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Ergonomic Evaluation
Schnitzer Steel, Portland, Oregon
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By Rob Strickland, OTR

A work site visit was conducted in the Auto Shredder Residue (ASR) area at the request of Pat Kraft, Manufacturing Consultant and Project Director. This is a follow-up visit from the initial Ergonomic Review and report dated 11/23/99. Videotaping and digital photos of the work station areas were performed and are available for review. Employee discomfort surveys were completed.

Purpose/Background:

The ASR equipment is newly constructed and implemented as of November 8,1999. There have been three incidents of employee back discomfort associated with this work activity within the first 30 days of operation. Schnitzer as been awarded a Worksite Redesign Program grant from Oregon OSHA to make Engineering improvements to the workstations to reduce identified Musculoskeletal Disorder (MSD) risk factors in order to prevent work injury related to this task.

Observations (video taping performed):

Employees stand on an elevated platform next to a moving conveyor belt which contains small ground-up auto parts. (There are three such work stations which are very similar in design). Their task is to pull out small pieces of non ferrous metals and toss them into bins or chutes. Workers are exposed to this job activity for 8 hours per day.

Work station dimensions:

Height: platform to top of leaning support= 45" *(was 36.5"- 38.5" on 11/23/99)*
Belt width: 36"
Effective reach distance: Closest reach = 12", furthest reach is 36" to 40" (this distance is measured from the edge of standing platform to the farthest point where material passes on the conveyor. This includes a 3.5"- 6" gap between the platform and the front of leaning support plus 8.5"- 10" depth of leaning support and approximate 24" reach to furthest point of material on the conveyor.)
Padded sit/stand stools (adjustable height) have been added *(since 11/23/99)* to give employees the option of leaning back in a semi-sit position.

Key physical demands of this job which are likely to contribute to significant risk of work related Musculoskeletal disorders include:

1. Static postures- of the trunk (forward flexion of the lumbar spine estimated from 10 to 40 degrees) with moderate flexion of the shoulders. (Since 11/23/99 the leaning support has been raised to improve availability of trunk support)
2. Repetition- forward flexion of the trunk and both shoulders while reaching for metal pieces.

3. Forces & loads- primarily in the extensors of the back and flexors of the shoulders to resist the forces of gravity while leaning forward and reaching for small pieces of metal (somewhat improved since 11/23/99)
4. Poor posture and body mechanics- primarily due to design of equipment (forward flexion of trunk and arms with loss of neutral spine positioning)
5. Inadequate muscle recovery time- due to sustained forward leaning/ reaching postures.

Most of these risk factors can be attributed to the excessive reach distances involved along with a lack of height adjustability.

Preliminary Recommendations:
Engineering controls

The following recommendations were developed with a committee of employees, company management, and outside consultants.

1. Design, fabricate and install a prototype adjustable height work platform which will allow the employee to adjust the floor height relative to the conveyor. Ideal range from floor to top of leaning support is 38" to 45" (based on anthropometric data from Kroemer 1993 and Kodak 1984.

2. Provide a height and angle adjustable, padded leaning stand for optimal trunk support against the chest (exact specifications to be determined during prototype testing).

3. Design conveyor belt effective reach distance if possible, to accommodate 5th percentile male. i.e. 22” measured from front edge of leaning support to the furthest point of material on conveyor.

4. Extend elevated standing platform 8” to 10” under conveyor allowing worker to stand closer.

Administrative controls

Explore options for employee rotation to minimize exposure to this job.
Implement an employee stretching program (pre-work warm up and for micro breaks during shift)

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

Respectfully,

Rob Strickland, OTR
Ergonomic Specialist

Schnitzer ASR Work station

Employee standing/leaning forward to reach and sort metal materials from conveyor

Elevated work platform and catwalk in front of conveyor

Schnitzer ASR Work station

Ergonomics and Musculoskeletal Disorders

BACKGROUND (Adapted from Federal Register, Nov. 23,1999, Department of Labor, OSHA, Ergonomics Program; Proposed Rule)

Ergonomics is the science of fitting the workplace conditions and job demands to the capabilities of the working population. It is an applied science, incorporating engineering, anatomy, physiology, psychology, anthropology and medical sciences. Effective "fits" assure high productivity, avoidance of illness and injury risks, with increased comfort and satisfaction among the work force. A primary goal of occupational ergonomics is the prevention of work-related musculoskeletal disorders (MSDs).

