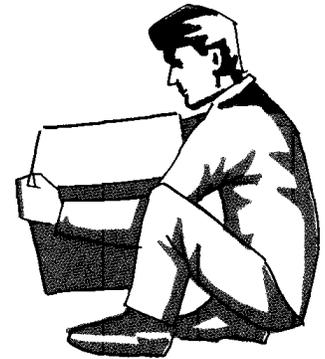
For the purposes of training, applying the following principles will reduce the risk of overexertion injuries for most manual handling tasks.

### **PLAN**

Anyone undertaking a manual handling task should assess the load, determine where it will be placed and decide how it will be handled. By first assessing the situation, they can decide if any equipment or another person is needed to move the object, animal or person.



**Fig 22 Plan the task**



**Fig 23 Keeping the load in close to the body**

### **DETERMINE THE BEST TECHNIQUE**

All factors should be taken into account when determining the best technique. The best handling technique involves suitable balance and avoidance of unnecessary bending, twisting or reaching. Anyone undertaking a lift should lift efficiently and rhythmically, minimising bending of the lower back. The knees should be bent, but preferably not at a right angle.

## **VARY HEAVY HANDLING TASKS WITH LIGHTER WORK**

Manual handling work should be designed so as to provide alternative tasks that do not heavily stress the same muscles. Throughout the work shift, heavier handling tasks should be alternated with lighter tasks which allow the active muscles to recover.

## **TEAM LIFTING**

To enable load sharing, lifting partners should be of similar height and build and should be trained in lifting techniques. There should be a person nominated as team leader to coordinate the lift. Team lifting should not be used as a first option in risk control. (See section 5.1 above.)

The increased experience and skills of older workers may compensate substantially for any decline in strength or physical fitness.

In making decisions about individuals with special needs, it may be necessary to seek medical assessment of individual cases in relation to the specific duties of a job, rather than generalised conclusions about the capacities of groups to perform manual handling tasks,

## **CLOTHING/FOOTWEAR**

In some situations, special clothing is required to reduce risk of injury. The following examples demonstrate how special clothing can reduce the risk of injury:

- Gloves provide protection from cuts and abrasions;
- Proper footwear helps prevent injuries from slips and falls, and from dropped loads; and
- Proper clothing allows loads to be carried close to the body.

## **NEW AND RETURNING EMPLOYEES**

Employees newly engaged on a manual handling task or process, or returning from an extended absence should, where necessary, be allowed a period of adjustment to build up the skill and ability demanded by the tasks they are required to perform.

# **5.5 Other Risk Controls**

## **SPECIAL NEEDS**

The state of an individual's health should be taken into consideration when allocating manual handling duties -- drawing upon medical advice as appropriate. When an individual's health changes and those changes affect capacity to perform normal duties --whether permanently or temporarily (such as a hernia, pregnancy or post-operative recovery) --either the job should be adapted to suit the new circumstances or the individual should be allocated other tasks.

# ● APPENDIX A

## RISK IDENTIFICATION CHECKLIST

The purpose of risk identification is to highlight the risks that require further action and to place them in order of priority. This checklist focuses on direct observation methods. However, equal attention should be given to the analysis of workplace injury records and to consultation with employees.

The direct observation of work areas and of the task being performed will assist in identifying risk. Workplace inspections, audits and walk-through surveys and the use of worksheets such as this one can assist in the risk identification process.

### Movements, posture and layout

1. Is there frequent or prolonged bending down where the hands pass below mid-thigh height? [ ] Yes [ ] No
2. Is there frequent or prolonged reaching above the shoulder? [ ] Yes [ ] No
3. Is there frequent or prolonged bending due to extended reach forward? [ ] Yes [ ] No
4. Is there frequent or prolonged twisting of the back? [ ] Yes [ ] No

### Task and object

5. Are awkward postures assumed frequently or over prolonged periods, that is. postures that are not forward facing and upright? [ ] Yes [ ] No
6. Is manual handling performed frequently or for long periods by the employee(s)? [ ] Yes [ ] No  
loads moved or carried over long distances? [ ] Yes [ ] No

If any of the questions in the worksheet result in a YES answer, further assessment of that risk factor is required. Generally, the more YES answers that result for a particular task, then the higher the priority for risk assessment.

Description of work location

Date .....

Task description

Assessed by .....

