

## CASE STUDY – Palletizing

<b>TASK TITLE: Palletizing</b>	
<b>Task Description:</b>	<p>The Palletizing task occurs primarily in the warehouse environment and is typically performed to prepare a load for delivery to a specified location. The task usually involves consolidation, that is, taking individual items from carts or various pallet stacks and placing them on a centralized pallet according to the specifications of the requesting location. After the items are placed on the centralized pallet, the pallet is secured (by shrink-wrap, straps or other means) and delivered by fork truck to the desired location. Items that are too heavy to move manually are loaded onto the pallet by fork truck (Note: Refer to Fork Truck Operating (sitting) Case Study 8, for additional information since the use of fork trucks will not be discussed here.)</p> <p>Typical examples in which the Palletizing tasks can occur include (but are not limited to) are:</p> <ul style="list-style-type: none"><li>• Load consolidation</li><li>• Pallet build-up/tie-down</li><li>• Packing mail into tri-wall containers.</li></ul>
<b>Job Performance Measures Most Often Impacted by Palletizing:</b>	<p>Measures of work performance can include (but are not necessarily limited to):</p> <ul style="list-style-type: none"><li>• Load stability/material integrity</li><li>• Number of loads assembled/distributed per day</li></ul>
<b>Typical Employee Comments about Palletizing:</b>	<p>Employees experience discomfort in the back/torso, shoulders, and wrists.</p> <p>The back/torso and shoulder are the body areas that most commonly receive a “High” priority rating. The remaining body areas, with the exception of the head/eyes, are more likely to receive “Medium” priority rating, or lower.</p>
<b>Suggested Level II Analysis:</b>	<p>Dynamic task Analysis, Grip Force Measurement (for jobs using tie-down straps), Biomechanical Lifting Analysis, NIOSH Lifting Equation</p>

**Shoulder/Neck**

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
1. Reaching	<ul style="list-style-type: none"> <li>Material is too low</li> <li>Material is too far from the edge of the pallet</li> </ul>	124. Raise the work piece/work surface	✓		low	low	low
		<ul style="list-style-type: none"> <li>place empty pallets under the active pallet to increase the height during loading/unloading</li> <li>provide a lift table to elevate the active pallet</li> </ul>		✓	high	low	med
		38. Move closer to the work location	✓		low	low	med
		<ul style="list-style-type: none"> <li>provide unobstructed access to at least three, preferably four sides of the pallet</li> </ul>					
		13. Encourage ergonomic work technique	✓		low	low	low
		<ul style="list-style-type: none"> <li>encourage person to walk around pallet</li> </ul>					
		41. Move work piece closer to body				✓	med
<ul style="list-style-type: none"> <li>provide a turntable for the pallet</li> </ul>							
127. Reduce depth of storage container							
<ul style="list-style-type: none"> <li>provide tri-wall containers with removable sides to allow better access</li> <li>provide containers with drop down flaps</li> </ul>				✓	med	low	med

**Shoulder/Neck (cont'd)**

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	<ul style="list-style-type: none"> <li>Material is too high during placement of tie-down nets</li> <li>Shrink wrapping</li> </ul>	83. Provide an adjustable height lift table <ul style="list-style-type: none"> <li>use pits to lower the pallet during positioning of the netting over the load</li> </ul> 62. Provide a mechanical lift device <ul style="list-style-type: none"> <li>use a fork truck and rack to position netting over large loads</li> </ul> 149. Provide appropriate tools <ul style="list-style-type: none"> <li>provide a height adjustable table for shrink wrapping</li> </ul>		✓  ✓  ✓	high  med  med	low  low  low	high  high  med
2. Arm forces: Repeated arm forces or holding/ Carrying materials	<ul style="list-style-type: none"> <li>Transferring heavy loads</li> <li>Operating strapper</li> </ul>	61. Provide a mechanical lift device <ul style="list-style-type: none"> <li>use a fork truck to lift and place heavy items</li> <li>provide a hoist or other lifting device to lift and place heavy loads</li> </ul> 149. Provide appropriate tools <ul style="list-style-type: none"> <li>provide strapper with a better gearing ratio which requires less force</li> </ul> 34. Maintain hand tool/power tools <ul style="list-style-type: none"> <li>maintain strappers to reduce forces</li> </ul>	✓  ✓  ✓	✓  ✓	low med to high med low	low low low low	med med med low

