ERGONOMICS DEMONSTRATION PROJECT

Jennings Distributing

Beer and Wine Distribution

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Department of LABOR AND INDUSTRIES

Jennings Distributing

Ergonomics demonstration project report

Introduction

In August 2002, Jennings Distributing, located in Bremerton, WA, and the Washington State Department of Labor and Industries (L&I) began an ergonomics demonstration project. The purpose of the project was to perform an ergonomics review of current warehouse operations, and to document existing use of risk reduction equipment, and methodologies. Any observed hazardous exposures would also be identified. This report provides examples of ergonomics methods of risk reduction in the beer/wine distribution industry and their benefits to employees' health and safety at work.

About Jennings Distributing

Jennings Distributing is a leading distributor of beer and wine products in Washington State, distributing to over 400 locations from its Bremerton distribution warehouse.

Warehouse tasks include loading dock receiving of beer (cases of cans and bottles, kegs) from brewers and wine (cases) from vintners; product storage; stocking of the order picking area; order picking, palletizing, labeling, and shrink wrapping of orders; and loading of beer and wine products onto drive-on and side loading trucks for subsequent delivery to customer sites.

Jennings Distributing reports that it invests significant time, money and effort into training employees to ensure their safety and well-being. The company trains workers on safe and productive methods for warehouse activities. As part of this preventive approach to safety and health, Jennings Distributing has implemented a number of good ergonomics practices. Warehouse-based distribution of beer and wine, as described in this report, includes a number of product handling jobs required to take pallet loads of product received from individual suppliers, and assemble custom orders for delivery to customers. Some of these jobs, if done manually, would likely expose workers to hazardous levels of lifting, bending, repetitive motions, and high hand force that could lead to work-related musculoskeletal disorders (WMSDs).

This report describes ergonomics applications to beer and wine warehouse product handling operations that reduce the need for lifting, bending, repetitive motions, and high hand force. These include the use of mechanical product handling equipment, other equipment, and work procedures.

Table 1 summarizes the results of the ergonomics workplace evaluation for the beer-related operations.

Table 2 summarizes the wine-related operations.

Table 3 lists the most significant ergonomics accomplishments implemented at the warehouse to-date.

Table 4 lists possible Ergonomics Rule concerns. Further analysis is suggested in these areas.

Table 1. Summary of Ergonomics Risk Reduction (beer operations)

Activities	Possible WMSD Risk Factors *	Risk Reduction Ideas
Receiving Dock Offloading pallets of beer from drive-on trucks Placing full pallets into storage	Lifting (heavy, frequent, awkward) Back bending Highly repetitive motions Forceful gripping	* Forklifts, pallet jacks
Stocking Pick Area Maintaining pick area beer levels	Lifting (heavy, frequent, awkward) Back bending Highly repetitive motions Forceful gripping	* Forklifts, pallet jacks
Coordination/distribution of pick lists	None	N/A

continued

Assembling Orders (cases) Hand picking cases (product weights are listed in Appendix 2)	Lifting (heavy, frequent, awkward) Back bending Highly repetitive motions Forceful gripping	* Mechanical lifting of kegs (forklifts, pallet jacks) * Warehouse layout and product storage designed for unobstructed access by powered lifts * Maintain unobstructed picking pathways (e.g., remove emptied source pallets from forklift/worker pathways) * Place forklift as close as possible to source pallets (slide product units from source pallet to customer pallet, where feasible) (minimize carry distance, where carrying is required) * Good lifting practices, where lifting is required (e.g., lifting close to body, starting lift at knee to waist height wherever possible, sliding rather than lifting wherever possible) * Job/task rotation (e.g., between picking and driving/pick list, or other non-lifting tasks)

continued

Assembling Orders (kegs) Hand picking kegs (1/2 keg weighs approximately 165 lbs)	Lifting (heavy, frequent, awkward)	* Mechanical lifting of kegs (forklift, keg lifter) * Keg bumpers (controlled drop) or mechanical keg lifts * Edge rolling or sliding kegs (not lifting) from floor onto beer boards and pallets * Edge rolling or sliding kegs (not lifting) from a raised forklift pallet to adjacent second tier of kegs on order pallet * Two-person lifting of kegs from ground to beer board or pallet (where manual lifting required) * Two-person lifting of kegs from ground to van * Good lifting practices (where manual lifting is performed): (e.g., lifting close to body, starting lift at knee to waist height wherever possible, sliding rather than lifting wherever possible) Note: One person manual lifting of a ½ keg (165 lb) is still a hazard, even with good lifting practices. * Job/task rotation (from keg lifting to case lifting, or other non lifting tasks like forklift driving or checklisting picked orders) Note: Simply rotating between picking kegs and picking cases does not guarantee compliant lifting. Each can still be hazardous. It may be beneficial (in general) for a worker to rotate between keg lifting (heavy lifting) and case lifting (frequent lifting) because they are somewhat different kinds of lifting.

