



# What is manual materials handling?

## Manual Materials Handling

Although technology has advanced industrial production techniques, employees still perform manual materials handling tasks in many workplaces. Tightly linked to the manual handling of materials is the possibility of back injuries.

Throughout the country, the number of workers' compensation claims for back injuries remains high. In Ohio, back injuries, on average, account for nearly one out of every five workers' compensation claims. That ratio has declined very little during the last few decades despite efforts to reduce these injuries.

Other Ohio statistics indicate the average back injury costs approximately \$5,126 in compensation and \$2,694 in medical expenses. The average reserve, or potential future liability, is \$10,471, for a total average cost of \$18,290 per injury. The annual cost for back injuries exceeds \$100 million in Ohio alone, increasing at an annual rate of approximately 14 percent.

As staggering as these figures seem, there are other losses to consider. Lost income to employees, lost productivity for employers, and the pain, suffering and lengthy disabilities that go along with these injuries are all a part of the cost. The higher probability of accidents to inexperienced replacement employees — new to the job and its techniques — must also be considered.

Industry has had difficulty dealing with this complex problem. The typical and, often, only remedy has been to initiate a "canned" lifting program in which the employee is trained to make a certain type of lift aimed at preventing back injuries. But the results of such an approach are too often lacking, with no lasting reduction in injuries.

A new line of thinking incorporates advanced ergonomic (science seeking to adapt work or working conditions to fit the worker) trends in manual materi-

als handling. Most importantly, specific procedures now evaluate and improve existing manual materials handling tasks. Employees take ergonomic considerations more thoroughly into account.

## Anatomy of the back

The back has 300 muscles, 33 vertebrae, 30 discs between the vertebrae and many ligaments. Each vertebra has two main parts — a body and bony extensions — that encase the spinal cord. The spinal cord branches out in the opening space at each side of the vertebrae. The offshoots are referred to as nerve roots.

Numerous muscles and ligaments hold the vertebrae together. Discs, which fit between the vertebrae, are made of tough, fibrous cartilage surrounding a softer, gelatinous material. Discs maintain alignment of the vertebrae and cushion forces imposed by daily activities.

Over a period of time, undue stress 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 contents may leak out, causing the disc to narrow. The disc may also suddenly rupture (usually toward the rear), with the inner disc material pressing on the nerve root. The result of this disc narrowing is occasional root pinching, deterioration of the joints, inflammation and pain.

A strain is defined as an overexertion or stretching of the muscles. Generally, strains are the result of an acute, physically traumatic event. Thus, back-injury prevention programs 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 an employee reports back pain, an investigation usually focuses on the immediate incident responsible for the back injury. However, you must

give consideration to the repeated motions that may have led to the traumatic incident. Fatigued muscles are more susceptible to injury.

Workers' compensation now recognizes these cumulative back injuries — injuries caused by weeks, months or years of repetitive motions — as compensable claims. But accurate diagnosis of back pain and its causes is a long and costly process.

One theory is that most industrial back pain is the result of cumulative strains to the disc created by repeated, stressful work such as manual materials handling. In this theory, the underlying factors responsible for these strains take on much greater importance. Consequently, the need for workplace design to reduce the cause of back injuries becomes a primary goal.

BWC's Division of Safety & Hygiene has reviewed a substantial amount of international literature on lifting techniques. There is no convincing evidence that such techniques alone have been effective in reducing back injuries. Therefore, the division no longer advocates the use of specific lifting techniques as a viable means of reducing back injuries.

Also, behavior modification has not worked. So it is necessary to analyze materials handling methods and examine the design of the workplace. This analysis finds repeated awkward and unnecessary handling can sustain injuries. It is important to review all materials handling tasks — regardless of their extent — to make improvements.

When we continuously are exposed to an operation, we sometimes become oblivious to the possibilities of improving it. This is especially true of materials handling tasks. Take a fresh, completely objective view of the job.

Using a systematic method of reviewing jobs for reducing materials handling injuries usually pays dividends through increased productivity and reduced operating costs.

### **Analyze management operations**

We must first recognize that materials handling is often one of the largest cost components of a product, operation or service. Unnecessary handling of materials costs time and money.

We must understand the relationship between workstation design and the jobs employees expect workers to perform. People responsible for designing work methods must pay particular attention to details of the task involved to ensure the greatest possible harmony between the work method and the worker.

Make purchasing agents an important part of the materials handling program. Have them pay attention to details, such as size, weight, packaging and convenience for handling.

Use sold to/ship to arrangements to eliminate in-plant handling wherever possible. Products shipped to your company for distribution may be more efficiently transported from your supplier to the customer, saving freight and handling.