**Shoulder/Neck (cont'd)**

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	<ul style="list-style-type: none"> <li>Obtaining tangled tie-downs from containers can require repeated forceful exertions</li> </ul>	147. Provide an alternate container <ul style="list-style-type: none"> <li>after use in the field, fold tie downs in a pattern which minimizes tangling</li> <li>provide a rack for hanging tie-downs after use to eliminate tangling</li> </ul> 11. Eliminate unnecessary tasks <ul style="list-style-type: none"> <li>eliminate the use of tie-down netting; use shrink wrap</li> </ul>	✓		low	low	med
				✓	med	low	med
				✓	high	low	high
3. High speed, sudden shoulder movements	<ul style="list-style-type: none"> <li>Tightening tie-downs can require excessive force and jerking motions</li> <li>Obtaining tangled tie-downs from containers can require repeated forceful exertions</li> </ul>	147. Provide appropriate tools <ul style="list-style-type: none"> <li>provide tie-downs that are equipped with a ratcheting mechanism – eliminate excessive pulling force for tightening</li> </ul> 148. Provide an alternate container <ul style="list-style-type: none"> <li>after use in the field, fold tie downs in a pattern which minimizes tangling</li> <li>provide a rack for hanging tie-downs after use to eliminate tangling</li> </ul> 11. Eliminate unnecessary tasks <ul style="list-style-type: none"> <li>eliminate the use of tie-down netting; use shrink wrap</li> </ul>	✓	✓	med	med	high
			✓		low	low	med
				✓	med	low	med
				✓	high	low	high

**Shoulder/Neck (cont'd)**

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
3. High speed, sudden shoulder movements (cont'd)	<ul style="list-style-type: none"> <li>Operating strapper</li> <li>Material is too high during placement of tie-down nets</li> </ul>	149. Provide appropriate tools <ul style="list-style-type: none"> <li>provide strapper with a better gearing ratio which requires less force</li> </ul>		✓	med	low	med
		34. Maintain hand tool/power tools <ul style="list-style-type: none"> <li>maintain strappers to reduce forces</li> </ul>	✓		low	low	low
		32. Lower the work piece/work surface <ul style="list-style-type: none"> <li>use pits to lower the pallet during positioning of the netting over the load</li> </ul>		✓	high	low	high
		61. Provide a mechanical lift device <ul style="list-style-type: none"> <li>use a fork truck and rack to position netting over large loads</li> </ul>		✓	med	low	high
		13. Encourage ergonomic work techniques	✓		low	low	low
4. Head/neck bent or twisted	<ul style="list-style-type: none"> <li>Inadequate headroom</li> </ul>	82. Provide adequate workspace <ul style="list-style-type: none"> <li>move palletizing area to where there is adequate head clearance</li> </ul>	✓	✓	low to high	low	med

## Hands/Wrists/Arms

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
5. Bent wrists/repeated wrist movements or repeated forearm rotation	<ul style="list-style-type: none"> <li>Repeated handling of multiple items/boxes</li> <li>One handed manual shrink wrapper</li> </ul>	11. Eliminate unnecessary tasks <ul style="list-style-type: none"> <li>investigate possibility of providing full pallet load of certain items and handling with a fork truck</li> <li>whenever possible, load pallet in the opposite order of delivery needs (i.e., first item on is last item off) to avoid re-handling</li> </ul>	✓		low	low	med
			✓		low	low	low
		149. Provide appropriate tools <ul style="list-style-type: none"> <li>provide two-handed manual shrink wrapper</li> <li>provide an automatic shrink wrapper</li> </ul>		✓	med	low	med
				✓	high	med	high
6. Repeated manipulations with fingers	<ul style="list-style-type: none"> <li>Rarely occurs</li> </ul>	N/A					
7. Hyper-extension of finger/thumb or repeated single finger activation	<ul style="list-style-type: none"> <li>Awkward containers</li> </ul>	147. Provide an alternative container <ul style="list-style-type: none"> <li>provide a smaller container</li> <li>provide a more stable container</li> </ul>	✓	✓	med	med	med
		94. Provide appropriate handles		✓	med	med	med
		61. Provide a mechanical lift device		✓	med	med	low

