Conducting a Manual Handling Risk Assessment.
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1. **ROLES AND RESPONSIBILITIES**

Risk assessors may be a manager with responsibility for a department, or a suitably trained and competent individual appointed to assist the manager in discharging their responsibilities.

**Criteria**

The factors that would help to facilitate the risk assessor's role:

- Clinically / department based - This would help in understanding the issues in the work environment.
- Ability to work in partnership - Management, health and safety representatives and manual handling Key Workers can offer valued support and many issues can be addressed as a group.
- A commitment by staff at all levels to completing risk assessments within the work environment. (Refer to Trust Manual Handling Policy).

**NOTE:**

*RISK ASSESSORS WHO ARE NOT LINE MANAGERS CARRY NO ADDITIONAL LEGAL RESPONSIBILITY OVER THAT OF ANY OTHER EMPLOYEE FOR THE OUTCOMES OF THEIR ASSESSMENTS.*

*(Refer to the Trust Health and Safety Policy)*

*NB:* To be read in conjunction with the manager's role and responsibility.

2. **MANAGEMENT RESPONSIBILITY**

Local line managers are responsible for the overall operation of the risk assessment process at the local level and must be involved in the process.

Management must be committed to:

- Ensuring the risk assessor has allocated time to complete the risk assessments
- Ensuring that the risk assessor is released from the workplace to attend training / update sessions in order that the assessor can maintain the necessary skills and knowledge liaising and supporting the assessor
3. **WHAT IS MANUAL HANDLING?**

A manual handling operation is interpreted as:

"Any transporting or supporting of a load, including:

Lifting; lowering; holding; carrying; pushing; pulling; throwing; moving.

Anything that applies bodily force to move an object."

*(Manual Handling Operations 1992)*

**A LOAD IS:**

- Furniture
- People
- Animals
- Packages
- Boxes
- Tools
4. **LEGISLATION**

There are five pieces of legislation relevant to manual handling:

**These are:**

- The Health and Safety at Work Act (1974)
- The Management of Health and Safety at Work Regulations (1999)
- The Provision and Use of Work Equipment Regulations (1998)
- The Lifting Operation and Lifting Equipment Regulations (1998)

The **Health and Safety at Work Act (1974)** places **duties on the employer** to ensure health, safety and welfare of employees at work so far as reasonably practicable by:

**Section 2:**

- Providing and maintaining safe systems of work
- Providing arrangements to ensure safety and health in transporting, storage, and handling of articles and substances.
- Providing information, instruction, supervision, and training to protect employees
- Maintaining the work place in a safe and healthy condition

**Section 7: Duties on the employee**

The employee must:

- Take reasonable care of their own health and safety and that of others
- Co-operate with the employers in discharging their duties under the act

The **Management of Health and Safety at Work Regulations (1999)** impose a requirement upon employers to undertake an assessment of any risk to health and safety of their employees.

**Relevant Points are:**

**Regulation 3:**

Every employer shall make a suitable and sufficient assessment of:

- “The risks to the health and safety of his employees to which they are exposed whilst they are at work” (refer to risk assessments).
Regulation 6:

- Every employer shall appoint one or more competent persons to assist him in undertaking the measures he needs to comply with the requirements.

- The employer shall ensure that the number of persons appointed will have the time available for them to fulfill their functions and the means at their disposal are adequate having regard to the size of his undertaking.


This has an established hierarchy of measures to reduce manual handling risks

- **AVOID** handling where ever possible
- **ASSESS** the risks of those tasks, which cannot be avoided, using T.I.L.E.
- **REDUCE** the risk as far as reasonably practicable
- **MONITOR** and review
- **PROVIDE INFORMATION** for example the weight of the load to be handled

There was only a small change to the regulations in the 2002 amendment. This took in the factors that a worker may be at risk if he/she:

A. Is physically unsuited to carry out the task in question
B. Is wearing unsuitable clothing, footwear or other personal effects
C. Does not have adequate or appropriate knowledge or training

These factors were in schedule 1 of the 1992 Regulations but are now included in a new regulation 4(3). This amendment does not introduce any new duties on employers.

The Provision and use of work Equipment Regulations 1998


(PUWER 98) PUWER 98 replaces PUWER 92

PUWER 98 applies to the provision and use of all work equipment, including mobile and lifting equipment.
Although PUWER 98 applies to all lifting equipment, LOLER (Lifting Operations and Lifting Equipment Regulations) applies over and above the general requirements of PUWER98, in dealing with specific hazards/risks associated with lifting equipment and lifting operations.

Regulations 4 – 10

Are the management duties of PUWER 98 covering

- Selection of suitable equipment
- Maintenance
- Inspection
- Specific risks
- Information, instruction and training.

PUWER 1998 cannot be considered in isolation from other health and safety legislation. In particular it needs to be considered with the requirements of the HSW Act.

The Lifting Operations and Lifting Equipment Regulations 1998 (LOLER 98)


The Regulations aim to reduce risks to people’s health and safety from lifting equipment provided for use at work. In addition to the requirements of LOLER, lifting equipment is also subject to the requirements of the Provision and Use of Work Equipment Regulations 1998 (PUWER)

Generally, the Regulations require that lifting equipment provided for use at work is:

- Strong and stable enough for the particular use and marked to indicate safe working loads;
- Positioned and installed to minimise any risks;
- Used safely, i.e. the work is planned, organised and performed by competent people; and
- Subject to ongoing thorough examination and, where appropriate, inspection by competent people.
- The employer needs to ensure that in using any lifting equipment the requirements of LOLER are met.
For example, you should ensure that all lifting equipment is:

- Sufficiently strong, stable and suitable for the proposed use. Similarly, the load and anything attached must be suitable;

- Positioned or installed to prevent the risk of injury, e.g. from the equipment or the load falling or striking people;

- Visibly marked with any appropriate information to be taken into account for its safe use, e.g. safe working loads. Accessories, e.g. slings should be similarly marked.

Additionally, you must ensure that:

- Lifting operations are planned, supervised and carried out in a safe manner by people who are competent;

- Where equipment is used for lifting people it is marked accordingly, and it should be safe for such a purpose, e.g. all necessary precautions have been taken to eliminate or reduce any risk;

- Where appropriate, before lifting equipment (including accessories) is used for the first time, it is thoroughly examined. Lifting equipment may need to be thoroughly examined in use at periods specified in the Regulations (i.e. at least six-monthly for accessories and equipment used for lifting people and, at a minimum, annually for all other equipment) or at intervals laid down in an examination scheme drawn up by a competent person. All examination work should be performed by a competent person; and following a thorough examination or inspection of any lifting equipment, a report is submitted by the competent person to the employer to take the appropriate action.
5. MANUAL HANDLING PROCESS

Manual Handling Process

- Undertaking Manual Handling operation for inanimate object.
  - No → No further action
  - Yes
    - Can the Manual Handling be avoided, eliminated or automated.
      - Yes → Avoid, eliminate or mechanise the Manual Handling operation.
      - No
        - Review
          - Undertake a Manual Handling risk assessment for the inanimate object
            - Determine remedial measures to reduce risk and record findings.
              - Communicate to employees findings on inanimate object handling.
                - Implement Manual Handling operation.
6. RISK ASSESSMENT

What is a Risk Assessment?
A risk assessment is a proactive system of assessing the hazards associated with activities and processes within an organisation. It is an essential part to managing health and safety as well as quality issues.

Why do a Risk Assessment?
Legislation requires that risk assessments are performed. Regulations 3(1) of the management of Health and Safety at Work Regulations 1999 requires employers to make a suitable and sufficient assessment of the risks to the health and safety of employers whilst at work.

