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Division of Workers' Compensation

Ergonomics for General Industry

Workplace Program

Texas Department of Insurance, Division of Workers' Compensation
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INTRODUCTION

Workplace Program

Musculoskeletal disorders (MSDs) – injuries to the muscles, nerves, tendons, joints, cartilage, or spine – cost an estimated $213 billion in annual treatment, care, and lost wages in the United States.[1] In 2019, 266,530 American employees reported missing at least one day of work due to these injuries, most caused by strenuous or repetitive activities.[2] As a company focuses on the bottom line, management must consider the costs of workplace accidents and the resulting lost time, medical expenses, attorney fees, and business disruptions. Developing a process to decrease MSDs is an effective way to lower workers' compensation costs and lessen lost productivity due to accidents. It also shows employees that management cares about the health and welfare of their employees. Understanding ergonomics, identifying some of the common risk factors, and providing solutions to prevent these hazards can reduce MSDs in the workplace.

Musculoskeletal disorder (MSD)-
an injury or illness of soft tissues of the upper extremity (fingers through upper arm), shoulders and neck, low back, and lower extremity (hips through toes). It is primarily caused or made worse by workplace risk factors, such as sustained and repeated exertions or awkward postures and manipulations. Included are disorders of the muscles, nerves, tendons, ligaments, joints, cartilage, and spinal disks. Medical conditions generally develop gradually over a period of time and do not typically result from a single event. Injuries arising from slips, trips, falls and similar accidents are not considered to be an MSD.

Ergonomics-
the scientific study of human work. Ergonomics considers the physical and mental capabilities and limits of the worker as he or she interacts with tools, equipment, work methods, tasks, and the working environment.

[1] American Academy of Orthopedic Surgeons. "One in two Americans have a musculoskeletal condition: New report outlines the prevalence, scope, cost, and projected growth of musculoskeletal disorders in the U.S." Science Daily, 1 March 2016. Website. www.sciencedaily.com/releases/2016/03/160301114116.htm. Accessed March 24, 2021.

[2] U.S. Bureau of Labor Statistics. Occupational injuries/Illnesses and Fatal Injuries profiles. Case and Demographic Numbers, 2019, All U.S., Musculoskeletal Disorder, Private Industry. Website. https://data.bls.gov/gqt/InitialPage. Accessed March 24, 2021.

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What is ergonomics?

Ergonomics is the study of ways to help people work more efficiently and injury-free in their environment. In a workplace, ergonomics helps fit the job to the worker. The Greek form of the word is broken into ergo (work) and nomos (laws of). So, the literal meaning of the word ergonomics is "the laws of work."

Ergonomics draws on many other disciplines, such as **physiology** (the study of living organisms and their parts), **anthropometry** (the study of the measurements and proportions of the human body), and **biomechanics** (the study of how a living body moves). To understand how to fit the job to the worker, an understanding of how the human body works is vital.

Once there is an understanding of body mechanics, **ergonomists**, those trained in ergonomics, assist in designing machines, tools, and other equipment that are easier and more comfortable to use. **Ergonomically-engineered equipment** assists in protecting workers from one or more MSDs. Examples may include cubicles designed with adjustable work surfaces to meet workers' height needs; longer handles on pliers so workers can apply more pressure with less stress to the wrist; or adjustable handcarts to help employees move heavy items while keeping their backs safe from injury.

Ergonomists also draw on social sciences for information. Disciplines, such as **psychology** (the study of mind and behavior) and **sociology** (the study of human society), can explain people's interactions with their workplaces and help reduce stressful situations.

Ergonomists want to understand how people deal with this stress, both as an individual and as a society so that they can design better working environments. Stress causes muscle tension, one of the many causes of MSDs; and MSDs cause pain that increases stress. Ergonomists try to end the cycle of job-related injuries and stress and create a more healthful, productive workplace.

Ergonomists also draw on **history**. The first ergonomic disorders were named after occupations where individuals suffered similar ailments. **Carpenter's elbow**, for example, referred to an inflammation of the elbow caused by the back-and-forth motions of sawing and hammering. Today it is referred to as **tennis elbow** because carpenters now use nail guns and electric saws. Tennis players, however, still use **repetitive motions** to swing the racket during play. These types of repetitive motions throughout history are what ergonomists look at to help prevent MSDs today.

Ergonomic Keyboard

What are some common risk factors?