**Hands/Wrists/Arms (cont'd)**

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
8. Hand/grip forces	<ul style="list-style-type: none"> <li>Tightening tie-downs can require excessive force of the hands</li> <li>Operating strapper</li> </ul>	149. Provide appropriate tools <ul style="list-style-type: none"> <li>provide tie-downs that are equipped with a ratcheting mechanism to eliminate excessive pulling force when tightening</li> </ul>		✓	med	med	high
		149. Provide appropriate tools <ul style="list-style-type: none"> <li>provide strapper with a better gearing ratio which requires less force</li> </ul>		✓	med	low	med
	<ul style="list-style-type: none"> <li>One handed manual shrink wrapper</li> </ul>	34. Maintain hand tool/power tools <ul style="list-style-type: none"> <li>maintain strappers to reduce forces</li> </ul>	✓		low	low	low
		149. Provide appropriate tools <ul style="list-style-type: none"> <li>provide two-handed manual shrink wrapper</li> <li>provide an automatic shrink wrapper</li> </ul>		✓	med	low	med
				✓	high	med	high

**Hands/Wrists/Arms (cont'd)**

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
9. High speed hand/wrist/arm movements or vibration, impact or torque to the hand	<ul style="list-style-type: none"> <li>Operating strapper</li> </ul>	149. Provide appropriate tools <ul style="list-style-type: none"> <li>provide strapper with a better gearing ratio which requires less force</li> </ul>		✓	med	low	med
		34. Maintain hand tool/power tools <ul style="list-style-type: none"> <li>maintain strappers to reduce forces</li> </ul>	✓		low	low	low
10. Exposure to hard edges	<ul style="list-style-type: none"> <li>Handling products with hard edges</li> </ul>	93. Provide appropriate gloves	✓		low to med	low	low
11. Hands and fingers exposed to cold temperatures	<ul style="list-style-type: none"> <li>Work area is too cold</li> </ul>	23. Increase room temperature <ul style="list-style-type: none"> <li>encourage employees to keep doors shut</li> </ul>	✓		low	low	low
		93. Provide appropriate gloves <ul style="list-style-type: none"> <li>provide thin gloves with high friction surface (e.g., rubber dots)</li> </ul>	✓		low	low	low
		12. Encourage appropriate seasonal clothing	✓		low	low	low

**Back/Torso**

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On		
			✓ Minor Modification	✓ Major Change		Quality	Productivity	
12. Repeated forward or sideways bending movements	• Material is too low	124. Raise the work piece/work surface	✓		low	low	low	
		<ul style="list-style-type: none"> <li>place empty pallets under the active pallet to increase the height during loading/unloading</li> <li>provide a lift table to elevate the active pallet</li> </ul>		✓	high	low	med	
	• Material is too far from the edge of the pallet	38. Move closer to the work location.	✓		low	low	med	
		<ul style="list-style-type: none"> <li>provide unobstructed access to at least three, preferably four sides of the pallet</li> </ul>						
	• Shrink wrapping	127. Reduce depth of storage container			✓	med	low	med
		<ul style="list-style-type: none"> <li>provide containers (tri-wall) with removable sides to allow better access</li> <li>provide containers with drop down flaps</li> </ul>			✓	med	low	med
		124. Raise the work piece/work surface		✓	med	low	med	
		<ul style="list-style-type: none"> <li>provide a height adjustable table for shrink wrapping</li> </ul>						

