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## What Is Ergonomics?

The word “Ergonomics” comes from two Greek words: “ergon,” meaning “work”, and “nomos” meaning “laws.” Today, however, the word is used to describe the science of designing the job to fit the worker, rather than forcing the worker to fit the job. The

International Ergonomics Association has adopted a technical definition:

***Ergonomics** (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance.*

That is not the most efficient definition of ergonomics. To put it simply, ergonomics is the science of eliminating sources of discomfort. It also makes things efficient. Essentially, ergonomics makes things comfortable and efficient. Efficiency is quite simply making something easier to do. Efficiency comes in many forms. Reducing the strength required to perform a task makes a process more physically efficient. Reducing the number of steps in a task makes it quicker to complete (i.e., efficient). Reducing the number of parts in a product makes repairs more efficient. Reducing the amount of training needed (i.e., making it more intuitive) gives you a larger number of people who are qualified to perform the task.

Efficiency can be found almost everywhere. If something is easier to do, people are more likely to do it. If someone does it more, then it is more useful. And if someone willingly does something more often, they have a greater chance of liking it. If someone likes doing it, they will be more comfortable doing it.

Most companies have jobs, processes, or operations that may lead or have lead to injuries from repeated actions, awkward postures, or heavy loads. Unfortunately, many employees have suffered from a workplace injury as a result. If work is performed in awkward postures or with excessive effort, fatigue and discomfort may be the result. Under these conditions, muscles, tendons, ligaments, nerves, and blood vessels can be damaged. Injuries of this type are known as musculoskeletal disorders or MSDs. MSDs can increase the cost of doing business both directly and indirectly. Direct costs may include medical services and higher Workers' Compensation premiums. Indirect costs may be from increased employee turnover, absenteeism, and retraining that may also occur. Productivity, product quality, and employee morale may also suffer. Estimates indicate that the indirect costs associated with MSDs may be four to ten times higher than the direct costs.

This does not have to be the case. Organizations can reduce or prevent costly MSDs and avoid the other problems mentioned above. One way to do this is to apply the principles of ergonomics in the workplace. Ergonomics can show how to improve the fit between the physical demands of the workplace and the employees who perform the work. That means considering the variability in human capabilities when selecting, designing, or modifying equipment, tools, work tasks, and the work environment. Employees' abilities to perform physical tasks may vary because of differences in age, physical condition, strength, gender, stature, and other factors.

## Be Proactive

Do not wait for a problem to show itself before it needs to be addressed. Being proactive helps get a jump on solving problems. Taking a proactive approach in the workplace can be as simple as taking a look around, talking to employees, and asking questions such as these:

- Do employees have ideas about how to improve products and make their jobs less physically demanding and more efficient?
- Are employees working in comfortable postures—that is, with no significant fatigue and discomfort?



Become aware of early warning signs such as:

- Employee fatigue or discomfort
- Employees restricting their movements or range of motion because of fatigue or discomfort (e.g., a stiff neck, sore shoulder, or backache)
- Employees modifying tools, equipment, or workstations on their own
- High absenteeism or employee turnover rates
- Poor product or service quality
- High error rates or waste of materials
- Customer complaints
- Production bottlenecks
- Employee reports of problems

Also, review your written records (e.g., OSHA Log 300, past employee reports, and Workers' Compensation information).

### Some additional items to consider when reviewing previous employee injuries might be:

- Were injured employees working at the same or similar workstations ?
- Were the employees of similar physical heights or weights?
- Had the employees been performing the job for similar periods of time?
- Were the repetitive motion injuries predominantly (i.e., 50% or more) caused by a repetitive job, process, or operation?
- Were the employees incurring injuries performing a job, process, or operation of identical work activity? Identical work activity means that the employees were performing the same repetitive motion task, such as (but not limited to) word processing, assembly, or loading.
- Were the MSD injuries objectively identified and diagnosed by a licensed physician?

Looking at these similarities, employers may be able to find specific jobs that result in employee injury and some of the causes of those injuries.

### Remember it is always best to:

- Take action as soon as early warning signs become apparent (e.g., employee fatigue or discomfort, reports of problems, or high levels of absenteeism).
- Minimize factors that may contribute to MSDs at the design stage of the work process, if possible.

Early action is particularly important when addressing MSDs, because they tend to be treatable and less expensive in the early stages but irreversible and very expensive later.

## Taking a Closer Look

Jobs are made up of tasks. Tasks are the processes employees must do to accomplish their jobs. Put simply, tasks are the parts of a job. Some jobs may contain only a single task, but many jobs are made up of multiple tasks.