The workplace of today strives for paperwork reduction and job specialization. Paperwork reduction puts people in front of computers more often and for a longer time. Job specialization also keeps workers at the same workstations performing the same jobs day-in and day-out. These factors, coupled with growing production demands, increase the chances of suffering from MSDs.

MSD risk factors are found in most occupations, from construction, manufacturing, restaurants, retail stores, and offices. While the potential for on-the-job injuries are many, the following work activities and conditions increase the chances for MSDs:

- ***Repetitive motions***
  Hourly or daily production targets may require a worker's wrists, arms, back, neck, or knees to perform repeated movements at a fast pace. Frequent repetitive motions fatigue the muscles and can damage nerves, joints, and ligaments.
- ***Excessive force***
  Many work tasks require moments of excessive force or localized pressure, such as removing a rusty bolt. Force requires muscle effort, which causes fatigue and increases the chances of MSDs.
- ***Awkward postures***
  Neutral postures lessen stress on muscles, tendons, nerves, and bones. Bending, reaching, or twisting the neck, back, arms, or legs can put muscles and tendons at a disadvantage and increase the probability of MSDs.
- ***Vibration***
  Whole-body or hand-arm vibrations increase shoulder, hand, and neck MSDs. Work tasks such as using grinders, sanders, needle guns, chipping hammers, impact wrenches, or chainsaws can slowly rob the body of much-needed blood flow and result in injury to the blood vessels, nerves, or muscles.
- ***Force***
  Forceful exertion, such as lifting, pulling, gripping, or pushing heavy or awkward items, can overload muscles and lead to MSDs.
- ***Cold temperatures***
  Colder temperatures can increase muscle tension and reduce both dexterity and sensitivity. Cold environments may also cause a worker to grip a tool more tightly, restricting blood flow or causing the tissue to become stiff, creating discomfort and pain.
- ***Stationary positions***
  Static or stationary positions rob the muscles of needed oxygen and can result in fatigue and MSDs. Examples of potentially damaging postures include standing in the same position for eight hours, holding a hand tool for 60 minutes straight, or keeping arms raised overhead for 30 minutes.
- ***Contact stress***
  Contact stress results from constant rubbing between hard or sharp surfaces and sensitive body tissue, usually on the fingers, palms, thighs, or feet. The localized pressure contact stress places on an area of the body can reduce blood flow, nerve function, and the movement of tendons and muscles.

What are some common MSDs?

As mentioned earlier, MSDs are associated with high costs to employers, from absenteeism, lost productivity, increased health care, disability, and workers' compensation claims. Examples of common work-related MSDs are:

Carpal tunnel syndrome (CTS)

The U.S. Department of Labor defines CTS as a disorder of the peripheral nervous system. CTS is the compression of the median nerve at the wrist, resulting in numbness, tingling, weakness, or muscle atrophy in the hand and fingers.

- CTS affects as many as 1.9 million people in the United States. An estimated 300,000 to 500,000 surgeries are performed each year to correct this condition.[3]
- CTS is the most expensive upper-extremity MSD in the United States, with costs exceeding $2 billion annually.[4]
- Two occupational groups account for more than 70% of all CTS cases: 1) operators, fabricators, and laborers; and 2) technical, sales, and administrative support.[5]

Back injury and back pain

Back symptoms are among the top 10 reasons for medical visits in the United States.[5]

- In 2019, the Bureau of Labor Statistics reported 136,190 back injury cases involving days away from work.[6]
- Two occupational groups accounted for nearly 52% of all back injury cases: 1) transportation and materials moving (28%); and 2) the service industry (24%).[7]

Arthritis

The term arthritis is used to describe more than 100 rheumatic diseases and MSDs that affect joints, the tissues surrounding joints, and other connective tissue. The pattern, severity, and location of symptoms can vary depending on the specific form of the disease. Forty-six million Americans report having a diagnosis of arthritis or other rheumatic conditions.[8] Arthritis is the most common cause of disability in the United States. Two thirds of individuals with arthritis are under the age of 65.[9]

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[3] Centers for Disease Control and Prevention. Workplace Health Promotion. "Work-Related Musculoskeletal Disorders & Ergonomics." Webpage. https://www.cdc.gov/workplacehealthpromotion/health-strategies/musculoskeletal-disorders/index.html. Accessed March 25, 2021.

[4] U.S. National Library of Medicine, National Institutes of Health. "Carpal Tunnel Syndrome: An Update for the Primary Care Physician." Website. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6874691/. Accessed March 25, 2021.