Risk identified [ ] Yes [ ] No

Action taken:

Risk assessment completed [ ] Yes [ ] No

Risk control measures completed [ ] Yes [ ] No

Other (specify) [ ] Yes [ ] No

8. Is the weight of the object:  
(a) more than 4.5 kg and handled from a seated position?  Yes  No  
(b) more than 16 kg and handled in a working posture other than seated?  Yes  No
- Note:** Weight is not used to prescribe absolute limits. but is one of the important factors to be considered when assessing and controlling risk.
9. For pushing, pulling, or other application of forces: are large push/pulling forces involved?  Yes  No
10. Is the load difficult or awkward to handle, for example, due to its size, shape, temperature, instability or unpredictability?  Yes  No
11. Is it difficult or unsafe to get adequate grip of the load?  Yes  No

## Work environment

12. Is the task performed in a confined space?  Yes  No
13. Is the lighting inadequate for safe manual handling?  Yes  No
14. Is the climate particularly cold or hot?  Yes  No
15. Are the floor working surfaces cluttered, uneven, slippery or otherwise unsafe?  Yes  No

## Individual factors

16. Is the employee new to the work or returning from an extended period away from work?  Yes  No
17. Are there age-related factors, disabilities or other special factors that may affect task performance?  Yes  No
18. Does the employee's clothing or personal protective equipment interfere with manual handling performance?  Yes  No

# ● APPENDIX B

# RISK

# ASSESSMENT

# WORKSHEET

To be filled out with consultation between employer, health and safety representative and employee.

The preceding risk identification checklist should be completed before using this worksheet.

Description of work location Date .....

Task description

Assessed by: Employer'(include position)

Assessed by: Employee (include position)

Assessed by: Safety representative (incl. position)

Have there been any records of injury related to this task at the workplace?

Yes  No

If YES, before proceeding to the risk assessment below, review section 3.1, Analysis of workplace injury records, page 9 of the *Manual Handling Guidelines*.

If NO, proceed directly to the risk assessment below.

Section in <i>Guidelines</i>	Identify risk factor by circling key words	Is there a risk?
<b>4.1</b>	<b>ACTIONS AND MOVEMENTS INVOLVED</b> Unbalanced or uncomfortable posture Overreaching, bending or twisting Sudden or jerky movements Prolonged or repetitive actions	<input type="checkbox"/> Yes <input type="checkbox"/> No
<b>4.2</b>	<b>LAYOUT OF WORKPLACE</b> Posture other than upright and forward facing Poor presentation of object to handier Tasks performed outside limits of easy reach Poor visibility	<input type="checkbox"/> Yes <input type="checkbox"/> No
<b>4.3</b>	<b>POSTURE AND POSITION</b> Restricted to a single working posture Little opportunity to change posture through variation of activity or rest breaks Work done sitting or standing, but not both	<input type="checkbox"/> Yes <input type="checkbox"/> No
<b>4.4</b>	<b>DURATION AND FREQUENCY OF ACTIVITY</b> Frequent repetitive activities Same activity carried out for long periods	<input type="checkbox"/> Yes <input type="checkbox"/> No

Section in <i>Guidelines</i>	Identify risk factor by circling key words	Is there a risk?
<b>4.5</b>	<b>DISTANCE AND TIME HANDLED</b> Loads moved long distances Loads located outside shoulder and mid-thigh height reach range Accurate locating requiring manoeuvring	[ ] Yes [ ] No
4.6	<b>LOADS AND FORCES</b> Forces include pushing, pulling, sliding, restraining Restricting personal factors. size, sex, age, level of fitness Loads above 4.5 kg seated. 16-20 kg standing	[ ] Yes [ ] No
<b>4.7</b>	<b>CHARACTERISTICS OF LOAD AND EQUIPMENT</b> Consider factors such as: Dimensions, stability, rigidity, predictability of delivery, surface texture. temperature, grips and handles. lifting aids such as straps or special holders required	[ ] Yes [ ] No
<b>4.8</b>	<b>WORK ORGANISATION</b> Insufficient staff or equipment Little variation in workplace or task No recovery time or rest breaks between tasks	[ ] Yes [ ] No
<b>4.9</b>	<b>WORK ENVIRONMENT</b> Employee working in a less than ideal environment due to factors such as: Climate. lighting, space. floor surface, confined space. housekeeping, fumes, dusts, vibrations	[ ] Yes [ ] No
<b>4.10</b>	<b>SKILL AND EXPERIENCE OF EMPLOYEE</b> Lack of knowledge and ability to perform the task correctly Little or no training in manual handling techniques Lack of induction programme covering job practice/safety and health issues	[ ] Yes [ ] No
<b>4.11</b>	<b>AGE OF EMPLOYEE</b> Employee under 18 years of age and/or still developing Older worker with decreasing physical capacity	[ ] Yes [ ] No
4.12	<b>CLOTHING</b> Movements hindered by poor clothing design or the need to wear personal protective equipment Footwear unsuitable for the job	[ ] Yes [ ] No
<b>4.13</b>	<b>SPECIAL NEEDS</b> New or returning employee Illness, pregnancy, specific disability	[ ] Yes [ ] No