Where this general assessment indicates the possibility of risks to employees from the manual handling of loads the requirement of the present regulations should be followed. This relates to the manual handling operation regulations 1992 Regulation 4(1) which establishes a clear hierarchy of measures and these are to:

A. Avoid hazardous manual handling operations so far as is reasonably practicable – this may be done by redesigning the task to avoid moving the load or by automating the load.
B. Make a suitable and sufficient assessment of any hazardous manual handling operations that can be avoided, and
C. Reduce the risk of injury from those operations so far as is reasonably practicable.

Many manual handling tasks may have been performed for years with little thought being given to how the task can be made easier. To prevent injuries occurring we need to ask ourselves questions such as, does the task still need to be done or are we continually doing it through habit?
7. WHAT TO CONSIDER WHILST CONDUCTING A RISK ASSESSMENT

The Manual Handling Regulations 1992 (MHOR) state clearly that four factors need to be assessed, these are **T.I.L.E**

- **TASK**
- **INDIVIDUAL**
- **LOAD**
- **ENVIRONMENT**

The following are prompts associated with the risk assessment factors:

**TASK**

*Is the load being held at a distance from the trunk?*

Holding the load at arm’s length imposes about five times the stress experienced when holding the same load very close to the trunk

*Check the posture*

Hands and feet which are not well placed, many result in lost control of the load and a sudden increase in physical stress

*Does the task involve stooping?*

Stooping can also increase stress on the lower back

*Does the task involve reaching upwards?*

This places stress on the arms and back

*Does the task involve a combination of the above movements?*

This would reduce an individual’s capability

*Does the task involve excessive lifting or lowering distances?*

Large distances are physically more demanding than small ones

*Does the task involve excessive carrying distances?*

This may result in reduced individual capacity

*Does the task involve excessive pushing or pulling of the load?*

The risk of injury is increased if pushing or pulling is carried out with the hands much below knuckle height or above shoulder height

*Does the task involve a risk of sudden movement of the load?*
Sudden movement creates unpredictable stresses which can injure the body

**Does the task involve frequent or prolonged physical effort?**

Frequent lifting or even a modest load can lead to injury

**Does the task involve sufficient rest or recovery periods?**

Insufficient rest or recovery periods lead to fatigue

**Does the task involve a rate of work imposed by a process?**

This may lead to fatigue

**Handling while seated**

This involves the task being carried out by the trunk and arms, resulting in twisting, stooping, leaning, forward and reaching

**INDIVIDUAL**

Individual capability means taking into account of the fact that each individual varies according to height, weight, fitness skills and knowledge. Naturally there are significant variations in any group of employees, but the intention of the regulations is that manual handling operations are designed by employer to be safe for the majority of its people. It follows therefore; that employers should be aware of any factors which might place individuals at significant risk of handling injury and take necessary precautions to protect that person.

Special features of individual capability should be given attention by the risk assessor. They include:

- **The differences between men and women**

  On average, the manual handling ability of women is less than that of men depending on the type of activity involved. HSE guidance suggests that safe loads for women are about 70% of the loads for men, these figures only refer to averages however and some women are significantly stronger than men.

- **Age/fitness**

  Age is an important factor in strength. Strength peaks in the early 20s and declines gradually from that point, with the rate of decline accelerating from the mid 40s. Young workers particularly, have less experience and may be inclined to take more risks because of this.

- **Experience**

  In fact, experience and skills acquired over some years spent doing a particular job are important factors and it may be that loads which appear to be handled comfortably by the existing employees are deemed to be excessive by the assessment process. The regulations are quite
clear: the employer should regard an operation as unacceptable if it cannot be performed by the majority of reasonably fit employees.

- **Pregnancy/health**
  Women should not handle significant loads during and after pregnancy, especially three months before and three months after delivery. This is due to the fact that hormonal and biochemical processes soften the ligaments enabling the fibres to stretch and accommodate the baby growing; it does mean that the restraining properties of ligaments are reduced and significant manual handling injury can occur without this protection.

- **Knowledge/training**
  Previous training on how to perform principles of good movement and handling equipment such as slide sheets and hoists will help safeguard the individual against injury.

**LOAD**
If we consider the load to be the patient, there are numerous factors to consider including:

- **The medical condition**
  A person with difficulty breathing would find it very distressing if laid supine for a movement up the bed

- **Comprehension**
  A person with difficulty understanding commands or having no insight into their own disabilities can potentially put themselves and staff at risk.

- **Medical interventions**
  Having an intravenous drip, cardiac monitor leads or a catheter may restrict movement for a patient or the patient may feel they have to lay motionless!

- **Weight**
  The weight of the patient will/may exceed the safe working load requirements of the equipment. It may also cause problems with ensuring there are enough handlers available to ensure the safe movement of a load.

- **Communication**
  A person with hearing or visual problems may potentially provide a barrier for ensuring the patient understands manoeuvres affecting them.

- **Cultural issues**
  Particular cultures may discourage movements in which close contact is needed.
**ENVIRONMENT**

*Are there space constraints preventing good posture?*

This may lead to stooping, twisting or leaning

*Are there uneven, slippery or unstable floors?*

Are there variations in level of floors or work surfaces

*Are there extremes of temperature or humidity?*

High temperatures cause rapid fatigue and perspiration may reduce the effectiveness of grip. Low temperatures also affects grip.

*Are there poor lighting conditions?*

Dimness of glare may cause poor posture and contract between bright light and deep shadow may aggravate tripping hazards

For more information on T.I.L.E see appendix 1

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**8. WHEN SHOULD YOU NEED TO PERFORM A RISK ASSESSMENT?**

As guidance, the MHOR 1992 produced a flow chart to assist in the decision to perform risk assessments on common or generic tasks. Examples of such tasks could be emptying linen trolleys, bathing children or pushing a child in the bed.

A detailed assessment of every manual handling operation however, could be a major undertaking and might involve wasted effort. Many handling operations, e.g. lifting a teacup, will involve negligible handling risk. To help identify situations where a more detailed risk assessment is necessary, the Health and Safety Executive has developed a filter to screen out straightforward cases.

The filter is based on a set of numerical guidelines developed from data in published scientific literature and on practical experience of assessing risks from manual handling. They are pragmatic, tried and tested; they are not based on any precise scientific formulae. The intention is to set out an approximate boundary within which the load is unlikely to create a risk of injury sufficient to warrant a detailed assessment.
The application of the guidelines will provide a reasonable level of protection to around 95% of working men and women. However, the guidelines should not be regarded as safe weight limits for lifting. There is no threshold below which manual handling operations may be regarded as ‘safe’. Even operations lying within the boundary mapped out by the guidelines should be avoided or made less demanding wherever it is reasonably practicable to do so.

Guidelines for Lifting & Lowering

The guidelines for lifting and lowering operations assume that the load is easy to grasp with both hands and that the operation takes place in reasonable working conditions with the handler in a stable body position. They take into consideration the vertical and horizontal position of the hands as they move the load during the operation, as well as the height and reach of the individual handler. For example, if a load is held at arm’s length or the hands pass above shoulder height, the capability to lift or lower is reduced significantly. The basic guideline figures for identifying when the manual lifting and lowering operations may need a detailed assessment are set out in Appendix 2.

If the handler’s hands enter more than one of the box zones during the operation, the smallest weight figures apply. It is important to remember, however, that the transition from one box zone to another is not abrupt; an intermediate figure may be chosen when the handler’s hands are close to a boundary. Where lifting or lowering with the hands beyond the box zone is unavoidable, a more detailed assessment should always be made.

These basic guideline figures for lifting and lowering are for relatively infrequent operations – up to approximately 30 operations per hour. The guideline figures will have to be reduced if the operation is repeated more often. As a rough guide, the figures should be reduced by 30% where the operation is repeated once or twice per minute, by 50% where the operation is repeated around five to eight times per minute and by 80% where the operation is repeated more than 12 times per minute.

Even if the above conditions are satisfied, a risk assessment should be made where:

- the worker does not control the pace of work
- pauses for rest are inadequate or there is on change of activity which provides an opportunity to use different muscles
- the handler must support the load for any length of time
- Concerns are expressed by staff, accident forms indicate a need for assessments or work related musculo-skeletal injuries have occurred.

