ZURICH
Resilience Solutions

RiskTopics

Manual material handling (MMH)

Zurich Resilience Solutions - Risk Engineering

Approaches to help reduce manual material handling risks and the incidence of chronic types of injuries for employees.

Introduction

Manual material handling is one of the most common work activities encountered by employees. This also makes it one of the most common sources of employee discomfort and injury. Occupational injuries are caused by overexertion and body reaction. Strains, sprains, or tears typically cause occupational injuries that involve days away from work. Efforts undertaken to address manual material handling risks can result in reduced costs and discomfort among workers.

Discussion

Many low back problems are due to muscle strains and sprains. Lower back pain is often acute in nature, and employees return to work within a few weeks. However, studies show employees who have experienced back pain are up to four times more susceptible to a recurrence in the future. Low back impairment, in some instances, can reduce the ability to function effectively on the job, impacting individual and company performance and productivity. It is important to realize 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, size of the object, and the frequency of lift. Injuries to the shoulder, elbows, and wrists, as well as the back, become a concern.

Forward bending is a significant risk factor. Bending 45 degrees or more gives about 20 to 50 times increased risk for spinal displacement (1 cm shift between vertebrae and discs). Tools such as the NIOSH Lifting Formula App can be used to calculate the recommended weight limit for single and multiple lifts. This application provides risk estimates to help evaluate lifting tasks and reduce the incidence of low back injuries in workers.

NIOSH Lifting Equation A: NLE Calc

The formula takes into account factors such as the 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, and quality of the hand grasp. If all of these factors are within certain criteria, then 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.

Guidance

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

- Mechanizing and automating handling operations, including the 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 forward reaches, as well as those 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 can 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 weight of the load
- Reducing the distances 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, some companies use a pinch grip. A pinch grip is only 25 percent as powerful as a power grasp and can be associated with carpal tunnel and other wrist disorders. Therefore, it 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 should exist around the hands and gloves where they will be worn to 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 allows the weight to be carried by the stronger biceps instead of the weaker shoulder muscles. The recommended length is 19 inches, but 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 the 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.

Handcart 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
- Handles located at the swivel end
- Handles being placed to straddle the load center of gravity
- Handle height of 36 to 44 inches
- Unloading products to shelves with a height between 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

Employee selection and training

Employee selection through a health history questionnaire and clinical examination using back X-rays may be considered, 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 examination. 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 the 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 Americans with Disabilities Act (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 integrated into the actual work situation is likely to be more effective than training that relies solely on classroom instruction, videos, or slides. Continual reinforcement training by the direct supervisor has been shown to be the most impactful.

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

Conclusion

Manual material handling activities are common tasks that can cause discomfort and injuries for employees. Conducting a systematic review of work activities and implementing some of the design and work practice suggestions in this document may help reduce discomfort/injury and improve productivity. The checklist included in Appendix A is intended to help guide the review. Additional tools available are also listed below. Contact your Zurich Risk Engineer for copies of these tools.

For more information on Zurich's extensive Risk Engineering and Sustainability services, please contact your Risk Engineer or visit us at Risk Engineering and Sustainability Services | Zurich Resilience Solutions.

References

NIOSH [1994]. Applications manual for the revised NIOSH lifting equation. By Waters TR, Ph.D., Putz–Anderson V, Ph.D., Garg A, Ph.D. Cincinnati, OH: US Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 94-110 (Revised 9/2021), https://doi.org/10.26616/NIOSHPUB94110revised092021

NIOSH 1981. Work Practices Guide for Manual Lifting. NIOSH Technical Report No. 81 -122, US Department of Health and Human Services, National Institute for Occupational Safety and Health, Cincinnati, OH

Other resources

Elements of Ergonomics Programs

Applications Manual for the Revised NIOSH Lifting Equation

NIOSH Ergonomic Guidelines for Manual Material Handling

Ergonomics - Overview | Occupational Safety and Health Administration (osha.gov)

Warehousing - Hazards and Solutions | Occupational Safety and Health Administration (osha.gov)

Other related Zurich Resilience Solutions

- A guide to controlling lifting exposures
- Minimizing lower back injuries caused by lifting, pushing, and pulling

Appendices

Appendix A

Material Handling Task Checklist

Date _____ Job _____

Shift _____ Department _____

Yes	No	
		Has the lifting of excessive weights been minimized at the workstation?
		Are mechanical assists provided at the workstation?
		Have employees been trained in correct lifting and handling techniques?
		Has the distance between the object and the employee's body been minimized?
		Has the distance the object is being moved been minimized?
		Have reaches below knee level been minimized?
		Have reaches above shoulder level been minimized?
		Has static muscle loading been minimized?
		Have extended reaches been minimized? (Recommended reach distances from the standing position are 16 to 18 inches) (Recommended reach distances from the sitting position are 14 to 16 inches)
		Does the employee twist at the waist during lifts?
		Have pushing and pulling forces been minimized?
		Is help available for heavy or awkward lifts?
		Has repetition been addressed using job rotation?
		Has repetition been addressed using rest breaks?
		Has repetition been addressed through pacing techniques?
		Is the standing/walking surface level, clean, dry, and wide enough?
		Do the lighting levels meet the recommended guidelines of the ANSI RP-7?
		Is there an unobstructed view of the materials at the workstation?
		Are materials used easily grasped and stable?
		Do materials and parts have handholds?
		Are proper gloves worn at the workstation?
		Is proper footwear worn at the workstation?
		Does the employee have sufficient room to maneuver at the workstation?
		Is there a preventive maintenance program for material handling equipment?

Comments

October 2023

The Zurich Services Corporation
Zurich Resilience Solutions I Risk Engineering
1299 Zurich Way, Schaumburg, IL 60196-1056
800.982.5964 www.zurichna.com

ZURICH®
Resilience Solutions