Chapter 16 Ergonomics for Manual Tasks

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¶16-010 Key points

- Ergonomics is the interdisciplinary scientific field concerned with understanding interactions between humans and the systems within which they exist. The field draws on knowledge from diverse areas, and ergonomists seek to apply this knowledge to enhance health and safety, comfort, quality and productivity.
- Manual tasks involve lifting, pushing, pulling, carrying, moving, manipulating, holding, or restraining a person, animal or item.
- The change in terminology from ‘‘manual handling’’ to ‘‘manual tasks’’ reflects an understanding that injuries are also caused by tasks other than pushing, pulling, lifting and carrying.
- Managing manual task risks requires identifying hazardous manual tasks and, where possible, eliminating them. Where hazardous manual tasks cannot be eliminated, the degree and source of risk associated with the tasks require assessment, and design controls need to be implemented to reduce the risk as far as reasonably practicable.
- Administrative controls may also be required to manage the residual risks. These controls rely on human behaviour and supervision, and on their own, are not an effective way of controlling manual task injury risk. Administrative controls must always be used in combination with appropriate design controls.
- Training is an important administrative control regardless of which design controls are employed, in that training in the appropriate way of performing work and using equipment should always be provided. Training in the ‘‘best’’ way of handling loads, however, does not result in sustained behavioural change and has been shown to be ineffective in reducing injuries.

¶16-020 What are manual tasks and why are they a problem?

Manual tasks are any task involving lifting, pushing, pulling, carrying, moving, manipulating, holding, or restraining a person, animal, or item. Many manual tasks have the potential to cause musculoskeletal disorders, and these are referred to as hazardous manual tasks. Manual tasks at work resulted in 437,852 claims in six years to June 2003 (73,000 claims per year) across Australia or 42% of all claims. The direct cost of these injuries was $12 billion ($2 billion per year).

Injuries occur when forces on anatomical structures are, either instantly, or over time, greater than the structures can withstand. Tissues at risk of damage due to manual tasks include bone, muscle, tendon, ligament, articular cartilage and other connective tissues, nerves, and blood vessels.

The mechanisms of injury to specific tissues vary, however injuries associated with manual tasks may be generally characterised as having either sudden or gradual onset. Sudden onset injuries are associated with a relatively short exposure to forces that exceed a tissue's capability. Gradual onset injuries occur as a consequence of relatively long-term exposure to forces. In the latter case, the general mechanism of injury is believed to be an accumulation of microdamage which exceeds the tissue's capacity for repair. Injuries may also occur as a combination of both general mechanisms where a history of cumulative loading leads to reduced tissue tolerance, which is then exceeded by short-term exposure to a relatively high force.

Considerable attention has been paid to the associations between various possible risk factors and occupational musculoskeletal injuries. A relationship exists between musculoskeletal disorders and prolonged exposure to forceful exertions, awkward and static postures, vibration, and repetition. Injuries are particularly associated with exposure to multiple risk factors (NIOSH 1997).

In many areas of occupational health, threshold limit values are provided to assist in managing exposure to risk factors. Similarly, there is attraction, particularly to occupational health and safety enforcement agencies and the courts, in providing quantitative threshold limit values for manual task risk factors. For example, limits were historically placed on the weight of loads to be handled. Such a simplistic approach fell out of favour as it became appreciated that weight was only one factor that contributed to the risk of injury.

The general problem with assessing the risks posed by manual tasks, and with providing quantitative threshold limit values, is the variability of tasks encountered, and the variability and extreme complexity of the human musculoskeletal system. This variability and complexity make both the loads on structures (especially over time), and the capabilities of structures, very difficult to estimate.

¶16-030 What is ergonomics and how can it help?

Ergonomics is the interdisciplinary scientific field concerned with understanding interactions between humans and the systems within which they exist. The field draws on knowledge from diverse areas, and ergonomists seek to apply this knowledge to enhance health and safety, comfort, quality and productivity. Ergonomics is also a way of looking at the world which has as its focus the capabilities, motivations, behaviours and preferences of people.

Ergonomics is about maximising efficiency, effectiveness, quality, comfort, safety and pleasure in the interactions between people and the systems within which they live, work and play. The aim is to achieve this by ensuring that systems are designed in such a way that the interactions are consistent with those capabilities, motivations, behaviours and preferences. The emphasis is on changing the systems to suit people, rather than requiring people to adapt to systems.