Guidelines for Carrying
Similar guideline figures apply to carrying out operations where the load is held against the body and is carried no further than about 10m without resting. If the load is carried over a longer distance without resting or the hands are below knuckle height then a more detailed risk assessment should be made.

Where the load can be carried securely on the shoulder without first having to be lifted (as for example when unloading sacks from a lorry) the guideline figures can be applied to carrying distances in excess of 10m.

**Guidelines for Pushing & Pulling**

For pushing and pulling operations (whether the load is slid, rolled or supported on wheels), the guidelines figures assume the force is applied with the hands between knuckle and shoulder height. The guideline figure for starting or stopping the load is a force of about 25kg (i.e. about 250 Newtons) for men and about 16kg (i.e. about 160 Newtons) for women. The guideline figure for keeping the load in motion is a force of about 10kg (i.e. about 100 Newton’s) for men and about 7kg (i.e. about 70 Newtons) for women.

There is no specific limit to the distance over which the load is pushed or pulled provided there are adequate opportunities for rest or recovery.

See Appendix 3 and 4 for further guidance.

**Guidelines for handling while seated**

The basic guideline figure for handling operations carried out while seated, shown in diagram below, is 5kg for men and 3kg for women. These guidelines only apply when the hands are within the box zone indicated.

**Other Considerations- Twisting**

In many cases, manual-handling operations will involve some twisting and this will increase the risk of injury. Where the handling task involves twisting and turning, therefore, a detailed risk assessment should normally be made. However, if the operation is relatively infrequent and there are no other posture problems then the filter can be used. In such cases, the basic guideline figures shown above should be reduced.
if the handler twists to the side during the operation. As a rough guide, the figures should be reduced by about 10% where the handler twists through 45° and by about 20% where the handler twists through 90°.

**Remember:** The use of these guidelines does not affect the employer’s duty to avoid or reduce risk of injury where this is reasonably practicable. The guideline figures therefore, should not be regarded as weight limits for safe lifting. They are an aid to highlight where a risk assessment is most needed.

### 9. PERFORMING A RISK ASSESSMENT

Manual handling key workers are ideal for performing risk assessment. This is because they will have a good understanding of the nature of the work and processes within their areas.

It is very important to ensure the manager is also aware when the assessment is being performed and that they take responsibility for ‘actioning’ strategies of reducing the risk to employees. Actions to reduce the risk to employees may be to provide training sessions, purchase new equipment or to redesign the task.

Some actions will have cost implications; it will be the managers’ decision to compare the nature of the risk against the cost of reducing the risk.

Source: Manual Handling at Work a Brief Guide

[http://www.hse.gov.uk/pubns/indg143.pdf](http://www.hse.gov.uk/pubns/indg143.pdf)
10. THE IMPORTANCE OF KEEPING LIFTED WEIGHT AS CLOSE TO YOUR BODY AS POSSIBLE
10. HOW DIFFERENT POSITIONS AFFECT SPINAL PRESSURE

Relative changes in spinal pressure/load in the 3\textsuperscript{rd} lumbar disc in various positions in living subjects.

11. SIMPLE TECHNIQUES OF SAFE LIFTING

Think before lifting/handling.

Plan the lift. Roughly how heavy is it? Will you need help—another person, a mechanical aid? Where is the load going to be put? How do you intend to get it there?
Keep the load close to the waist.

Don’t flex the back any further while lifting.

This can happen if the legs begin to straighten before starting to raise the load.

Keep the load close to the body for as long as possible while lifting. Keep the heaviest side of the load next to the body. If a close approach to the load is not possible, try to slide it towards the body before attempting to lift it.
Avoid twisting the back or leaning sideways, especially while the back is bent. Shoulders should be kept level and facing in the same direction as the hips. Turning by moving the feet is better than twisting and lifting at the same time.

Adopt a stable position.

The feet should be apart with one leg slightly forward to maintain balance (alongside the load, if it is on the ground). Be prepared to move your feet during the lift to maintain your stability.

Get a good hold.

Where possible the load should be hugged as close as possible to the body.

Start in a good position.

At the start of the lift, slight bending of the back, hips and knees is preferable to fully flexing the back (stooping) or fully flexing the hips and knees (squatting).
Move smoothly.

The load should not be jerked or snatched as this can make it harder to keep control and can increase injury.

Don’t lift or handle more than can be easily managed.

Put down, then adjust.

If precise positioning of the load is necessary, put it down first, then slide it into the desired position.

http://www.hse.gov.uk/pubns/indg143.pdf

Keep the head up when handling.

Look ahead, not down at the load, once it has been held securely.
Situations Where Special Care is Needed

Lifting Odd Shapes:

Be sure to get help if the item is too bulky or awkward to handle alone. If you can handle it alone:

- Test the load to check its weight.
- Get as close as you can to the load.
- Follow the steps for lifting correctly, remembering to lift with your legs.

12. THE ANATOMY OF THE HUMAN SPINE
The spine is a column of 33 bones – called vertebrae – separated from one another by ‘cushions’ of elastic tissue – the intervertebral discs.
The spine has 3 main functions:

- To support the upper body
- To allow you to be mobile
- To provide a protective casing for the spinal cord

The spine of a newborn baby is ‘C’ shaped having two primary curves in the chest and sacral regions. Once the infant lifts its head and, later, begins to walk, the secondary curves of the neck and the lower back regions develop, and the spine takes on its characteristic 4 curved ‘double S’ shape.

No two vertebrae are exactly alike: their size and shape varies slightly according to their position in the spinal column. The first two cervical vertebrae – the atlas and the axis - are especially designed to give the greatest degree of mobility for head movements, but the general shape of all the vertebrae permits wide ranging mobility in all directions. However, the bones of the sacrum and coccyx are fused together and are generally classed as just two bones. There is very little movement in this region of the spine. The upper surface of S1 bears the full weight of the whole upper body: this would tend to rotate the whole sacrum forwards were it not for strong controlling ligaments.

The remaining vertebrae have a broadly similar structure. Although formed from just one piece of bone, each vertebra has several parts: at the front is the body, the thick, kidney shaped weight-bearing portion; from this, two short thick portions – the pedicles – project backwards, one on either side, and join with a flat piece of bone called the lamina. Thus, a space is formed through which the spinal cord and blood vessels can pass. Intervertebral notches between the pedicles of adjacent vertebra form the intervertebral foramen through which the spinal nerves emerge, and through which blood vessels pass. Finally, 7 small pieces of bone – the processes – project from the lamina: those projecting backward and to either side provide points to which ligaments and muscles are attached, and those projecting upwards and downwards form facet or zygapophyseal joints (sometimes referred to, more simply, as Z joints) with the vertebrae above and below.

The thoracic vertebrae provide attachments for the rib cage, which, in turn, limits spinal movement in this region. The lumbar vertebrae are the biggest and the toughest, designed to bear the full weight of the trunk, arms and head and to withstand the strain placed upon them from the stresses of twisting trunk movements. There is a considerable degree of mobility in this region of the spine.

With the exception of the intervertebral disc, all the structures of the vertebral column have a liberal blood and nerve supply.

Any two vertebrae and all the structures around and between them form the motion segment - also known as a spinal unit.

The Joints of the Spine
The joints of the spine are of two types: synovial and cartilaginous.

In a synovial joint, the ends of the articulating bones are surrounded and enclosed by a fibrous capsule. This is lined by a synovial membrane, which secretes a thick, synovial fluid into the joint, one of the functions of which is to keep the joint friction-free. The flow of synovial fluid is stimulated by exercise hence inactivity diminishes its production; this is an important reason for continuing exercise into old age. Injury causes the synovial fluid to increase, resulting in swelling of the damaged joint.

