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MANUAL LIFTING: PRODUCT DESIGN AND LABELING

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INTRODUCTION

Because most products must be handled during the distribution and marketing process as well as periodically thereafter during use, the risk of serious injury due to unsafe product handling is foreseeable and should be a fundamental consideration in every designer's mind during the product design process. A conscious effort by prudent product designers, manufacturers, distributors, and retailers is needed to stop the continuing trend of manual materials handling injuries. Fortunately, an authoritative guideline for eliminating unwarranted risk of injury caused by lifting is provided by the NIOSH *Work Practices Guide for Manual Lifting*.

OBJECTIVE

Every lifting task involves the dynamic interaction of four elements (the physiology of the back, the lifting method, the lifting environment, and the object being lifted), this fact sheet will focus on the various features and characteristics that make specific objects relatively safe or relatively dangerous to lift. Further, this fact sheet will examine and emphasize responsibilities of those who design or market commonly lifted products and the impact that product design can have on the risk of injury to people when they lift such products.

PRODUCT DESIGN QUESTIONS RAISED BY THE CURRENT LIFTING STANDARD

Manual lifting can be performed safely under certain conditions. The *Work Practices Guide for Manual Lifting* provides a method for evaluating proposed or existing lifting tasks and for pinpointing the degree of risk associated with the object to be lifted. It explains that the critical elements that determine the safety of lifting an object include its weight, size, shape, center of gravity, and body position. The Guide emphasizes that the object's weight and distance away from the body are the most important of these elements. Originally published in March 1981, the NIOSH equation was revised and expanded to apply to a larger percentage of lifting tasks in 1991, and was published in July 1993.

These considerations raise several critical questions. Can manufacturers continue to package bulk products in containers weighing 100 pounds (or more) when it is anticipated that such containers are to be manually lifted? Can designers continue to design products without identifying balance points, without proper handholds, without mechanical lift eyelets, or other provisions for safe handling? Can we continue to distribute industrial or consumer products whose labels do not include their weight and recommended methods for safe handling? The answers to these questions must be "NO". The excuse that "we have always done it that way" is invalid. In light of today's knowledge, such design practices are not merely questionable; they are entirely unacceptable.

CAN PRODUCT DESIGNERS ASSIST IN PROTECTING THOSE WHO HANDLE AND LIFT PRODUCTS?

Those who design, approve, and accept the design of products must ensure that individuals who

handle, install, use, maintain, and dispose of their products are not exposed to unwarranted risk of serious injury. Basic principles of product safety engineering require that three methods of product hazard control be given careful consideration during the design process.

The first and most effective method of protecting product users against unreasonably dangerous product hazards associated with manual lifting is to eliminate such hazards on the drawing board. Here, the primary design considerations are "what can be done to reduce unit weight?", "where are the balance points?", and "can a different design eliminate this hazard?"

The second method of protecting users against unreasonably dangerous product hazards associated with manual lifting is to add safeguards to the product to reduce the risk of injury. Safeguards are only to be used when hazard elimination through design is not feasible. Primary safeguards related to the material handling of products include providing appropriate handles, mechanical lift eyelets, or other provision for mechanical lifting, and ensuring that these aids are properly attached and located on the products to be lifted.

When it is not technically feasible to achieve reasonable user protection by either eliminating or safeguarding product hazards, it becomes necessary to use the third and least effective method of protecting product users against unreasonable product hazards. That method is to provide product warnings and instructions. Warnings and instructions should only address residual hazards that could not be eliminated or safeguarded by product design.

Since protecting product users by providing instructions and warnings is the least effective of the three methods by which designers may control product hazards, it is critical that such instructions and warnings be conspicuous and provide adequate content in order to be effective.

According to product safety engineering criteria, warnings and instructions designed to promote safe product handling should include (1) the type and potential severity of injury associated with unsafe product handling, (2) how such unsafe product handling can occur, and (3) specific methods of manual and mechanical product handling that are recommended to minimize the risk of injury.

Among other things, product warnings and instructions should conspicuously state the product weight and whether or not manual lifting is recommended. If manual lifting is not recommended, a clear and conspicuous warning against manual lifting must be provided along with recommendations concerning safe alternative methods for mechanical handling. If manual lifting can be performed under conditions of acceptable risk as defined in current manual lifting standards, product warnings and instructions should further state the number of persons required to safely perform manual lifting maneuvers and a clear description of safe manual lifting technique that must be used to keep compressive spinal forces at acceptable limits. The description of technique would include body position and maximum extension of hands away from the body while lifting.

