ERGONOMIC BEST PRACTICES FOR THE WOOD PALLET AND CONTAINER ASSOCIATION

Background

Musculoskeletal disorders (MSDs), also known as repetitive strain injuries, are conditions or injuries that generally develop over a period of time as a result of repeated exposure to awkward postures, excessive force, and high rates of repetition. They are the most prevalent injury reported to the WSIB and within the wood pallet and container industry this is no exception.

For this industry (rate group 312) overexertion, repetitive motion, and bodily reactions accounted for 36% of the claims in 2012 (WSIB). They accounted for 45% in 2011 yet 33% in 2010. MSDs often result in debilitating long-term injuries to workers and high costs to employers, directly and indirectly. According to the Workplace Safety and Insurance Board, in 2010 the average cost of a lost-time injury was about $140,000 in Ontario. Re-hiring, re-training, lost production, and lower productivity while on light-duty can account for this cost.

The real costs associated with injuries, however, is much greater. Fines and penalties levied by the MOL or WSIB, negative perception from the community, and lost future contracts, for example, can all have an impact on your bottom line. Then, depending on your profit margin, it may cost almost a million dollars in sales to recover these costs. Yet, on the other hand, it does not cost almost a million dollars to make improvements in your workplace to reduce the risks associated with MSDs.

Musculoskeletal Disorders are preventable. Ergonomics is the science of matching the work and the work environment to the people who do the work. It’s about working smarter, not harder. By applying ergonomic principles you can protect your bottom line while protecting the well-being of your employees. You can also improve productivity and quality by improving the efficiency of the work performed.

This guideline aims to highlight the common hazards associated with poor ergonomic design within the wood pallet and container industry and offer practical, cost-effective solutions (best practices) to reduce the risk to musculoskeletal disorders. The guideline is based on a review of 47 jobs over four job sites, relevant research, and past experience of the ergonomist. A quick analysis, using the Caution Zone Checklist (included in the resource section), was also used to identify potential high-risk tasks.
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Job Descriptions

Firms in this industry manufacture pallets (standard and custom size), crates, tri-walls, and/or spools. Some firms also recycle used pallets. Males, mostly young, perform the majority of work within the plant and are often paid on a piecework incentive system. Jobs performed in this industry generally include machine operators to process raw material, assemblers (of pallets, crates, tri-walls, or spools), graders, equipment operators (e.g., forklift or bobcat operators), recyclers, and dismantlers.

Machine Operators

Various machines may be used to prepare the wood pieces for assembly. For example, often a multi-cut machine is used to cut pieces to length, a re-saw machine to cut its thickness in half, and a multi-rip saw machine to cut pieces to width. To create a notch at both ends for the forks of the forklift truck either a single or double-head notching machine is used. Anywhere from one to three employees are assigned to a machine to load and unload individual pieces for processing. Wood pieces before and after processing are usually stacked between ankle and head height on skids or carts, resulting in repetitive bending, twisting, and reaching activities. Utilizing the caution zone checklist some operators are exposed to awkward shoulder postures and high hand forces.

Assemblers

Depending on the firm pallets can be assembled manually with one or two workers, working on a flat or angled workbench, or automatically using an automatic nailing machine with two workers. Pallets can be of standard size or large customized size and in low volumes or in bulk. When assembling manually, the job involves physically handling individual wood pieces from a stack between ankle to head height, operating a pneumatic nailing gun, gripping and handling of partially assembled pallets to flip them over, and lifting pallets (14 – 18 kg) once assembled for stacking between the floor to a height well above the head. Forward bending and extended forward reaching are additional physical activities common in this job. The work pace is fast and steady with a typical work cycle time of 1 pallet every 3 minutes. Utilizing the caution zone checklist assemblers are exposed to awkward shoulder and back postures, particularly when working alone on flat workbenches, high hand forces, highly repetitive motions to operate the pneumatic nailing gun and heavy awkward lifting to stack pallets above shoulder level.
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Recyclers and Dismantlers

