PRÉVENTEX

Association paritaire du textile

Volume 20, nº 4 • April 2004

# MANUAL HANDLING: Not Only a Matter of Weight

Stéphane Patenaude MSc
Ergonomist - ACE Member



## Introduction

People responsible for health and safety in the workplace are often in the dark as to the proper way to evaluate handling tasks. They ask themselves questions such as: What is the maximum load that can be lifted without injury? Are there standards applicable to hazardous loads?

Standards have been set to "quantify" physiological limits but other aspects remain unclear like the exact link between bad posture and injuries. The established standards, however, are useful used to evaluate the risks associated with specific work stations or tasks. If work requirements fall below the set limits, the risk level is fairly low; conversely, the risk of injuries increases as the limits are exceeded.

## Ergonomic standards

Ergonomic standards are applied to varying degrees. Following is a list of the standards most widely used by ergonomists.

- ISO Standard 11228-1
- MMH
- National Institute for Occupational Safety and Health (NIOSH) equation

These standards establish maximum loads for manual handling tasks performed under optimal conditions (see Figure 1). In other words, the standards determine the maximum weight that can be safely lifted by workers. The values need to be adjusted according to five main factors affecting workers' health and safety:

- lifting duration (work-time / recovery-time)
- lifting frequency
- properties of load
- working environment
- posture of worker

Figure 1: **Maximum load weight under optimal conditions**

| Standard* | Maximum load weight (kg) | Comments |
|---|---|---|
| ISO 11228-1 | 25 | Load can be handled by 95 % of men and 70 % of women. |
| MMH | 27 | Load can be handled by 90 % of men. Maximum load for women is 20 kg. |
| NIOSH | 23 | Load can be handled by 90 % of the population (men and women). |

* *International Standard Organization (ISO), May 2003. Ergonomics – Manual handling. Part 1: Lifting and carrying. ISO 11228-1.*

*Mital, A., Nicholson, A.S., and Ayoub, M.M. A guide to manual materials handling (MMH). Second Edition. Taylor & Francis. 1997.*

*Water, T.R., Putz-Anderson, V., Garg, A., and Fine, L.J. Revised NIOSH equation for the design and evaluation of manual lifting tasks. Ergonomics, 1993, 36 (7), 749-776*

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## Factors for ergonomic evaluation of manual handling tasks

### *Lifting duration*

In the assessment of a work station involving manual handling, it is crucial to take into account the period of time taken by workers to complete the task. The longer this time is, the higher the degree of fatigue (Asfour and Tritar, 1991). Factors such as the frequency and duration of recovery-time also affect fatigue levels and can reduce the impact of other factors such as the total duration of work and the lifting frequency per minute. Periods of recovery-time allow workers to compensate for the fatigue caused by repetitive handling tasks, and make it easier for workers to sustain their work load.

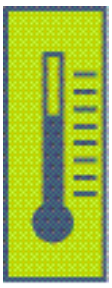
### *Lifting frequency*

The second factor is the frequency of handling tasks, measured in number of lifts per minute. This element is factored into the evaluation of the consequences of load weight and lifting duration on worker fatigue. The load itself is not the only consideration and the number of manual handling operations performed within a set period of time should also be taken into account (lifting frequency). The combined effects of load weight and lifting frequency directly affect worker fatigue (Genaidy, 1989, Asfour, 1991 and Stälhammar, 1996). In addition, increases in lifting frequency diminish the worker's capacity to assess loads (Karkowski, 1992). Workers who are unable to estimate loads correctly will not apply appropriate muscular effort and will tire more easily than if they had evaluated the load correctly (Patenaude, 1997).

### *Properties of the load*

Third, the specific properties of the load should be taken into consideration because they affect the way the charge is handled. The weight of the load is one example. Another is the location of the load: picking up loads from an elevated area is more likely to cause fatigue (Genaidy, 1989, et Water, 1993). In addition, heavier loads increase the risk of musculoskeletal injuries (Water, 1993, et Hidalgo, 1997). The grip on the load is another important feature of the load. The grip is a function of the shape, texture (friction rate) and balance of the load. Workers have to exert greater force to handle loads with a poor grip in a safe way. For example, handles make boxes much easier to handle (Stälhammar, 1989).