Labeling Products (where required)	None	N/A
Wrapping Orders Orders wrapped by hand on pallets	Back bending	* Job/task rotation (wrapping currently performed intermittently) * Consider using automatic wrapping machine if wrapping task is performed for many hours per day (i.e. if duration places back bending in the hazard zone)
Loading Orders (drive-on trucks) Pallet loads	Lifting (heavy, frequent, awkward) Back bending Highly repetitive motions Forceful gripping	* Forklifts, pallet jacks
Loading Orders (side-loaded trucks) Pallet loads	Lifting (heavy, frequent, awkward) Back bending Highly repetitive motions Forceful gripping	* Forklifts * Keg (beer board) sized bays on trucks
Unloading Empty Pallets From returning trucks	Lifting (heavy, frequent, awkward)	* Fork lifts, pallet jacks

*** See Ergonomics Rule for specific Caution Zone and hazard limits associated with these risk factors**

Table 2. Summary of Ergonomics Risk Reduction (wine operations)

Activities	Possible WMSD Risk Factors *	Risk Reduction Ideas
Receiving Dock Offloading pallets of wine from drive-on trucks Placing full pallets into storage	Lifting (heavy, frequent, awkward) Back bending Highly repetitive motions Forceful gripping	* Forklifts, pallet jacks
Coordination/distribution of pick lists	None	N/A
Assembling Orders Picking cases and partial cases (product weights are listed in Appendix 2)	Lifting (heavy, frequent, awkward) Back bending Highly repetitive motions Forceful gripping	* Forklifts, pallet jacks * Removing emptied pallets from forklift/worker paths (place forklift as close as possible to new source pallets) * Good lifting practices (e.g., lift close to body, start lift at knee to waist height wherever possible, slide rather than lift wherever possible)
Wrapping Orders Orders wrapped by hand on pallets	Back bending	* Job/task rotation (wrapping currently performed intermittently) * Consider using automatic wrapping machine if wrapping task is performed for many hours per day (i.e. if duration places back bending in the hazard zone)
Loading Orders (drive-on trucks) Pallet loads	Lifting (heavy, frequent, awkward) Back bending Highly repetitive motions Forceful gripping	* Forklifts, pallet jacks

continued

Loading Orders (side-loaded trucks) Pallet loads	Lifting (heavy, frequent, awkward) Back bending Highly repetitive motions Forceful gripping	* Forklifts
Unloading Empty Pallets From returning trucks	Lifting (heavy, frequent, awkward)	* Forklifts

*** See Ergonomics Rule for specific Caution Zone and hazard limits associated with these risk factors**

Beer-related operations at Jennings Distributing

1. Drive-on trucks arrive at the loading dock (Figure 1) and full pallets are unloaded using forklifts and pallet jacks.
Full pallets are placed into storage (at either room temperature or cold storage where required). Kegs are stored in a separate cold room.

Figure 1. Jennings Distributing receiving docks.

2. Full pallets are moved from storage to the picking area on as as-needed basis – using forklifts.

3. Pick lists are distributed from the supervisor's table to forklift / pallet jack operators, who assemble the order onto one or more pallets by hand picking the order. Often two workers perform this task as a team (Figure 2).

Figure 2a. 2-person team (fork lift).

Figure 2b. 2-person team (pallet jack)

Good worker picking techniques include getting the forklift / pallet jack as close to the source pallet as possible (to enable sliding of product units from source pallet to customer pallet where feasible, and to minimize lifting and carrying of product units, where sliding is not feasible), sliding units to the near side of the source pallet (close to the worker's body) before lifting, and keeping the unit close to the body when lifting/carrying (Figure 3).

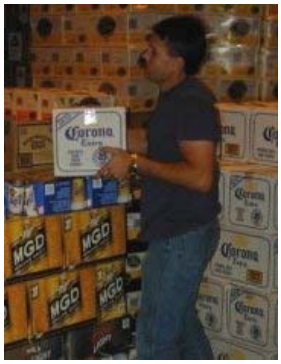

Figure 3. Lifting/carrying close to the body.

Workers picking cases of cans or bottles can be exposed to hazardous levels of lifting, due primarily to the high frequency of lifting that occurs when manually picking large quantities of packaged product.

The Ergonomics Rule Appendix B one-page lifting calculator can be used to determine whether workers picking packaged beer are exposed to hazardous levels of lifting. Where picking takes place fairly steadily over the workshift, the lifting rate (#lifts/minute) can be calculated by dividing the number of individual beer product units a worker picks during the workshift by the amount of time (in minutes) the worker picks product during his or her workshift. Break time and time spent doing other activities, such as cleanup, equipment maintenance, planning meetings, time spent on extensive paperwork, or time assigned to other (non-picking) tasks should not be counted as picking time. Appendix 3 of this report further discusses use of the lifting calculator for picking tasks.

Workers picking packaged beer are not generally exposed to hazardous levels of lifting when the picking task is defined as including a variety of (non-lifting) activities in addition to the actual lifting of individual product units, such as driving of forklifts/pallet jacks, using order checklists, moving from storage pallet to storage pallet in the warehouse to fill an order, and transporting order pallets to the loading dock.

Picking by an individual worker can reach hazardous levels when the worker manually lifts product at a high rate for extended periods of time, without rotation to other non-lifting parts of the picking task or to other tasks that do not involve lifting. Hazardous levels of lifting could occur, for example, when one worker on a picking team does all of the lifting, in a non-stop manner, for an extended amount of time.