In the recycling business each pallet is visually inspected. Damaged boards are removed and replaced with new boards. Once repaired, pallets are then stacked according to size and type. Tools used include a pneumatic nailing gun, circular saw, hammer, and pry bar. Each pallet is handled at least twice and sometimes as much as four times, depending on the habits of the worker. Bending, lifting, twisting, and climbing over stacks of pallets are common physical activities associated with this job. Pallets beyond repair are processed through the dismantler, a large band saw, which separates the top boards from the baseboards. The individual pieces are then cut to the appropriate size and re-used where possible. Utilizing the caution zone checklist recyclers are exposed to awkward shoulder postures, high hand force, and frequent heavy awkward lifting of pallets.
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Major Risk Factors

Musculoskeletal disorders (MSD), also known as repetitive strain injuries (RSI), are associated with three main risk factors: repetition, force, and awkward postures. These risk factors in isolation may not be enough to create an injury or aggravate a previous injury. Certainly collectively, the need cannot be over-emphasized for these factors to be avoided or designed out of the workplace.

Awkward Postures

Regarding posture, a neutral posture is the most efficient and preferred body position. This position places the least amount of strain on the body and requires the least amount of effort to maintain.

Moving any joint away from its neutral position increases the strain on the tendons, muscles, and other soft tissues at the joint. The further a joint is moved away from its neutral position, the greater the amount of stress and/or effort placed on the joint and surrounding tissues. It also reduces strength capabilities, thereby increasing the amount of effort required.

Work postures can be affected by the appropriateness of the work height (refer to Data Sheet 03), the forward reach requirements of the job (refer to Data Sheet 03), and the tools (refer to Data Sheet 02) and equipment used to complete the job.

In the wood pallet and container industry, the following awkward postures were observed:

- Extended reaching, at or above shoulder level to activate palm buttons (swing saw machine)
- Bending and extended reaching during pallet assembly
- Bending and twisting to stack or remove raw material for processing
- Long reaches to load material into machines
- Above shoulder level work to stack wood pieces in hopper (automatic nailing machine)
- Above shoulder level work to handle material stacked high on carts
- Twisting and reaching due to crowded or congested workspace
Forceful Exertions

Force refers to the amount of effort involved to move or handle an item. Manual material handling activities (e.g., lifting, lowering, pushing, pulling, carrying, etc.) often result in low back or shoulder injuries. Handling pallets, for example, involves forceful exertions because of the size and weight of the load and where it is lifted. The type of grip used can also contribute to forceful exertions. A pinch grip, for example, involves the use of the hand muscles, which are smaller, and therefore weaker compared to the larger, stronger arm muscles that are used when using a power grip. Forceful exertions can therefore be affected by manual material handling conditions (refer to Data Sheet 01) and hand tool design (refer to Data Sheet 02).

In the wood pallet and container industry, the following forceful exertions were observed:

- Awkward wide grip to handle a number of 2x4s
- Lifting with load away from body to process material
- Stacking large custom pallets
- Holding and operating pneumatic nailing guns
- Forceful pinch grips with awkward wrist postures to bend thick cardboard (tri-walls)
- Handling heavy bags of sawdust
- Forceful gripping of 4x6 material for processing
- Heavy awkward lifting of pallets and stacking to heights well above shoulder level
- Forceful pinching with awkward wrist positions to handle material for assembly or processing
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Repetition

Regarding repetition, the body tends to have a natural limit to the amount of repetitive movements it can withstand. Duration and recovery time should also be taken into consideration when evaluating repetition. A fast work pace and jerky movements contribute to the stress placed on the body. There is a greater risk to injury when multiple risk factors, such as, repetitive forceful exertions or repetitive awkward postures, are present.

In the wood pallet and container industry the following repetitive motions were observed:

- Repetitive handling of pallets, multiple times, at a fast work pace
- Repetitive gripping of material before and after processing
- Repetitive gripping and turning of wooden studs for grading
- Repetitive extended reaching at shoulder level throughout pallet assembly

Data Sheet 01 – Manual Material Handling (MMH)

MMH activities often lead to overexertion injuries resulting in low back sprains and strains. For this industry group, overexertion injuries accounted for 22% of the claims, sprains and strains 32%, and back injuries 17% in 2012. In addition to the weight of a load, the further a load is held away from the body the greater the stress placed on the discs in the low back due to leverage principles. Loads handled below knuckle height require the employee to lift the weight of his upper body, which represents 60% of their body weight. While loads handled above shoulder level become more difficult to control and use weaker muscle groups thereby increasing the amount of work required and stress placed on the employee. For these reasons, an ideal lift is one that can be held close to the body and handled between knuckle and shoulder level – the ideal lifting zone.