What are work-related musculoskeletal disorders?

MSDs are injuries or disorders of the muscles, tendons, joints, spinal discs, nerves, ligaments or cartilage. MSDs develop as a result of repeated exposure to ergonomic risk factors. Work related MSD's are those disorders to which the work environment and the performance of work contribute significantly. Another familiar and related term is cumulative trauma disorders, (CTDs). Common examples of MSDs include carpal tunnel syndrome, tendonitis, epicondylitis, herniated spinal discs, sciatica, low back pain, trigger finger and DeQuervain's disease.

What are ergonomic risk factors?

Ergonomic risk factors are the aspects of a job or task that impose biomechanical stress on the worker. Ergonomic risk factors are the synergistic elements of MSD hazards. OSHA discusses a large body of evidence supporting the finding that exposure to ergonomic risk factors in the workplace can cause or contribute to the risk of developing an MSD. This evidence, which includes thousands of epidemiologic studies, laboratory studies, and extensive reviews of the existing scientific evidence by NIOSH and the National Academy of Science, shows that the following ergonomic risk factors are most likely to cause or contribute to and MSD:

1. Force (i.e., forceful exertions, including dynamic motions)
2. Repetition
3. Awkward postures
4. Static postures
5. Contact Stress
6. Vibration
7. Cold temperatures

These risk factors are described briefly below:

Force

Force refers to the amount of physical effort that is required to accomplish a task or motion. Tasks or motions that require application of higher force place higher mechanical loads on muscles, tendons, ligaments and joints. Tasks involving high forces may cause muscles to fatigue more quickly. High forces also may lead to irritation, inflammation, strains and tears of muscles, tendons and other tissues.

Force can be internal, such as when tension develops within the muscles, ligaments and tendons during movement. Force can also be external, as when a force is applied to the body, either voluntarily or involuntarily. Forceful exertion is often associated with the movement of heavy loads, such as lifting heavy packages, pushing a heavy cart, or moving a pallet. Hand tools that involve pinch grips require more forceful exertions than those that allow other grips such as a power grip.

Repetition

Repetition refers to performing a task or series of motions over and over again with little variation. When motions are repeated frequently (e.g., every few seconds) for prolonged periods (e.g., several hours, a work shift), fatigue and strain of the muscle and tendons can occur because there may be inadequate time for recovery. Repetition often involves the use of only a few muscles and body parts, which can become extremely fatigued while the rest of the body is little used. As task cycles in jobs get shorter (and the number of repetitions per minute increases) employees are at greater risk of injury. Where tasks cycles are short, the same muscles are in constant use and the muscles get no rest from the force required to perform the task cycle.

Awkward postures

Award postures refer to positions of the body (e.g., limbs, joints, back) that deviate significantly from the neutral position while job tasks are being performed. Neutral posture is the position of a body joint that requires the least amount of muscle activity to maintain. For example, the wrist is neutral in a handshake position, the shoulder is neutral when the elbow is near the waist, the back is neutral when standing upright.

Examples of awkward postures include: bent wrists while typing, bending over to grasp or lift an object, twisting back and torso while moving heavy objects and squatting. Awkward postures often are significant contributors to MSDs because they increase the work and the muscle force that is required.

Static postures

Static postures (or “static loading”) refer to physical exertion in which the same posture or position is held throughout the exertion. These types of exertions put increase loads or forces on the muscles and tendons, which contributes to fatigue. This occurs because not moving impedes the flow of blood that is needed to bring nutrients to the muscles and to carry away the wasted products of muscle metabolism. Examples of static postures include gripping tools that cannot be put down, holding the arms out or up to perform tasks, or standing in one place for prolonged periods.