[5] Centers for Disease Control and Prevention. Workplace Health Promotion. "Work-Related Musculoskeletal Disorders & Ergonomics." Webpage. https://www.cdc.gov/workplacehealthpromotion/health-strategies/musculoskeletal-disorders/index.html. Accessed March 25, 2021.

[6] U.S. Bureau of Labor Statistics. Occupational Injuries/Illnesses and Fatal Injuries Profiles, Case and Demographic Numbers, 2019, All U.S., Part of Body, Back including spine and spinal cord, Private Industry. Website. https://data.bls.gov/gqt/ProfileData. Accessed March 25, 2021.

[7] U.S. Bureau of Labor Statistics. Occupational Injuries/Illnesses and Fatal Injuries Profiles, Case and Demographic Numbers, 2019, All U.S., Part of Body, Back including spine and spinal cord, Private Industry. Website. https://data.bls.gov/gqt/ProfileData. Accessed March 25, 2021.

[8] Centers for Disease Control and Prevention. MMWR Weekly, "Prevalence and Most Common Causes of Disability Among Adults – United States, 2005." Webpage. https://www.cdc.gov/mmwr/preview/mmwrhtml/mm5816a2.htm. Accessed March 25, 2021.

[9] National Library of Medicine, National Center for Biotechnology Information. "Estimates of the Prevalence of Arthritis and Other Rheumatic Conditions in the United States. Part I." Website. https://pubmed.ncbi.nlm.nih.gov/18163481/. Accessed March 25, 2021.

Certain occupations – such as mining, construction, agriculture, and sectors of the service industry -- are associated with increased arthritis, specifically, **osteoarthritis**.[10] Osteoarthritis is a type of arthritis caused when the protective cartilage that cushions the ends of a person's bones wears down over time. Common features of these occupations are physically demanding and heavy labor tasks, such as lifting or carrying heavy loads, exposure to vibration, and long periods of working in awkward or unnatural postures, such as kneeling or crawling.

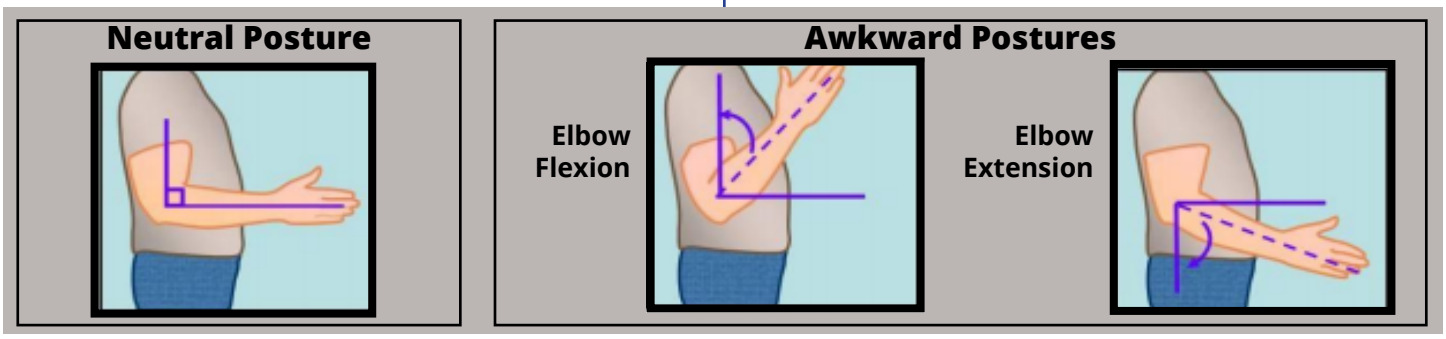
What can be done to prevent MSDs?

Whether it is changing positions, lifting correctly, or taking appropriate breaks, everyone can do something to prevent MSDs. These common ergonomic principles can reduce the risks of MSDs and are easily adaptable in all organizations and work areas:

- ***Maintain a neutral posture***
  A neutral posture represents the natural stance the body wants to take. A straight line can be drawn from the ear through the shoulder, the hips, the knees, and the ankles when standing in a neutral posture. Work surfaces at about waist level prevent an employee from reaching above or below the body's mid-range. To help, place items, as much as possible, in a position that keeps elbows bent at about a 90-degree angle. While seated, try to keep the back straight, and the knees bent parallel to the hips with feet flat on the floor. Workstations and offices should be designed with a neutral body position in mind.