Specific examples of manual material handling activities in this industry are

- Lifting raw material from ankle to well above shoulder level to load/unload processing machines (e.g., Multi-cut, double head notching machine)
- Lifting pallets (14 – 18 kg) from floor to well above head height in the assembly department
- Twisting and lifting heavy loads (15 – 20 kg) away from the body to process 4x4 pieces of raw material
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Best Practices

Optimize postures

- Provide scissor lift tables with rotating top for processing raw material to maintain an ideal handling height
- Use a stack of skids to raise the height of wood material to improve handling heights
- Limit stack heights of processed material and assembled pallets.
- Utilize the forklift trucks to build the completed stacks
- Encourage manual material handling (MMH) within the ideal zone
- Avoid handling of pallets above shoulder level
- Encourage, educate, and train employees to utilize good body mechanics (refer to Data Sheet 05 for details)
- Optimize workspace and layout to minimize twisting activities
- Minimize conveyor width, work surfaces, etc. to reduce long reaches with loads

Other considerations

- Install an automatic feed (unloading) system to eliminate manually handling the pieces for processing
- Install an automatic stacker to eliminate manually handling the pieces after processing
- Protect wood in the yard from the elements to reduce unnecessary weight (wet wood is heavier)
- Eliminate shovelling of sawdust using a vacuum system to collect it directly
- Eliminate bending and lifting scrap material from off the floor with bins or containers to catch the pieces from the conveyor
ERGONOMIC BEST PRACTICES FOR THE WOOD PALLET AND CONTAINER ASSOCIATION

- Install specialty machines (e.g., Holtec machine) to process entire skid loads to reduce manual handling
- Orientate stacks of material with machine’s orientation to reduce need for gripping and turning of individual pieces
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Data Sheet 02 – Hand Tools

Powered and manual hand tools accounted for 6% of the claims in 2011 for the wood pallet and container industry. Posture, force, and vibration are the main risk factors often associated with tool use. Using the appropriate tool for the task and of optimal design can help reduce the likelihood of injury. The pneumatic nailing gun, the most commonly used tool in this industry, does not meet design guidelines, as indicated in the table below.

<table>
<thead>
<tr>
<th>Tool Characteristic</th>
<th>Design Guidelines</th>
<th>Existing Pneumatic Nailing Gun</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tool weight</td>
<td>1.12 kg (ideal), 2.3 kg (max)</td>
<td>4.5 - 6.6 kg</td>
</tr>
<tr>
<td></td>
<td>&gt;2.3 kg (suspend with tool balancer)</td>
<td></td>
</tr>
<tr>
<td>Handle size (diameter)</td>
<td>50 - 60 mm</td>
<td>45 mm</td>
</tr>
<tr>
<td>Handle length</td>
<td>120 mm (minimum)</td>
<td>130 mm</td>
</tr>
<tr>
<td>Handle surface</td>
<td>Smooth, slightly compressible, and non-conductive</td>
<td>Smooth metal (most often)</td>
</tr>
</tbody>
</table>

Best Practices

**Optimize design of existing pneumatic nailing guns**

- Suspend pneumatic nailing guns on tool balancers
- Apply tool wrap to handle to increase its size, reduce grip force, and exposure to vibration
- Provide/utilize special attachments to optimize working postures where appropriate

**Optimize design of other tools used**

- Attach handle grips to existing brooms or shovels to reduce grip force
- Ensure handle length is appropriate to reduce the amount of bending during sweeping and shovelling
- Provide lightweight brooms and shovels
ERGONOMIC BEST PRACTICES FOR THE WOOD PALLETT AND CONTAINER ASSOCIATION

General tool design considerations

- Select lightweight and balanced tools
- Minimize tool weight as much as possible
- Select tools with bent handles to keep wrist in straight (handshaking) positions
- Select tools with a trigger strip, rather than a button, to reduce repetition and force
- Select tools that can be used by either hand
- Minimize exposure to vibration
- Maintain tools on a regular basis
- Use the appropriate tool for the task

Data Sheet 03 – Work Heights and Reaches

Workstations should allow all employees to work in an upright posture and access items easily. A work surface that is too low involves bending forward in the neck and low back. A work surface that is too high involves stressful arm and shoulder postures.