### Most work tasks involve movement and physical exertion, and it is difficult to know:

- When repeated movements, forceful exertions, and other aspects of work tasks may lead to fatigue, symptoms of MSDs, and injuries.
- Why workplace problems are occurring (i.e., the reasons or root causes).



In short, how is it possible to find out which work tasks may be causing problems and what to do about them? One possible way to help answer these questions is to become aware of workplace “contributing factors.” Contributing factors are aspects of work tasks which can lead to fatigue, MSD symptoms and injuries, or other types of problems. These factors may be present in one or more of the tasks employees must perform to accomplish their jobs. A few of the contributing factors to be aware of are below.

**Awkward postures** – Posture affects which muscle groups are engaged during physical activity. Awkward postures can make work tasks more physically demanding by increasing the exertion required from smaller muscle groups and preventing the stronger, larger muscle groups from working at maximum efficiencies. The increased exertion from the weaker, smaller muscle groups impairs blood flow and increases the rate of fatigue. Awkward postures typically include repeated or prolonged reaching, twisting, bending, working overhead, kneeling, squatting, and holding fixed positions or pinch grips. They may affect various areas of the body such as the hands, wrists, arms, shoulders, neck, back, and knees. The effects of awkward postures are worse if work tasks also involve repetitive motions or forceful exertions. Awkward postures may be caused by using poorly designed or arranged workstations, tools, and equipment and poor work practices.

Sometimes employees assume awkward postures or experience eye strain and fatigue because it is hard for them to see their work. For example, when the lighting is bad, the work is too far away, or materials are blocking the field of vision, employees may have to bend, reach, twist, or hold fixed positions. Similarly, handling or assembling very small parts and materials or performing extremely precise tasks may contribute to eye strain and awkward postures.

**Repetitive motions** - In repetitive work the same types of motions are performed over and over again using the same muscles, tendons, or joints. The amount of repetition can be affected by the pace of work, the recovery time provided (i.e., number and length of muscle relaxation breaks), and the amount of variety in work tasks. The pace of work may be controlled by the employee performing the task, machines, other employees, or administrative procedures. Examples of jobs involving machine-controlled pace include working on assembly, packaging, or quality-control lines. Work tasks linked to performance or incentives are examples of administratively controlled pace. The risk of injury is greater when repetitious jobs involve awkward posture or forceful exertions. Injuries may also develop when highly repetitive jobs are combined with low-force exertions, such as in light assembly tasks involving the hands, wrists, elbows, and shoulders. For example, having to grip a cutting or trimming tool throughout the entire work task without being able to set it down momentarily to rest the hand.

**Forceful exertions** - Force is the amount of muscular effort used to perform work. Exerting large amounts of force can result in fatigue and physical damage to the body. The amount of force exerted when moving or handling materials, tools, or objects depends on a combination of factors, including the:

- Load shape, weight, dimensions, and bulkiness
- Grip type, position, and friction characteristics
- Amount of effort required to start and stop the load when moving it (i.e., how physically demanding it is to accelerate or decelerate the load)
- Length of time continuous force is applied by the muscles (e.g., the amount of time the load or object is held, carried, or handled without a muscle relaxation break)
- Number of times the load is handled per hour or work shift
- Amount of associated vibration
- Body posture used
- Resistance associated with moving the load (e.g., over rough flooring or with poorly maintained equipment)
- Duration of the task over the work shift
- Environmental temperature
- Amount of rotational force (e.g., torque from tools or equipment)



**Pressure points (e.g., local contact stress)** - Pressure points result from the body pressing against hard or sharp surfaces. Certain areas of the body are more susceptible because nerves, tendons, and blood vessels are close to the skin and underlying bones. These areas include the sides of the fingers, palms, wrists and forearms, elbows, and the knees.

**Vibration** - Vibration exposure is of concern when it is continuous or of very high intensity. Using vibrating tools such as sanders, grinders, chippers, routers, impact guns, drills, chainsaws, and circular saws can cause exposure to hand-arm vibration. Tools that are not properly maintained or are inappropriate for the task may increase the amount of hand-arm vibration. These exposures may result in fatigue, pain, numbness, tingling, increased sensitivity to cold, and decreased sensitivity to touch in the fingers, hands, and arms.

Whole-body vibration commonly results from sitting or standing on work surfaces that vibrate. Examples of such surfaces include vibrating vehicles, equipment, and platforms. Whole-body vibration may be associated with general discomfort and lower back pain.

