

## Lifting Frequencies and Aerobic Rates

The terms for lifting (occasional, frequent and constant) are taken from the U. S. Department of Labor: Dictionary of Occupational Titles, Fourth Edition Supplement, Appendix D pp. 101-102, 1986. Occasional lifting would be 1 - 100 lifts, frequent lifting would be 100 - 500 lifts and constant lifting would be 500 or more lifts.

### Frequent lifting rate

Per-Olof Astrand's Textbook of Work Physiology suggests a person can work comfortably over an 8 hour working day at around 40% of his maximal muscle strength, with the periods of rest between muscle contractions being 2 times the period of work. Thus, if the period it takes to lift a box from the floor to a table is 5 seconds then the period of rest between lifts should be 10 seconds. This would translate into four lifts a minute. If a person was working at 40% of his maximal muscle strength then he should be able to work at 4 lifts a minute for an eight hour day.

Based on Astrand's work and the NIOSH manual, The Work Practices Guide for Manual Lifting, we have selected 1 to 4 lifts a minute over an 8 hour working day to represent frequent lifting. On page 64 of the NIOSH manual reference is made to occasional lifting metabolic energy expenditure rates as being 9 Kcal/min. and continuous lifting expenditure rates as being 5 Kcal/min. for a physically fit male. In an article written by Garg, Chaffin and Herring ("Prediction of Metabolic Rates for Manual Materials Handling Jobs") it is stated that 16 Kcal/min. is usually considered the maximum aerobic power for a healthy male. Dividing 9 Kcal/min by 16 Kcal/min would give us 56% of aerobic capacity for occasional lifting and dividing 5 Kcal/min by 16 Kcal/min would give us 31% of aerobic capacity for continuous lifting. This indicates that frequent lifting which falls between occasional and continuous can be estimated to be around 40% of aerobic capacity.

### Occasional lifting rate

Using the formula from the preceding section we rounded the 56% to 60% for aerobic capacity. For the number of lifts we used the Dictionary of Occupational Titles' classification of 1 - 100 lifts which represents 1 lift every 5 minutes over an 8 hour period.

### Continuous lifting rate

Using the formula from the preceding section on aerobic capacity we rounded the 31% down to 25%. For the number of lifts we use 5 or more lifts every minute over an 8 hour day which would fit in with the Dictionary of Occupational Titles' classification for continuous lifting.

## INTERPRETATION OF SUMMARY DATA

In the previous section we discussed report production. The final item produced during a normal report writing sequence would be the summary and the narrative recap of the summary. Examples of these two print-outs are at the end of this section of the manual. In this section we will explain the numbers contained in the summary and how the percent of strength impairment and weight restriction are computed.

### NORMS FOR FREQUENT LIFTING FOR 8 HOURS

The Biomechanical Model was used to compute weights for 75% of the population lifting an object from the floor to a table. The average height and weight used for a male and female were 70 in. 165 lbs. and 64 in. 136 lbs. respectively. The acceptable weights were 90 lbs. for a male and 45 lbs. for a female.

Studies on work physiology state that a person can work comfortably at about 40% of his maximum lifting capacity. This suggests that the average male and female could lift about 35 lbs. and 20 lbs. respectively in a high frequency situation.

$$90 \text{ lbs.} \times 40\% = 36 \text{ lbs. rounded to } 35 \text{ lbs.}$$

$$45 \text{ lbs.} \times 40\% = 18 \text{ lbs. rounded to } 20 \text{ lbs.}$$

### SUMMARY CALCULATIONS

The following definitions apply to the summary section:

Total Exertions - Sum of Exertions entered in the summary divided by the number of tasks entered in the summary.

Total Expected Limits - Sum of the expected limits for 75% of the population divided by the number of tasks entered in the summary.

Score - Total Exertions/Total Expected Limits

Percent of Strength Impairment - (95% - Score)

Weight Restriction - Score x 8 hour norm(35 lbs. male, 20 lbs. female).

Please note that a person who has a score of 95% or better is not considered impaired and a N/A will appear for the percent of strength impairment and weight restriction. Additionally, if a person scores in excess of 100% the computer will list the score as 100% (not higher) and place an N/A next to the percent of strength impairment and weight restriction. As previously stated these limits and restrictions apply to frequent lifting. Methods for setting limits for continuous and occasional lifting covering both the injured and uninjured worker are discussed below.

#### INJURED WORKER

The first method, setting lifting restrictions for the injured worker, is calculated as follows:

1. To determine what a male and female can lift dynamically over an eight hour day the 90 lbs. or 45 lbs. is reduced by the frequency of the lift. Occasional lifting (1 lift every five minutes) is 60% of either number. Frequent lifting (4 lifts every minute) is 40% of either number. Continuous lifting (5 or more lifts every minute) is 25% of either number.
2. The 60%, 40% and 25% in the case of the injured worker is further reduced by the percentage of impairment which is discussed above.

#### UNINJURED WORKER

The second method, setting lifting guidelines for the uninjured worker, is calculated as follows:

1. The back lift or torso lift has been determined to be the most critical lift performed by the majority of workers. Likewise, it is the most limiting factor in most dynamic lifting.
2. To determine what a male or female can dynamically lift over an eight hour day, the actual pounds exerted in the torso lift is adjusted for the frequency of the lift. Occasional lifting is 60%, frequent lifting is 40% and continuous lifting is 25% of the actual torso lift.

## CONCLUSIONS

The theory behind this impairment computation is that a lift encompasses a total body effort. The affected areas will show a consistent impairment throughout the test sequence. Be cognizant, however, of any one particular area that reflects a much greater degree of impairment than demonstrated in other areas. This particular task should be reviewed in relation to the above impairment formula to check the overall effect on the impairment rating. If this particular task seriously skews your results make a notation in your final report.