

This program provides information on an ergonomic approach to manual material handling.

Objective

The participant will understand the anatomy of the back, how to analyze management operations, consider material flow, prioritize job elements through analysis of the job tasks and load. They will also learn what to look for in the work space and how to plan for the job, including equipment available to assist in handling materials.

Introduction

Manual handling of materials is very closely linked to the risk of back injury. While progressive technology has provided some assistance in other production techniques, manual handling of materials has remained essentially the same. Generally, companies initiate lifting programs to train their employees on appropriate lifting techniques to reduce the likelihood of back injury. Training is a major component of back injury prevention, but it is best accompanied by changes to working conditions to minimize the actual number of back injuries.



Anatomy of the Back

Vertebra – The back has 33 vertebrae, and each has two main parts: the body and the bony extensions, which encase the spinal cord. The spinal cord branches out in the open spaces at each side of the vertebrae, and these offshoots are nerve roots.

Discs - 30 discs fit between the vertebrae. They are made of tough, fibrous cartilage surrounding a softer,

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gelatinous material. Their purpose is to maintain alignment of the vertebrae and to cushion forces imposed by daily activities.

300 **muscles** and many **ligaments** hold the vertebrae and discs together.

Over time, undue stress on the back can create very small tears in the fibrous outer casing of the discs. Since the discs have no blood supply for healing, the number and extent of these small tears gradually increases. Eventually, the inner gelatinous contents of the disc may leak out, causing the disc to narrow. The result of this disc narrowing is occasional root pinching, deterioration of the joints, inflammation, and pain. It is also possible for the disc to suddenly rupture (usually toward the rear), causing the inner disc material to press on the nerve root.



Almost all industrial back injuries are referred to as “back strains,” which is defined as an overexertion or stretching of the muscles. Generally, strains are the result of a single, physically traumatic event causing an acute injury. Thus, back injury prevention programs tend to focus on the prevention of “one shot” strains; that is, injuries resulting from single lifting incidents in which employees may overexert or overextend themselves.

When back pain is reported, an investigation generally focuses on the immediate incident responsible for the back injury. However, consideration must be given to any ergonomic risk factors (e.g., repetitive motions) that may have led to muscle fatigue, leaving muscles more susceptible to injury.

Back pain has many causes and it is often difficult and costly to pinpoint the factors responsible. One emerging theory states that most industrial back pain results from cumulative strains to the discs caused by

repeated, stressful work, which is often manual material handling.

Workers' compensation recognizes these cumulative back injuries are caused by weeks, months, or years of ergonomic stressors, such as lifting in an awkward posture or a repetitive lifting job assignment. The underlying factors responsible for these strains take on much greater importance than trying to fix the one-shot incidents, and finding those factors needs to become a primary goal to reduce back injuries.

Analyze Management Operations

Analysis of jobs in the workplace shows that injuries can be sustained through repeated, awkward, or unnecessary handling of materials, so improvements are best made by reviewing all material handling tasks, regardless of their extent. It's important to keep in mind that when continuously exposed to an operation, we sometimes become oblivious to the possibilities of improving it, so a fresh and completely objective view of the job is needed. While a possible solution may not seem practical at first, it may be worth it to give it a try.

When analyzing jobs to reduce material handling injuries, using a systematic method can lead to increased productivity and a reduction in operating costs. Consider the following:

- Material handling often composes one of the largest cost components of a product, operation, or service, and unnecessary handling of materials costs time and money.
- The individual(s) responsible for designing workstations should understand the relationship between the workers, the workstations, and the jobs to ensure the greatest possible harmony between the work and the worker. The details of the tasks being completed are important to providing an appropriately and ergonomically designed workstation.
- The individual(s) responsible for purchasing are also an important part of the material handling program. They control such details as size, weight, packaging, and convenience for handling, and can also consider using "sold to/ship to" arrangement to eliminate in-plant handling wherever possible. Products being shipped to your company for distribution may be more wisely shipped directly from your supplier to the customer, saving cost in freight and possible injury in handling.

- Housekeeping can quickly become a concern in a busy material handling area, such as a warehouse, which can lead to material handling vehicle accidents and damage to materials or finished goods.
- Reducing overall work-in-progress quantities relieves problems such as overcrowding, extra handling, using larger containers, or stacking parts higher. To reduce work-in-progress quantities, tighten controls and shorten forecasting for inventory, scheduling, ordering, and shipping. Manufacture products on an "as-ordered" basis instead of stockpiling for anticipated use. This is also important when planning for future expansion or changes.
- Managers can also perform product analysis, as changes in the product sometimes result in reduced material handling. Consider lightening the product to allow a worker or conveyor to handle more pieces at one time.



- Top management creates policy and procedure; therefore, they must initiate the first step in analyzing material handling operations. Even in the absence of management's analysis, it is good to personally analyze and implement changes in certain situations.