**Back/Torso (cont'd)**

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	<ul style="list-style-type: none"> <li>Obtaining tangled tie-downs from containers can require repeated bending</li> </ul>	147. Provide an alternate container <ul style="list-style-type: none"> <li>provide containers that have a side latched spring</li> <li>provide a rack for hanging tie-downs after use to eliminate tangling</li> </ul> 11. Eliminate unnecessary tasks <ul style="list-style-type: none"> <li>reduce the use of tie-down netting; use shrink wrap whenever feasible</li> </ul> 146. Angle the work surface <ul style="list-style-type: none"> <li>tilt the container for easier access</li> </ul>	✓		low	low	med
				✓	med	low	med
				✓	high	low	high
				✓	med	low	med
13. Twisting of the lower back	<ul style="list-style-type: none"> <li>Inappropriate positioning of pallets may increase twisting</li> <li>Access to all sides of pallet is limited</li> <li>Person tends to twist with the back instead of using the legs and feet to pivot</li> </ul>	82. Provide adequate work space <ul style="list-style-type: none"> <li>place enough space between pallets so that employee is required to turn the entire body and take a step, rather than twist the back</li> </ul> 38. Move closer to the work location. <ul style="list-style-type: none"> <li>provide unobstructed access to at least three, preferably four side of the pallet</li> </ul>	✓		low	low	low
			✓		low	low	med

**Back/Torso (cont'd)**

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
		146. Angle the worksurface <ul style="list-style-type: none"> <li>• tilt the container for easier access</li> </ul> 13. Encourage ergonomic work techniques <ul style="list-style-type: none"> <li>• provide training on ergonomics principles and materials handling techniques</li> <li>• encourage person to use legs to pivot while transferring loads or loading/unloading pallets</li> </ul>	✓		low	low	low
			✓		low	low	low
			✓		low	low	low
14. High speed, sudden movements or lifting awkward, uneven, shifting, or bulky items.	<ul style="list-style-type: none"> <li>• Manual handling of large, bulky items</li> <li>• Tightening tie-downs can require excessive force and jerking motions</li> <li>• Obtaining tangled tie-downs from containers can require repeated forceful exertions</li> </ul>	61. Provide a mechanical lift device <ul style="list-style-type: none"> <li>• provide a hoist or other lifting device for handling large items</li> </ul> 149. Provide appropriate tools <ul style="list-style-type: none"> <li>• provide tie-downs that are equipped with a ratcheting mechanism – minimize excessive pulling force for tightening</li> <li>• provide a rack for hanging tie-downs after use to eliminate tangling</li> </ul> 11. Eliminate unnecessary tasks <ul style="list-style-type: none"> <li>• eliminate the use of tie-down netting; use shrink wrap</li> </ul>		✓	high	low	low
				✓	med	med	high
				✓	med	low	med
				✓	high	low	high

**Back/Torso (cont'd)**

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
	<ul style="list-style-type: none"> <li>Throwing tie-down netting over tall loads creates uneven force in the back</li> <li>Operating strapper</li> </ul>	13. Encourage ergonomic work techniques  61. Provide a mechanical lift device <ul style="list-style-type: none"> <li>use a fork truck to lift and position netting over the load</li> <li>provide a special portable rack for positioning the netting over the load</li> </ul> 149. Provide appropriate tools <ul style="list-style-type: none"> <li>provide strapper with a better gearing ratio which requires less force</li> </ul> 34. Maintain hand tool/power tools <ul style="list-style-type: none"> <li>maintain strappers to reduce forces</li> </ul>	✓		low	low	low
				✓	med	low	med
				✓	med	med	med
				✓	med	low	med
			✓		low	low	low
15. Static, awkward back postures	<ul style="list-style-type: none"> <li>One handed manual shrink wrapper</li> </ul>	149. Provide appropriate tools <ul style="list-style-type: none"> <li>provide an automatic shrink wrapper</li> </ul>		✓	high	med	high