**OTHER FACTORS/COMMENTS**

.....  
.....

# • APPENDIX C

# RISK CONTROL

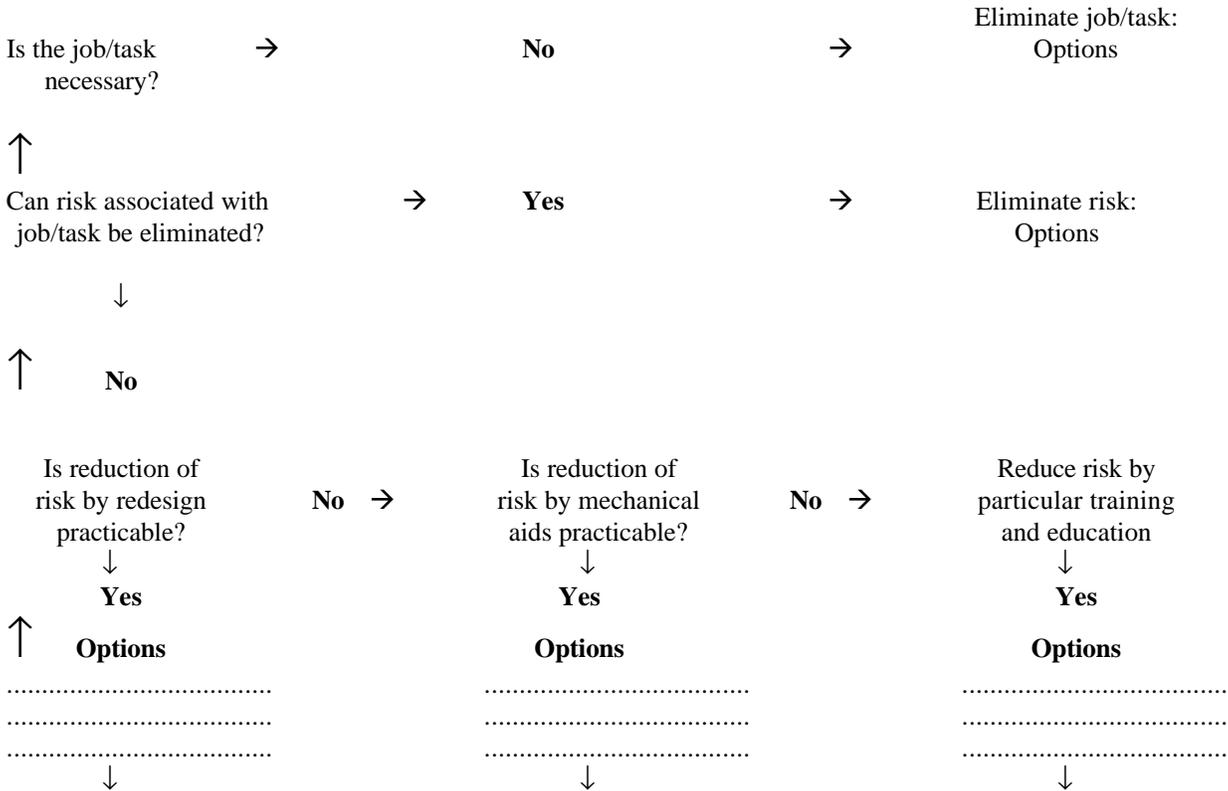
# WORKSHEETS

Consider factors assessed as risks from the risk assessment worksheet.

Refer to part 5 of the *Manual Handling Guidelines* for control options. These are summarised in the table on p 10.



## A Risk Control Method



### Risk Control Plan

(In consultation with health and safety representative and employee)

Risk Control Plan is to be documented on next page.