Picking (lifting) hazards due to frequent lifting of packaged product can be reduced by a variety of means, such as job/task rotation (e.g., from picking to forklift driving/pick list, or other non-lifting tasks), picking bulk quantities mechanically where possible (instead of manually transferring individual product units from one pallet to another), providing unobstructed access to product by powered lift equipment (forklifts, pallet jacks), placing lifts as close as practical to product source pallets (reducing the need to lift and carry product by enabling some sliding of product from pallet to pallet, where feasible).

4. Completed customer orders are wrapped and stored in the outgoing dock area, ready to be loaded onto delivery trucks by forklifts (Figure 4).

Figure 4a. Completed customer orders.

Figure 4b. Completed grocery boards.

5. Beer keg picking is performed separately from case picking. Different techniques are required for kegs, given their size and weight (approximately 165 lbs. for 1/2 kegs).

Kegs orders are assembled by placing individual kegs onto order pallets and forklifting these pallets from keg storage areas to the delivery docks. One-person manual lifting of these heavy kegs (even once) from their storage locations onto order pallets exceeds the hazard level lifting limits specified in the Ergonomics Rule, Appendix B. The primary concern for Ergonomics Rule lifting compliance is when the full weight of the keg is lifted (or supported). Edge rolling, sliding, controlled dropping, etc., of kegs is typically not a hazard, and these methods of keg handling are preferable to lifting (Figures 5, 6).

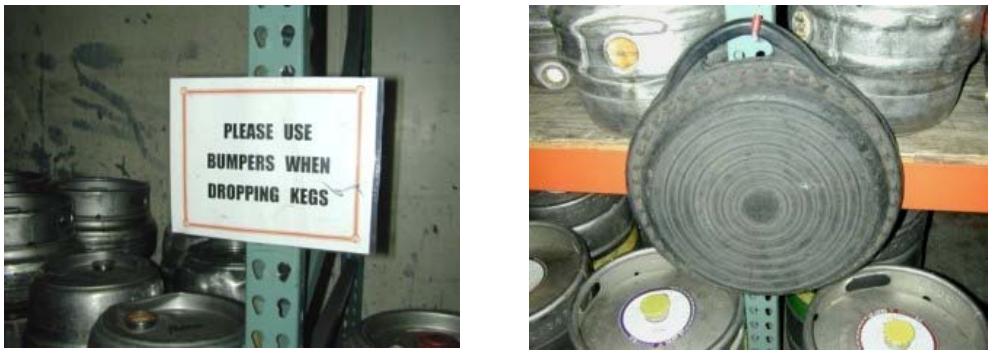

Figure 5. Rubber bumpers are used when dropping kegs from shelf level to floor level. (minimizes the need for heavy lifting (lowering) of kegs)

Figure 6. Edge rolling keg onto pallet.

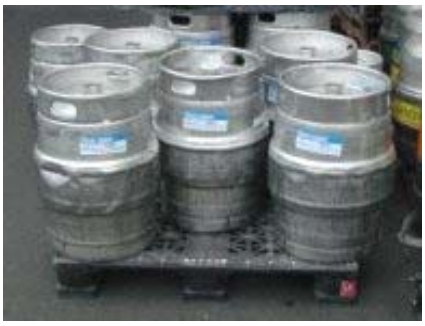

Figure 7. Five kegs are loaded onto beer boards.

A worker lifting a ½ keg (approximately 165 lbs) exceeds the lifting limits of the Ergonomics Rule, which specifies 90 lbs as the maximum per-worker limit for lifting heavy objects under ideal conditions (ideal conditions are: lifting done close to the body, hands between knee to waist height at the start of the lift, body not twisted to the side at the start of the lift, lifting not done frequently or for long durations). The limit is less than 90 lbs for lifting that is not done under these ideal conditions (see the Ergonomics Rule, Appendix B, one-page lifting limit calculator for further information).

Kegs stored on shelves or upper level stacked pallets are often lowered to the floor initially, and then edge rolled onto the first level of an order pallet. Lifting kegs from the floor to the second level of an order pallet would exceed the lifting limits of the Ergonomics Rule. Lifting to the second level should be done by two workers, or by one worker using a mechanical lift (such as a forklift). A forklift can be used to raise floor level kegs on a pallet so they can be edge rolled onto the second level of the order pallet using only one worker (Figure 8).

Figure 8. Lifting kegs from floor level to the second level of an order pallet.

a) Improperly lifted from floor by only one worker (two workers required)

b) Edge rolled/slid from raised pallet on forklift (only one worker required)

Kegs at the warehouse are stored either a) upright on the floor, b) upright on waist high shelves, c) upright on stacked flat pallets, or d) horizontally on stacked cradle pallets.

Appendix 1 of this report lists possible risk reduction ideas for lifting ½ kegs stored on the floor as well as for kegs stored on shelves or stacked pallets. These methods, or others, can be used to reduce or eliminate hazardous lifting of kegs – methods such as

edge rolling, sliding, controlled dropping, lifting with two workers, fork lifting of complete pallets without having to pick individual kegs, raising an order pallet up to shelf level or the second level of stacked pallets, placing kegs on an intermediate pallet that is raised with a fork lift up to the second level of a final order pallet, and using a keg lifter or similar devices).

Beer boards are wider than standard pallets. Forklift loading of these pallets onto delivery trucks requires a wider bay (Figure 9b).