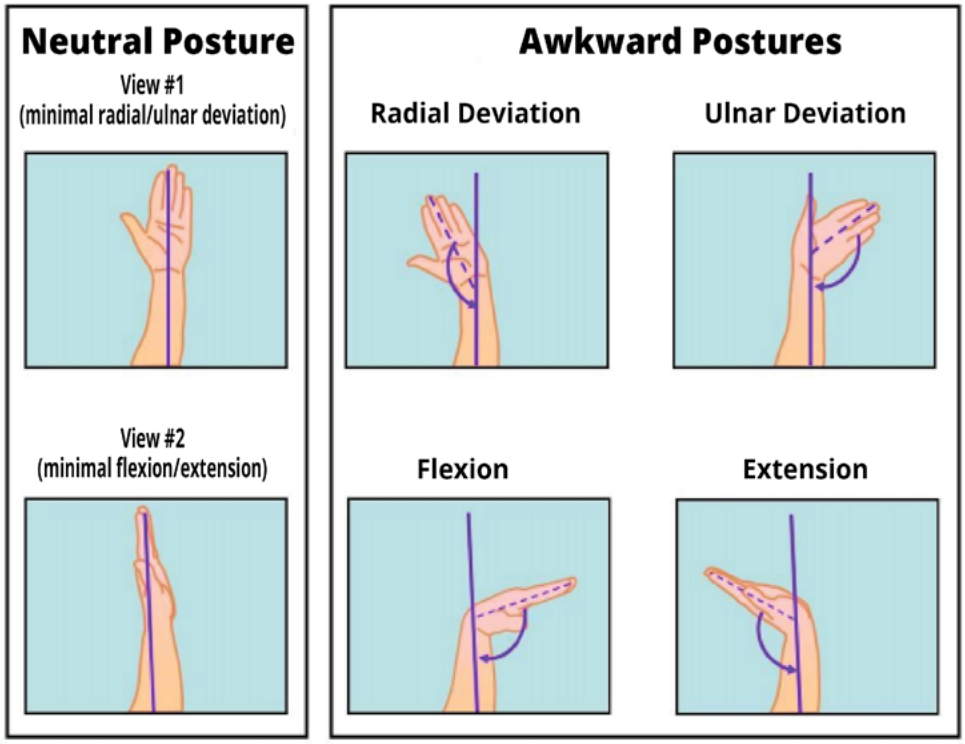
- ***Prevent excessive repetition***
  One of the major causes of CTS, tendonitis, and other MSDs is excessive repetition. There are several ways to prevent repetitive movements while working. If possible, try not to perform the same task all day. Vary work routines and taking short breaks every 20 to 30 minutes, when possible. If the same tasks are performed every day, try completing them in a different sequence. The key to preventing excessive repetition is not sitting or doing the same things for hours on end.