This philosophy implies a concern with obtaining information about the characteristics and capabilities of people, and this is achieved through the underlying disciplines of anatomy, physiology, biomechanics, anthropometry, neuroscience, (cognitive, social, and organisational) psychology, management, epidemiology, public health, and sociology. A reciprocal concern of ergonomists lies in design-based disciplines and fields such as product design, engineering, architecture, town planning and computer science, where the opportunity exists to influence the design of systems, artifacts, and environments.

A risk management framework is frequently adopted by ergonomists to guide the application of the principles of ergonomics to any particular problem. The process starts with establishing an understanding of the broader context in which the particular person-system interaction takes place before undertaking hazard identification and risk assessment. Assuming the outcome of the risk assessment is that action is indicated, the risk control phase incorporates identifying and evaluating potential control options, before implementation and ongoing review. From an ergonomist's perspective, the emphasis for risk control is on elimination or reduction of risk through design controls rather than administrative controls such as training, selection or personal protective equipment (PPE).

Most importantly, this process also places emphasis on consultation with the people concerned at each step. This issue is at the heart of ''participative ergonomics'' approaches, which take as an underlying assumption the notion that the people involved are the ''experts'' and must be involved at each stage of the risk management cycle if the process is to be executed successfully. In an occupational injury management context, this implies in particular that employees and management participate through hazard identification, risk assessment, risk control and review steps of the risk management cycle. The role of the ergonomist in this context is to facilitate the process and provide the expertise necessary to undertake the process. Ideally, skills transfer also occurs and the risk management process is sustainable without further intervention.

Many variations in the models and techniques used in participative ergonomics have developed including differences in the role of the ergonomist and the training provided to work teams (see Haines and Wilson 1998; Haims & Carayon 1998; Laing et al 2005; Burgess-Limerick et al 2007). However a common element is to ensure utilisation of the expert knowledge that workers have of their own tasks by involving the workers in improving their workplaces. Management commitment and provision of resources, workers and management understanding of relevant ergonomics concepts and techniques, and a process to efficiently develop and implement suggested controls also appear to be important components of successful participative ergonomics interventions.

Participative ergonomics has been used to create more human centred work and to improve work organisational climate, as well as to prevent musculoskeletal disorders associated with manual tasks. This approach to manual tasks risk management requires work teams to be knowledgeable about the risk management framework, to have the skills and tools required to assess manual tasks risks, to understand the risk control hierarchy, and to have knowledge of general principles of control strategies for eliminating and controlling manual task risks. Training workers to acquire these skills and work within a risk management framework is consequently a key concern.

Team members identify hazards in their work and are facilitated through a risk assessment process that requires them to develop control suggestions. The work teams plan the implementation of key controls and are subsequently shown how to evaluate

those controls. Management commitment and effective risk management systems are required for the approach to be effective, and access to external ergonomics expert assistance may be necessary for particularly difficult or complex problems.

It is also important to note that ergonomics is equally concerned with improving productivity and reducing waste, as with reducing injury risks (see Dul 2003). This is crucial, because any design modification implemented to reduce injury risk must be easier, quicker, and more efficient than the previous methods of work. If not, the chance of adherence to the new methods is markedly reduced and ongoing supervision will be required to ensure compliance.

Control manual tasks risk requires participation at all levels of the organisation

¶16-040 The legislative context

On May 16, 2007, the Australian Safety and Compensation Council (ASCC) agreed by majority vote to declare the National Standard for Manual Tasks; and the National Code of Practice for the Prevention of Musculoskeletal Disorders from Performing Manual Tasks at Work; and implement these documents within two years of declaration.

The ASCC also agreed to review the national standard and code under the national OHS standards framework, once work on the framework has been completed. The new standard and code replaces the National Standard for Manual Handling (1990), the National Code of Practice for Manual Handling (1990) and the National Code of Practice for the Prevention of Occupational Overuse Syndrome (1994). The change in terminology from ‘‘manual handling’’ to ‘‘manual tasks’’ reflects an understanding that injuries are also caused by tasks other than pushing, pulling, lifting and carrying.