Material Flow

- Once management operations have been analyzed, it's good to consider how the material is routed through the facility or worksite. Get a look at the big picture to make sure the material flow makes sense through the space.
- Eliminate unnecessary material handling by combining operations or shortening the distances that material must be moved.

- Look for crossing paths, loops, backtracking, and a general lack of direction as production of a material goes from start to finish. Short distances enable workstations to link by conveyors and reduce carrying distances. In addition, less mechanical handling means fewer opportunities for accidents. Managers can walk through operations with an employee, make simple changes immediately, and make written suggestions for observed “cost saving” and “people-saving” changes that need approval or further evaluation.
- Simplify, rearrange, or change processes. Simplify processes so similar material handled differently can be worked in a similar fashion, improving material flow. Listen to suggestions made by employees to simplify processes.
- Analyze each workstation individually to establish disposal and storage methods as well as ways to improve material flow from scrap, waste materials, containers, tools, and equipment.



- Aisle-ways should be considered for both intended material flow and emergency access. When possible, work should not take place in aisle- ways. Personnel must be able to evacuate quickly in an emergency, and cramped aisle-ways may restrict exits causing panic. Emergency vehicles must also be able to gain access quickly. Adequate aisle-ways and exits facilitate the orderly movement of materials.

Prioritize Job Analysis

Once material flow has been considered, we can break the work processes into smaller job elements, established on a priority basis, with the worst or most strenuous tasks being examined first. Review accident statistics to determine priorities. Take the time to examine the current accident investigation

procedure to see if it really collects useful information for analysis.

Employees usually have useful and crucial input when managers are performing job analysis. Managers should ask employees for their views on where the most strenuous, demanding, and dangerous material handling tasks exist. Likewise, supervisors and other management personnel should be polled for their observations.

Tasks

Once priorities have been set, break the job down into elements, or “tasks;” the simplest single actions needed to define the process at each stage of an operation. Among the considerations are:

- Fit the task to the worker using an ergonomics approach as described here.
- Recognize manual material handling is more than just lifting; it includes lowering, pushing, pulling, holding, carrying, and transferring.
- Measure the frequency and average duration of the task. Frequency is activities per minute, keeping in mind how the activity varies. Be careful in estimating an average frequency which may be cyclical; that is, very fast then very slow.
- Be aware of the trade-off between frequency and weight. As loads become lighter and are lifted more frequently, fatigue becomes a factor. As loads become heavier and are lifted less frequently, considerations regarding the structure and strength of the back rise in importance. Allow the employee as much time as possible to complete the task, considering the needs of production.
- Determine the type of pacing. Additional allowances should be made for forced pacing. One example might require removing evenly spaced loads as they come off the end of the conveyor.
- Minimize reach requirements. Design the operation to accommodate the smallest person’s reach. Avoid unnecessary material stacking, storing, or placement for work-in-progress material (such as neatly orienting parts in containers when they will be dumped out in the next operation).
- Structure equipment so gravity moves materials wherever feasible.
- Simplify tasks by combining operations and steps.

Load

When analyzing the load of a job, it helps to utilize deliberately small or large containers. This can remove any doubt about whether an object should be handled manually or mechanically. Small loads meant to be handled manually should be kept in containers that are as small as possible to prevent obstructed vision during handling.

The weight of containers that are used repeatedly should also be considered against the weight of the materials being transferred inside them; the weight of the container should be minimal compared to the weight of the product.

Containers should also be easily gripped – consider ordering cardboard boxes with handle cutouts or use containers with handles, lift straps, or texture, and avoid awkwardly designed containers.

The contents of a container should be stabilized by inserting vertical baffles or dividers, balancing the weight in the box, or using packing materials. This will reduce sudden shifting of contents and minimize the potential for injury by protecting the employee from loads with sharp edges or projections, and from reactive loads such as metal shavings.

While handling manual materials, position the load's center of gravity (or balancing point) as close to your body as possible. The further the distance from your center of gravity, the more stress increases on the back. For example, a 10-pound dictionary held 30 inches away from the body's center of gravity is equivalent to a 50-pound load held close to the body.

Plan for outgoing materials to leave in suitable containers, minimizing product handling. Managers can also ask customers how best to design product packaging to meet their material handling needs.

Finally, include worker feedback on required material handling necessary for the job when performing any job analysis.



Workplace

Ergonomics is important in the work space. Consider the following in jobs with considerable manual material handling:

- Rotate employees to keep individuals from continuously working strenuous jobs.
- Split work among two or more employees.
- Institute appropriate work/rest schedules.

The worker should receive specific training in the following areas:

- Use of mechanical handling aids - Employees may avoid mechanical aids because they do not know how to use them, or may use them when improperly trained and cause injury to themselves or another.
- Recognizing material handling problems in the workplace.
- Identifying procedures that can prevent excessive manual material handling.