Vibration

Vibration is the oscillatory motion of a physical body. Localized vibration, such as vibration of the hand and arm, occurs when a specific part of the body comes into contact with vibration objects such as powered hand tools (e.g., chain saw, electric drill, chipping hammer) or equipment (e.g., wood planer, punch press, packaging machine). Whole-body vibration occurs when standing or sitting in vibrating environments (e.g., driving a truck over bumpy roads) or when using heavy vibrating equipment that requires whole-body involvement (e.g., jackhammers).

Contact stress

Contact stress results from occasional, repeated or continuous contact between sensitive body tissue and a hard or sharp object. Contact stress commonly affects the soft tissue on the fingers, palms, forearms, thighs, shins and feet. This contact may create pressure over a single area of the body (e.g., wrist, forearm) that can inhibit blood flow, tendon and muscle movement and nerve function. Examples of contact stress include resting wrists on the sharp edge of a desk or workstation while performing tasks, pressing of tool handles into the palms, especially when they cannot be put down, tasks that require hand hammering, and sitting down without adequate space for the knees.

Cold temperatures

Cold temperatures refer to exposure to excessive cold while performing work tasks. Cold temperatures can reduce the dexterity and sensitivity of the hand. Cold temperatures, for example, cause the worker to apply more grip force to hold hand tools and objects. Also, prolonged contact with cold surfaces (e.g., handling cold meat) can impair dexterity and induce numbness. Cold is a problem when it is present with other risk factors and is especially problematic when it is present with vibration exposure.

Exposure to one ergonomic risk factor may be enough to cause or contribute to an MSD. For example, a job task may require exertion of so much physical force that, even though the task does not involve additional risk factors such as awkward postures or repetition, an MSD is likely to occur. However, most often ergonomic risk factors act in combination to create a hazard. Evidence shows that of these risk factors, the combination of force, repetition and awkward postures, especially when occurring at high levels are most often associated with the occurrence of MSDs. Jobs that have multiple risk factors have a greater likelihood of causing or contributing to MSDs, depending on the duration, frequency and magnitude of employee exposure to each risk factor or to a combination of them. Thus, it is important that ergonomic risk factors be considered in light of their combined effect in causing or contributing to an MSD.

Solving Ergonomic Problems

As stated above, a primary goal of ergonomics is the prevention of work-related musculoskeletal disorders (MSDs). Ideally, this is accomplished while simultaneously enhancing the productivity and job satisfaction of the employee work group. This is accomplished by identifying the ergonomic risk factors and systematically eliminating or reducing employee exposure to them. There are three approaches to this process described briefly below:

Engineering controls:

Engineering controls are physical changes to a job that eliminate or materially reduce the presence of MSD hazards. They are the primary and preferred method of improving job tasks to reduce exposure to MSD risk factors. Examples of engineering controls for MSD hazards include changing, modifying or redesigning the following:

1. Workstations
2. Tools
3. Facilities
4. Equipment
5. Materials
6. Processes

Work practice controls:

Work practice controls involve changes in the way an employee does the job. They are defined as changes in the way an employee performs the physical work activities of a job that reduce exposure to MSD hazards. Work practice controls involve procedures and methods for performing work safely. Examples of this type of control are training workers to: use good body mechanics and lifting techniques, to vary the tasks they perform throughout the day to minimize muscle fatigue and to use a new or modified tool properly. In the context of ergonomic programs, work practice controls are essential, both because they reduce ergonomic stressors in their own right and because they are critical if engineering controls are to work effectively.

Administrative controls:

Administrative controls are management-controlled work practices and policies designed to reduce exposures to MSD hazard by changing the way work is assigned or scheduled. Administrative controls reduce the frequency, magnitude, and/or duration of exposure and thus reduce the cumulative dose to any one worker. Examples of this type of control are employee rotation, job enlargement, and employer-authorized changes in the pace of work. Administrative controls should be used with caution and only after careful consideration of all reasonable engineering controls.

Ergonomic assessment tools:

•NIOSH Guide to Manual Lifting
•Postural assessments
•Risk factor check lists
•Task frequency and duration
•Force/weight measurements
•Dimension measurements
•Anthropometry data comparisons
•Energy demand
•Body mechanics assessment
•Environmental factors