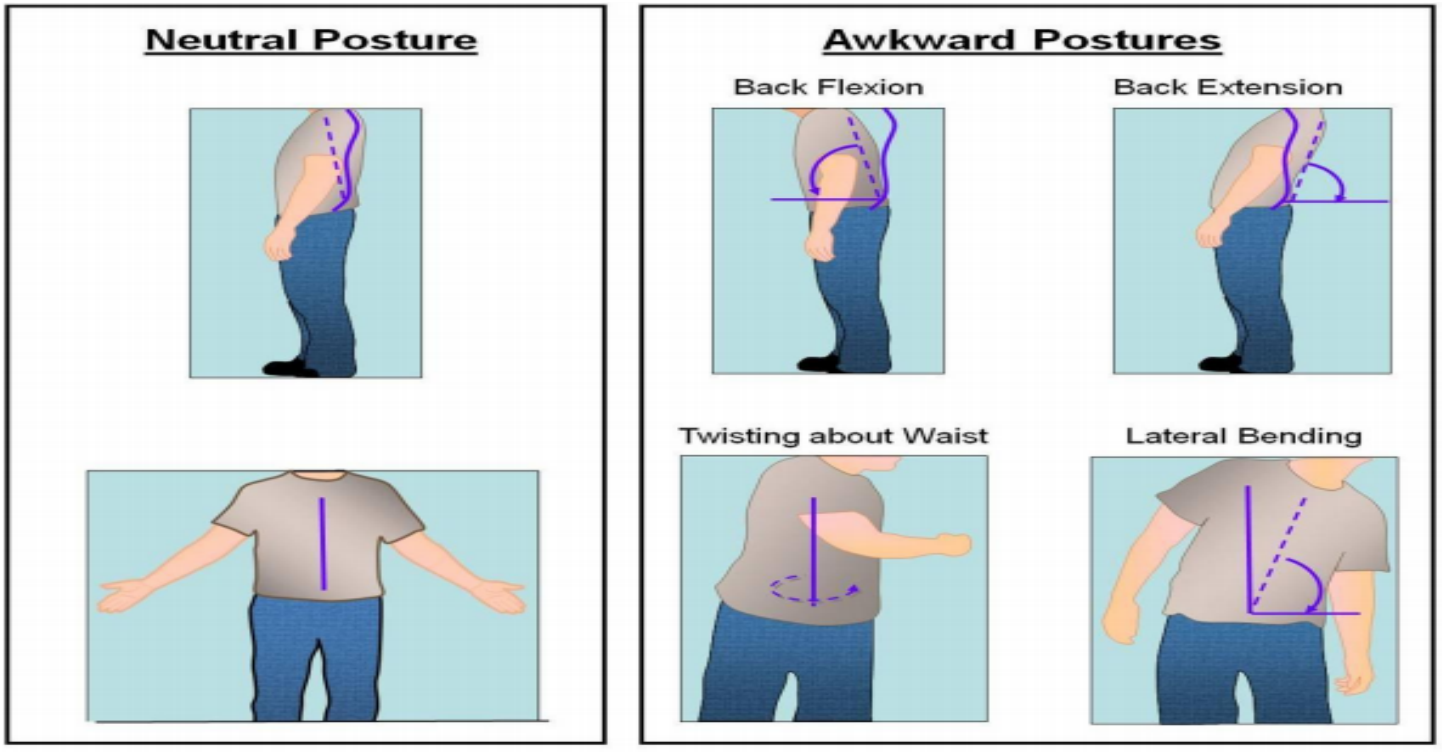
  For employees who spend most of their time in front of a computer, consider an ergonomic keyboard and mouse or foam wrist pad to keep wrists from bending upward or side-to-side. Change hand grips on tablets and mobile phones often. Alternate between thumb and fingers when texting. Use a hands-free option as much as possible.