### *Working environment*



The forth factor relates to the working environment. This includes the layout of work areas (height of surface where load is picked up and deposited), distances covered with and without load, features of circulation areas (stairs, graded surface, elevators, etc.) temperature and humidity rate. These variables directly affect the level of difficulty associated with manual handling tasks (Waters, 1993, et Hidalgo, 1997).

### *Worker posture*

The fifth and final element is the posture adopted by workers to carry out handling operations. The physical strength required to perform the task increases along with the distance between the center of gravity of the load and that of the worker. Excessive distances also cause intervertebral disks to compress, increasing the risk of lower back injuries (Chaffin, 1999).

## A practical example

Here is an illustration of a manual handling task performed typical of the textile industry, where a worker is lifting and stacking cones on a rack. Depending on the specific type of rack, the worker lifts cones to heights varying between 25cm and 200cm from the floor. Performing this task forces the worker to adopt extreme postures (see pictures 1 and 2). The handling frequency is 120 cones per hour for an eight-hour work shift (2 cones per minute). Including recovery-time, this means that the task is performed over a seven-hour period. Cones weigh 14kg each.

*Picture 1*

*Picture 2*

The ergonomic evaluation of the task reveals that this is a hazardous operation: according to the five factors affecting worker health and safety, the maximum weight should be 12kg.

**27 kg**
Maximum weight load set by the MMH under optimal conditions

## Actual situation

- *Lifting duration: 8 hours of work (including 1 hour of recovery-time)*
- *Lifting frequency: 120 cones per hour*
- *Properties of the load: weight 14 kg, shape, size, quality of grip*
- *Working environment: height of pick up and deposit, location of cart*
- *Posture of worker: trunk bent, shoulders bent over 90°*

**12 kg**
**Maximum weight load set by MMH considering actual conditions**

## Possible solutions

Once the evaluation has been completed, corrective measures should be taken. Here are some suggestions.

### *Improvements to tools and working environment*

- Use a platform to install the cones, tie wires to the higher sections of the rack.
- Modify the rack to reduce the surface of the work area, by eliminating the lower and higher shelves of the rack.

### *Improvements to the organization of work*

- Use lighter cones or lower lifting frequency.
- Reduce the duration of the stacking operation to lower the lifting frequency. If the total amount of handling time is reduced, the worker will be able to handle heavier loads.
- Eliminate unnecessary handling operations: transferring cones to the cart increases the lifting frequency so the original packaging should be used as often as possible.

### *Improvements to work methods*

- Eliminate the need to use the pliers method for handling cones, because this technique requires greater muscular strength. If the cones are handled properly, workers will be able to handle heavier loads in a safe way.
- Provide training on proper work methods. Posture is directly related to lower back injuries and workers should be given information on appropriate body positions.

## Conclusion

When evaluating manual handling tasks, it is important to **take into consideration a full range of factors**. Following the initial assessment, use applicable standards to determine **potential hazards**. Recommendations are then issued to reduce the risk factors. The impact of recommendations can be determined by using the set standards. If the assessment reveals that standards are being respected, apply the recommendations. Préventex can assist with the evaluation of handling tasks, for instance by sending a specialist to analyze the situation and suggest appropriate solutions. Recommendations aim to lower the constraints noted and can help develop tailored solutions. Workers and production managers are consulted prior to the implementation of any suggestions. They may also wish to develop their own set of corrective measures; these should be validated by a specialist in ergonomics to ensure they are appropriate.

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PRÉVENTEX

**Association paritaire du textile**

The Préventex newsletter is published by
Préventex – Association paritaire du textile
2035, Victoria avenue, suite 203
Saint-Lambert QC J4S 1H1
Telephone: (450) 671-6925
Fax: (450) 671-9267
e-mail: info@preventex.qc.ca

**General manager and newsletter editor:** Michel Rouleau

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**Coordination:** Lise Laplante

**Copy editor:**
Pierre Bouchard
INDICO Communication

**Translation:** Paule Champoux-Blair

**Graphic design:** Passerelle bleue

**Printing:** Imprimerie For inc.





**Legal deposit:**
**September 1st, 1994**
**ISSN 0825-4230**
**Printing: 2500 copies**