Likewise, frequently required items should be located within easy reach to minimize the amount of stress placed on the body.
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Specific examples in the industry are:
- Bending and extended reaching during pallet and container assembly
- Long reach at above shoulder level to activate machine controls (e.g., swing saw)

Best Practices
- Provide work platforms to optimize work heights for shorter workers (Ensure the risk of trips and falls is properly assessed and controlled prior to implementing)
- Keep forward reach requirements within easy reach for the shortest worker (approx. 23.4 cm)
- Keep controls below shoulder level for the shortest worker (approx. 129.5 cm)
- Utilize angled workbenches for pallet assembly to reduce bending and reaching (Set work range height between 92.5 – 129.5 cm and maximum forward reach within 67.3 cm where possible)
- Provide adjustable workbenches with an easy mode of adjustment to suit different worker heights
- Avoid reaching behind the mid-line of the body
- Optimize the layout of the work area and process flow to avoid awkward postures (For example, position the pallet in line to the conveyor)
- Face upstream of line to minimize twisting or shoulder extension (reaching behind body)
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- Provide matting in front of machines where standing predominately in one spot is required to reduce postural fatigue from concrete floor
- Ensure employees wear good supportive footwear, possibly with cushioned shoe insoles to minimize the effect of prolonged weight bearing activities
- Avoid the use of foot pedals during standing operations to reduce postural fatigue due to unequal weight distribution through the legs. Either replace foot pedals with foot treadles to allow for a more balanced weight distribution or perform the job while sitting or partially sitting (with a sit/stand stool) if knee space is limited

Data Sheet 04 – Upper Extremity Musculoskeletal Disorders (MSDs)

Workers handle a lot of material in this industry regardless of job classification. Repetitive forceful and/or awkward gripping activities can lead to muscle, tendon (e.g., tendonitis), or nerve (e.g., carpal tunnel syndrome) injuries. Generally, objects handled on a repetitive basis should not exceed 1 kg when held in a pinch grip and 4 kg when held in a power grip. Keeping the wrist in a straight (handshaking) position maximizes grip strength while minimizing strain on the hand and wrist.

Best Practices

- Alter number of pieces of material handled at a time based on thickness and weight of wood to avoid awkward grips and high hand forces
- Create a clamp to hold 4-5 pieces of wood together to reduce force and optimize posture
- Utilize appropriate machines (e.g., double head notching machine instead of single head notching machine) to reduce repetitive handling of processed pieces
- Provide specialty machines (e.g., Holtec machine) to process entire skids of material to reduce repetitiveness
- Utilize the appropriate machine (e.g., multi-cut machine instead of radial arm saw) to improve efficiency
- Utilize multi-purpose machines (e.g., Pendu machine) to reduce repetitiveness
- Design/provide a tool to bend thick cardboard (e.g., during tri-wall assembly) to reduce awkward forceful wrist actions
- Provide gloves in a variety of sizes that are made of the appropriate material to minimize forceful gripping
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Data Sheet 05 – Training

Employee training is important to effectively control hazards in the workplace. After all, how employees interact with their environment is just as important as providing appropriate tools and making adjustments to the work area. Employees need to be informed of the workplace hazards and how to protect themselves using proper work procedures and practices. Remember, these injuries are usually the result of an accumulation of factors and employees need to be aware of their body mechanics and posture at all times.