Always check the area you'll be completing work in. Some considerations:

- When setting up a work area, bring only enough material to complete the job in the immediate work area. Extra material will either need additional handling to get back into storage or will create congestion. Likewise, too little will require extra handling to complete the job.
- Check floor surfaces. The force required to move carts to move on poor surfaces can double or triple, so quickly repair damaged flooring and surfaces to prevent overexertion. You should also keep wheels in good repair because worn-out or damaged wheels can also increase the required force.
- Poor housekeeping only increases material handling obstacles. Keep floor surfaces clean. Water, oil, grease and material scrap reduce traction and increase the force required to push or pull carts. Insist on good housekeeping.
- In material handling, "what goes down must come up." To prevent repeated stooping and bending, bring both incoming and outgoing materials at each process to a suitable work height, at least 20 inches from the floor, but ideally to knuckle height of about 30 inches.
- Reduce the need to raise or lower materials from above shoulder height. If you must raise or lower

materials above shoulder height, store lighter objects on top shelves.

- Remove constraints that prevent materials from being positioned close to the body, allow enough space for feet to get under tables and conveyor belts and provide clear access to shelves and adequate space to go around pallets.
- Reduce height differences during load travel. Keep loads between knuckle and shoulder height from the origin of the lift to its destination.
- Slide objects rather than lifting and lowering them. Arrange to lower an object rather than lift it.
- Provide adjustable chairs for all operations, whether they are in the company president's office or on the small-parts assembly line. Chairs should offer maximum adjustability providing support for any lifting that will be done from that workstation.



Equipment

Consider the use of mechanical aids whenever possible to assist employees in their material handling needs. Some examples are:

- Pallet Jack
- Two-wheeled Hand Truck
- Four-wheeled Cart
- Motorized Hand Truck
- Hoist
- Crane
- Conveyor
- Powered Industrial Vehicle
- Lift Table
- Lift and Tilt Table
- Winch
- Manipulator
- Positioner
- Up-ender
- Dumper
- Chute

Try to incorporate concepts that fit the job to the worker. Consider maintenance and setup needs when planning, designing, purchasing and installing equipment, and build equipment around material handling requirements.

Review work areas for proper illumination levels; poor lighting can contribute to accidents and injuries and diminish quality of products.

Make allowances for weather conditions:

- Issue appropriate clothing, such as gloves.
- Take measures to prevent cold and heat stress.
- Maintain aisles.
- Shield storage areas from mud and rain.

Evaluate noise levels to ensure that mechanical-handling warning signals can be heard.

Be sure air-contaminant levels are not excessive. This can be achieved through routine monitoring in high-exposure areas.

Summary

Once workers, staff and line personnel have identified problems, these problems must be eliminated. At this point, deficiencies have been identified with possible solutions in mind. The process is broken down into two stages:

- **Prioritize** – Categorize priorities by degree of hazard and risk associated with an operation. Determine these priorities as part of the initial management analysis of the material handling process, essentially a historical approach. Risk itself is based on the frequency of worker exposure to the hazards of any given task and the number of workers routinely exposed.
- **Review** - Establish a company policy to review the material handling safety programs as part of the planning procedure for any proposed process. This review should also be ongoing since new material handling equipment comes on the market continuously, and “state of the art” in ergonomic equipment is changing rapidly.

The most effective review is conducted in an atmosphere of participatory management. There should be strong involvement and representation from all levels of management and employment. This can be accomplished generally through established committees or quality circles.

Two key elements of the review process are determining the impact the proposed changes will

have on other jobs and what new problems will arise as a consequence of these changes. Considering these elements ensures a successful result for the newly emphasized material handling process.

After review, changes will either be accepted and implemented, or rejected. When suggestions are accepted, assign target dates for completion, put them into action as soon as possible, and communicate any intended changes to all affected employees. If changes have been rejected, the persons responsible for the suggestions deserve and will appreciate feedback concerning its their rejection.

In a broader context, the possibility for change should be viewed not just departmentally, but throughout the workplace. Build on the successes of the program and share your success stories with others.

These actions mark a dramatic departure from the way we have viewed material handling in the past. Reducing back injuries requires a comprehensive look at the facility to include the jobs, workstations, and the workers. Technology and management approaches have been continuously changing and ergonomics incorporates those changes to create safer, healthier work environments.

For more information on material handling, lifting techniques, and other topics, see the Service Lloyds website. In Risk Control's Training Materials section, we have additional resources including:

- Back Injury Prevention
- Safe Lifting Techniques – Toolbox Talk
- Empty Skids and Pallets – Toolbox Talk
- General Ergonomics – Toolbox Talk

Remember to practice Safety; don't learn it by accident.

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