Reduce overall work-in-process quantities. Failure to do so often results in overcrowding problems — extra handling, use of larger containers or parts stacked higher. Housekeeping problems may develop, increasing possibilities of materials handling vehicle accidents and damage to materials and finished goods.

To reduce work-in-process quantities, it is necessary to tighten controls and shorten forecasting for inventory, scheduling, ordering and shipping. Manufacture products on an as-ordered basis, instead of stockpiling for anticipated use.

Perform product analysis. Changes in the product sometimes result in reduced materials handling. Consider lightening the product, and allowing a worker or conveyor to handle more pieces at one time.

Plan to expand or change. Production usually suffers under crowded conditions.

Much of this material is dependent upon management's policies and procedures. Even in the absence of management analysis, you personally can analyze and implement change.

Establish disposal and storage methods, and ways to improve material flow for scrap, waste materials, containers, tools and equipment. Each workstation must be analyzed.

## Material flow

It is usually not enough to simply observe and study a specific manual materials handling task. Key questions arise regarding how the material is routed through the facility or work site that you can only answer by looking at the bigger picture.

Eliminate unnecessary materials handling by combining operations or shortening the distances that the materials must move.

Look for crossing paths, loops, backtracking and a lack of direction during production. One benefit of short distances is the ability to link workstations by conveyors and reduce carrying distances. Also, less mechanical handling can mean fewer opportunities for forklift accidents. Walk through your operations with an employee. Make immediate simple changes. (Make written suggestions for observed cost-saving and people-saving changes that need approval or further evaluation.)

Simplify, rearrange or change the process. Often, you can perform processes that you handle differently in a similar fashion to simplify the material flow.

Plan adequate aisleways for intended material flow, and emergency access and exit. Make sure personnel can evacuate quickly in an emergency. Cramped aisleways may restrict exits and cause panic.

Ensure emergency vehicles can quickly gain access. Adequate aisleways and exits facilitate the orderly movement of materials. Avoid the necessity of working in aisleways.

## Workplace

Check floor surfaces. Repair cracks, depressions, holes, damaged flooring and surfaces. Starting forces for carts can double or triple on poor surfaces. Worn-out or damaged wheels also can increase the required force. Insist on good housekeeping. Keep floor surfaces clean. Water, oil, grease and material scrap reduce traction and increase the force required to push or pull carts. Poor housekeeping only increases materials handling obstacles. Review plant design to remove building obstructions that interfere with materials handling.

In materials handling, “what goes down must come up.” To prevent repeated stooping and bending, the goal is to bring both incoming and outgoing materials at each process to a suitable work height. We recommend at least a minimum of 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. Provide clear access to shelves and adequate space around pallets.

Reduce height differences during load travel. Keep loads between knuckle and shoulder height from origin to destination. Slide objects rather than lifting and lowering them.

Provide adjustable chairs for all operations. Chairs should swivel for side-lifting, whether they are located in the company president’s office or on the small-parts assembly line.

## Analyzing manual materials handling tasks

### Prioritize task analysis

Once we understand material flow, it is time to evaluate tasks. Do this on a priority basis, first examining the worst and most strenuous tasks.

The safety and health department should review accident statistics to determine priorities. The employees who perform the tasks the department is evaluating are a vital source of information.

Ask employees for their views on where the most strenuous, demanding and dangerous materials handling tasks exist. Likewise, poll supervisors and other management personnel. This also is the time to examine the accident-investigation procedure to see if it is effective.

## Analyze the job — tasks

Once you set priorities, break the tasks down into elements, which are the simplest single actions needed to define the process at a particular stage of an operation. Among the considerations are:

- Recognize manual materials handling is more than just lifting. It also includes lowering, pushing, pulling, holding, carrying and transferring activities.
- Measure the frequency and duration of the task. Determine the frequency of the task in activities-per-minute. Be sure to note how the activity varies. Be careful in estimating an average frequency which may be cyclical; that is, very fast then very slow. Note the average duration of the task.

Be aware of the tradeoff 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 are important. Allow the employee as much time as possible to complete the task, considering the needs of production.

Determine the type of pacing. Make additional allowances for forced pacing.

Minimize reach requirements. Design the operation to accommodate the smallest person's reach.

Avoid unnecessary material stacking, storing or placement for work-in-process material (such as neatly orienting parts in containers when they will be dumped out in the next operation). Structure equipment to use gravity to move materials wherever feasible. Simplify tasks by combining operations and steps.

