

# Risk *topics*

## Manual Material Handling

### Background

One-third to one-half of all occupational injuries involve overexertion. Workers in jobs with more demanding lifting requirements, such as hospital patient care, report an even higher incidence of strains and sprains. The National Institute for Occupational Safety and Health (NIOSH) has estimated that at least 30 percent of the work force is exposed to the hazard of lifting every day. Handling tasks have been responsible for 23 percent of all work injuries at an estimated cost of \$5.2 billion per year. Trends toward greater numbers of women in the workplace and a generally older workforce increase the risk of injuries due to manual material handling in this more physically vulnerable population. Certain job tasks, the amount of overtime worked, and other personal factors can place an employee at risk for injury.

Manual material handling (MMH) is defined as the unaided moving of objects, often combined with twisting and awkward postures, and contributing to musculoskeletal disorders. Traumatic occurrences (slips, trips, falls, blows to the body) cause other bodily injuries, pain, and disability. Typically, not one specific occurrence but rather the awkward body positions, repetition, force, and duration associated with movement lead to back,

neck, and other problems (Cumulative Trauma Disorders).

Most low back problems are due to muscle strains and sprains. Most low back pain is acute in nature, and employees return to work within a few weeks. However, studies show that employees who have experienced back pain are up to four times more susceptible to a recurrence in the future. Low back impairment reduces the ability to function effectively on the job, impacting individual and company performance and productivity. It is important to realize that low back pain may or may not involve low back impairment and therefore may not qualify as a disability requiring compensation.

Because of the biomechanical structure of the back, lifting even relatively light loads can produce high pressures within the spinal discs. Handling less than 40 pounds does not usually produce severe sprain or strain. However, some studies have found that even lifting 35 pounds close to the body may be hazardous for some people. The incidence and severity of injuries increase with increasing weight and size of the object and the frequency of lift. Injuries to the shoulder, elbows, and wrists, as well as the back become a concern.

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OSHA uses the NIOSH Lifting Formula to calculate the recommended weight limit for single and multiple lifts. The formula takes into account the factors such as: weight of the object; distance of the object from the center of the body; start and end point of the lift; amount of body twist, frequency and duration; quality of the hand grasp. If all of these factors were perfect, the maximum recommended weight limit is 51 pounds. Any changes in the above mentioned factors reduce the 51 pound figure. This figure gives a starting point for reducing stress. Any changes to the workstation or job task can then be factored in to change the allowable weights at the workstation.

This Risk Topic focuses on approaches to reducing the incidence of chronic types of injuries for employees.

### **Systematic Review**

A systems approach is used to reduce the total amount of required MMH and minimize the hazards associated with these activities during the planning and construction phases, by creating a unified material handling system. This approach could involve:

- Mechanizing and automating handling operations, including use of robots.
- Increasing the quantity, size, or weight of unit loads and then handling them with powered equipment.
- Using gravity to move material.
- Standardizing handling methods.
- Reducing the weight of handling equipment, like substituting lighter plastic materials for heavier metals in carts.
- Minimizing reaches above the shoulder and below the knee.

### **Process Redesign**

Process redesign should be done to improve handling tasks physically, thus making tasks more acceptable for a larger percentage of the workforce. It is estimated that up to two-thirds of material handling injuries could be prevented if the task were designed to be within the physical capacities of 75 percent of the workforce.

General principles for such redesign include:

- Reducing the size and/or weight of the load.
- Reducing the distances that the load must be lifted or carried.
- Designing workstations to allow materials to be slid rather than lifted.
- Using a lifting jack that lifts materials to conveyor height will reduce stressful lifts from floor to conveyor.
- Providing handles on objects to be lifted.
- Providing aids such as carts or jacks when items must be moved between workstations.
- Providing ergonomically designed tools to make efficient and safe usage of force applied with the hand.
- Considering job rotation for those involved in constant manual material handling tasks.

The following items should be addressed in task redesign:

- Handles should be provided for units weighing more than 10 pounds. Bulky objects weighing more than 40 pounds should have handles for two-person lifting.
- Handles of equipment and material containers should be designed to accommodate a power (cylindrical) or oblique (thumb extended) grasp. Without a handle, a pinch grip that

is only 25 percent as powerful as a power grasp, is used. The pinch grip can be associated with carpal tunnel and other wrist disorders and should be avoided.

- Handles should be textured to reduce slippage. They should be designed to minimize the force on the fingers and hands.
- Adequate clearance of at least one inch around the hands and gloves, where they will be worn, should allow the wrist to be in its most natural and strongest position.

Where trays are used, the following design and usage guidelines should be observed:

- To reduce the load on the spinal column and upper extremities, tray width (front to back) should be reduced to 14 inches or less, with a maximum acceptable width of 20 inches.
- Tray length impacts the shoulder muscle. Minimizing length ensures that the weight is carried by the stronger biceps instead of the weaker shoulder muscles. Recommended length is 19 inches, never to exceed 24 inches.
- Tray depth should be 5 inches or less. Handles or handholds should be above the center of gravity of the typical load. The tray or tote should not be so deep as to interfere with walking when carried in front of the body.
- Improve tray stability by loading it uniformly, using dividers or baffles and sizing it for the particular material.

Shipping boxes are among the most frequently handled items in industry.

- Recommended dimensions are 20 inches long by 14 inches wide by 6 inches deep.
- The following dimensions should not be exceeded for an unaided lift of 40 pounds at 30 inches: 30 inches long, 20 inches wide, 19 inches deep or high.
- Handholds should be provided where weight exceeds 40 pounds and for cases moved constantly onto pallets.