The information provided in this chapter is consistent with the new standard and code. Whether all jurisdictions adopt the new standard and code remains to be seen.

In the meantime, some state legislation refers to the previous national standard and code, while other states have their own Regulations and advisory documents. In instances where there are approved codes of practices, generally, the codes provide guidance and are admissible as evidence. The codes are not mandatory but must be followed unless health and safety is achieved in other ways.

The OHS regulatory framework in each jurisdiction requires the provision of both a safe place, and a safe process of work. A safe process is of particular importance in the reduction of risk from exposure to the performance of hazardous manual tasks.

Jurisdiction	**Legislation**
Commonwealth	Occupational Health and Safety (Safety Standards) Regulations 1994, Pt 5 Manual Handling.
Qld	General obligations under the *Workplace Health and Safety Act 1995* plus two advisory standards now known as codes of practice: Manual Tasks Advisory Standard (2000) and Manual Tasks Involving the Handling of People Advisory Standard (2001). See http://www.deir.qld.gov.au/workplace/subjects/manualhandling/law/. See also Risk Management Advisory Standard (2000).
NSW	General and specific obligations in the Occupational Health and Safety Regulation 2001. See Pt 4.4 Manual handling in particular.
Victoria	Occupational Health and Safety Regulations 2007, Pt 3.1. The *Occupational Health and Safety Act 2004* does not provide for Codes of Practice, however the Manual Handling (Code of Practice No 25 2000) is made available as a source of practical guidance.
Tasmania	General obligations under *Workplace Health and Safety Act 1995* and Workplace Health and Safety Regulations 1998. Also reg 65 calls up National Standard.
South Australia	Division 2.9 Manual Handling of the Occupational Health Safety and Welfare Regulations 1995, supported by an Approved Code of Practice for Manual Handling (1990).
Western Australia	*Occupational Safety and Health Act 1984.* Occupational Safety and Health Regulations 1996, reg 3.4. Supported by Code of Practice: Manual Handling.
ACT	*Occupational Health and Safety Act 1989* . Occupational Health and Safety (Manual Handling) Regulations 1997. Supported by ACT Manual Handling Code of Practice (1999).
NT	Work Health (Occupational Health and Safety) Regulations reg 59 and 60. The National Code of Practice for Manual Handling (1990) and National Code of Practice for the Prevention of Occupational Overuse Syndrome (1994) are approved codes.

¶16-050 Who is responsible for managing manual tasks risks?

All people involved in work have responsibilities in relation to the management of manual task risks. Duty holders include: persons who design, manufacture, construct or supply items, systems of work or buildings or structures used as a workplace where manual tasks are performed; persons with control of a workplace (including the owner and occupier); persons with control of work (including employers, self-employed persons, labour hire company, and principal contractors or subcontractors). Workers also have responsibilities.

Duty holders have a responsibility to identify and eliminate the risk of an injury occurring as a result of performing manual tasks at work. If it is not practicable to eliminate the risk, it must be minimised as far as reasonably practicable. What is reasonably practicable will depend on a number of factors such as:

- the likelihood of exposure to the hazard
- the potential consequences of the exposure
- what is known about the risk and how to eliminate it
- the feasibility of elimination of the hazard
- the availability of an effective control
- the cost of elimination or control.

Duties apply only to the matters over which the duty holder has control. A duty holder has an obligation to protect all people who could be exposed to risk as a result of performing manual tasks at work, including workers (whether paid or unpaid), trainees, and contractors.

Duties of persons who design, manufacture and supply

Persons who make management decisions about design, manufacture or supply of products, workplaces or systems of work have a duty to eliminate or minimise risks of musculoskeletal disorder posed by the product, workplace, or system involved in the performance of manual tasks. Where hazards can not be eliminated, information about the risks and conditions for safe use must be supplied.

Duties of persons in control of workplaces and work

Persons in control of workplaces and work are required to: identify potential hazards; assess the risks associated with these hazards; eliminate hazardous manual tasks or minimise the risk as far as reasonably practicable; monitor and review the effectiveness of controls implemented to minimise risks.

Persons in control of work or workplaces have a duty to consult persons in the workplace or who perform work. Consultation is required when new manual tasks are introduced, existing tasks are changed, when workplaces are altered, or new equipment is selected. Consultation is essential to the successful management of manual tasks risks, and is a central feature of participative ergonomics approaches.

