

Ergonomic Evaluation:

Rotatruck Self Supporting Hand Truck

For: Rotacaster Wheel Limited

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Summary

An ergonomic evaluation was conducted specifically with respect to postural and lifting implications associated with the use of the Rotacaster Self Supporting Hand Truck.

The Rotatruck Self Supporting Hand Truck was found to reduce the risks of musculoskeletal injury associated with performing manual tasks otherwise performed with a conventional two-wheeled trolley.

Methodology

- 1) Observation of:
 - a) Actual tasks including:
 - i) loading and unloading of a typical load involving the hand truck;
 - ii) transporting a typical load involving the hand truck:
 - iii) across varying levels in a building including access and egress from a lift;
 - iv) across varying floor surfaces including polished stone tiles; commercial grade carpet; concrete floor; and paved foot path; up and down a kerb (170mm);
 - v) in and out of a kerb ramp; and
 - vi) change of direction of load.
- 2) Assessment of:
 - a) Postures through observation in conjunction with tasks performed;
 - b) Effort: self-reported in conjunction with tasks performed; and
 - c) Forces involved in handling a typical load with the Rotatruck. A representative load of 81kg (61.8kg load of 8 cartons + 19.2kg hand truck) was used. Forces were measured using a Chantillon DFS Series Digital Force Gauge.
- 3) Consultation with:
 - a) Rotacaster representatives including:
 - i) Peter McKinnon, Managing Director
 - ii) Kate Purcell, Logistics

Environment

Assessment was conducted: In the building and environs surrounding the offices of Rotacaster on Tuesday 4th August, 2009 from 10:30am.

Results

- 1) Postures
 - a) The configuration of the dual Rotacasters on each side of the base of the Rotatruck Self Supporting Hand Truck, and the features of the Rotacaster multidirectional wheels supports the adoption of safe manual handling techniques by the user whilst performing manual tasks with the aid of the Rotatruck Self Supporting Hand Truck. The maintenance of the natural curves of the spine is supported and twisting of the back is alleviated during manual tasks including:
 - i) transporting a load from the gutter to the kerb; and vice versa;
 - ii) transporting a load across varying surfaces including polished, concrete, carpet and paved;
 - iii) turning the Hand Truck (loaded and unloaded) in limited circulation spaces; and
 - iv) moving the Hand Truck (loaded and unloaded) in a sideways movement.
 - b) Due to the self supporting feature of the Hand Truck:
 - i) Repeated need to change position from parked to transport is eliminated;
 - ii) The Hand Truck can be positioned into the transport position after the base load has been stacked onto the Toe, reducing the force required for the change of position from parked to transport;
 - iii) The hands can be freed to perform:

- iv) administrative tasks in association with dispatch and delivery;
- v) access and egress tasks such as: unlocking and locking doors;
- vi) swipe card use; opening and closing of doors.

2) Effort

- a) Reduced subjective effort compared to use of a conventional Hand Truck was reported in:
 - i) transporting a load:
 - (1) from the gutter to the kerb;
 - (2) from the gutter up a kerb ramp; and
 - (3) across varying surfaces including polished, concrete, carpet and paved.
 - ii) changing direction with a load:
 - (1) in the limited confines of a lift; and
 - (2) across varying surfaces including polished, concrete, carpet and paved.

3) Forces

Rotatruck Force Test Results					
	Force (kg)	Initial		Sustained	
Action					
Lower handle whilst parked		11.71		n/a	
	Flooring	Smooth	Carpet	Smooth	Carpet
Forward transport		5.8	7.3	2.2	3.6
Sideways (lateral push)		12.8	18.9	n/a	n/a

*Note: the assessor acknowledges that International unit of force is the Newton (N) however this is not in common use in reported comparable data.

Lawson & Potiki, 1994 cited in WorkCover NSW 1996 and Fallshaw 2005 recommend the following guidelines for pushing/pulling forces:

Recommended Guidelines For Pushing/Pulling Forces		
	Initial (kg)	Sustained (kg)
Female	17-21	6-12
Male	20-27	7-16

Forces measured during the assessment of the Rotatruck Self Supporting Hand Truck are within the guideline ranges for female workers (Lawson, et. al., 1994).

Photo: Rotatruck Self Supporting Hand Truck



Photo: Rotatruck Self Supporting Hand Truck. Note that the parked load is fully supported and permits the operator's hands to be free to conduct administrative tasks.

Discussion

Two-wheel trolleys or "hand trucks" traditionally require the user to support some of the load. For this reason they are not the best option for long distances on smooth floors where a platform trolley may be used. The Rotatruck Self Supporting Hand Truck is designed to alleviate: the requirement for the user to support some of the load and the use of a platform trolley for transport over longer distances on smooth floors.

Pushing loads is reported to be preferable to pulling loads because it involves less work by the muscles of the lower back, allows maximum use of body weight, less awkward postures, and generally allows a forward facing posture to be adopted providing better vision in the direction of travel (ASCC, 2007, p.78). When pushing a trolley, the reaction tends to extend the trunk and is resisted by the abdominal muscles and the hip flexors, whereas in pulling a trolley the reaction tends to flex the trunk and is resisted by the back muscles. The superiority of pushing over pulling has been confirmed by laboratory studies (Lee et. al., 1991 cited in Bridger, 2009). The design of the Rotatruck Self Supporting Hand Truck requires pushing/forward direction of movement to engage the kerb from gutter/street level; and supports pushing/forward direction of movement through doorways.

Conclusion

The Rotatruck Self Supporting Hand Truck offers some advantages for the user relative to a conventional hand truck. These advantages are specifically with respect to reducing the risks for musculoskeletal injury associated with performing manual tasks and include:

- 1) The maintenance of the natural curves of the spine is supported and twisting of the back is alleviated.
- 2) Reduces the physical demands associated with changing position from parked to transport.
- 3) Frees the hands for performing associated tasks.
- 4) Reduced effort in transporting and changing direction with a load.
- 5) Initial forces being within the guidelines recommended by Lawson & Potiki, 1994 cited in WorkCover NSW 1996 and Fallshaw 2005.
- 6) Sustained forces being within the guidelines recommended by Lawson & Potiki, 1994 cited in WorkCover NSW 1996 and Fallshaw 2005.
- 7) The user is required to access the kerb in a forward direction, providing a clear view in the direction of travel and eliminating twisting of the neck, and reducing the risk for trip and fall.
- 8) A mechanical advantage is provided for levering the load from the gutter to the kerb level or where there is a short height difference between one surface and another.
- 9) Alleviation of the user supporting some of the load as is required in using a conventional hand truck.
- 10) Permitting loads to be transported across longer distances over smooth surfaces alleviating the need to use a 2nd platform trolley.
- 11) The design of the handle:
 - a) being continuous allows a range of users of varying heights to be accommodated;
 - b) has an upper height of 1060mm and lower height of 950mm when in the self-supporting position/transport positions;
 - c) having a diameter of approximately 25.5mm; and
 - d) being cylindrical, smooth and having no sharp edges, seams or 'hot spots.
- 12) The opportunity to move the hand truck sideways if indicated:
 - a) this function may be performed within the initial force guidelines outlined in Lawson & Potiki, 1994 cited in WorkCover NSW 1996 and Fallshaw 2005.
 - b) allows the maintenance of the natural curves in the back, involving all limbs and the large number of muscles associated with these; and having a clear view in the direction of movement.

References

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