Good Body Mechanics and Personal Work Practices

- Remove obstacles during machine set-up to optimize postures
- Perform simple stretching exercises before and after machine set-up to minimize risk to injury
- Avoid jumping down from the forklift truck
- Handle material (raw or processed pieces) in the amount that is comfortable
- Avoid quick and jerky motions, particularly during manual material handling (MMH) of pallets
- Remain in-line with load during manual material handling (MMH) activities to avoid twisting actions
- Refrain from climbing up stacks of pallets to align or stencil

Proper Lifting Techniques

- Avoid lifting from low levels
- Avoid twisting while lifting – keep load square to the body and move your feet
- Obtain a good grip of the load prior to lifting
- Assess the weight of the load to properly prepare the back
- Bend the knees, not the back
- Establish a wide base of support to keep the load as close to your centre of gravity as possible
- Place one foot in front of the other when handling loads above shoulder level

Team Lifting Principles

- Communicate with each other prior to initiating the lift and until the task is completed
- Assign one person to take the lead and coordinate your actions throughout the lift
- Where possible, choose someone of your similar height to be your lifting partner
- Walk in step with each other for a smoother carrying task
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Data Sheet 06 – Work Organization

The way in which work is organized (e.g., structure, supervision, task variety, work pace, etc.) can have an adverse effect on employees’ well-being, resulting in musculoskeletal disorders. These psychosocial factors (e.g., low levels of social support at work, deadlines, and low levels of recognition, etc.) are equally important, as are the biomechanical factors (e.g., optimizing the workstation, redesigning the hand tool, etc.).

Best Practices

- Implement regular job rotation schedules to distribute the workload evenly
- Consider job enlargement (adding additional tasks to the job) to increase the variety of tasks performed
- Consider the use of Bobcats instead of forklift trucks to maximize operator comfort and posture while maximizing work efficiency
- Review the flow of work throughout the plant to ensure layout optimizes workflow efficiencies
- Increase the amount of control employees have over performance quality
- Increase the amount and timing of employee feedback
- Improve means of employee/employer communication
- Keep employees properly trained and informed
- Ensure employees take regularly scheduled breaks to provide relief for the working muscles
- Increase employee awareness of MSD signs and symptoms and encourage early reporting of any problems
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Data Sheet 07 – Office Workstations

While the focus for this guideline is directed towards the jobs out in the plant, the employees working in the office environment are also exposed to potential hazards associated with MSDs. Workstations in the office should be assessed to ensure exposures are eliminated through proper ergonomic set up and good work practices.

Monitor (1)
- Top of screen at eye level, lower for bifocal wearers
- Distance away approximately arm’s length
- Images on screen are sharp, easy to read, and don’t flicker
- Positioned at right angle to windows
- Lighting is adequate and glare avoided
- Positioned directly in front, if viewed regularly

Document Holder (2)
- Adjusted to same height, distance, and angle to the screen
- If frequently reaching for documents, positioned between the monitor and keyboard

Work surface (3)
- Adjusted to position keyboard, mouse, and monitor at the appropriate height
- Large enough to hold all work materials
- Frequently used items are within easy reach (i.e., able to keep elbows close to body)
- Less frequently used items within arm’s reach
- Leg room is sufficient and obstacles under the work surface avoided
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Chair (4)
- Fully adjustable to optimize comfort and support (height, depth, width, tilt)
- Firm lumbar support for the small of the back
- Adjustable arm rests are provided and do not interfere with natural movements
- Five leg base of support
- Sit back in the chair, adjust chair height so the thighs are parallel to the floor (7) and feet are fully supported on the floor or with a footrest (8)

Keyboard and mouse (5, 6)
- Adjustable to allow for approximately 90° bend at elbows and straight wrist position
- Keyboard and mouse are at the same height and allow for the elbows to remain close to the body
- Padded wrist rest provided to maintain neutral wrist postures
- Sufficient space between thighs and keyboard tray or work surface

Work Practices
- Take frequent micro breaks (5 minutes every hour) to change posture and stretch
- Vary tasks to avoid prolonged positions and/or continuous keyboarding
- Vary your viewing distance by focusing on items further away
- Check your posture, adjust your work station, and sit in the chair properly
Caution Zone Checklist