Persons in control of workplaces and work have a duty to provide information, training and supervision to ensure that workers know how to do their job safely. In the area of manual tasks, this should include ensuring that workers can identify hazardous manual tasks and have sufficient understanding of the risk factors involved to be able to contribute to the management of the risks. However, training in the ‘‘best’’ way of handling loads does not result in sustained behavioural change and has been shown to be ineffective in reducing injuries.

Duties of workers

Workers performing manual tasks have duties to: follow appropriate systems of work; use equipment provided in accordance with the instructions and training provided; take care not to put anyone else at risk; cooperate in the identification, assessment and management of manual tasks risks; notify management of safety concerns, such as, faulty equipment or any experience of pain of discomfort associated with work.

¶16-060 How are manual tasks risks managed?

Managing manual tasks risks requires identifying hazardous manual tasks and, where possible, eliminating them. Where hazardous manual tasks cannot be eliminated, the degree and source of risk associated with the tasks requires assessment, and design controls need to be implemented to reduce the risk as far as reasonably practicable.

Administrative controls may also be required to manage the residual risks. Successful management of manual tasks risk requires involvement of the people who perform the tasks, as well as other people in the workplace such as supervisors and managers. Training in manual task risk assessment and control is required to ensure this participation is successful.

Identifying hazardous manual tasks

Identification of hazardous manual tasks requires: (i) consultation with employees; (ii) observation of manual tasks; and (iii) reviewing workplace records.

A task should be considered as potentially hazardous if any of the following apply:

- a musculoskeletal injury has been recorded that was associated with performance of the task
- any employee is physically incapable of performing the task
- the task can be done only for a short time before stopping
- the mass of any object, person, or animal being handled exceeds 16 kg
- if the force exerted on any object, person, or animal exceeds 200 n
- if the postures adopted to perform the task involve substantial deviations from neutral
- if the task involves static postures held for longer than 30 seconds and the task is performed for more that 30 minutes without a break, or for more than two hours per shift
- if the task involves repetitive movements of any body part and is performed for more that 30 minutes without a break, or for more than two hours per shift
- if the task is performed for > 60 min at a time without a break
- if the task is performed for longer than four hours per shift
- any employee reports discomfort associated with the manual task
- a person is observed having difficulty performing the manual task
- employees have improvised controls for the task (eg phone books for foot stools, use of furniture other than that provided for the task)

- the task has a high error rate
- workers doing this task have a higher turnover, or rate of sick leave, than elsewhere in the organisation
- if exposure to whole body vibration (vehicles) or peripheral vibration (power tools) exceeds two hours per shift.

If after adequate consultation, observation, and review of records, none of the above conditions or thresholds is met for any manual tasks in a workplace, then it is reasonable to conclude that the manual tasks are likely to constitute a low musculoskeletal injury risk.

For each manual task identified as requiring assessment, it is sensible to ask whether the task can be easily eliminated. If the manual task can be eliminated, and this is done, then there is no need for further analysis.

Reassessment should be conducted whenever there is a change in equipment or work processes. Any new injury or report of discomfort that is associated with any manual task should trigger either elimination or a risk assessment.

Assessing manual tasks risks

If hazardous manual tasks exist that cannot be eliminated, the next step is to assess the risks. The aim of the risk assessment is to assist the risk control process by providing information about the sources of the risk and the severity of the risk. The assessment should be undertaken with the involvement of the people who perform the tasks.

The assessment of manual tasks risks is complicated by the number of aspects of the task that contribute to determining the injury risk, and by the interactions between these different risk factors. The risk assessment process is also complicated by the number of different parts of the body that can be injured, and by the variety of possible ways injury can occur.

Injuries occur when the forces on a body tissue (eg muscle, tendon, ligament, bone) are greater than the tissue can withstand. Injuries can occur suddenly as a consequence of a single exposure to a high force. Injuries can also arise gradually, as a consequence of repeated or long duration exposure to lower levels of force. Even low levels of force can cause small amounts of damage to body tissues. This damage is normally repaired before injury occurs. However, if the rate of damage is greater than the rate at which repair can occur, then an injury may result. Injuries can also result from a combination of these mechanisms, for example, a tissue that has been weakened by cumulative damage may be vulnerable to sudden injury by lower forces. Manual task risk assessment needs to consider these possible mechanisms.