**Environmental** - Extremely high temperatures can increase the rate at which the body will fatigue. Alternatively, exposure of the hands and feet to cold temperatures can decrease blood flow, muscle strength, and manual dexterity. These conditions can also cause excessive grip force to be applied to tool handles or objects. Another problem may be caused by tools or equipment that exhaust cold or hot air directly onto the operator. In addition, the lighting in a workplace may be too dark or too bright for the work task. This may result in employees assuming awkward postures to accomplish work tasks and a loss of product quality. Be aware of the amount of time in a workday that employees spend performing physically demanding or repetitive tasks (i.e., the duration of tasks). Both the total time per work shift and the length of uninterrupted periods of work can be significant in contributing to problems.

As repetitive motions, forceful exertions, and other contributing factors increase in work tasks, so does the recovery time (i.e., the length and frequency of muscle relaxation breaks) needed to help reduce fatigue and prevent injury.

Finally, remember that it is important to uncover the “why” (i.e., the reasons or root causes) the contributing factors are occurring in work tasks. The “why” is important because it allows full understanding of the nature of the problem and eventually contributes to coming up with effective options for improvements.

Contributing factors are similar to speed limits. No one knows exactly at what speed people will get into accidents. However, it is known that after a certain point the faster one drives the more likely one is to have an accident, and the more severe that accident is likely to be. Similarly, with workplace contributing factors it cannot be known exactly how much is too much. Therefore, contributing factors should be minimized in work tasks as much as possible to prevent fatigue, pain, and disability. Finally, remember that activities outside the workplace can also contribute to the development or aggravation of MSDs.

## Analyzing Jobs to Eliminate Sources of Injury

There are many different types of ergonomic job analysis methods. These methods consist of various techniques for taking a systematic look at jobs and work tasks. They help decide which jobs and specific tasks may contribute to problems. Once it is possible to know where problems may exist, it is easier to come up with ideas for making improvements. Some methods are relatively simple, and others require detailed analysis and sophisticated equipment. Checklists are generally a simpler, less comprehensive type of ergonomic job analysis method. More comprehensive methods break jobs down into specific movements (e.g., reach, grasp, place) or use other complicated techniques.

Ergonomic job analysis methods also vary according to what type of work activities they address. Some focus on workstation design. Others are more specific to certain types of work (e.g., manual materials handling or the office environment) or focus on the work environment (e.g., lighting, cold exposures).

The purpose of a checklist is to increase basic awareness of potential problems associated with jobs and their tasks. This awareness can help provide clues on how to make effective improvements. There are many checklists available for analyzing jobs, but an organization can easily make up its own just by breaking the job down into its required tasks.



**Observe the work.** The majority of the work in the ergonomic analysis is observation. Observe only one job at a time, using one complete copy of the checklist for each job. Make copies of the checklist for as many jobs that will be observed.

**Look at each task in the job separately.** Begin with job tasks that require the most effort. Any tasks that are “very hard” should automatically be looked at because they might contribute to fatigue and injury even if they are performed very rarely (e.g., on a seasonal basis). For each task, list the contributing factors observed and the reasons for them.

Talking to the employees who actually perform the work can often provide valuable information about why tasks are hard and how they may be improved. Also, remember it is important to carefully observe all of the tasks in a given job because each of them may contain contributing factors.

MSDs can be associated with a combination of contributing factors in multiple tasks. When looking at the work tasks has been completed, consider the items noted. These results can be useful when considering ergonomic improvements and evaluating the effectiveness of changes that will be made.

On a cautionary note, a simple checklist may not always be the best method for addressing particular workplace problems. There may be need for more sophisticated methods for addressing workplace MSDs. If problems seem complicated, severe, or widespread, additional help may be needed. If this is the case, contact any of the following sources:

- OSHA Consultation Service
- Western National's Loss Control service
- Ergonomics consultants or other outside experts
- Ergonomics equipment vendors
- Peers in your industry
- Trade associations/industry groups

Once some areas where changes might bring some improvement have been identified, a process for bringing about those changes will need to be developed. A few places to start might include:

**Include ergonomics awareness training as a part of the new-hire process.** Whether a session on office ergonomics is given or online training is provided, empower employees to know how to set up their workstation and adjust equipment properly. This can help to reduce claims down the road.

**Train the IT Department in ergonomics.** Many times, IT is the department in charge of setting up workstations for new hires. IT should learn where to put the monitor, keyboard, and CPU.

**Make ergonomics a part of the overall safety program.** Talk about the accidents that have happened and include a healthy discussion on those “near-miss” events. Take the time to review any ergonomics issues, too. Are these issues coming from one location? Is there a common piece of equipment that workers are complaining about?

These changes combined with knowledge of the causes for ergonomic-related injuries will guide the organization towards a goal of eliminating these injuries.

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