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Ergonomic Evaluation
Hamann Angus Ranch
Mint Trailer Landing Gear Power Unit
May 2001

A worksite visit was conducted at Hamann Angus Ranch on May 12, 2001 to evaluate the task of manually raising/lowering truck trailer landing gear of mint trailers. This was done at the request of Don Hulick, Manufacturing Consultant from OMEP as a part of an Oregon OSHA Worksite Redesign Grant project for this company. Videotaping and digital photos of the work tasks were conducted and are available for review. Employee discomfort surveys were completed.

Purpose/Background:

The purpose of this evaluation is to provide an initial assessment of the musuculo-skeletal disorder (MSD) risk factors associated with the job. Hamann Angus Ranch intends to improve this job process in an effort to reduce the risks of MSD injuries.

General Description & Observations: The following description is adapted from information provided by Hamann Angus Ranch and Mr. Hulick.

Truck drivers couple and uncouple trailers used to haul and process mint, up to 24 times per shift. The landing gear turning force varies considerably, requiring a pull of up to 54 pounds of force on the handle (in high gear with resistance) and can require up to 75 turns of the handle to raise a trailer while uncoupling it from the tractor truck. This is done while bending at the trunk and reaching forward. Truck drivers have verbalized complaints of discomfort in the low back, shoulder, wrist and forearm related to this task.

Work Environment and Equipment: Relevant dimensions:

Work is performed outdoors during mint harvest (summer).

Landing gear handle: Center pivot point is approximately 36" high (when truck and trailer are coupled). Turning radius is 12.5" around the pivot point. Low handle position is approximately 22" high. High handle position is approximately 47" high. In high gear with no resistance the force to turn handle is 4-5 lb., with resistance the force increases to 40-54 lb. In low gear with resistance the turning force is 12-16 lb. Typically, the landing gear is cranked up or down in high gear (faster gear movement) until resistance is encountered and then switched to low gear to complete the process.

The primary physical demands likely to contribute to risk of musculo-skeletal injury include:

1. Forces and Loads- significant sustained muscle loading of the trunk extensors while bending forward and of the muscles in the dominant upper extremity while grasping and turning the crank handle.

2. Repetition- moderately high rate of repetitive movements related to grasping and rotating the crank handles affecting the back, shoulders, arms, wrists and hands. Each turn of the crank handle involves shoulder flexion and extension, abduction and adduction, elbow flexion and extension to complete one full turn of the handle around a 12.5" turning radius. (75 turns X 24 coupling/uncouplings = 1,800 turns, or 225 turns/hour).

3. Awkward postures- Frequent bending and twisting of the trunk, extension and rotation of the neck, reaching forward with the dominant shoulder, elbow flexion/extension and wrist flexion/extension related to turning the crank handle.

4. Poor posture and Body Mechanics- workers are generally unable to maintain good body mechanics technique due largely to the position of the crank handle under the truck trailer.

Job Hazard Analysis Tools Utilized

Rapid Upper Limb Assessment (RULA)* results: Action level = **4** (rating score **7**).

A RULA rating of 7 (on a scale of 1-7) results in a RULA action level score of 4. This is the highest possible classification (4 on a 1-4 classification scale) and results in a recommendation of investigate and changes are required immediately

**See Applied Ergonomics 1993, 24(2), 91-99, RULA: a survey method for the investigation of work-related upper limb disorders RULA is a survey method developed for use in ergonomics investigations of workplaces where work-related upper limb disorders are reported. This tool requires no special equipment in providing a quick assessment of the postures of the neck, trunk and upper limbs along with muscle function and the external loads experienced by the body. A coding system is used to generate an action list which indicated the level of intervention required to reduce the risks of injury due to the physical loading on the operator.*

The Requirements for action into which the grand scores are divided is summarized into action levels as follows: (The action level leads in most cases, to proposals for a more detailed investigation)

Action level 1- A score or 1 or 2 indicates that posture is acceptable if it is not maintained or repeated for long periods

Action level 2- A score of 3 or 4 indicated that further investigation is needed and changes may be required.