Injuries associated with manual tasks can occur to a range of different parts of the body, and the injury risks associated with a task will vary for different body regions. Consequently, the degree of exposure to different risk factors must be assessed independently for different body regions.

As well as the forces involved, the risk of injury to a body part is also dependent on the movements and postures involved, the duration of the exposure, and whether there is exposure to vibration. The risk assessment must address each of these risk factors and the interactions between them.

The first step in assessing the risk of injury associated with a particular hazardous manual task is to determine the body regions of interest. This may be self-evident, in that the task has been identified as causing injuries or discomfort to a particular body

part or parts. Alternately, the risk assessment should consider the risk of injury to each of the following regions independently: lower limbs, back, neck/shoulder, elbow/wrist/hand.

The ultimate aim of manual task risk management is to ensure that all tasks performed in workplaces require dynamic and varied movements of all body regions with low to moderate levels of force, comfortable and varied postures, no exposure to whole body or peripheral vibration, and that breaks are taken at appropriate intervals to allow adequate recovery. Injury risk is elevated by deviations from this optimal situation, and injuries are most likely to occur when significant exposure to multiple risk factors occurs.

Exposure to multiple risk factors

Direct Risk Factors

Force & Speed. An important factor in determining the likelihood of injury to a specific body part is how much force is involved. Historically, the mass of objects being handled has been the focus, however the force involved in a task depends on a number of other factors as well. For example, in lifting and lowering tasks, the force required by the back muscles depends as much on the distance of the load from the body as on the mass of the load. Similarly, if the task involves pushing or pulling a load, the force involved will depend on the frictional properties of the load and the surface, as well as the mass of the load. Other manual tasks may not involve the manipulation of any load, however high forces can still be required.

If the force exerted by a body part is close to the maximum the person is capable of then the risk of sudden injury is high, and urgent action is indicated. Even if the forces involved are not close to maximum, the task may pose a high risk of injury if the body part is also exposed to other risk factors. High speed movements (eg hammering, throwing) are an indication of elevated risk, mostly because high speed implies high acceleration, which in turn implies high force, especially if the speed is achieved in a short time. Such ‘‘jerky’’ movements are a sure indication of high exertion at the body parts involved. This also includes rapid changes in the direction of movement. The strength of muscles is in part dependent on the speed at which they

shorten, and high speed movements consequently reduce the strength of the muscles producing the movement. Another high force situation occurs when impact force is applied by the hand to strike an object or surface, in this case there is a high force applied to the hand by the object or surface being struck.

The magnitude of the force relative to the capabilities of the body part is what is important in assessing injury risks. For example, the small muscles of the hand and forearm may be injured by relatively small forces, especially if the task also involves extremes of the range of movement at a joint. This also implies that the capability of the individual performing the work must be taken into consideration when assessing the injury risk. This is also true of the assessment of posture, in that people of different sizes may well adopt very different postures to perform the same task.

Exertion depends on the magnitude of the force relative to the capabilities of the structures

High speed movements require high forces

Movement and Repetition. The optimal design of work provides tasks that involve slow to moderately paced movements and varied patterns of movement. Little or no movement at a body part elevates the risk of discomfort and injury because the flow of blood through muscles to provide energy and remove waste depends on movement. Tasks that involve static postures quickly lead to discomfort, especially if combined with exposure to other risk factors.

If the task involves repetitively performing identical patterns of movement, and especially if the cycle time of the repeated movement is short, then the same tissues are being loaded in the same way with little opportunity for recovery. Such repetitive tasks are likely to pose a high risk of cumulative injury if combined with moderate to high forces (or speeds), awkward postures, and/or long durations.

Static postures quickly lead to discomfort if maintained for long duration

Performing frequent similar movements does not allow tissues to recover.

Body Posture. The postures adopted by a body region during a task influence the likelihood of injury in a number of ways. If joints are exposed to postures that involve extremes of the range of movement, the tissues around the joint are stretched and the risk of injury is increased. Ligaments, in particular, are stretched in extreme postures. If the exposure to extreme postures is prolonged the ligaments do not immediately return to their resting length afterwards. Tissue compression may also occur as a consequence of extreme postures, for example, extreme postures at the wrist increase the pressure on the nerve that passes through the carpal tunnel.