A cartilaginous joint, by contrast, is simpler, merely consisting of a layer of cartilage uniting two bony surfaces.

Ligaments are firm bands of fibrous tissue placed in and around joints. They are like rubber bands in that they resist stretching but by buckle when released. Their function is to control movement of the joint, in particular preventing excessive movement.

The Facet Joints

These are small synovial joints, which are well designed to cope with the precise alteration of direction demanded of them in spinal movements. The angle and inclination of the joints varies according to the degree of mobility required.

The Invertebral Disc Joint

Between each pair of vertebrae are the intervertebral discs. They act as cushions or shock absorber transmitting the forces of weight bearing down through the tough bones of the vertebral bodies. They are connected to the vertebral bodies above and below by a layer of cartilage. The whole mechanism forms a cartilaginous joint, which moves as the vertebra rock to and from side to side. Ligaments regulate stretch and separation between each pair of adjacent vertebrae.

The Mechanism of Movement

The intervertebral disc joint and the two facet joints on either side form a triad. The disc joint is the major member of the triad, taking 80% of the weight-bearing force, but the facet joints have an essential stabilising role, acting like the held handles of a wheelbarrow to help control excessive movement of the disc joint. At each level the range of movement of the triad is very small, but the overall large range of spinal movement is achieved by a cumulative effect: the bottom vertebrae moves a few degrees while the next one up moves it’s few degrees in the same direction, and so on. This interdependence of the constituent joints of the triad obviously has implications if just one joint is ‘faulty’ for whatever reason, for the balanced interplay between them is crucial to perfect spinal co-ordination and function.
The Intervertabral Discs

In order to perform its shock absorbing function the disc needs to be malleable, adaptable to change of movement yet able to resume its form at rest. It must be strong enough to sustain weight, as load is transmitted from one vertebra to the next during all activities involving the spine.

Its composition reflects these needs:

The **nucleus pulposus** is an oval shaped gelatinous mass, composed partly of collagen fibres, but with 75 – 90 % of its weight being fluid. The nucleus is indistinctly separated from the surrounding annulus fibrosus. Because of its fluid nature the nucleus is deformed under pressure like a water-filled balloon: the displaced pressure is transmitted in all directions towards the perimeter of the annulus.

The **annulus fibrosus** is also made up of collagen fibres packed in a gel-like substance, with water amounting to 60-70% of its weight. Its fluid content is greatest where it merges with the nucleus and least towards the outer edge, where the fibres form a ‘skin’, which resists bending and twisting movements. Throughout the annulus, the fibres are arranged in layers of concentric circles and the fibres of each layer run in obliquely opposite directions. The only nerve endings in the disc lie in the outer 3mm, but very little compressive stress is transmitted to this region.

The **vertebral end plate** is a layer of cartilage covering the centre of the vertebral body and attached centrally to the disc.

**Intervertabral Disc Mechanics**

The vertebral body exerts a compressive force on the disc, creating pressure within the nucleus, which is dispersed into the fibres of the annulus and out towards the periphery. The construction of the annulus gives the disc its strength and the ability to resist deformation due to such pressure. Although compressive forces descend through the vertebral bodies in all upright postures, straight compression has been found to be the least damaging force. The most damaging force is that of flexion for the disc is squashed in front but pressure is exerted towards its stretched posterior annular boundary. In addition, the facet joints have less control over rotational movements in this position, making it especially damaging when combined with twisting.
Disc Nutrition

The disc has no blood supply of its own, and so obtains its nourishment in one of two ways:

- By diffusion from a capillary bed beneath the vertebral end plates
- By fluid absorption from the surrounding tissues

Fluid absorption is greatest when lying – the stress-free discs tank up with fluid overnight, causing an increase in height of 15-25mm. During the day, forces on the discs resulting from activity in upright postures cause moisture to be squeezed out, and we lose height again. The greatest loss of fluid takes place within the first ½ - 1 hour of rising, and exercise or lifting during this period increases the potential for injury.

Because the discs have no blood supply of their own, injured discs heal very slowly, if at all.

Wear and tear – as a result of prolonged abuse of static and repetitive postures – together with trauma can lead to a variety of changes within the disc, all of which compromise its efficiency. In addition, ageing affects flexibility of the disc, and thus the mobility of the spine. Forward bending and rotation, particularly traumatises the back of the disc and the resulting distortion may progress to herniation or prolapse of the disc, should this occur the spinal cord, or the adjacent spinal nerve root, will be compressed, resulting in the pain.
The Motion Segment or Spinal Unit
The Muscles of the Trunk

Both the back and abdominal muscles play a part in supporting, stabilising and controlling movement of the spine.

The back muscles are in 3 layers. The deepest layer is made up of short muscles, which travel between a pair of vertebrae. The next layer contains slightly longer muscles, which travel over several vertebrae. The function of these muscles is essentially to maintain posture. The outer layer consists of large muscles which are attached to the pelvis, scapula and to the thoracic and cervical vertebrae; the diversity of size and attachment of these muscles enables the body to perform minor movements of intricate adjustments as well a major changes of trunk position.

The abdominal muscles, also arranged in layers, work together to lift and support the spine. They run vertically, horizontally and obliquely, providing a strong ‘girdle’ of muscle, protecting the contents of the abdomen and permitting movements of the spine.

The back and abdominal muscles work in unison to allow movement.
Mechanisms to Support the Spine Whilst Lifting

There are 3 main physiological and anatomical mechanisms that enable the spine to be supported during lifting, carrying, pulling and pushing.

These are:

- Raised intra-abdominal pressure:
- Tension in the thoracolumbar fascia:
- And combinations of the two together with correct use of muscles of the abdomen and back.

The first of these — intra-abdominal pressure is a physiological mechanism created by contraction of the transverse and oblique abdominal muscles and the muscles of the pelvic floor. These muscles contract involuntarily during lifting which raises the intra-abdominal pressure. This then acts upwards on the diaphragm like a balloon, which has the effect of converting the trunk into a more solid cylinder. The spine is, therefore, braced and the load is transmitted over a wider area.

The described movement can be performed actively by contracting the abdominal muscles to expel air against a close glottis. This forcing movement is known as the Valsalva Manoeuvre and is used to evaluate low back pain. The movement increases intradiscal pressure and increases pain because the mechanical load on the spine, produced by muscular contraction, is raised.

The Thoracolumbar Fascia comes into action passively at the limit of lumbar flexion on a contraction of the back and abdominal muscles. It has the effect of stabilising the ligamentous mechanisms of the back and helps to maintain the equilibrium of the spine by resisting flexion. This provides a major support mechanism for lifting.

The abdominal and back muscles provide the third mechanism for back support. These muscles interact in a complex way to resist the force of flexion and stabilise the spine. They are an important part of the process of lifting and it is vital that their strength is maintained.

Biomechanics

“Biomechanics is the study of the application of mechanical principles to living tissue, for example, forces and levers.”

(Guide to the Handling of People (2005))

There are two main areas we wish to explore:

- Centre of Gravity
Centre of Gravity

- Centre of gravity is the centre of the space that a body occupies.
- This is straightforward with bodies of a regular or uniform shape such as a cylinder.
- The human body is not a uniform shape however, and the centre of gravity moves as the body changes position.
- When a person stands upright with arms by his sides the centre of gravity approximates to his pelvis – (i.e. the centre of his physical dimensions.)
- People who cannot control their pelvis when standing cannot stand without help.
- In order to walk the body needs to shift the pelvis to one side. This alters the centre or gravity to allow the non-weight bearing leg to swing forward.

In summary therefore:

A person with no static pelvic control cannot stand.
And a person with no dynamic pelvic control cannot walk.

If a person raises his arms above his head the centre of gravity will rise.

This results in the body becoming less stable. The general rule being that the further the centre of gravity is from the centre of the body the more effort is needed to keep the body stable.

