Ergonomics Assessment

Unloading boxes from skid

Concern Details

Task Description:

One worker is responsible for unloading all packages off a skid onto an automated conveyer. Initially the task was performed without the use of a pallet lifter, at a vertical lifting height range of 20-140 cm and a horizontal reach ranging from 30-60 cm. A pallet lifter was implemented which lifts and rotates the load. After the pallet lifter was implemented the vertical height range was changed to 80-170 cm. The height of the pallet lifter was controlled by the load weight. The average lifting frequency when unloading the packages from the skid was 19 lifts per minute. An assessment was done before and after the pallet lifter was implemented.

Evaluation:

This job is cause for concern for the following reasons:

(1) Some of the population may not be able to perform because it exceeds strength capabilities.
(2) High back loads that exceed acceptable levels of which risk of injury increases.
(3) The weights exceed value outlined by Snook thus resulting in increased risk of injury.
(4) The packages are outside the accepted lifting zones.
(5) The high lifting frequency may induce fatigue.

These concerns are discussed in further detail below. Overall, the concerns on this job expose workers to increased risk of injury.

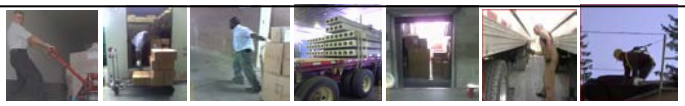
Concern Details

(1) Some of the population may not be able to perform because it exceeds strength capabilities.

Based on the biomechanical assessment less than 90 percent of the population has sufficient strength to unload the skids of packages due to the awkward postures and heavy loads (1). The workforce as a whole has strength limitations at the shoulder and elbows for lifts greater than 15 kg at vertical heights over 100 cm and back strength limitations when lifting 25 kg packages. When forces exceed strength capabilities, it hinders an individual's ability to perform the task, and the higher the portion of the population not capable of performing a task, the greater the risk of overexertion injury.

(2) High back loads that exceed acceptable levels of which risk of injury increases.

The biomechanical human model revealed concern with spinal loading and strength limitations for workers to perform the job (1). Lifting all packages (5-25 kg) from a vertical height of 20 cm or less causes high spine loads that causes shear force at the L4/L5 to exceed the maximum permissible limit, and lifting 25 kg packages at a



vertical height of 60 cm or less results in compression that exceeded the action limit. These high spine loads increases the risk of injury for some of the population.

(3) The weights exceed maximum acceptable weight limits.

According to a well accepted manual handling guide (Liberty Mutual Tables, i.e. Snook Tables) (2), the package weights exceed the maximum acceptable weight of lift (MAWL). Due to the high frequency and awkward postures associated with this job, the maximum acceptable weight for this job is 5 kg for packages over shoulder height, 6 kg for packages between knuckle and shoulder height, and 7 kg for packages below knuckle height. Workers are three times more susceptible to injury if the job exceeds the MAWL.

(4) The packages are outside the accepted lifting zones.

This job results in poor lifting conditions which are causes for concern as the location of the packages are outside the preferred lifting zone of 75 cm to 110 cm vertical height and horizontal reach of 40 cm (5^{th} percentile female reach distance with elbow at side of body) (3).

Unloading the skids with the pallet lifter eliminated lifting packages below 80 cm which brought the minimum lifting height to acceptable lifting height and thus reduced the high spine loads caused by bending to lift packages less than 60 cm from the floor. However, putting the skid on the lifter increased the vertical height to the top of the skid which results in increased the risk of injury to the upper extremity. Furthermore, the pallet lifter did not affect the high lifting frequency or the heavy loads.

(5) The high lifting frequency may induce fatigue.

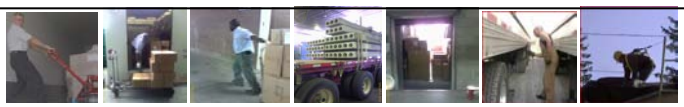
Furthermore, high frequency lifting tasks (≥ 15 lifts/min) result in fatigue if there is inadequate recovery time between lifts or lifting bouts (4) as well as repetitive, awkward shoulder and back postures which are causes for concern (5)

Using a method proposed by the National Institute of Occupational Safety and Health in the USA to create a composite lifting index, unloading the packages off of the skid at a frequency of 19 lifts per minute results in a frequency multiplier of 0, which results in a composite lifting index score of infinity. A score of infinity suggests the work demands of the job exceeds physiological demands, and thus, increases fatigue and the risk of injury. On the other hand, unloading the packages off the skid that is on a pallet lifter results in a score of 6.6. A score above 1.0 indicates the job poses risk of injury for some of the workforce, and a score over 3.0 indicates high risk of injury to the majority of the population (6).

Due to these concerns and risk factors, countermeasures are recommended to reduce the risk of developing musculoskeletal disorders when unloading packages from the skid. The following section provides countermeasure recommendations to mitigate the risk of injury.

Pallet lifter.

Skid of packages being unload from pallet lifter.



Countermeasures

Several countermeasures should be implemented to reduce the risk of injury to the workforce when unloading packages from the pallet lifter (Table 1). To reduce the risks associated with the awkward shoulder postures, it is recommended that the maximum vertical height of lift be reduced to 140 cm (3). This could be accomplished by sinking the pallet lifting into the floor, removing the top levels of packages before putting the skid on the pallet lifter, or having the skids stacked 40 cm lower from the supplier. However, reducing only the vertical height, the cumulative lifting score is still unacceptable due to the high frequency and weight of the task.

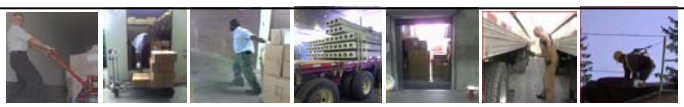
To minimize the risk of injury, countermeasures are also recommended to reduce the lifting frequency. The lifting frequency could be reduced by slowing the conveyor belt speed to half of the current speed, which will reduce the speed at which the packages can be loaded onto it. In addition, the lifting frequency must also be reduced by adding an additional worker.

Even with the above modifications that improve lifting frequency and vertical heights, the package weights still exceed the maximum acceptable weight of 9 kg (2). Since the majority of the packages exceed that weight, the use of a hoist or team lifting boxes over 9 kg is required to reduce the risk of injury. However, if the above countermeasures are not implemented, a hoist or team lift would be required for packages over 6 kg.

Thus, a combination of engineering and administrative controls is required to reduce the risk of injury for the workforce.

Table 1: Countermeasure summary

Risk Factors	Countermeasures
Lifting from low vertical heights	Pallet lifter
Lifting from high vertical heights	Sink the pallet lifting into the floor, or remove the top levels of packages before putting the skid on the pallet lifter, or have the supplier stack the skids 40 cm lower from
High lifting frequency	Reduce conveyor speed by half and add an additional worker.
Heavy loads	Vacuum hoist or team lifting boxes over 9 kg



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