Figure 9a. Delivery truck.

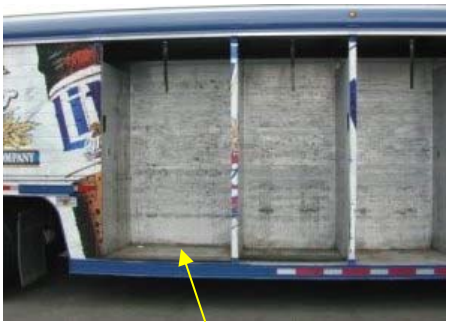

Figure 9b. Wider bay for beer boards.

6. Palletized orders of packaged beer or kegs are loaded onto delivery trucks (using forklifts) to be delivered to customer sites. Empty kegs are stored on pallets and forklifted onto return trucks (Figure 10).

Figure 10a. Forklift loading of keg pallets onto delivery trucks.

Figure 10b. Empty kegs on return pallets waiting to be loaded on return trucks.

7. Empty pallets are unloaded from returning trucks using a forklift.

Stacks of pallets are generally unloaded from trucks using a forklift. Small numbers of pallets are sometimes unloaded by hand but this lifting may exceed the lifting limits of the Ergonomics Rule if a large number of pallets are unloaded during the day.

Note that mechanical lifting equipment, such as forklifts and pallet jacks, are widely used at the warehouse for product receiving, stocking, order assembly, and loading. This equipment has significant productivity and ergonomic advantages when compared to manual handling of product. Powered equipment enables larger quantities of product to be moved, in palletized form, reducing worker exposures to lifting, bending, repetitive motions, and high hand force. Effective use of this equipment requires warehouse layout and product storage access to be designed to accommodate its use.

Wine-related operations at Jennings Distributing

1. Drive-on trucks arrive at the loading dock (Figure 11) and full pallets are unloaded using forklifts and pallet jacks.
Full pallets are placed into storage.

Figure 11. Wine receiving dock.

2. Pick lists are distributed from the supervisor to a pallet jack operator, who assembles the order onto one or more pallets by hand picking the order in the storage area.

The operator assembles the order by driving the pallet jack through the storage area to pick product, or using a hand truck to bring product to the pallet (Figure 12). Smaller quantities of product are also carried to the pallet. For some customer orders, a pallet load of product can be picked from storage to serve as the starting point for an order, but for most smaller or mixed orders, individual product boxes (or partial boxes) are transferred by hand from several storage pallets to an order pallet. Assembly of the order requires effective stacking of full and partial/mixed cases of product in order to ensure physical stability of the order after wrapping (Figure 13).

Figure 12. Wine order assembly.

a) Pallet jack.

b) Hand truck.

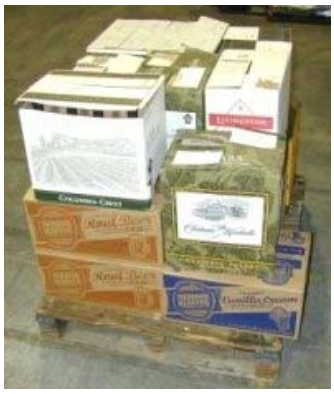

Figure 13. Stacking of different size wine cases for a customer order.

Picking of wine product, and assembly of customer orders, requires lifting, sliding, and carrying of product boxes, to assemble the customer order on a pallet for subsequent wrapping. Weights for a range of wine products are listed in Appendix 2 of this report.

Customer orders consisting of large quantities of the same product boxes are typically picked using a pallet jack, which minimizes worker handling of product if the boxes do not have to be transferred to a new pallet.

Smaller orders and mixed orders are assembled using a combination of pallet jack, hand truck, and hand carrying of boxes and partial boxes of product. This does not typically involve highly frequent lifting, since product boxes must be picked from storage pallets in different locations throughout the wine warehouse. Exposure to heavy lifting can be minimized for these smaller or mixed orders if the transfer from storage pallet to order pallet involves sliding where possible. Assembling different types of orders (those involving both more and less manual handling of product will reduce exposure to lifting, back bending, and highly repetitive motions.

3. Completed customer orders are wrapped and stored in the outgoing dock area, ready to be loaded onto delivery trucks by pallet jack or forklift.
Wrapping (Figure 14a) involves back bending most of the task time, since most palletized orders are limited to medium height, given the irregular product size mix of the order. When this task is performed only intermittently during the workday, there is not likely to be enough total time spent in this awkward posture for the task to be considered a hazard. Near continuous performance of this task, however, would likely be a hazard.

Figure 14a. Wrapping a smaller customer order.

Figure 14b. A wrapped larger customer order.

4. Palletized orders (such as Figure 14b) are loaded onto delivery trucks to be delivered to customer sites (Figure 15).

Figure 15a. Wine delivery truck at dock.

Figure 15b. Wine loading dock ramp.

5. Empty pallets are unloaded from returning trucks using a forklift.

Stacks of pallets are generally unloaded from trucks using a forklift. Small numbers of pallets are sometimes unloaded by hand but this lifting may exceed the lifting limits of the Ergonomics Rule if a large number of pallets are unloaded during the day.