Sometimes the centre of gravity will face outside the physical body – for example when a person is in a sitting position. Though this may seem strange it explains the movement a body has to make in order to get out of such positions. To move from a seated position the person would have to move to the edge of the seat in order that the centre of gravity moves closer in to the body.

Though straightforward for many of us, this manoeuvre is difficult for people who have problems with the muscles of the abdomen such as pregnant women or elderly, frail men and women. This is because in order to move from sitting, the body must be able to lean forward at the abdomen.

Line of Gravity

This is an imaginary line that runs in a vertical direction down from the centre of gravity.
For a body to remain stable it must retain the line of gravity within its base (The Guide to the Handling of People 2005).

When walking normally as already mentioned the centre of gravity moves from side to side. The line of gravity therefore always falls along the supporting leg; the foot forming the supporting base.

The supporting base could be widened by spreading the feet, changing position, or by artificial means such as crutches or a Zimer Frame if stability has been lost. In order to move from a position of stability a temporary instability must be created – for example when divers or speed skaters lean forward. Their position is unstable but needs to be so to help them move.

If, however, instability is created by adopting a leaning forward position but no movement occurs the body is forced to provide a counterbalance. This is provided by the effort of internal structures of muscles and ligaments in the back. If the body did not do this it would topple over. The person has become unstable in this care because the centre of gravity has moved forward and the line of gravity has fallen outside the base.

The longer the external lever which pulls the body forward the greater force the muscles ligaments must produce in order to keep the body in this leaning position. Unfortunately for the body this causes compression of the spinal discs, which in turn leads to muscles becoming fatigued. Ultimately all the major groups of muscles are working to prevent the body falling forward. If the person wanted to move something from this position only the minor muscle groups of the arms are available to provide the effort needed. The action intended has therefore become inefficient.

In effort, when load bearing, the greater the distance of the lever arm from the centre of gravity the more impact that load has on the structures of the spine.

In order to reduce these forces the body must bend the knees and spread the feet therefore widening the base. The line of gravity is therefore brought back into the base and the body remains stable. Now there is less demand on the muscles and ligaments and less tension in the body as a whole. Because the lever arm has been reduced the effective force of any load has been minimised though the weight remains constant.


The Back Functions, Malfunctions and Care.

Briggs S Mosby (1994)

Static Muscle Work
When you are using a muscle but it is not moving, then the muscle is working statically e.g. when holding a tray your arm muscles are working statically.

When muscles work statically, the blood flow is restricted, causing a build-up of waste products. This rapidly makes the muscles fatigue and more prone to injury.

“IT IS IMPORTANT WHEN HANDLING TO LIMIT THE AMOUNT OF STATIC WORK”

What is static loading?

Static loading (or static postures) occurs when the body is kept in the same and unsound position for a prolonged period of time.

Sometimes known as the “invisible load”.

Occurs during all kinds of ordinary activities within health:

- Making beds
- Chatting with clients in wheelchairs
- Taking care of hygiene needs
- Working at computers
- Gripping tools

These static positions can cause pain in the neck back and shoulders

Not moving impedes the flow of blood that is needed to bring nutrients to the muscles and to carry away the waste products of muscle metabolism. When awkward working positions must be maintained (without support) it also increases the static loading of muscles and tendons, and causes the body to fatigue even more quickly.

Exposure to contact stress maybe a by-product of prolonged static loading. When muscles become fatigued, employees look for ways to rest the affected areas. Sometimes employees may rest their arms or wrists on the hard surface and edges of the workstation. For example computer operators may relieve static loading on their forearms and wrists by resting their wrists on computer table. However the blood flow and the movement of their wrist may continue to be, due to the contact stress.

Constant muscle tension can lead to swelling and pressure on nearby nerves, static loading of the tendons can also lead to inflammation and swelling to the point where motion is restricted and the swelling may put pressure on (pinch) the nerves.
13. CARE OF YOUR SPINE

Care of your spine is not just work related. It is vital to look after your spine at home, at work and in leisure activities. There is evidence that heavy manual labour, awkward postures, manual handling, and a previous or existing injury are all risk factors in the development of musculoskeletal disorders.

Contributory factors include:

- Top heavy postures (see diagram)
- Static postures
- Poor posture
- Imposed repetitive movements

Care must be taken when handling any object, both large and small.

It is often the one extra bad manoeuvre which is the final straw and produces pain. Your back has had enough.

**BEWARE!**

**REMEMBER IF YOU DAMAGE YOUR SPINE YOU MAY NOT ALWAYS MAKE A FULL RECOVERY**
There are four situations which are known to be especially risky for your back.

They are:

- **Lifting after sitting for prolonged periods** (e.g. lifting suitcases out of the car after a long journey) – because the back has been kept in a static posture for a long period of time (imagine the forces on your discs and the amount of sustained stretch in your muscles and ligaments)

  Avoid injury by arching your back as soon as you stand up (you should also do this after stooping - although you should, of course, avoid stooping!)

- **Slouching after vigorous exercise** (the resulting aches are usually – incorrectly – blamed on the exercise) – because the muscles are warm yet tired and are easily over-stretched and damaged)

  Avoid injury by lying face down (or flat on your back if this is more comfortable) for 10-15 minutes, then arch your back when you stand up (it is a good idea to arch your back when you stand up after resting – as well as after sitting and stooping!). Alternatively, lie on your back on the floor with both lower legs on a chair.
• **Reaching or stretching** – because your body weight is often not evenly distributed between both feet and the spine is stretched at one side more than the other, making it easily prone to injury.

• **Prolonged standing** – e.g. slow, shopping trip, visiting a museum, as well as standing still. This causes back fatigue and it becomes increasingly difficult to maintain a good posture.

Relieve the stresses this causes by adapting a curled up posture.

*This information was taken from The Back – Functions, Malfunctions and Care by Sheila Braggins, a physiotherapist (Mosby, Landon, 1994)*
## 14. APPENDICES

### Appendix 1

**Assessment Help Checklist**

<table>
<thead>
<tr>
<th>Problems to look for when Making an assessment</th>
<th>Ways of reducing the risk of injury</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The tasks:</strong> do they involve:</td>
<td><strong>Can you:</strong></td>
</tr>
<tr>
<td>• Holding loads away from the body?</td>
<td>• Use a lifting aid?</td>
</tr>
<tr>
<td>• Twisting, stooping or reaching upwards?</td>
<td>• Improve workplace layout to improve efficiency?</td>
</tr>
<tr>
<td>• Large vertical movement?</td>
<td>• Reduce the amount of twisting and stooping?</td>
</tr>
<tr>
<td>• Long carrying distances?</td>
<td>• Avoid lifting from floor level or above shoulder height, especially heavy loads?</td>
</tr>
<tr>
<td>• Strenuous pushing or pulling?</td>
<td>• Reduce carrying distances?</td>
</tr>
<tr>
<td>• Repetitive handling?</td>
<td>• Avoid repetitive handling?</td>
</tr>
<tr>
<td>• Insufficient rest or recovery time?</td>
<td>• Vary the work, allowing one set of muscles to rest while another is used?</td>
</tr>
<tr>
<td>• A work rate imposed by a process?</td>
<td>• Push rather than pull?</td>
</tr>
</tbody>
</table>

| **The loads:** are they:                      | **Can you make the load:**          |
| • Heavy, bulky or unwieldy?                   | • Lighter or less bulky?            |
| • Difficult to grasp?                         | • Easier to grasp?                  |
| • Unstable or likely to move unpredictably (like animals)? | • More stable?                      |
| • Harmful? e.g. sharp or hot                  | • Less damaging to hold?            |
| • Awkwardly stacked?                          | If the load comes in from elsewhere, have you asked the supplier to help, e.g. provide handles or smaller packages? |
| • Too large for the handler to see over?      |                                      |