## Analyze the job — load

The load consists of the item or collection of items handled, many of which are stored in containers.

Adjust all containers for the required volumes. Use large containers for high-flow volume and small containers for low volume. Avoid using large containers for low-volume materials to reduce the need for workers to reach.

Remove handling uncertainties. Remove an employee's doubt about whether he or she should manually or mechanically handle an object by using obviously small and large containers or parts.

Plan for incoming materials to arrive in suitable containers to minimize product handling. Ask customers how you can best design product-needs packaging to meet their materials handling needs.

Reduce deadweight ratio of containers. Consider the weight of the container that employees must repeatedly handle and transfer versus the parts inside. The weight of the container should be minimal compared to the weight of the product.

Keep manually handled loads as small as possible, paying attention to the width and length. To prevent obstructed vision, make sure load height is 30 inches or less when manually handled.

Make the load center of gravity (or balancing point) should as close as possible to the person handling it. Stress on the back increases as the distance from your center of gravity increases. For example, a 10-pound dictionary held 30 inches away from the body's center of gravity would be the equivalent of a compact 50-pound load held close to the body.

Ensure the load will be easy to grip. Accomplish this by ordering cardboard boxes with handle cutouts; using containers with handles, lift straps or textured containers; and avoiding awkwardly designed items.

Stabilize contents in boxes and containers to reduce surprises. Insert vertical baffles or dividers, balancing the weight in a box or using packing materials to avoid shifting parts.

Minimize the potential for injury by protecting the employee from loads with sharp edges or projections. Potential for injury also exists with reactive loads, such as metal shavings.

## Equipment

Consider the use of mechanical aids whenever possible to assist employees in their materials-handling needs. Examples include:

- Pallet jack;
- Two-wheeled hand truck;
- Four-wheeled cart;
- Motorized hand truck;
- Hoist;
- Crane;
- Dumper;
- Chute;
- Lift table;
- Lift and tilt table;
- Winch;
- Manipulator;
- Positioner;
- Uprender;
- Conveyor;
- Powered industrial vehicle.

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

## Work scheduling

Bring only enough material to complete the job in the immediate work area. Extra material will either need additional handling to get it back to storage or will create congestion. Likewise, too little will require extra handling.

Consider the following, whenever possible, in jobs with considerable manual materials handling:

- Rotate employees from less strenuous jobs;
- Split work among two or more employees;
- Institute appropriate work/rest schedules.

Provide the worker with specific training in the following areas:

- Using mechanical handling aids. Employees may avoid mechanical aids because they simply do not know how to use them;
- Recognizing materials handling problems in the workplace;
- Identifying procedures that can prevent excessive manual materials handling;
- Proper body mechanics.

Remember that requiring employees to use particular lifting techniques — like the squat lift— has not proved to offer significant value. We do not recommend it. However, make training on manual handling techniques should be part of a comprehensive back injury reduction program (even though lifting training alone is not effective in reducing back injuries).

## Environment

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, including the following:

- Issue appropriate clothing, including gloves;
- Take measures to prevent cold and heat stress;
- Maintain aisles;
- Shield storage areas from mud and snow.

Evaluate noise levels to ensure workers can hear and heed mechanical handling warning signals.

Be sure air-contaminant levels are not excessive. Achieve this through routine monitoring programs in high-exposure areas.

## Recommend, review and implement changes

Once workers, staff and line personnel have identified problems, you must act upon them. At this point, you have identified deficiencies with possible solutions in mind. The process is broken down into the following stages:

- **Prioritize** — Categorize priorities by the degree of hazard and risk associated with materials handling. Determine these as part of the initial management analysis of the materials handling process, essentially a historical approach. Risk is based on the frequency of worker exposure to the hazards of any given task and the number of workers routinely exposed;
- **Review** — Establish as company policy the review of materials handling safety as part of the planning procedure for any proposed process.

This review should be ongoing since new materials handling equipment is on the market, and the state of the art in ergonomics is rapidly changing.

The most effective review is conducted in an atmosphere of participatory management. There should be strong involvement and representation from all groups of employees. Accomplish this generally through established committees or quality circles.

Two key elements of the review process are determining the impact proposed changes will have on other jobs, and what new problems will arise as a consequence of the changes made. Failure to consider these elements can result in a loss of credibility for the newly emphasized materials handling process.

View the possibility for change not just departmentally, but, where applicable, throughout the plant. Build on successes. Share your success stories with others.

These actions mark a dramatic departure from the way we may have viewed materials handling in the past. Through the years, technology and management approaches have evolved. This guide has incorporated technological and managerial changes into the safety and health field.