Table 3. Existing Ergonomics-Related Accomplishments (Summary)

In-Place Accomplishment	WMSD Risk Factors Reduced or Eliminated *
Fork lifts, pallet jacks (receiving, stocking, assembling, loading)	Lifting (heavy, frequent, awkward) Back bending Highly repetitive motions Forceful gripping
Keg bumpers	Lifting (heavy, awkward)
Delivery trucks with beer board width bays	Lifting (heavy, awkward)
Storage areas, shelving, and placement of pallet loads of product configured for unobstructed access (where feasible given warehouse space constraints)	Lifting (heavy, awkward) Back bending
Work procedures * Maintaining unobstructed access to product * Good housekeeping (clear work areas) * Removing empty pallets from work areas (minimizes carry distance from storage pallet to forklift/pallet jack, reduces tripping hazards) (Note: carrying and tripping are not Ergonomics Rule risk factors) * Lifting product close to body wherever possible (e.g., pull product across pile close to body before lifting) (Note: push/pull is not an Ergonomics Rule risk factor) * Job rotation (e.g., from driving / pick list to hand picking) (e.g., alternating between picking and labeling) * Lifting ½ kegs (165 lbs) with 2 workers, or using a mechanical lift * Lifting ¼ kegs (82 lbs) with 2 workers (or using a mechanical lift) when lifted from below knee level or from above waist level) (lifting ¼ kegs from between knee and waist level with 1 worker is OK if done infrequently)	Lifting (heavy, awkward) Back bending Highly repetitive motions Forceful gripping

(Note: Lifting ¼ kegs with two workers is not generally done currently)	

*** See Ergonomics Rule for specific Caution Zone and hazard limits associated with these risk factors**

Table 4. Ergonomics Rule Primary Concerns

Operation/Task	WMSD Risk Factors Of Possible Concern *	Possible Risk Reduction Ideas
Assembling Orders Hand picking cases (quantities and frequency of lifting vary based on workloads and product mixes) (employer analysis of specific picking scenarios is suggested) (product weights are listed in Appendix 2)	Lifting (heavy, frequent, awkward), with possible twisting	* Mechanical lifting of cases (forklift, pallet jack) * Warehouse layout designed for unobstructed access by powered lifts * Maintain unobstructed picking pathways * Place forklift as close as possible to source pallets (slide product where feasible, and minimize carrying) * Good lifting practices (e.g., lift close to body, start lift at knee to waist height wherever possible, slide rather than lift wherever possible) * Job/task rotation (e.g., between picking and driving/pick list, or other non-lifting tasks)

continued

Assembling Orders Hand picking kegs (1/2 keg weighs approximately 165 lbs)	Lifting (heavy, awkward), with possible twisting	* Mechanical lifting of kegs (forklift, keg lifter) * Keg bumpers to drop kegs * Edge roll or slide kegs * Use a fork lift to raise a storage pallet, an intermediate pallet, or a final order pallet to permit edge rolling of kegs from one pallet to another, or from a shelf to a pallet * Two person lifting of kegs (where manual lifting required) (from floor to beer board or pallet) (from ground to van) * Good lifting practices, where lifting is required (e.g., lifting close to body, starting lift at knee to waist height wherever possible, sliding rather than lifting wherever possible) * Job/task rotation (from keg lifting to case lifting, or other non-lifting tasks like forklift driving or checklisting picked orders)

*** See Ergonomics Rule for specific Caution Zone and hazard limits associated with these risk factors**

Note: Employers can use the risk reduction ideas in this table, or other ideas, to eliminate WMSD hazards.

Keg Delivery at customer sites (on-premises) ***(<u>Not</u> covered in this report)*** Manually dropping of kegs from delivery truck level to ground. Transporting kegs to customer storage location. Possible lifting to shelf level or into crowded keg storage spaces.	Lifting (heavy, awkward)	Analysis of customer site (on-premises) delivery scenarios for delivery drivers lifting / wheeling / carrying of product is suggested, with a particular focus on keg delivery.

Other significant activities

Design of the warehouse layout

The design of warehouse layout is important for reducing potential exposures to WMSD hazards, as well as for enhancing overall productivity. A storage layout that includes ready access to palletized product by both workers and mechanized equipment can reduce redundant or awkward worker handling of product, including a reduction in the need for lifting and carrying.

Good housekeeping

Good housekeeping in the warehouse environment reduces employee potential for injury from ergonomics and safety-related hazards such as trips and falls, redundant motions and awkward postures. A clean and organized work environment may also improve overall employee morale.
Keeping warehouse work areas such as aisleways, storage areas, picking areas and shipping docks free of obstacles, such as emptied pallets that block the flow of forklift and worker movements, reduces hazards and increases productivity.

Conclusions

Bulk product handling of beer and wine in the warehouse is performed using forklifts and pallet jacks. Worker manual handling of product occurs primarily during picking, where customer orders are assembled on pallets for subsequent shipping.
Potentially hazardous exposures encountered during picking are significantly reduced by such means as:

a) Warehouse layout and good housekeeping that provides ready access to product
b) Training on low risk means of equipment operation and product handling
c) Task rotation (e.g., between forklift driver and order picker, or for a picker working alone who alternates between picking and labeling individual product units), and
d) Product handling techniques, such as bumpers for dropping kegs to floor level to reduce heavy lifting, and use of mechanical equipment wherever feasible.