<p>| <strong>The working environment:</strong> are there:       | <strong>Can you:</strong>                        |
| • Constraints on posture?                     | • Remove obstructions to free movement? |
| • Bumpy, obstructed or slippery floors?       | • Provide better flooring?           |
| • Variations in levels?                       | • Avoid steps and steep ramps?       |
| • Hot/cold/humid conditions?                  | • Prevent extremes of hot and cold?  |
| • Gusts of wind or other strong air movements?| • Improve lighting?                  |
| • Poor lighting conditions?                   | • Provide protective clothing or PPE that is less restrictive? |
| • Restrictions on movements or posture        | • Ensure your employees’ clothing and footwear is |</p>
<table>
<thead>
<tr>
<th>Problems to look for when making an assessment</th>
<th>Ways of reducing the risk of injury</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Individual capacity: does the job:</strong></td>
<td><strong>Can you:</strong></td>
</tr>
<tr>
<td>▪ Require unusual capability, e.g. above-average strength or agility?</td>
<td>▪ Pay particular attention to those who have a physical weakness?</td>
</tr>
<tr>
<td>▪ Endanger those with a health problem or learning/physical disability?</td>
<td>▪ Take extra care of pregnant workers?</td>
</tr>
<tr>
<td>▪ Endanger pregnant women?</td>
<td>▪ Give your employees more information, e.g. about the range of tasks they are likely to face?</td>
</tr>
<tr>
<td>▪ Call for special information or training?</td>
<td>▪ Provide more training (see 'What about training?')</td>
</tr>
<tr>
<td><strong>Handling aids and equipment:</strong></td>
<td><strong>Can you:</strong></td>
</tr>
<tr>
<td>▪ Is the device the correct type for the job?</td>
<td>▪ Provide equipment that is more suitable for the task?</td>
</tr>
<tr>
<td>▪ Is it well maintained?</td>
<td>▪ Carry out planned preventive maintenance to prevent problems?</td>
</tr>
<tr>
<td>▪ Are the wheels on the device suited to the floor?</td>
<td>▪ Change the wheels, tyres and/or flooring so that equipment moves easily?</td>
</tr>
<tr>
<td>▪ Do the wheels run freely?</td>
<td>▪ Provide better handles and handle grips?</td>
</tr>
<tr>
<td>▪ Is the handle height between the waist and shoulders?</td>
<td>▪ Make the brakes easier to use, reliable and effective?</td>
</tr>
<tr>
<td>▪ Are the handle grips in good order and comfortable?</td>
<td></td>
</tr>
<tr>
<td>▪ Are there any brakes? If so, do they work?</td>
<td></td>
</tr>
<tr>
<td><strong>Work organization factors:</strong></td>
<td><strong>Can you:</strong></td>
</tr>
<tr>
<td>▪ Is the work repetitive or boring?</td>
<td>▪ Change tasks to reduce the monotony?</td>
</tr>
<tr>
<td>▪ Is work machine or system-paced?</td>
<td>▪ Make more use of workers' skills?</td>
</tr>
<tr>
<td>▪ Do workers feel the demands of the work are excessive?</td>
<td>▪ Make workloads and deadlines more achievable?</td>
</tr>
<tr>
<td>▪ Have workers little control of the work and working methods?</td>
<td>▪ Encourage good communication and teamwork?</td>
</tr>
<tr>
<td>▪ Is there poor communication between managers and employees?</td>
<td>▪ Involve workers in decisions?</td>
</tr>
<tr>
<td></td>
<td>▪ Provide better training and information?</td>
</tr>
</tbody>
</table>
Appendix 2

Guidelines for Lifting & Lowering Capacity

<table>
<thead>
<tr>
<th>Women</th>
<th>Men</th>
</tr>
</thead>
<tbody>
<tr>
<td>3Kg</td>
<td>10Kg</td>
</tr>
<tr>
<td>7Kg</td>
<td>13Kg</td>
</tr>
<tr>
<td>10Kg</td>
<td>16Kg</td>
</tr>
<tr>
<td>7Kg</td>
<td>13Kg</td>
</tr>
<tr>
<td>3Kg</td>
<td>7Kg</td>
</tr>
</tbody>
</table>
These guidelines assume that the handler is fit, well trained, working under favourable conditions, in a stable body position and with a load that is easy to grasp. If this is not the case, the recommended weights should be reduced further.

Appendix 3

Manual Pushing & Pulling

Few definitions exist which describe the application of human effort involved in pushing and pulling. This may well stem from the considerable variations in bodily actions, which these types of force exertion entail.

Hoozemans et al. (1998), in a review of musculoskeletal risk factors associated with pushing and pulling, elected to use definitions provided by Martin and Chaffin (1972), and Baril-Gingras and Lortie (1995):

“Pushing and pulling could be defined as the exertion of (hand) force, of which the direction of the major component of the resultant force is horizontal, by someone on another object or person. In pushing the (hand) force is directed away from the body

They went on to specify that:

“The exertion of force is not always directed horizontal to be called a push or a pull force, for instance, in pulling a cord to start a lawn mower engine (Garg et al., 1988)”

Adapted from NIOSH, 1997)

<table>
<thead>
<tr>
<th>Design Principles for Pushing / Pulling Tasks</th>
<th>Possible Control Measures for Reducing the Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eliminate the need to push or pull using mechanical aids, where applicable</td>
<td>• Powered conveyors</td>
</tr>
<tr>
<td></td>
<td>• Powered trucks</td>
</tr>
<tr>
<td></td>
<td>• Lift tables</td>
</tr>
<tr>
<td></td>
<td>• Slides or chutes</td>
</tr>
<tr>
<td>Reduce the force required to push or pull</td>
<td>• Reduce size and/or weight of load</td>
</tr>
<tr>
<td></td>
<td>• Use four-wheeled trucks or dollies</td>
</tr>
<tr>
<td></td>
<td>• Ensure wheels and castors on hand-trucks or dollies have:</td>
</tr>
<tr>
<td></td>
<td>1) Periodic lubrication of bearings</td>
</tr>
</tbody>
</table>

2) Adequate maintenance

3) Proper sizing (provide larger diameter wheels & castors)
   - Maintain the floors to eliminate holes and bumps
   - Use surface treatment of floors to reduce friction

Reduce the distance of the push or pull
   - Move receiving, storage, production, or shipping areas closer to work production areas
   - Improve the production process to eliminate unnecessary materials handling steps.

Optimise the technique of the push or pull
   - Provide variable-height handles so that both short and tall employees can maintain an elbow bend of 80 to 100 degrees
   - Replace a pull with a push wherever possible
   - Use ramps with a slope of less than 1:10 (9°)

It should be recognised that the competency required to assess a pushing or pulling operation may be greater than that required to assess a lifting or carrying operation. Users may require further information on how and why pushing and pulling force must be measured and how such measurements shall be used.

When pushing and pulling loads, floor or ground surfaces should be level, clean, dry and unbroken. Slopes or ramps should be low gradient. For pushing and pulling loads on uneven surfaces the force required to start the load moving could increase by as much as 10%.

Where more than one level is involved, the transition should preferably be made by a gentle slope or, by well-positioned and properly maintained steps. **Manual handling on steep slopes should be avoided as far as possible.**

The presence of slopes is an important consideration when pushing or pulling loads. Pushing is generally preferable to pulling. Slopes should not be so steep as to make keeping control of the load difficult.

Another risk from pushing/pulling on a slope is that the forces involved are increased. For example, for a load of 400 kg and a slope of 1 in 12 (4.8°), the additional force required is 33 kg (330 Newton’s). This is above the guideline weight for males and well in excess of the guideline weight for females. Table 2 shows the approximate increase in push forces that can be expected per 100 kg of load, on different slope angles.