RULA (cont.)

Action level 3- A score of 5 or 6 indicated that investigation and changes are required soon.

Action level 4- A score of 7 indicates that investigation and changes are required immediately.

Employee Discomfort Survey Results:

Job Title- Mint Harvesting Number of surveys completed= **9**

Discomfort Area	Number of employees with discomfort	Percentage of the total (9)	Average Rating (0-10 scale)
Shoulder	9	100%	7.0
Lower back	9	100%	6.6
Hand/wrist	9	100%	5.1
Elbow/forearm	8	89%	6.0
Upper back	7	78%	5.1
Hip/thigh	7	78%	3.4
Neck	6	67%	4.8
Knee	5	56%	3.6
Lower leg	4	44%	3.3

These identified ergonomic risk factors, job hazard analysis tool results and discomfort survey results together indicate a need for engineering controls to eliminate or greatly reduce worker exposure to this task.

Recommendations:
Engineering controls

Design and build a tool as per Section C of the Worksite Re-design Program Grant Application, which will eliminate manual effort or turning the crank handle. The goal would be to eliminate the physical effort, repetition and awkward postures related to manually turning the landing gear crank handle. The tool should be light weight, portable and able to be easily attached to the trailer landing gear rod or handle. The new tool should be efficient, simple to operate and not create additional MSD risk Factors.

The following design principles for hand tools should be incorporated to the extent that they are feasible:

Hand Tool Design Principles:

1. Maintain neutral joint postures- Avoid tool designs that cause awkward wrist, forearm and shoulder positions. The hands should remain in front and close to the body, elbows near the trunk and not raised, shoulders should stay relaxed, not elevated. The neck should not have to bend severely downward, sideward or rotate significantly to see while operating the tool.

2. Use the appropriate muscle groups- Use larger muscle groups (i.e. the whole hand or arm) when exerting higher levels of force. Use smaller muscle groups (i.e. the fingers) when doing fine precision work. Design tools to be used by the entire hand rather than individual fingers. Design in low trigger forces if the trigger is used repetitively. Use trigger strips or 2-finger triggers for repetitive work rather than single finger triggers.

3. Use proper grips- The grip orientation should encourage maintenance of neutral joint postures. The handles should extend from either side of the hand when in use. Recommended handle diameter is 1.5" for power grip (whole hand) with an acceptable range of 1.25" to 2". Recommended diameter for precision grip (finger pinch) is .45" with an acceptable range of .3 to .6" Grip span for tools with two grips like pliers and strippers should not exceed 3.5" grip span. For maximum grip force the ideal span is between 2.5" and 3.5".

4. Design adequate grip surfaces- Mildly compressible, slightly textured handles enhance gripping ability, minimizing slip. Grips should be non-conductive to heat and electricity. Avoid using finger recesses on the gripping surface.

5. Minimize repetitions- Design tools that can be used by either hand to split the workload. Consider incorporating foot controls to reduce repetitive hand movements. Minimize repetitive gripping and squeezing (use power when possible).

6. Minimize the amount and duration of force- Avoid static muscle loading associated with the tool use. (Minimize tool weight or use tool balancers for heavy tools). For precision operations, tools should not weigh over 1 pound.

7. Allow sufficient hand clearance- Be careful that the tool use does not cause pinch points, contact to hot surfaces or sharp materials.

8. Eliminate pressure points on hands and fingers- Pressure points (contact stress) on fingers and palms of hands can cause localized damage to nerves and blood vessels. Minimize exposure through padded and rounded edges. Be careful not to increase recommended grip diameters by added padding.

9. Use power tools rather than human muscle- Mechanical energy is more efficient than human energy while minimizing exposure to repetition and force risk factors. Power cords should be flexible and not interfere with the job.

For further assistance or questions regarding this report please contact Rob Strickland, 503-667-3564 or 503-413-2204.

Respectfully,

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Ergonomic Specialist