The complete product design process includes merchandising. Even with the safest product design feasible, the packaged product (as merchandized) can still be unsafe to lift! For example, a hydraulic floor jack weighing 85 pounds was packaged for sale to the public with its center of gravity considerably offset from the center of its packaging. As a customer attempted to lift the box off the retail display shelf, the unexpected imbalance of the load caused a corresponding unexpected twisting of the customer's body during the lifting process, which resulted in a spinal disc injury.

The entire product design team - including those who design product packaging - should follow the systems approach to injury prevention (in accordance with the basic principles of product safety engineering previously listed). Many things can be done to reduce the risk of back injury during the manual handling of products including:

1. During the design review process, consider alternatives that would reduce product weight such as using alternate materials, reducing size, separating components, and reducing weight of product unit packaging.

2. Where feasible, design products so as to align actual center of gravity with a product's physical or visual center.

3. During the design process, provide proper handholds or mechanical lift points for later use.

4. Conspicuously label products and product packaging to state the product weight. This is especially important when it can reasonably be anticipated, due to product size or compact weight, that persons may attempt to lift products manually.

5. Conspicuously label products and product packaging to indicate the product center of gravity and provide conspicuous warning if the center of gravity is significantly offset from the physical center of the product or packaging.

6. Based on the product center of gravity and manual lifting criteria, provide appropriate "couplings" such as handles, handgrip components, or mechanical lift points.

7. Based on manual lifting criteria and the design and placement of handholds, etc., provide conspicuous warning and illustration concerning the proper number and position of persons required to perform safe manual lifting operations.

8. Based on manual lifting criteria, warn of the consequences of using poor lifting technique and instruct product users concerning proper methods required to perform safe manual lifting operations.

Failure to take into account the expectancies of users and the environment of product use can lead to avoidable accidents and injuries. The following example is an illustration of an injury that might have been prevented if the product had been labeled with its actual weight.

An individual worker attempted to lift an industrial valve assembly that was designed for use on a six-inch pipeline. Unknown to this worker the valve assembly, although deceptively small in size, weighed 160 pounds. While lifting the valve, he suffered a severe back injury.

Designers should foresee the human tendency to judge the weight of an object by its dimensions. The weight of heavy products should be displayed conspicuously when the product's deceptively compact size multiplies the risk of injury.

Severe injuries can also result from failure to design lifting aids carefully, failure to reduce product size, and when only ideal handling conditions are assumed, as illustrated by the following examples:

A 400-pound railroad tie puller was designed to be lifted manually to its working position on a set of railroad tracks. Handles were placed at various points around the perimeter of the machine and, if shared, could accommodate eight workers. If such a weight could be evenly distributed at all times among the eight workers, and if each worker could support the load close to his body, the lifting task might be considered acceptable. However, the engine and hydraulic equipment were not centered on this machine, the handles were not positioned to evenly distribute the load, and the designer did not take into account that this machine would have to be carried over soft and uneven ground. During a lift of this machine attempted by seven workers, two workers stumbled and a weight of over 200 pounds suddenly shifted to one worker. This worker suffered a compressed fracture of a vertebra in his back.

A laborer was required to manually unload a railroad boxcar loaded with 100-pound bags of sugar. The bags were lifted chest-high with two hands in front of the body followed by further lifting to one shoulder for carrying. During this lifting process, the worker suffered severe injury to his spine.

A worker filled a toolbox three-quarters full with tools. The box was 12 inches high, 12 inches deep, and 36 inches long with a total weight of 120 pounds. The worker carried the box to a jobsite using the handle provided for that purpose. The handle was centered on the top of the toolbox permitting only one person to use one hand to carry the box. In order to maintain balance, it was necessary for the worker to bend (the spine) away

from the side of the body carrying the toolbox. The combination of excessive weight and bending the body during the lifting process resulted in a severe injury to the worker's back. The *Work Practices Guide for Manual Lifting* provides a method for analyzing specific lifting tasks. Such an analysis would have revealed the high risk of injury to which workers were exposed in the foregoing examples.

For further information about the control of hazards associated with the handling of excessive weight, request the following Nelson & Associates fact sheets:

"Manual Lifting: Historical Sources of Current Standards Regarding Acceptable Weights of Lift"

"Manual Lifting: The NIOSH Work Practices Guide for Manual Lifting - Determining Acceptable Weights of Lift" (Effective from March 1981 to July 1994)."

"Manual Lifting: The Revised NIOSH Lifting Equation for Evaluating Acceptable Weights for Manual Lifting (Effective July 1994)"

"Manual Lifting: Training Programs in Manual Materials Handling"

"Core Principles of Safety Engineering and the Cardinal Rules of Hazard Control"