The strength of muscles is also influenced by the posture of the joints over which they cross. Muscles are weaker if they are shortened, and this effect will be greatest when the joints approach the extreme of the range of movement. Consequently, one general principle of the design of work is to avoid postures that involve extremes of the range of movement at any joint.

Some non-extreme joint postures are also known to be associated with increased risk of discomfort and injury. These include trunk rotation, lateral trunk flexion, or trunk extension; neck extension, lateral flexion or rotation; and wrist extension or ulnar deviation.

Some other postures increase the risk of injury without involving extremes of the range of movement. These can be called awkward postures, and can be defined as any posture that causes discomfort. Such postures can occur without significant deviation of the joint from neutral, especially if the orientation of the body with respect to gravity is altered.

The optimal design of work aims to provide tasks that involve movements within a normal range about neutral.

Awkward postures are frequently caused by poor access for maintenance tasks

Vibration. Exposure to vibration in manual tasks takes two distinct types: peripheral vibration (typically associated with power tools) and whole body vibration (typically associated with vehicles). In both cases the vibration exposure impacts on injury risk both directly and indirectly.

Exposure of the upper limbs, and particularly the hands, to high frequency vibration associated with power tools is a direct cause of damage to nerves and blood vessels. Short term effects are temporary loss of sensation and control, and blanching of the fingers — hence ‘‘Vibration White Finger Syndrome’’. These effects become irreversible with long term exposure. Use of vibrating power tools is also an indirect cause of injury risk to the upper limbs because the vibration increases the force required by the upper limbs to perform the task. The degree of risk increases with higher amplitude vibration tools (eg hammer drills or jack hammers).

The use of power tools causes exposure to peripheral vibration

Similarly, long term exposure to whole body vibration (typically from vehicles) is strongly associated with back injury. As well as a direct effect on the back, exposure to whole body vibration also has an indirect influence on injury risk by causing fatigue of the back muscles. Again, the risk is greater when the amplitude of vibration is high (eg heavy vehicles and/or rough terrain).

Long term exposure to whole body vibration is associated with back pain

Duration. If a task is performed continuously without a break for a long time, the tissues involved do not have opportunity for recovery, and cumulative injury risk increases. This is especially likely if the task involves a combination of moderate force, little or repetitive movement, and awkward postures. Changing tasks can provide recovery if the second task involves different body parts and movement patterns. The appropriate task duration also depends on environmental factors.

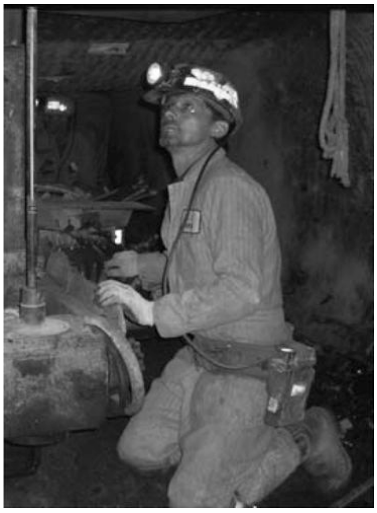
Contributory factors

The issues presented below as contributory factors modify the degree of risk in two ways. Some of the contributory factors are characteristics of the work that commonly lead to increased exposure to the direct risk factors discussed above. Modification of these factors, if present, will be likely to directly reduce the injury risk. The remaining contributory risk factors are secondary risk factors, which have an indirect influence on manual task injury risk.

Workplace or workstation layout

- working in confined spaces is very likely to result in the necessity to adopt awkward postures to perform tasks
- workstations with restricted visibility, typically result in awkward and static postures, especially of the neck
- workstations with inappropriate location of visual displays (usually too high) cause awkward postures, especially of the neck
- standing work leads to fatigue if undertaken for long durations
- kneeling work causes high force on the knees
- working below the height of the feet inevitably leads to extreme trunk postures
- working overhead requires awkward and static postures of the shoulders
- workstations that require reaching to handle objects create awkward postures
- work surfaces that are too high or too low lead to awkward postures
- locating objects to be handled below waist height increases injury risk
- locating objects to be handled above shoulder height increases injury risk

- carrying loads for long distances creates an injury risk
- inappropriate location of objects or tools can cause awkward postures to be adopted.



