

NIOSH (1981) standards for lifting

In 1981 the National Institute for Occupational Safety and Health produced a standard for manual materials handling (in particular lifting). This standard was created to help ergonomists and occupational safety workers identify potentially injurious lifting hazards. The standard was intended only as a guideline to evaluate lifts that take place predominantly in the sagittal (side view) plane. To use the standard the ergonomist needed to examine the workplace and by taking only a few simple measures could derive two limiting loads, called the Action Limit and the Maximum Permissible Limit. These limits distinguished three different areas—the first of which was safe for all workers, the second which required worker training to be safe and the third which was unsafe.

The standard took into consideration the following four factors: (1) the horizontal distance to the load, called the Horizontal Multiplier (HM); (2) the starting height of the load, called the Vertical Multiplier (VM); (3) the vertical distance the load was to be moved, called the Distance Multiplier (DM); and (4) the frequency with which the load was to be lifted in a normal working day, called the Frequency Multiplier (FM). When each of these factors or multipliers were determined, based upon research literature, they were multiplied together and by a fixed Load Constant (LC) which was set to a load of 40 kg (actually 392 newtons or 88 lbs.). Each factor could take on a maximum value of 1 under ideal conditions or less than 1 whenever the factor increased the risk of injury.

In 1991 NIOSH developed a second standard which extended the first standard by including the influence of handles (called the Coupling Multiplier, CM) and allowing for lifts that included some degree of turning while doing the lift (called the Asymmetric Multiplier, AM). In addition, the Load Constant was reduced to 23 kg (51 lbs.), the Frequency Multiplier was designed to be more comprehensive, depending upon the number of lifts and the vertical height at the start of the lift. Small changes were also made to the other three factors. Furthermore, the Action and Maximum Permissible Limits were replaced by the Recommended Weight Limit (RWL) and the Lifting Index (LI). As the name indicates the RWL is the heaviest load the a worker should be allowed to lift under the particular lifting conditions. It was computed from the following equation:

$$RWL = LC \times HM \times VM \times DM \times AM \times FM \times CM$$

The LI provided an estimate of the hazard of overexertion injury of a particular lifting task based upon the actual load to be lifted versus the RWL. I.e.,

$$Lifting\ Index = \frac{Load\ Weight}{Recommended\ Weight\ Limit}$$

To ease the difficult task of computing the various multipliers and the resulting RWL and spreadsheet was developed that requires the user to enter only the essential data required for determining the RWL.

Before using the spreadsheet the user must determine the appropriate coupling factor

based on the quality of the handles (or lack of handles) on the material being lifted. (Guidelines for this factor will be provided.) The user must also determine the frequency multiplier from the table provided at the end of the spreadsheet. To determine this factor the user must consider three conditions. The first is the frequency of the lifts measured by the number of lifts per minute. The second is whether the worker performs these lifts for (a) less than one hour per day, (b) more than one hour but less than 2 and (c) more the two hours per day (but not more than eight). The third condition is whether the lift starts below or above 75 centimetres. For example, the Frequency Multiplier (FM) for 11 lifts per minute, done between 1 and 2 hours per day, with a starting height greater or equal to 75 centimetres would be 0.23. Notice that the factor is zero (0.00) for a starting height below 75 cm. This means that this lift is hazardous for any load and should not be performed. On the other hand, a lifting situation where the worker lifts once per minute for between more than two hours produces a FM of 0.75 for any starting height.

To use the spreadsheet load it with either Lotus 1-2-3, Quattro or Excel or other compatible software. The user then need only measure the following quantities and the enter them into the spreadsheet in the appropriate places. The spreadsheet is protected and data may only be entered at several locations on the sheet. These areas should show up in a different colour depending on the computer software being used. Enter the appropriate data beside the letter and equal sign listed below:

V= Vertical location of the load from the floor at the start of the lift in centimetres

D= vertical distance from the start of the load to its destination in centimetres

FM= frequency multiplier from the table below (see preceding text)

A= angular displacement of the load in the horizontal plane from start to destination in degrees.

C= coupling factor, enter 1 for “good” , 2 for “fair” or 3 for “poor” (see above)

H= horizontal distance from midpoint between ankles to midpoint between hands at start of load.

This value does not need to be entered because the computer will compute RWL for horizontal distances between 15 and 75 cm in 5 cm increments automatically.

To view the RWLs for various horizontal distances press the F10 key (for Lotus 1-2-3 or Quattro Pro for DOS) or the F11 key (for Excel) to view these values graphically.

References

Chaffin, D.B. and Andersson, G. *Occupational Biomechanics*, Toronto: John Wiley & Sons, 1984.

National Institute of Occupational Safety and Health, *A Work Practices Guide for Manual Lifting*, Tech. Report No. 81-122, U.S. Dept. of Health and Human Services (NIOSH), Cincinnati, OH, 1981.