**Table:** Effect of slope angle on push force

<table>
<thead>
<tr>
<th>Slope Gradient (degrees)</th>
<th>Push force (kg) increase per 100kg of laden trolley weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix 4
Criteria Guidance for the Selection of Trollies/ Wheeled Equipment
http://www.hse.gov.uk/research/rrpdf/rr228.pdf

Limit load height
(visibility, stability)

Hands between waist and shoulder height

Secure footing

Large wheels with easy pivot
Clear, even and dry floor

Good Practice Measures

- Avoid / reduce the need for pushing / pulling by using mechanical aids
- Conveyors (powered or non-powered)
- Powered trucks
✓ Lift tables
✓ Slides or chutes

- **Reduce the force required to push / pull**
  ✓ Reduce the weight of the trolley and/or load
  ✓ Provide suitable handles positioned between waist and shoulder height
  ✓ Provide trolleys with suitable wheels / castors (e.g. proper sizing, composition) and ensure that they are regularly lubricated and adequately maintained according to manufacturer’s specifications
  ✓ Provide even, but slightly rough, and unbroken floor surfaces which are clean and dry
  ✓ Provide soft sole shoes with good grip

- **Reduce the distance of the push / pull**
  ✓ Reposition receiving and storage areas closer to production areas
  ✓ Improve production process to eliminate unnecessary materials handling

- **Optimise handling techniques when pushing / pulling**
  ✓ Provide variable handle heights, which are at a suitable distance apart.
  ✓ Ensure low gradient ramps / slopes.
  ✓ Restrict maximum stacking heights to improve visibility, weight and body posture.
  ✓ Provide automatic opening doors.
<table>
<thead>
<tr>
<th>Principal design features</th>
<th>Impact on handling operation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Trolley types</strong></td>
<td></td>
</tr>
<tr>
<td>Two-wheeled trolleys</td>
<td>Two wheeled trolleys are versatile and suitable for tall items that must be picked up and set down at floor level. They can be used on uneven ground and over kerbs and for delivery work where the trolley is lifted to and from a vehicle. As the load must be supported, they are not suitable for long distances on smooth floors; a platform trolley might be more appropriate.</td>
</tr>
<tr>
<td>Low-platform trolleys</td>
<td>Low-platform trolleys are stable and suitable for luggage and large items. The low platform means that a large volume of stock can be carried without the overall height becoming excessive. Care needs to be taken, however, to avoid awkward bending / stooping when handling items to and from the trolley.</td>
</tr>
<tr>
<td>High-platform trolleys</td>
<td>The top shelf of a high platform trolley keeps items at a more convenient height for manual handling. Lower levels provide extra capacity but should not be used for heavy or awkward items.</td>
</tr>
<tr>
<td>Box-sided trolleys</td>
<td>A box-sided trolley or tub on wheels is often used for linen and loose items that are not easily stacked on a shelf. One disadvantage is the need to bend over the sides of the trolley to remove items. Drop-down sides or spring assisted false bottoms should be used to aid access.</td>
</tr>
<tr>
<td>Principal design features</td>
<td>Impact on handling operation</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td><strong>Handling factors</strong></td>
<td></td>
</tr>
<tr>
<td>Speed of movement</td>
<td>A trolley should be moved at walking pace to ensure that it is under control at all times and that it can be stopped almost immediately. A walking pace of 3.2 to 4 km/hr (covering a distance of approximately 60 m in one minute) is reasonable; for heavier loads the speed should be reduced.</td>
</tr>
<tr>
<td>Height of shelves</td>
<td>The weight of products placed on shelves will determine the optimum height. Shelves and load platforms should be arranged to minimise manual handling risk while transferring items to and from the trolley. Ideally, the handling of items should be carried out without stooping or twisting, and with the hands between mid-thigh and waist height. The preferred height for trolley shelves should be between 510 mm and 1140 mm above floor. Handling heights less than 360 mm and greater than 1300 mm should be avoided. A trolley with a platform approximately 800 mm high is suitable for handling heavy objects. A low platform, approximately 250 mm high, is better for handling items which have handles on the top, such as a suitcase. Smooth shelves without a lip allow objects to be slid to and from the trolley easily, making large objects easier to handle.</td>
</tr>
<tr>
<td>Access to shelves</td>
<td>Obstructions or barriers that result in awkward postures when handling items on shelves (e.g. deep shelves and small clearances between shelves) should be avoided. In some cases, a drop-down or fold back side permits easier loading and unloading.</td>
</tr>
</tbody>
</table>
### Task for which the trolley is used

<table>
<thead>
<tr>
<th>Principal design features</th>
<th>Impact on handling operation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Trolley dimensions</strong></td>
<td></td>
</tr>
<tr>
<td>Overall dimensions</td>
<td>Trolley dimensions will be determined primarily by practical considerations, but the overall dimensions should be limited to a size that, when full, can be pushed without exceeding the recommended pushing forces. Trolleys longer than 1.3 m or wider than 1 m cannot easily be turned in many product-area aisles.</td>
</tr>
<tr>
<td>Overall height</td>
<td>The operator should be able to see over the top of a trolley without restrictions to their visibility. Restricted forward vision often results in the operator adopting twisted postures to see around the sides of the trolley. A maximum laden height of 1300 mm is recommended. If the trolley must be taller than this, the sides should be open or have mesh areas so that the handler can see through it. An alternative might be designing the trolley for pulling.</td>
</tr>
<tr>
<td>Overall width</td>
<td>The overall width of the trolley should be at least 80 mm smaller than the narrowest doorway the trolley will pass through. To ensure stability, however, the distance between the axles of castors when both swivel castors are pointing inwards should be at least $2/3$ of the trolley width and $1/6$ of the trolley height or, if the trolleys are used on slopes up to 6 degrees, $1/5$ of the trolley height.</td>
</tr>
<tr>
<td>Overall length</td>
<td>For ease of steering, the length of a trolley should generally be between 1.5 and 2.0 times its width.</td>
</tr>
<tr>
<td>Principal design features</td>
<td>Impact on handling operation</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Load supported or carried by the trolley</strong></td>
<td><em>Force</em></td>
</tr>
<tr>
<td><strong>Load</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Starting resistance</strong></td>
<td><em>A heavy trolley that has moulded rubber wheels has a starting resistance of approximately 196 N per 1000 kg total weight. The longer a trolley is stationary between operations and the heavier the load, the more potential there is for the wheels to ‘flatten’. This increases starting resistance.</em></td>
</tr>
<tr>
<td>Principal design features</td>
<td>Impact on handling operation</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>Handle grips and location</td>
<td></td>
</tr>
<tr>
<td>Handle design</td>
<td>Handle type will be determined by trolley dimensions and handling requirements. Handles may be orientated vertically or horizontally and for one- or two-handed operations. Adequate clearance for the gloved hand is needed where the handle is part of the trolley structure (e.g. vertical support), or attached to it. Handles should be gripped so that the hands are in from the sides of the trolley to prevent trapping or collision injuries. They should also protrude at least 200 mm from the back edge of the trolley to provide room for a normal walking stride without the shins contacting the bottom edge of the trolley. If a trolley is pulled rather than pushed (e.g. a pallet truck), the handle should be an adjustable T-bar. In addition, handles should extend far enough out to prevent the operator from being struck on the heels when walking in front of the trolley.</td>
</tr>
<tr>
<td>Handle placement</td>
<td>The width and length of the trolley and the distance between the handles will determine its manoeuvrability in tight spaces. Handles should be placed so that they straddle the load’s centre of gravity, but at a height that permits comfortable posture as well as good biomechanical advantage.</td>
</tr>
<tr>
<td>Handle height</td>
<td>The optimum height for a handle for pushing and pulling is between 910 mm and 1120 mm above the ground, depending upon operators stature. In general, the handle should be a little below elbow height. A middle height of 950 mm is a good compromise for most people. The higher the centre of gravity of the loaded trolley, the higher the handle should be. Handles lower than 910 mm are not recommended because they cause taller persons to stoop.</td>
</tr>
<tr>
<td>Principal design features</td>
<td>Impact on handling operation</td>
</tr>
<tr>
<td>----------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Handle grips and location</td>
<td>Vertical bars: Vertical handles, instead of a horizontal bar, allow users to find their own most convenient height. They should be about 450 mm apart to ensure good control of the trolley. They are most satisfactory for narrow trolleys, usually less than 510 mm wide. Vertical corner posts of a trolley's frame should not be used as handles because they expose the worker's hands to trapping / collision injuries.</td>
</tr>
<tr>
<td>Horizontal bars</td>
<td>Horizontal bar handles assist the handler in manoeuvring a trolley in confined spaces. They permit the handler to vary hand location to fit the task and accommodate a person's size and strength.</td>
</tr>
<tr>
<td>Swivel castors</td>
<td>Trolleys with swivel castors should have handles at both ends to maximise manoeuvrability in confined spaces.</td>
</tr>
</tbody>
</table>
### Task for which the trolley is used