Kneeling for long periods causes injuries

Objects, equipment and tools

- any unpredictability increases the risk of injury, eg handling of people or animals, or uneven or changing mass distribution
- handling loads of high mass, even if they are not lifted, can require high force because of the inertia of the load
- handling large loads, even if they are not heavy, can require high forces because of the distance of the centre of the load from the body
- objects that are hot, cold or otherwise noxious, increases the risk because the load is held away from the body
- objects that do not have appropriate handles increase the injury risk
- poorly maintained tools can increase the force required
- using inappropriate tools can cause an injury risk
- handling loads with one hand increases injury risk
- triggers that require sustained force to operate increase injury risks
- gloves generally increase the force requirements of a task.

Environmental conditions

- inappropriate lighting levels, or glare can cause awkward postures to be adopted
- exposure to hot environments increases fatigue, especially for heavy work
- exposure to cold increases the risk of some injuries, eg exposure to cold, in addition to other risk factors, is implicated in the development of carpal tunnel syndrome

- uneven or poorly maintained surfaces can increase injury risk by eg increasing the force required to push trolleys, or increasing the amplitude of whole body vibration.

Exposure to heat increases fatigue

Work organisation and systems of work

The following factors increase injury risk and should be modified if present:

- high work rates
- lack of task variety
- uneven temporal distribution of work causing high peak loads
- understaffing
- high stress levels caused by eg cognitive overload or underload, frequent deadlines, or interpersonal conflict
- lack of control over the pace of work, eg because the work is machine paced
- pay schemes that encourage working faster or longer
- lack of opportunity for communication and personal contact.

¶16-070 How are manual tasks risks controlled?

Elimination

Having determined that hazardous manual tasks are performed in a workplace, the first step is to determine whether any, or all, of the manual tasks can be eliminated. If this is possible, this will be the most effective way of reducing injuries. Some manual tasks can be eliminated by examining the flow of materials and reducing double handling. Others may be able to be eliminated by changing to bulk handling systems. Outsourcing hazardous manual tasks may also be an appropriate way of eliminating hazards if the organisation undertaking the task has specialised equipment that reduces the risk to acceptable levels. Some tasks, such as cleaning up waste, are non-productive and may be able to be eliminated or reduced by examining the source of the waste.

Design controls

If, after the possibilities have been examined, it is determined that some hazardous manual tasks cannot practicably be eliminated, and the risks associated with these tasks have been assessed, the next step is to devise design controls that will

reduce the injury risks. This step also is most effectively undertaken in consultation with the people who perform the work. Apart from the fact that these people are the ones who know most about the tasks, the probability of success of the design changes is enhanced if the people concerned have a sense of ownership of the changes. It is also important to ensure that all people affected by proposed design changes are consulted. For example, maintenance as well as operational staff may need to be involved. Before implementing the design controls it is also important to consider whether new hazards will be introduced as a consequence.

The following framework is a useful way of thinking about possible design controls.

Work Areas

- Work height, space, reach distances, work flow and adjustability.

The design of work areas has a large impact on manual tasks injury risks. For example, limited space, limited clearances, and restricted access to work are common causes of awkward postures. Work should be located at an appropriate height and close to the body. Providing adjustability of workstations may be an option to accommodate workers of different sizes. Workplaces should be designed to increase postural variability during work.

Loads

- Size, shape, weight, stability, location and height.

The nature of loads delivered to a workplace, handled within a workplace, or produced by a workplace are a common source of hazardous manual tasks. Increasing the size and mass of loads and implementing mechanised bulk handling systems is an effective design control. Reducing the size and weight of loads is another option, but requires training and ongoing supervision, otherwise multiple loads will be handled simultaneously to increase speed. Ensuring loads are easily gripped is important. Hot or cold loads should be insulated to allow them to be comfortably held close to the body. Where loads are manually handled, they should be stored at waist height rather than on the floor or above shoulder height.

Tools

- Size, weight, handles, grips, trigger and vibration.