**Back/Torso (cont'd)**

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
16. Lifting forces	<ul style="list-style-type: none"> <li>Item(s) being transferred between pallets are too heavy</li> <li>Inappropriate manual handling of pallets</li> </ul>	61. Provide a mechanical lift device <ul style="list-style-type: none"> <li>use a hoist to perform the lift</li> <li>use a portable pneumatic scissor jack; position the height of the jack so the operator can slide rather than lift the item between pallets</li> </ul>		✓ ✓	high high	low low	low low
		61. Provide a mechanical lift device <ul style="list-style-type: none"> <li>use a fork truck to move and position empty pallets</li> </ul>	✓	low	low	low	
		13. Encourage ergonomic work techniques <ul style="list-style-type: none"> <li>consider storing pallets on sides as opposed to flat if handled manually</li> <li>avoid throwing pallets on top of stacks</li> </ul>	✓	low	low	low	
		142. Use two or more persons to perform the transfer	✓	low	low	low	

**Back/Torso (cont'd)**

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
17. Pushing or pulling	<ul style="list-style-type: none"> <li>• Tightening tie-downs can require excessive pulling forces</li> <li>• Obtaining tangled tie-downs from containers can require repeated forceful pulling efforts</li> </ul>	149. Provide appropriate tools <ul style="list-style-type: none"> <li>• provide tie-downs that are equipped with a ratcheting mechanism; eliminate excessive pulling force for tightening</li> </ul>		✓	med	med	high
		147. Provide an alternate container <ul style="list-style-type: none"> <li>• after use in the field, fold tie downs in a pattern which minimizes tangling</li> <li>• provide a rack for hanging tie-downs after use to eliminate tangling</li> </ul>	✓		low	low	med
		11. Eliminate unnecessary tasks <ul style="list-style-type: none"> <li>• reduce the use of tie-down netting; use shrink wrap whenever feasible</li> </ul>		✓	med	low	med
			✓	high	low	high	
18. Whole body vibration	<ul style="list-style-type: none"> <li>• Rarely occurs</li> </ul>	N/A					

**Legs/Feet**

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
19. Fixed position, standing	<ul style="list-style-type: none"> <li>Rarely occurs</li> </ul>	N/A					
20. Exposure to hard edges on legs, knees, and feet <u>or</u> Standing on hard surfaces	<ul style="list-style-type: none"> <li>Material is too low, some kneeling on pallets or items may create contact stress to the knees</li> <li>Standing or walking on a hard surface</li> </ul>	124. Raise the work piece/work surface	✓		low	low	low
		<ul style="list-style-type: none"> <li>place empty pallets under the active pallet to increase the height during loading/unloading</li> <li>provide a lift table to elevate the active pallet</li> </ul>		✓	high	low	low
		9. Eliminate exposure to hard edges	✓		low	low	low
		<ul style="list-style-type: none"> <li>cover any sharp edges with padding if kneeling must occur</li> <li>provide knee pads if kneeling must occur</li> </ul>		✓	med	low	low
		96. Provide appropriate shoe inserts	✓		low to med	low	low
21. Awkward leg postures	<ul style="list-style-type: none"> <li>Material is too low/some squatting may be required</li> </ul>	124. Raise the work piece/work surface	✓		low	low	low
		<ul style="list-style-type: none"> <li>place empty pallets under the active pallet to increase the height during loading/unloading</li> <li>provide a lift table to elevate the active pallet</li> </ul>		✓	high	low	low

**Legs/Feet**

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
22. Awkward foot postures	<ul style="list-style-type: none"> <li>• Work too low</li> </ul>	124. Raise the work piece/work surface <ul style="list-style-type: none"> <li>• place empty pallets under the active pallet to increase the height during loading/unloading</li> <li>• provide a lift table to elevate active pallet</li> </ul>	✓		low	low	low
				✓	high	low	low

## Head/Eyes

Job Factor	Potential Causes	Corrective Action	Level of Changes		Cost	Impact On	
			✓ Minor Modification	✓ Major Change		Quality	Productivity
23. Difficult to see, light levels too low or too high	<ul style="list-style-type: none"> <li>Rarely occurs</li> </ul>	18. Improve visual access to work <ul style="list-style-type: none"> <li>Light levels should be 20fc to 50fc for work</li> </ul>		✓	low to high	med	med
24. Intensive visual tasks, staring at work objects for long periods	<ul style="list-style-type: none"> <li>Rarely occurs</li> </ul>	N/A					

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