<table>
<thead>
<tr>
<th>Caution Zone Checklist</th>
<th>Use one sheet for each position evaluated.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Awkward Posture</strong></td>
<td>Comments/Observations</td>
</tr>
<tr>
<td>1. Working with the hand(s) above the head, or the elbow(s) above the shoulders more than 2 hours total per day.</td>
<td></td>
</tr>
<tr>
<td>2. Working with the neck or back bent more than 30 degrees (without support and without the ability to vary posture) more than 2 hours total per day.</td>
<td></td>
</tr>
<tr>
<td>3. Squatting more than 2 hours total per day.</td>
<td></td>
</tr>
<tr>
<td>4. Kneeling more than 2 hours total per day.</td>
<td></td>
</tr>
</tbody>
</table>
# Ergonomic Best Practices for the Wood Pallet and Container Association

<table>
<thead>
<tr>
<th>High Hand Force</th>
<th>Comments/Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>5.</strong> Pinching an unsupported object(s) weighing 2 or more pounds per hand, or pinching with a force of 4 or more pounds per hand, more than 2 hours total per day (comparable to pinching half a ream of paper).</td>
<td>✔</td>
</tr>
<tr>
<td><strong>6.</strong> Gripping an unsupported objects(s) weighing 10 or more pounds per hand, or gripping with a force of 10 or more pounds per hand, more than 2 hours total per day (comparable to clamping light duty automotive jumper cables onto a battery).</td>
<td>✔</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Highly Repetitive Motion</th>
<th>Comments/Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>7.</strong> Repeating the same motion with the neck, shoulders, elbows, wrists, or hands (excluding keying activities) with little or no variation every few seconds, more than 2 hours total per day.</td>
<td>✔</td>
</tr>
<tr>
<td><strong>8.</strong> Performing intensive keying more than 4 hours total per day.</td>
<td>✔</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Repeated Impact</th>
<th>Comments/Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>9.</strong> Using the hand (heel/base of palm) or knee as a hammer more than 10 times per hour, more than 2 hours total per day.</td>
<td>✔</td>
</tr>
</tbody>
</table>
**ERGONOMIC BEST PRACTICES FOR THE WOOD PALLET AND CONTAINER ASSOCIATION**

<table>
<thead>
<tr>
<th>Heavy, Frequent or Awkward Lifting (A simple scale can be used to determine the weight of materials)</th>
<th>Comments/Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>10.</strong> Lifting object weighing more than 75 pounds once per day or more than 55 pounds more than 10 times per day.</td>
<td></td>
</tr>
<tr>
<td><strong>11.</strong> Lifting objects weighing more than 10 pounds if done more than twice per minute, more than 2 hours total per day.</td>
<td></td>
</tr>
<tr>
<td><strong>12.</strong> Lifting objects weighing more than 25 pounds above the shoulders, below the knees or at arms length more than 25 times per day.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Moderate to High Hand- Arm Vibration (Closely estimate or obtain the vibration value of the tool in use)</th>
<th>Comments/Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>13.</strong> Using impact wrenches, carpet strippers, chain saws, percussive tools (jack hammers, scalers, riveting or chipping hammers) or other tools that typically have high vibration levels, more than 30 minutes total per day.</td>
<td></td>
</tr>
<tr>
<td><strong>14.</strong> Using grinders, sanders, jigsaws or other hand tools that typically have moderate vibration levels more than 2 hours total per day.</td>
<td></td>
</tr>
</tbody>
</table>
## ERGONOMIC BEST PRACTICES FOR THE WOOD PALLET AND CONTAINER ASSOCIATION