The company plans to continue working to improve the storage and picking efficiency of their beer products warehouse, and is planning for a significant revision of their wine products warehouse, with increased picking efficiency and reduced product handling included in their design goals.

The company plans to continue training and enforcement of equipment use and work procedures that reduce exposures to possible WMSD hazards.

Appendix 1

Ideas for Eliminating the Hazard of Lifting Heavy Beer Kegs (165 lbs)

Floor level stored kegs:
* Edge rolled onto the first level of an order pallet
* Lifted up to the second level of an order pallet using two workers (or a mechanical keg lifter could be used by a single worker)
(alternately, the floor level keg could be edge rolled onto an intermediate pallet, then fork lift raised and edge rolled onto the second level of the order pallet)

Shelf level stored kegs:
* Control dropped from the shelf onto a rubber bumper placed on the floor, both to prevent damage to the kegs and to minimize the need for lifting (see Figure 5). Kegs are then edge rolled onto a floor level order pallet. For lifting to the second level of an order pallet, two workers are required to lift the keg (or a mechanical keg lifter could be used by a single worker).
(alternately, the floor level keg could be edge rolled onto an intermediate pallet, then a fork lift could raise the intermediate pallet and edge roll the keg onto the second level of the order pallet)
* It may be possible to edge roll or slide a keg directly from the shelf to a first or second level pallet if the order pallet is first raised up to the same height as the shelf using a forklift

Kegs stored on a flat pallet:
(kegs stored upright)
* Edge rolled onto the first level of an order pallet. Kegs lowered from a second level storage pallet can be control dropped onto a rubber bumper placed on the floor. Third level or higher storage pallets are first lowered by forklift before their kegs are loaded onto the order pallet.
* Lifted up from floor level to the second level of an order pallet using two workers (or a mechanical keg lifter could be used by a single worker)
(alternately, a floor level keg could be edge rolled onto an intermediate pallet, then fork lift raised and edge rolled onto the second level of the order pallet)
* Edge rolled directly from a second level storage pallet to the first level of an order pallet by first raising the order pallet up to the same height as the second level storage pallet using a forklift

Kegs stored on a cradle pallet:
(kegs stored on their side)
* Kegs are first tipped upright, then edge rolled onto an order pallet. Kegs lowered from a second level storage pallet can be control dropped onto a rubber bumper placed on the floor. Third level or higher storage pallets are first lowered by forklift before their kegs are loaded onto the order pallet.

* Lifted up from floor level to the second level of an order pallet using two workers (or a mechanical keg lifter could be used by a single worker)
(alternately, a floor level keg could be edge rolled onto an intermediate pallet, then fork lift raised and edge rolled onto the second level of the order pallet)
* Edge rolled directly from a second level storage pallet to the first level of an order pallet by first raising the order pallet up to the same height as the second level storage pallet using a forklift.

Employers and workers can use these, or other ideas, to eliminate hazardous lifting of kegs. The Ergonomics Rule requires that where a “hazard” is present (such as a worker lifting a 165 lb keg) the employer must “provide for and encourage” worker participation in identifying and selecting the methods that will be used to eliminate the hazard. Employers are expected to work with employees to review their keg lifting tasks (as well as any other hazardous tasks) and select risk reduction method(s) most suitable for eliminating the hazard(s) at their particular worksite(s).

Appendix 2

Approximate Weights

(for information purposes only)

Product	Weight (lbs)
Kegs	
Keg (1/2)	165 lbs. (estimated)
Keg (1/4)	82 lbs. (estimated)
6 bbl.	55 lbs. (estimated)
Packaged	
12 pack cans	10 lbs.
24 pack cans	20 lbs.
12 pack (24 oz)	20 lbs.
12 pack bottles	16 lbs.
(x2 with cardboard base)	32 lbs.
18 pack bottles	24 lbs.
24 pack bottles	32 lbs.
12 pack bottles (40oz)	46 lbs.
Champagne (case)	46 lbs.
Wine case (12 bottles)	33-36 lbs.
4 5-litre boxes	48 lbs.
4 4-litre bottles	50 lbs.
18-litre box	41 lbs.

Appendix 3

Lifting Limits for Picking Calculated from the Ergonomics Rule Appendix B Lifting Calculator

Copies of the Lifting Calculator

Copies of the Lifting Calculator are available as part of the Ergonomics Rule
http://www.lni.wa.gov/Safety/Topics/Ergonomics/History/Documents/default.asp
Appendix B: Heavy, Frequent or Awkward Lifting (one page)

Or more directly at the following website (evaluation tools):
http://www.lni.wa.gov/Safety/Topics/Ergonomics/ServicesResources/Tools/default.asp
(Interactive Web version, and PDF version)

Tables Showing Lifting Limits

The following two tables list the maximum weights of objects that can be lifted at different lifting rates without becoming a hazard (assuming lifting is done close to the body, without twisting). Different lifting scenarios can be analyzed using the lifting calculator given in the Ergonomics Rule. Product lifting at a warehouse involves lifting a variety of different products at different lifting frequencies. For lifting a mixture of different size/weight product, the Ergonomics Rule requires that the lifting limit be calculated using the most "commonly performed lift" – using the frequency and duration for all product of 10 lbs or more that are lifted during the work day. The heaviest product lifted (calculated as a one-time lift), and the lifting done in the most awkward posture (calculated as a one-time lift) are also required to be analyzed for hazardous lifting.