**Evaluation**



# Risk Control Plan

→To be developed in consultation with health and safety representatives and employees

Short term:

↑

.....  
.....  
.....  
.....

Medium term:

↑

.....  
.....  
.....

Long term:

↑

.....  
.....  
.....

↓  
**Yes**

Have all parties been consulted?

↓  
**Yes**

↑  
← **No**

Implement controls

↓  
**Yes**

Evaluation of all solutions

↓  
**Yes**

Risk identification and risk assessment may be repeated to evaluate the appropriateness of this control measure

# ● APPENDIX D

## RISK ASSESSMENT AND CONTROL OPTIONS

The table below indicates which risk control options are relevant for particular risk factors --job redesign being the preferred risk control option. No one single option will necessarily reduce a risk. A combination of different control options is often needed to address risk factors and reduce the overall risk of manual handling injuries.

<i>Risk assessment factor</i>	<i>Risk control option</i>								
	<i>Job redesign</i>	<i>Modify object</i>	<i>Modify workplace layout</i>	<i>Job redesign</i>					
Actions and movements	*	*	*	*	*	*	•	•	•
Workplace and workstation layout		*	*	*	*	*	•	•	•
Working posture and position	*	*		*	*	*	•	•	•
Duration and frequency			*	*	*	*			•
Location of loads and distances moved	*	*	*	*	*	*	•	•	•
Loads and forces		*	*	*	*	*	•	•	•
Characteristics of loads and equipment	*		*	*	*	*	•	•	•
Work organisation		*	*	*	*	*		•	•
Work environment		*	*				•		
Skills and experience				*	*	*	•		•
Age				*	*	*	•		•
Clothing								•	•
Special needs	*	*	*	*	*	*	•	•	•

The shaded area highlights the five preferred job redesign control options, and their connection with the key factors. Asterisks indicate the control option of job redesign as preferred to the other options, which are indicated by a dot.

# ● APPENDIX E: EXTRACTS FROM THE LEGISLATION

## Factories and Commercial Premises Act 1981

### SECTION 18. SAFETY GENERALLY (SAFETY, HEALTH, AND WELFARE)

(1) The occupier of an undertaking shall take all reasonable precautions for the safety and health of workers, and persons lawfully on the premises of the undertaking.

(2) No person employed in or about an undertaking shall, without reasonable cause, do anything likely to endanger himself or any other person.

(3) No person employed in or about an undertaking shall, without reasonable cause, interfere with or misuse any appliance, apparatus, clothing, convenience, device, equipment, guard, or other thing whatsoever, provided for securing the health, safety or welfare of persons employed in or about that undertaking.

(4) Every person employed in or about an undertaking shall, so often as the circumstances for which it is provided arise, use any appliance, apparatus, clothing, device, equipment, guard, or thing, provided as aforesaid.

### SECTION 20. TRAINING AND SUPERVISION (SAFETY, HEALTH, AND WELFARE)

The occupier of an undertaking shall ensure that no worker

undertakes any work unless--

(a) He has been adequately instructed as to the dangers likely to arise in connection with that work and the precautions to be taken against them; or

(b) He is a person with a sufficient knowledge and experience of that work; or

(c) He is being adequately supervised by a person with a sufficient knowledge and experience of that work.

### SECTION 26. CARRYING OF HEAVY LOADS (SAFETY, HEALTH, AND WELFARE)

No occupier of an undertaking shall require any worker to lift, carry, or move any load so heavy that its lifting, carriage, or movement would be likely to injure him.

## Construction Act 1959

### SECTION 11. GENERAL RULES (SAFETY PROVISIONS)

The following general rules shall be observed where any construction work is being carried out:

(a) Every employer shall exercise such supervision of the work as will ensure that the provisions of this Act and of regulations thereunder are complied with or, if he is unable to exercise sufficient personal supervision for that purpose, shall ensure that the work is adequately supervised on his behalf:

(b) All reasonable precautions shall be taken to ensure the safety of workmen employed in the work:

(d) All apparatus, plant, or gear used in connection with the work shall be operated by competent workmen:

(f) The provisions of any enactment making provision for the safety of persons and applicable in respect of workmen engaged in any construction work shall be complied with by the employer and workmen engaged in that construction work.

# ●APPENDIX F: SOURCES OF FURTHER INFORMATION

The following groups are able to offer advice about manual handling problems, or to indicate where further assistance may be obtained.