### Hazard Zone Checklist

<table>
<thead>
<tr>
<th>HAZARD ZONE JOBS CHECKLIST</th>
<th>Hazard Exists</th>
<th>Date:</th>
<th>Job Position evaluated:</th>
<th>No. of employees in these jobs?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Movements or postures that are a regular and foreseeable part of the job, occurring more than <strong>one day per week</strong>, and more frequently than <strong>one week per year</strong>.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Awkward Posture</strong></td>
<td>Comments/Observations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><img src="image1.png" alt="Image" /> 1. Working with the hand(s) above the head, or the elbows above the shoulders</td>
<td>More than <strong>4 hours total per day</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><img src="image2.png" alt="Image" /> 2. Repeatedly raising the hand(s) above the head, or the elbow(s) above the shoulder(s) more than once per minute</td>
<td>More than <strong>4 hours total per day</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><img src="image3.png" alt="Image" /> 3. Working with the neck bent more than 45° (without support or the ability to vary posture)</td>
<td>More than <strong>4 hours total per day</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><img src="image4.png" alt="Image" /> 4. Working with the back bent forward more than 30° (without support or the ability to vary posture)</td>
<td>More than <strong>4 hours total per day</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><img src="image5.png" alt="Image" /> 5. Working with the back bent forward more than 45° (without support or the ability to vary posture)</td>
<td>More than <strong>2 hours total per day</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><img src="image6.png" alt="Image" /> 6. Squatting</td>
<td>More than <strong>4 hours total per day</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><img src="image7.png" alt="Image" /> 7. Kneeling</td>
<td>More than <strong>4 hours total per day</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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<thead>
<tr>
<th>High Hand Force</th>
<th>Hazard Exists</th>
<th>Comments/Observations</th>
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</thead>
<tbody>
<tr>
<td>Pinching an unsupported object(s) weighing 2 lbs or more per hand, or pinching with a force of 4 lbs or more per hand (comparable to pinching a half a ream of paper)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>8. Highly repetitive motion + More than 3 hours total per day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. + More than 3 hours total per day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. No other risk factors + More than 4 hours total per day</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Gripping an unsupported object(s) weighing 10 lbs or more per hand, or gripping with a force of 10 lbs or more per hand (comparable to clamping light duty automotive jumper cables onto a battery)

| 11. Highly Repetitive motion + More than 3 hours total per day                    |               |                       |
| 12. + More than 3 hours total per day                                             |               |                       |
| 13. No other risk factors + More than 4 hours total per day                      |               |                       |
## ERGONOMIC BEST PRACTICES FOR THE WOOD PALLETT AND CONTAINER ASSOCIATION

<table>
<thead>
<tr>
<th>Highly Repetitive Motion</th>
<th>Comments/Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using the same motion with little or no variation every few seconds (excluding keying activities)</td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td></td>
</tr>
<tr>
<td>High, forceful exertions with the hand(s)</td>
<td>More than 2 hours total per day</td>
</tr>
<tr>
<td>15.</td>
<td></td>
</tr>
<tr>
<td>No other risk factors</td>
<td>More than 6 hours total per day</td>
</tr>
</tbody>
</table>

### Intensive keying

| 16. | |
| No other risk factors | More than 4 hours total per day |

| 17. | |
| No other risk factors | More than 7 hours total per day |

### Repeated Impact

| 18. | |
| Using the hand (heel/base of palm) as a hammer more than once per minute | More than 2 hours total per day |

| 19. | |
| Using the knee as a hammer more than once per minute | More than 2 hours total per day |
ERGONOMIC BEST PRACTICES FOR THE WOOD PALLETT AND CONTAINER ASSOCIATION

Calculator for analyzing lifting operations

<table>
<thead>
<tr>
<th>Weight Lifted</th>
<th>Company</th>
<th>Evaluator</th>
<th>Job</th>
<th>Date</th>
</tr>
</thead>
</table>

1. Enter the weight of the object lifted.

2. Circle the number on a rectangle below that corresponds to the position of the person’s hands when they begin to lift or lower the objects.

   - Above shoulder
     - 65 lbs.
   - Waist to shoulder
     - 50 lbs.
   - Knee to waist
     - 30 lbs.
   - Below Knee
     - 20 lbs.

3. Circle the number that corresponds to the times the person lifts per minute and the total number of hours per day spent lifting.