Important: The tables are intended as general guidelines only, listing product weight limits for lifting (picking) which is done close to the body, with less than 45 degrees of twisting while lifting.
For other conditions (for example, for product lifted with the hands extended out away from the body, or if the worker twists more than 45 degrees while lifting) values should be calculated using the Ergonomics Rule lifting calculator (the allowed weight limits will be less than the values shown in the following two tables).
General use of the lifting calculator is described later in this appendix.

Lifting Limit Tables
(derived from the Ergonomics Rule lifting calculator)

(The tables below show the lifting limits for product lifting done close to the body, without twisting. The first table is for lifting that starts between waist and shoulder height, the second table for lifting that starts between knee and waist height.)

Lift starting from between waist and shoulder level (close to the body)
(Once per day lifting limit = 70 lbs)

Lifts per minute	**Hours of lifting per day (total)**		
	1 hr or less	**1 hr to 2 hrs**	**2 hrs or more**
1 lift every 2-5 mins	70 lbs.	67 lbs.	60 lbs.
1 lift every min	67 lbs.	63 lbs.	53 lbs.
2-3 lifts every min	63 lbs.	60 lbs.	46 lbs.
4-5 lifts every min	60 lbs.	49 lbs.	32 lbs.
6-7 lifts every min	53 lbs.	35 lbs.	18 lbs.
8-9 lifts every min	42 lbs.	25 lbs.	11 lbs.
10+ lifts every min	21 lbs.	14 lbs.	10 lbs.

Note 1: Multiply table values by 0.85 if worker twists more than 45 degrees while lifting.
Note 2: Multiply table values by 50/70 = 0.7 for lifting done a medium distance out from the body. Multiply table values by 40/70 = 0.6 for lifting done far out from the body.

Lift starting from between knee and waist level (close to the body)
(Once per day lifting limit = 90 lbs)

Lifts per minute	**Hours of lifting per day (total)**		
	1 hr or less	**1 hr to 2 hrs**	**2 hrs or more**
1 lift every 2-5 mins	90 lbs.	86 lbs.	77 lbs.
1 lift every min	86 lbs.	81 lbs.	68 lbs.
2-3 lifts every min	81 lbs.	77 lbs.	59 lbs.
4-5 lifts every min	77 lbs.	63 lbs.	41 lbs.
6-7 lifts every min	68 lbs.	45 lbs.	23 lbs.
8-9 lifts every min	54 lbs.	32 lbs.	14 lbs.
10+ lifts every min	27 lbs.	18 lbs.	10 lbs.

Note 1: Multiply table values by 0.85 if worker twists more than 45 degrees while lifting.
Note 2: Multiply table values by 50/70 = 0.7 for lifting done a medium distance out from the body. Multiply table values by 40/70 = 0.6 for lifting done far out from the body.

Comparing these table values with the weights for packaged beer products listed in Appendix 2, it can be seen that for high frequency lifting, the allowed product weights are limited, or conversely, for a given product weight that is being lifted, the allowed frequency of lifting (picking) is limited.

Using the Lifting Calculator to Analyze a Specific Lifting Scenario

The Ergonomics Rule Appendix B one-page lifting calculator can be used to determine whether workers picking packaged beer products are exposed to hazardous levels of lifting.

The calculator requires 4 inputs (steps):

Step 1 – Product Weight

Product weights are listed in Appendix 2 of this report for the beer product observed at Jennings Distributing's warehouse. Where different weight products are lifted from different locations the Ergonomics Rule requires using the calculator for the following three separate analyses. If any of them are hazardous than the lifting task is determined to be hazardous:

1) The most common lift – use the most frequently lifted product weight, or an approximation based on combined different product weights, when different weight products are lifted (this is commonly true).
   (Note: To calculate the frequency of lifting for this situation, count the number of all product lifted, not just the amount of representative product (see lifting frequency below).

   The 2nd and 3rd lifting situations (below) must also be analyzed, but they are less important for the packaged beer lifting analysis:

2) The heaviest lift – for this calculation, assume the object is lifted only once.
   (Note: This lifting situation is unlikely to be hazardous for packaged beer lifting, since most all of the product weights that are lifted are under the calculator limits for one-time lifting. (The only observed exception is lifting a case of 12 pack bottles (40oz) which weighs 46 lbs. This would only be a lifting hazard if the product is lifted while reaching far out from the worker's feet (limit 30-40 lbs, depending on the height where the lift starts).

3) The most awkward lift – for this calculation, assume the object is lifted only once.
   (Note, this lifting situation is unlikely to be a hazard for the same reason as 2) above.