## **OCCUPATIONAL SAFETY AND HEALTH SERVICE**

The Occupational Safety and Health Service of the Department of Labour has eighteen branch offices nationally. Addresses may be found under "Department of Labour" in the government departments section at the front of the telephone book.

## **AREA HEALTH BOARDS**

Each area health board has a number of occupational health

nurses available to give advice. They may be listed in the telephone book under "Community health services" or "Health development unit", depending on the board concerned. Otherwise, contact your local area health board and ask for the number to ring.

## **NEW ZEALAND COUNCIL OF TRADE UNIONS**

Advisers are located at the CTU Health and Safety Centres in Auckland, Hamilton, Palmerston North, Wellington, Christchurch and Dunedin.

## **NEW ZEALAND EMPLOYERS' FEDERATION**

Advisers are located at Auckland, Wellington and Christchurch.

## **NEW ZEALAND ERGONOMICS SOCIETY**

Enquiries for assistance may be addressed to the Secretary, New Zealand Ergonomics Society, P O Box 802, Massey University, Palmerston North. The society holds a list of specialists in the field of manual handling. Other professional societies may offer the same service (physiotherapists, occupational therapists, etc.).

Health and safety professionals in private practice are another major source of assistance. They may be contacted through any of the above avenues.

# ● APPENDIX G: BRIEF BIBLIOGRAPHY

## GENERAL TEXTS

Accident Compensation Corporation. *Put J/our bad back behind J/ou*. Wellington, 1991.

Caillet R. *Low back pain sJ/ndrome*. F. A. Davis, Philadelphia, 1981.

Chaffin D. B, Andersson G. B.J. *Occupational biomechanics*. Wiley Interscience, New York, 1984.

Clark T. S and Corlett E. N. *The ergonomics of workspaces and machines: A design manual*. Taylor and Francis, London, 1984.

Department of Health. *Seating for office workers*. Wellington, 1989.

Department of Labour, Victoria. *Manual handling regulations and code of practice*. Melbourne, 1988.

Grandjean E. *Fitting the task to the man: an ergonomic approach*. Taylor and Francis, London, 1986.

McKenzie R. *Treat your own back: How to safely, simply and scientifically relieve your own back pain*. Spinal Publications, Waikanae, 1990.

Mital A. (ed.) *Trends in Ergonomics/Human Factors I*. Elsevier Science Publishing, Amsterdam, 1984.

Ring L. *Facts on backs: A simplified approach to back injury prevention and control*. Institute Press, Loganville, Ga, 1981.

Tichauer E. *The biomechanical basis of ergonomics*. John Wiley, New York, 1978.

Worksafe Australia. *Preventing back pain at work: Resource kit*. Sydney, 1989.

Worksafe Australia. *National standard for manual handling and national code of practice*

*for manual handling*. National Occupational Health and Safety Commission, Canberra, 1990.

## JOURNAL ARTICLES

Colombini D. and Occhipinti E. Posture analysis. *Ergonomics*, Vol. 28, No. 1, pp 275-84, 1985.

Karwowski W. and Mital A. The development of a safety index for manual handling tasks. *Applied Ergonomics*, Vol. 17, Nol, pp 58-64, 1986.

Liles D. H. The application of the job severity index to job design for the control of manual handling tasks. *Ergonomics*, Vol. 29, No. 1, pp 65-76, 1986.

Snook S. The design of manual handling tasks. The Ergonomics Society Lecture, 1978. *Ergonomics*, Vol. 21. pp 963-85, 1978.

The journals *Ergonomics* and *Applied Ergonomics* are held at most university libraries.

## SPECIALIST SOFTWARE

*Backsoft*. Centre for Ergonomics, University of Michigan. Two versions of this software exist. The 2D (two dimensional) static strength programme predicts static strength requirements for manual handling tasks. It estimates low back compression during exertions in two dimensions. Worker body sizes, postures and exertions are input and the programme calculates the values. It is limited by operating in only two dimensions where the body is operating symmetrically.

The more sophisticated 3D programme has become available recently, and estimates the forces involved when the body is being used asymmetrically in (the more common) three dimensions.

These programmes assist in the evaluation of manual handling tasks and the design of workstations to reduce muscle loading.

A list of further references is available from the Occupational Safety and Health Service of the Department of Labour on request.