Hand cart selection should include consideration of the following:

- loads of less than 500 pounds
- tasks occurring less than 200 times per day
- distances of less than 100 feet
- being pushed rather than pulled to take advantage of the body's strength
- the operator's pushing or pulling from the swivel end
- handles being placed to straddle the load center of gravity
- handle height of 36 to 44 inches
- Unloading product to shelves a level no lower than 20 and 45 inches above the floor.
- braking systems being used where ramps must be negotiated
- frequent ramp usage; carts carrying more than 500 pounds

### **Worker Selection and Training**

Employee selection through health history questionnaire and clinical examination using back x-rays has been used, but it is not currently considered predictive of injury. X-rays carry radiation exposure risks that must also be considered. For the physical examination to be of preventative value, a job analysis detailing the physical requirements of each essential job function must be available to the doctor prior to an individual's ex-

amination. Strength testing also lacks total reliability as a predictive indicator of injury risk due to flaws in the assumptions that must be made to develop strength test models. These models usually deal with the single most difficult lift rather than repetitive lifting of lower weight objects. They assume that lifting techniques are consistent among individuals and that injury occurs because of the most difficult lift, which may not always be true. Care should be taken to comply with the current ADA regulations.

Strength testing programs should meet the following criteria:

- They should be safe to administer.
- They must provide reliable quantitative data.
- They should be related to specific job requirements.
- They should be practical.

Training programs on safe lifting are widespread but have not succeeded in greatly reducing the back injury rate. Training that is integrated into the actual work situation is likely to be more effective than training that relies solely on classroom instruction, films, and slides. Continual reinforcement training by the direct supervisor has been shown to be the most productive.

Training should focus on making the employee aware of the dangers of careless and unskilled lifting and teaching the employee how to avoid stresses on the body. Curricula should deal with fitness, the effects of lifting on the body, the biomechanics of lifting, developing handling skills, avoiding unexpected occurrences, and usage of handling aids.

## References

1. Chaffin, D.B. and G. Anderson. *Occupational Biomechanics*. John Wiley & Sons. 1984.
2. Eastman Kodak Company, Human Factors Section. *Ergonomic Design for People at Work*, vols. I and II. Van Nostrand Reinhold Company, New York, NY. 1983.
3. National Institute for Occupational Safety and Health. *Work Practices Guide for Manual Lifting*. Cincinnati, OH. 1981.

## Material Handling Task Checklist

Date: \_\_\_\_\_ Location \_\_\_\_\_

Shift: \_\_\_\_\_ Department \_\_\_\_\_

Yes No

- |                          |                          |   |
|--------------------------|--------------------------|---|
| <input type="checkbox"/> | <input type="checkbox"/> | Has the lifting of excessive weights been minimized at the workstation?   |
| <input type="checkbox"/> | <input type="checkbox"/> | Are mechanical assists provided at the workstation?   |
| <input type="checkbox"/> | <input type="checkbox"/> | Have employees been trained in correct lifting and handling techniques?   |
| <input type="checkbox"/> | <input type="checkbox"/> | Has the distance between the object and the employee's body been minimized?   |
| <input type="checkbox"/> | <input type="checkbox"/> | Has the distance the object is being moved been minimized?  |
| <input type="checkbox"/> | <input type="checkbox"/> | Have reaches below knee level been minimized?   |
| <input type="checkbox"/> | <input type="checkbox"/> | Have reaches above shoulder level been minimized?   |
| <input type="checkbox"/> | <input type="checkbox"/> | Has static muscle loading been minimized?   |
| <input type="checkbox"/> | <input type="checkbox"/> | Have extended reaches been minimized?   |
|                          |                          | (Recommended reach distances from the standing position are 16 to 18 inches.)<br>(Recommended reach distances from the sitting position are 14 to 16 inches.) |
| <input type="checkbox"/> | <input type="checkbox"/> | Does the employee twist at the waist during lifts?  |
| <input type="checkbox"/> | <input type="checkbox"/> | Is help available for heavy or awkward lifts?   |
| <input type="checkbox"/> | <input type="checkbox"/> | Have pushing and pulling forces been minimized?   |
| <input type="checkbox"/> | <input type="checkbox"/> | Has repetition been addressed using job rotation?   |
| <input type="checkbox"/> | <input type="checkbox"/> | Has repetition been addressed using rest breaks?  |
| <input type="checkbox"/> | <input type="checkbox"/> | Has repetition been addressed through pacing techniques?  |
| <input type="checkbox"/> | <input type="checkbox"/> | Is the standing/walking surface level, clean, dry, and wide enough?   |
| <input type="checkbox"/> | <input type="checkbox"/> | Do the lighting levels meet the recommended guidelines of the ANSI RP-7?  |
| <input type="checkbox"/> | <input type="checkbox"/> | Is there an unobstructed view of the materials at the workstation?  |
| <input type="checkbox"/> | <input type="checkbox"/> | Are materials used easily grasped and stable?   |
| <input type="checkbox"/> | <input type="checkbox"/> | Do materials and parts have handholds?  |
| <input type="checkbox"/> | <input type="checkbox"/> | Are proper gloves worn at the workstation?  |
| <input type="checkbox"/> | <input type="checkbox"/> | Is proper footwear worn at the workstation?   |
| <input type="checkbox"/> | <input type="checkbox"/> | Does the employee have sufficient room to maneuver at the workstation?  |
| <input type="checkbox"/> | <input type="checkbox"/> | Is there a preventive maintenance program for material handling equipment?  |

**Comments:**

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