   Note: For lifting done less than once every five minutes, use 1.0

<table>
<thead>
<tr>
<th>How many lifts per minute?</th>
<th>How many hours per day?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 hr or less</td>
</tr>
<tr>
<td>1 lift every 2-5 min</td>
<td>1.0</td>
</tr>
<tr>
<td>1 lift every min</td>
<td>0.95</td>
</tr>
<tr>
<td>2-3 lifts every min</td>
<td>0.9</td>
</tr>
<tr>
<td>4-5 lifts every min</td>
<td>0.85</td>
</tr>
<tr>
<td>6-7 lifts every min</td>
<td>0.75</td>
</tr>
<tr>
<td>8-9 lifts every min</td>
<td>0.6</td>
</tr>
<tr>
<td>10+ lifts every min</td>
<td>0.3</td>
</tr>
</tbody>
</table>

4. Circle 0.85 if the person twists 45 degrees or more while lifting.

   Otherwise circle 1.0

5. Copy below the numbers you have circled in steps 2, 3, and 4.

   Lifting Limit = \( \text{Weight Lifted (lbs.)} \times \frac{1}{5} \times \frac{1}{10} \times \frac{1}{2} \) lbs.

6. Is the Weight Lifted (1) less than the Lifting Limit (5)?

   Yes — ok
   No — HAZARD

Note: If the job involves lifts of objects with a number of different weights and/or from a number of different locations, use Steps 1 through 5 above to:
1. Analyze the 2 worst-case lifts—the heaviest object lifted and the lift done in the most awkward posture.
2. Analyze the most commonly performed lift. In Step 3, use the frequency and duration for all the lifting done in a typical workday.
ERGONOMIC BEST PRACTICES FOR THE WOOD PALLETT AND CONTAINER ASSOCIATION

7 SOLUTIONS PRINCIPLES
To find the most appropriate solution for this job, look for the lowest number you used to do the calculations (2, 3, 4)

<table>
<thead>
<tr>
<th>HANDS POSITION (2)</th>
<th>FREQUENCY (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Reduce the horizontal distance from the body</td>
<td>• Increase weight of a load so it requires mechanical assist</td>
</tr>
<tr>
<td>• Remove barriers, obstacles</td>
<td>• Improve layout to minimize manual material handling</td>
</tr>
<tr>
<td>• Reduce weight of load</td>
<td>• Use mobile storage racks</td>
</tr>
<tr>
<td>• Reduce capacity of the container</td>
<td></td>
</tr>
<tr>
<td>• Team lift the object with two or more workers</td>
<td></td>
</tr>
<tr>
<td>• Design workstation with the adjustable heights to eliminate trunk bent forward</td>
<td></td>
</tr>
<tr>
<td>• Provide handholds</td>
<td></td>
</tr>
<tr>
<td>• Store objects at 30 inches off the floor</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DURATION (3)</th>
<th>TWISTING (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Use mechanical assist such as overhead hoist, manipulator, vacuum lift, pneumatic balancer, forklift</td>
<td>• Redesign workstation layout to eliminate trunk twisting</td>
</tr>
<tr>
<td>• Eliminate the use of deep shelves</td>
<td>• Locate lifting operations in front of the body</td>
</tr>
<tr>
<td>• Job rotation to other jobs where no lifting is required</td>
<td>• Use slides, gravity, chutes to eliminate lifting/twisting</td>
</tr>
</tbody>
</table>
ERGONOMIC BEST PRACTICES FOR THE WOOD PALLET AND CONTAINER ASSOCIATION

Calculator for Hand-Arm Vibration

1. Find the vibration value for the tool. (Get it from the manufacturer look it up at this website http://umtech.niwi.se/Vibration/action.lasso?database=HAVbase.fp3&layout=Normal&response=HAVSearch.html&show On the graph below mark the point on the left side shown as Vibration value.

2. Find out how many total hours per day the employee is using the tool and mark that point on the bottom of the chart below.

3. Trace a line into the graph from each of these two points until they cross.

4. Interpretation
   a. If that point lies in the crosshatched “Hazard” area above the upper curve, then the vibration hazard must be reduced below the hazard level or to the degree technologically and economically feasible.
   b. If the point lies between the two curves in the “Caution” area, then the job remains as a “Caution Zone Job.”
   c. If the point falls in the “OK” area below the bottom curve, then no further steps are required.

Note: The caution limit curve (bottom) is based on an 8-hour energy-equivalent frequency-weighted acceleration value of 2.5 m/s². The hazard limit curve (top) is based on an 8-hour energy-equivalent frequency-weighted acceleration value of 5 m/s².

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