Step 2 – Worker's Hand Location (height) at the start of each lift

This is the location where the worker first supports the product weight when it is lifted off the pallet. This height varies with the height of the product on the pallet at the time of picking. Most commonly, the height of a product unit at the start of the lift is either between the worker's waist and shoulder height, or between knee and waist height. To determine the "most common" height for the start of lifting when using the calculator for this situation, the waist to shoulder starting location could be assumed for all lifts, input to the calculator, and the lifting limit determined (this starting location has lower allowed limits than the knee to waist location). Alternatively, the calculator could be used to determine the lifting limit with first one starting height (for all lifts), then the other height

(for all lifts). These two results from the calculator can be combined mathematically to give a "weighted average" that is in between the results from these two different starting heights (the weighted average will be closer to the one with more lifts if most of the lifts are from that one lifting location, or the answer will be approximately the average of the two if there is about the same number of lifts from each of the two starting heights). This "weighted average" method can be used for any other combination of two or more variable starting heights for lifting.

Workers may lift product close to their body, or out away from their body. Lifting close to the body is encouraged, since the lifting limits are highest close to the body. This near, mid, or far reaching location for lifting is input to the calculator. If workers lift close to the body for some lifting situations, and far from the body for other situations, then the different lifting locations can be input to the calculator and analyzed, as described above for the starting hand height.

Remember: Make this input of hand location to the calculator as simple as possible. Typically, most all lifting for a picking task occurs from just one, or at most a few, locations for the range of product lifted. Calculator analysis of "the most common lift" should represent simply the most common lifting location(s).

Step 3 – #Lifts per Minute, #Hours per Day

#Hours per Day – Where picking takes place fairly steadily over the workshift, then picking time includes the time spent during the workshift actually lifting product, as well as non-lifting pick time spent driving forklifts/pallet jacks, using order checklists, moving from storage pallet to storage pallet in the warehouse to fill an order, and transporting order pallets to the loading dock. Where this is a worker's primary or only job, then this picking time will be most or all of the worker's shift time, and picking is likely to be performed for more than 2 hrs per day.
(Note: For purposes of the lifting calculator, this time (per day) is categorized as either 1 hr or less, 1 hr to 2 hrs, or 2 hrs or more.)

#Lifts per Minute – The lifting rate (#lifts/minute) can be calculated by dividing the number of individual beer product units a worker picks during the workshift by the amount of time (in minutes) the worker performs these picking activities during his or her workshift.
(Note: If a worker "palms" two 12 packs of cans while lifting, this counts as one lift of 2 x 10 = 20 lbs. Similarly, lifting two 12 packs of bottles on a cardboard base counts as one lift of 2 x 16 = 32 lbs).

Note: If picking takes place only sporadically during the workshift, as part of several jobs or tasks performed by a worker, then picking time includes only the time spent on picking activities. In this case, the total picking time per day may be 2 hours or more, or it may be less.
(Picking time (per day) is categorized as either 1 hr or less, 1 hr to 2 hrs, or 2 hrs or more.)

In this case, the lifting rate (#lifts/minute) is calculated the same way (# product units lifted divided by picking time) but here the picking time used for the calculation is only the time spent performing picking tasks during the workshift.

Step 4 – Twisting

If the worker routinely twists more than 45 degrees while lifting, then the calculator lifting limits are reduced by 15% (multiply calculator lifting limits by 0.85).
(Note: Twisting that counts as adding to the hazardous exposure here is *rotating* around the waist, not by bending sideways, forward, or backward at the waist. This type of twisting typically occurs when the worker's feet are "planted" in place and product is transferred from one side of the worker to the other (such as from one pallet to another). Twisting can be reduced by repositioning the feet while lifting.

Determining whether lifting is hazardous

To determine whether the picking (lifting) is hazardous, the maximum allowed lifting weight determined by the calculator is compared to the actual weight of the product units lifted (the actual weights were determined in *Step 1*). Lifting is hazardous if the beer product units (lifted manually) are heavier than the calculator determined limits.

Beer Packaged Product Weights

Product weights (listed in Appendix 2) range from 10 lbs (12 pack cans) to 46 lbs (12 pack of 40 oz bottles). The beer product weights listed in Appendix 2 are repeated below:

Product	**Weight (lbs)**
Packaged	
12 pack cans	10 lbs.
24 pack cans	20 lbs.
12 pack (24 oz)	20 lbs.
12 pack bottles	16 lbs.
(x2 with cardboard base)	32 lbs.
18 pack bottles	24 lbs.
24 pack bottles	32 lbs.
12 pack bottles (40oz)	46 lbs.

When these product weights are compared with the results from the lifting calculator, it is seen that most actual packaged beer product weights are below the calculator lifting limits – thus the lifting is generally not considered hazardous.

Employers should analyze their workers' picking tasks to determine if hazardous lifting is present. It is possible for workers to be exposed to hazardous lifting if the lifting by a particular worker involves mostly the heavier products, or is done near-continuously for extended periods of time without rotation to other non-lifting tasks.

Example: Picking 24 packs of cans (20 lb)

* Lifted close to the body, lifting from between waist and shoulder level
* 4-5 cases lifted per minute, for 2 hours or more per day

The maximum allowed lifting weight for this picking scenario is: 31.5 lbs
(70 x 0.45 = 31.5 lbs)
NOT HAZARDOUS, since 20 lb product is less than the 31.5 lb lifting limit.

Note: if the lifting rate increased to 6-7 lifts per minute, then the lifting would be considered hazardous:
(70 x 0.25 = 17.5 lbs)
HAZARDOUS, since 20 lb product is greater than the 17.5 lb lifting limit.