<table>
<thead>
<tr>
<th>Principal design features</th>
<th>Impact on handling operation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wheels and castors</strong></td>
<td></td>
</tr>
<tr>
<td>Diameter</td>
<td>Larger wheels have lower rolling resistance than smaller wheels and are less affected by gaps, ridges and irregularities in floor surfaces. A minimum diameter of 200 mm is recommended for all trolleys that have a laden weight over 200 kg or that are used outdoors. For other trolleys, a minimum diameter of 125 mm is recommended. However, smaller wheels may be acceptable for light trolleys that are moved only short distances on smooth floors.</td>
</tr>
<tr>
<td>Composition</td>
<td>Hard materials (e.g. cast iron and nylon) have the lowest rolling resistance on hard smooth surfaces, such as concrete, and are suitable in some industrial applications. However, hard wheels are more difficult to start when faced with an obstruction (e.g. debris on the floor) or gap in the floor. They also have a tendency to generate a lot of noise. Softer materials tend to even out the peak forces and may feel easier to push, even if the rolling resistance is higher on a smooth surface. Shock absorbing materials, such as rubber or polyurethane, may be required for rougher floors and outdoor surfaces. Non-marking rubber or polyurethane may be required to protect some floors. Pneumatic tyres roll easily over bumps and unpaved surfaces and may be preferred for some outdoor applications. However, they have a higher rolling resistance on smooth surfaces and need regular checking to maintain correct inflation pressure. Some softer tyre materials may have high friction on some floor surfaces and make it hard for the wheels to swivel into alignment when the trolley is started.</td>
</tr>
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<td>Wheels and castors</td>
<td>- Narrower wheels and rounded tyre profiles roll and swivel more easily on hard surfaces. Wider treads may be necessary on soft carpets or where there are gaps that could catch a narrow wheel (e.g. slots in drainage grates or gaps between a lift and floor), but this increases the force required to move the trolley and makes cornering more difficult. A combination of a wide soft tyre with a solid central rim may be more suitable when moving between different floor surfaces, such as carpets and concrete floors. The width of the wheel will be dictated to some extent by the load rating required.</td>
</tr>
<tr>
<td>Width and tyre profile</td>
<td></td>
</tr>
<tr>
<td>Wheel bearings</td>
<td>- Sealed precision ball bearings provide the lowest rolling resistance and should be used for manually moved trolleys that are used frequently or over reasonable distances. Pre-lubrication and effective sealing ensure that the low rolling resistance is maintained without the need for further lubrication. Roller bearings are more commonly available for industrial castors but require periodic lubrication to maintain low rolling resistance. Plain metal bearings are acceptable on trolleys moved infrequently and over short distances, but the rolling resistance is higher than ball or roller bearings and increases markedly if not regularly lubricated. Plastic (usually nylon or acetal) plain bearings are acceptable for light loads and do not require lubrication. Thread guards should be used to reduce the likelihood of bearings becoming clogged when used in environments where the floor is often contaminated with waste materials. They also assist in keeping dust and debris out of unsealed bearings. For this reason, they require less frequent maintenance.</td>
</tr>
<tr>
<td>Wheel bearings</td>
<td></td>
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<tr>
<td>Brakes</td>
<td>Brakes on at least two wheels are important if the trolley has to be loaded / unloaded on sloping surfaces or where it is important to stop movement while transferring large items. Castors are available which prevent swivelling of the castor as well as rotation of the wheel.</td>
</tr>
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## Task for which the trolley is used

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<tr>
<td>Wheel arrangements</td>
<td>Four swivelling wheels offer greater manoeuvrability and is the most suitable arrangement for trolleys moved over short distances in congested or confined spaces on level floors. They are not well suited to long distances because they require more effort to steer them. On sloped surfaces the trolley may tend to drift sideways and require twisting effort to maintain straight travel.</td>
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<tr>
<td></td>
<td>Two swivel, two fixed wheels are best suited to long distance pushing and use on sloped or uneven surfaces. The swivel wheels should be at the handle end of the trolley (rear) to reduce forces required to manoeuvre it.</td>
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<tr>
<td></td>
<td>Four swivel, two fixed centre wheels is best for long trolleys. The trolley pivots about its centre wheels making it easy to steer around corners in passageways. But it is not easily manoeuvred into a corner or parked against a wall. Some trolleys may possess a single swivel wheel at either end, which is acceptable for relatively narrow trolleys that are uniformly loaded.</td>
</tr>
<tr>
<td><strong>Maintenance</strong></td>
<td>Good bearings and regular maintenance reduces the push / pull force required. Tread wear should be monitored, as well as corrosion and other changes that might bind the wheels and increase the force required to move the trolley.</td>
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<tr>
<td>Working environment</td>
<td></td>
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<tr>
<td>Surface characteristics</td>
<td>Floors that are heavily ruted, cracked, with depressions or drains, or have caked materials on and in them, make trolley handling difficult. The coefficient of friction between the trolley wheels and floor can increase threefold when turning and manoeuvring (e.g. between a concrete and stone pavement), thereby requiring more physical effort from the operator. Large-wheel trolleys can overcome some of these handling problems on uneven surfaces, but they may not be practical in areas where aisle space is limited. Powered trucks are generally preferable if the floor or other surface irregularities cannot be remedied.</td>
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<tr>
<td></td>
<td>Peak forces due to irregular floor surfaces or short ramps should not exceed initial force limits. For different floor surfaces, sustained forces should not exceed the recommended limit for the most resistant floor surface (the force required to push a trolley on carpet is typically 30% to 50% higher than on a smooth hard surface).</td>
</tr>
</tbody>
</table>
15. RELEVANT LEGISLATION, BIBLIOGRAPHY AND ASSOCIATED DOCUMENTATION

This document was drafted with reference to the following:

**Relevant Legislation**

Health and Safety at Work Act 1974
Management of Health and Safety at Work Regulations 1999
Lifting Operations and Lifting Equipment Regulations 1998
Provision and Use of Work Equipment Regulations 1998

**Bibliography**

Manual Handling in the Health Service (Health Services Advisory Commission 1998)
Manual Handling at Work: A Brief Guide Health and Safety Executive 2012
Handling Assessments in Hospital and Community (RCN 1999)
Introducing a Safer Patient Handling Policy (RCN 1999)
RCN Code of Practice for Patient Handling (1999)
Handling Home Care: Achieving safe, efficient and positive outcomes for care workers and clients (HSE 2002)

http://www.hse.gov.uk/msd/index.htm
http://www.ergonomics.org.uk/
http://www.hse.gov.uk/research/rrpdf/rr228.pdf
Leicestershire Partnership NHS Trust Policies

Manual Handling Policy
Health and Safety Policy
Medical Devices Policy
Dress Code and Uniform Policy
Risk Management Strategy
Risk Assessment Guidance

All policy documents are available via the Policy Document Store available on E-source.

Leicestershire Partnership NHS Trust Manual Handling Procedures, Pathways, Guidelines and associated documentation are available from the Moving and Handling Section of the E-source