Poorly designed hand tools are a common source of awkward postures, high exertion, (particularly of small muscles of the hand and arm), and peripheral vibration. Hand tools should be designed such that joint postures remain close to neutral during use, and should be as light as possible. Heavy tools may be counter-balanced to reduce exertion. While power tools reduce exertion, the vibration associated with power tools introduces a new risk, and tools should be chosen to minimise the amplitude of the vibration as far as possible.

Mechanical aids

- Hoists, overhead cranes, vacuum lifters, trolleys, conveyers, turntables, monorails, adjustable height pallets, forklifts and pallet movers.

A large range of mechanical aids are available to reduce manual tasks risks, and these can be effective controls. However, care is required to ensure that the use of the aid does not slow down the performance of work. If it does, the probability that the control will be effective is reduced because administrative controls and ongoing supervision will be required to ensure compliance. The design of the mechanical aids requires careful consideration. For example, trolley wheels should be as large as possible to reduce rolling friction and vertical handles should be provided that allow

the trolley to be gripped at different heights by different sized people. Introducing mechanical equipment such as forklifts also introduces new risks, which require control. Where mechanical aids are introduced to control manual tasks risks, it is important to ensure they are maintained in working order, and available when, and where, required.

Administrative Controls

Depending on the design controls implemented, it may also be necessary to consider additional administrative controls. Administrative controls rely on human behaviour and supervision, and on their own, are not an effective way of controlling manual task injury risk. Administrative controls must always be used in combination with appropriate design controls. Administrative controls include:

Maintenance

Maintenance of tools, equipment, and mechanical aids is crucial, but requires a maintenance schedule to be developed and supervision to ensure that it occurs. Maintenance includes good housekeeping.

Workload

Injury risk associated with manual tasks may be reduced by reducing shift duration or the pace of work. It may be possible to change the distribution of work across the work day, or week, to avoid high peak workloads. Ensuring appropriate staff levels are maintained is important. Provision of adequate rest breaks can reduce injury risks.

Job rotation and task variety

It may be possible to reduce injury risks by rotating staff between different tasks to increase task variety. This requires that the tasks are sufficiently different to ensure that different body parts are loaded in different ways. Alternately, multiple tasks might be combined to increase task variety.

Team lifting

Team lifting may be effective in reducing injury risk where the load is bulky but relatively light. If team lifting is employed as a control, training and supervision are required to ensure the task is done only when appropriate staff are available to perform the task.

Personal Protective Equipment

Some forms of PPE may be effective in reducing manual task injury risk. Knee pads, protective aprons, and gloves are examples. However, there is no evidence to support the use of ‘‘back belts’’ or ‘‘abdominal belts’’ and these devices should not be employed.

Training

Training is an important administrative control regardless of which design controls are employed, in that training in the appropriate way of performing work and using equipment should always be provided. Implementing an effective manual task risk management program also requires that staff are able to identify hazardous manual tasks, and are aware of the aspects of manual tasks that increase injury risks. This might legitimately extend to principles such as ‘‘keep the load close’’ and ‘‘avoid twisting’’. However, the evidence is clear that training in ‘‘correct’’ load handling techniques is not effective in reducing injuries associated with manual tasks.

Monitor and Review

Managing manual tasks risk is an iterative ‘‘continuous improvement’’ process. Following implementation of any control measures it is important to check that the controls are working as anticipated and that new risks have not been introduced.

Record Keeping

Keeping records of the steps taken in the risk management process is important for a number of reasons. It will ensure you are able to demonstrate that an effective risk management process is in place, should that be necessary. More importantly, however, it provides a way of tracking the improvements made and the maintaining the corporate memory of the reasons changes have been made.

¶16-080 Conclusion

The prevention of injuries associated with manual tasks starts with genuine management commitment to providing resources to eliminate hazardous manual tasks, and implement appropriate design controls where this is not practicable. The identification of hazardous manual tasks, the assessment of risks associated with the tasks, and the implementation of design controls all require the participation of the workers who perform the tasks. In turn, meaningful participation requires the workers to have training in manual task risk assessment and control. The final ingredients are an effective safety management system which integrates the outcomes of the manual task risk management process, and a site champion to drive the process and, in particular, to ensure that suggested controls are developed, evaluated, implemented, and the outcomes reassessed.

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