RISK BULLETIN

Using The NIOSH Lifting Equation To Prevent Injuries And Control Costs

Each year, thousands of employees in the United States are injured while lifting or moving materials at work. The cost to industry is reflected in insurance premiums, disability payments and lost productivity. Approximately 25 percent of all occupational injuries in the United States are attributed to overexertion on the job. Employees experience painful and debilitating injuries, loss of income, and sometimes loss of livelihood. If they plan to remain competitive, companies must control this serious workplace hazard by taking a proactive stance.

SCREENING METHODS

Employers should develop job descriptions that specify physical requirements for specific jobs. The ability of applicants to perform those duties can be determined through post-offer capability assessments. It is important to note that eliminating prospective candidates on the basis of prior injuries or physical impairments may violate federal equal opportunity laws and may create other employer liabilities.

NIOSH LIFTING EQUATION

The National Institute for Occupational Safety and Health (NIOSH) recognizes a direct relationship between occupational injuries and the physical environment in which they occur. NIOSH has developed a mathematical equation to calculate recommended weight limits for individuals when performing static, two-handed lifting. OSHA currently uses this equation to support General Duty Clause citations against employers whose workplaces have uncontrolled exposures to lifting hazards.

The NIOSH lifting equation establishes a recommended weight limit (RWL) for a manual task by incorporating several key variables into a calculation. The importance of the handled object's weight depends to a high degree on its horizontal and vertical location, distance to be moved, frequency of movement, secureness of hand-to-object grasp, and degree of twisting involved in the lift.

The lifting equation is expressed as follows:

RWL = LC x HM x VM x DM x AM x FM x CM

Variables for the lifting equation are defined below:

VARIABLE	DEFINITION
LC Load Constant	Maximum acceptable weight for a single lift Load Constant (51 lbs)
HM Horizontal Multiplier	Factor derived from the horizontal location of hands from midpoint between the ankles
VM Vertical Multiplier	Factor derived from the vertical location of hands from the floor at start and finish of the lift
DM Distance Multiplier	Factor derived from the vertical travel distance between the origin and the destination of the lift
CM Coupling Multiplier	Factor that depends on the hand-to-load grasp
FM Frequency Multiplier	Factor derived from the average frequency rate of lifting
AM Asymmetric Multiplier	Factor derived from the angular displacement (twisting) of body load from start to finish of the lift.

Note that the maximum weight limit under ideal conditions is only 51 pounds. The other variables are given a weighing that is expressed as a decimal less than 1.0. This weighing effectively decreases the maximum load weight of 51 pounds to a recommended weight for lifting. The variables are determined from tables and calculations available at www.cdc.gov/niosh/94-110.html.

EXAMPLE

The following example illustrates how the lifting equation is used in a typical work scenario: A warehouse employee is required to lift 22-pound boxes from a 30-inch storage shelf to a 60-inch shelf (DM = 0.88). Before lifting, the horizontal distance from the employee's ankles to the center of the box is 20 inches (HM = 0.5). The vertical location of the employee's hands is 30 inches from the floor at the start of the lift (VM_{origin} = 1.0) and 60 inches at the destination ($VM_{destination}$ = 0.78). There is little anticipated twisting or turning (AM = 1.0). The boxes are not equipped with cutouts or handles for easy grasping (CM = 1.0). The number of boxes to be lifted per hour is 30, or 0.5 per minute for his entire 8-hour day (FM = 0.81).

Substituting the above modifiers into the NIOSH lifting equation:

RWL = LC x HM x VM x DM x AM x FM x CM

RWL_{origin} = 51 x 0.5 x 1.0 x 0.88 x 1.0 x 0.81 x 1.0 = 18 lbs., and

$RWL_{destination}$ = 51 x 0.5 x 0.78 x 0.88 x 1.0 x 0.81 x 1.0 = 14 lbs.

Note: The RWL for both the origin and destination of the lift is calculated due to the difference in vertical height.

Since the boxes in this example weigh 22 lbs., the RWL has been exceeded by eight pounds (taking the lower RWL, from the destination). In order to meet the NIOSH-recommended weight limit, one or more of the task variables have to be modified. Often, practical low-cost solutions are all it takes to reduce the potential for back injuries. In this case, using a forklift to move a pallet of boxes from one shelf to the other would reduce the risk of injury as well as improve efficiency.

PRACTICAL APPLICATION

After the RWL is determined, a lifting index (LI) can be calculated for specific tasks by obtaining the ratio of the actual load weight to the RWL. In the above example, an actual weight of 22 and an RWL of 14 gives an LI of 1.6. If this process is repeated for several job tasks, management can prioritize various lifting tasks for intervention, addressing the tasks with the highest LIs first, since these exhibit the highest risk. Another way the NIOSH lifting equation can be applied is to evaluate the variables for each task. The lowest value variable is the highest risk factor for a given task. The corresponding value of this variable can be increased by modifying the task by raising the initial height, reducing twisting, or adding handles. This increases the value of the modifier and thus can raise the value of the RWL.

General guidelines for reducing the risks associated with two-handed lifts include:

1. Avoid lifting objects to or from floor level or above the shoulders.
2. Keep the object as close as possible.
3. Reduce the frequency of lifts.
4. Reduce the distance the object is to be lifted.
5. Add handles.
6. Position tables and materials to prevent twisting.

The NIOSH lifting equation is only one tool for preventing lifting and other material-handling injuries. Personal fitness, prior work history, heredity, and lifestyle are just some of the other factors that influence an employee's susceptibility to overexertion injuries. Additional risk factors include vibration, static posture, and direct trauma from an accident.

XL INSURANCE

XL Environmental
Risk Control Division
505 Eagleview Boulevard
Suite 100
PO Box 636
Exton, PA 19341-0636
Phone: 800-327-1414
Fax: 610-458-7285
www.xlenvironmental.com

XL Environmental is a Division of XL Specialty Insurance Company.

3385-204