

Ergonomic Assessment

Recycling Collection

Concern Details

Background:

One worker is responsible for retrieving organic and recycling bins from the curb (vertical height of green bin: 66 cm, vertical height of blue bin: 30 cm) and lifting them into the side hopper of the truck (minimum vertical height 104 cm). The worker normally lifts one bin at a time; however, on occasion they will stack the bins on top of each other and carry them to the hopper. The average green bin weight is 10.8 kg, and the average blue bin weight is 5.4 kg. The worker does approximately 5 lifts per min.



Evaluation:

This job is cause for concern for the following reasons:

- (1) High back loads that increase risk of injury.
- (2) The weights exceed maximum acceptable weight limits.
- (3) The bins are outside the accepted lifting zones.
- (4) Repetitive awkward postures which increase risk of injury.

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

Concern Details

- (1) High back loads that increase risk of injury.

The biomechanical human model revealed concern with spinal loading and strength limitations for workers to perform the job [1]. Lifting the blue bins that are over 12 kg results in high back loads which exceed the action limit and result in risk of injury [1].

- (2) The weights exceed maximum acceptable weight limits.



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According to well accepted manual handling guide (Liberty Mutual Tables, i.e. Snook Tables) (2), the heavier bins exceed the maximum acceptable weight of lift (MAWL). For a lifting frequency of 5 per minute, lifting floor to knuckle height, 49 cm width and a distance of 51 cm, the maximum acceptable weight is 14 kg [2]. Workers are three times more susceptible to injury if the job exceeds the MAWL.

- (3) The bins are outside the accepted lifting zones

Retrieving the blue bins from a vertical height of 30 cm requires significant back flexion and places the workforce at increased risk of injury. This job results in poor lifting conditions which are causes for concern as the location of the bins are below the minimum preferred lifting height zone of 75 cm [3].

- (4) Repetitive awkward postures which increase risk of injury.

In addition, due to the height of the hopper plus the size of the bin, workers have to raise the bin to a vertical height above 120 cm. The vertical height to dump the recycling and organic material into the hopper causes repetitive awkward shoulder postures [4], increasing the risk of injury. The low vertical height of the bins results in repetitive awkward back postures which are cause for concern.

Awkward postures are much greater during winter conditions when customers put bins on snow banks.



- (5) Back exposure increases risk of injury.

Using a method proposed by the National Institute of Occupational Safety and Health in the USA to create a composite lifting index (CLI), lifting the bins results in a CLI of 1.7. 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 [5].

Summary:

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

Countermeasures

Due to the high risk of injury from repetitive, heavy lifting, it is recommended to eliminate the manual lifting of the waste. The optimal solution would be to investigate automated load trucks, with a lifting mechanism to



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automatically empty large carts called “toters” without the operator having to lift the recycling by hand. The challenge to this countermeasure is that it involves the community to change to a standard toter.

If the above solution is not feasible, it is recommended that the blue bins be redesigned to the same specifications of the green bin (vertical height of 60 cm), which would reduce the back flexion required to retrieve the bin. It is also recommended to investigate a recycling truck with a lower side hopper height which would reduce the awkward shoulder postures to dump the recycling bins. Implementing these countermeasures would reduce the risk of injury to the workforce.

Decreasing the lifting frequency can be achieved by reducing the number of stops for each individual worker. It is also recommended to consider payment by the hour instead of by tonnage or using a “finish and go home” pay scheme that encourages work at excessively fast rates which increases the potential for injuries.

Awkward postures can be improved by communicating with the community on where garbage should be placed, especially in winter months. In addition, trucks with lower hoppers should be purchased.

References

- (1) 3D Static Strength Prediction Program (3DSSPP) 6.0.1, University of Michigan.
- (2) Snook, S.H. and Cirello, V.M. (1991). “The design of manual handling tasks: Revised tables for maximum acceptable weights and forces.” *Ergonomics* 34(9): 1197-1213.
- (3) Pheasant, S. And Haslegrave, C. (2006). *Bodyspace: Anthropometry, ergonomics, and the design of work*, Taylor and Francis Group.
- (4) Kilbom, A. (1994). Repetitive work of the upper extremity: Part II: The scientific basis for the guide. *International Journal of Industrial Ergonomics*, 14:59-86.
- (5) Waters, T.R., Putz-Anderson, V., Garg, A., and Fine, L. J. (1994). “Revised NIOSH equation for the design and evaluation of manual lifting tasks.” *Ergonomics* 36: 749-776.