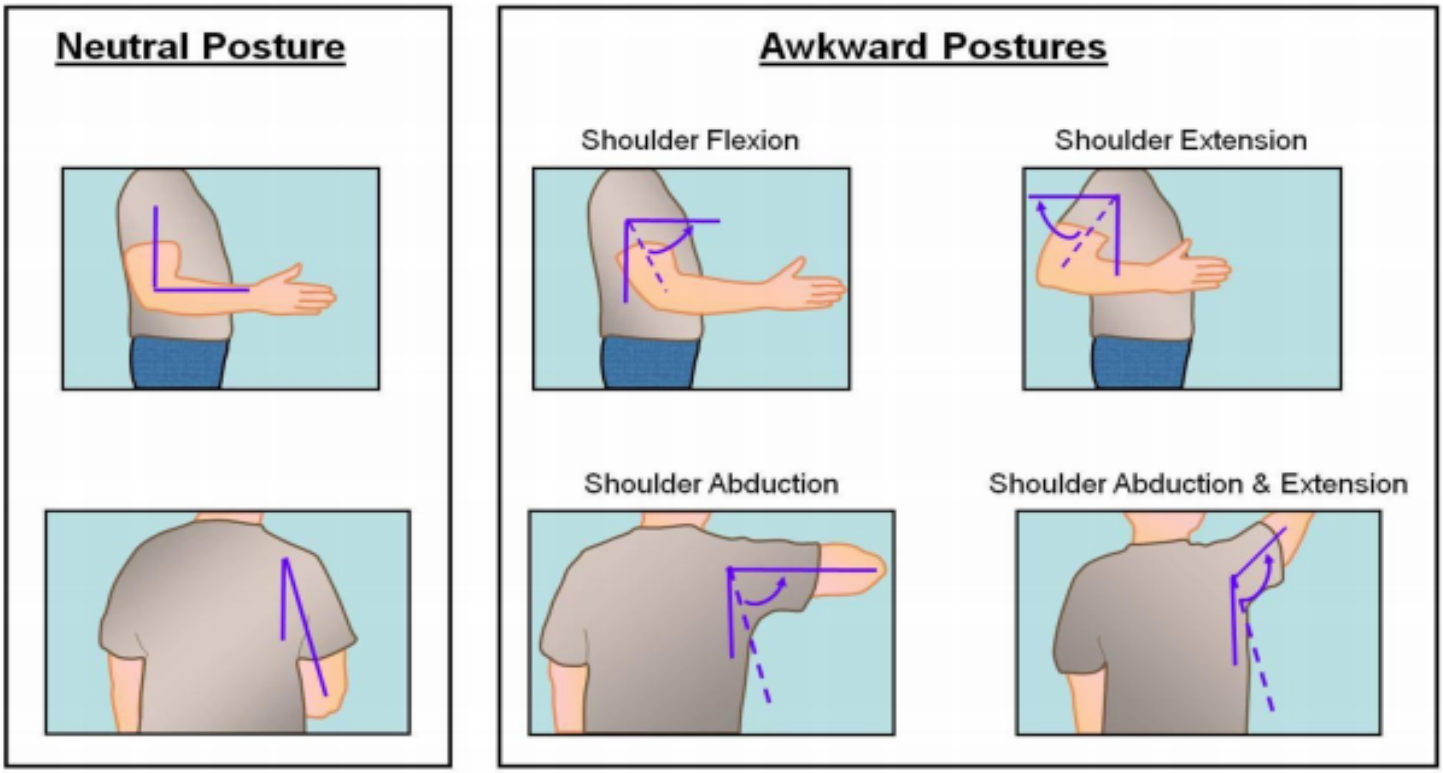


[10] National Institutes of Health. Occupational & Environmental Medicine, "Primary Osteoarthritis of Hip, Knee, and Hand in Relation to Occupational Exposure." Website. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1740886/. Accessed March 25, 2021.

- ***Adjust work surfaces***
  Whether standing or sitting, work surfaces need to encourage individuals to keep a neutral posture. The work surface should be about at waist height, keeping the worker from stooping over or having to raise their shoulders to reach. A workstation that fits one person may place another worker in an awkward posture. Adjustable work surfaces are the best option to allow different people to work at the same workstation. If adjustable workstations are not feasible, adjust the station for the taller employees and supply platforms or stepping stools for shorter employees. If more than one station exists in the company, adjust one higher than the other and assign employees to the appropriate station. The bottom line is to maintain the most neutral posture possible and keep employees working erect.







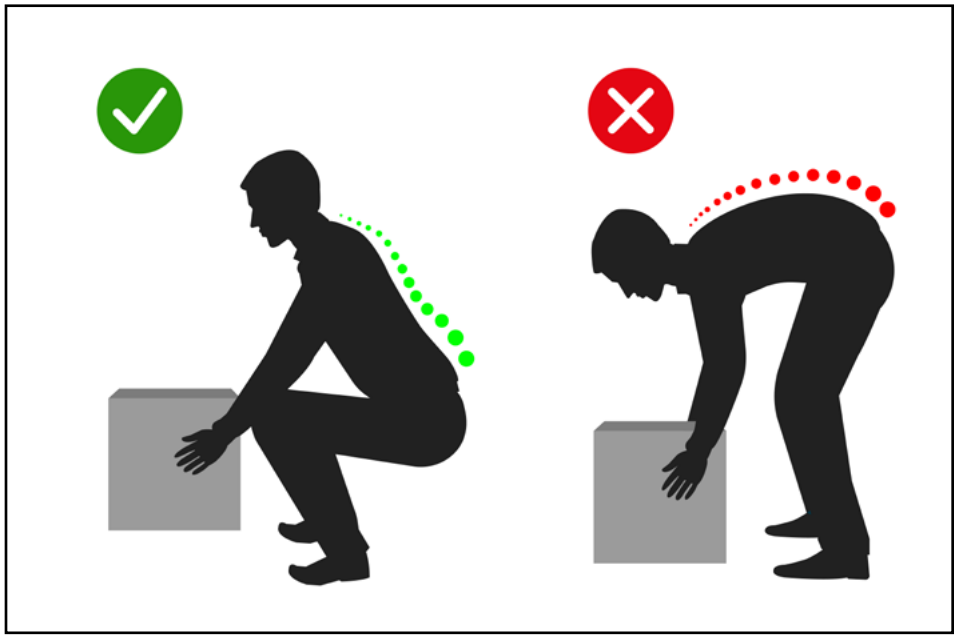
- ***Avoid reaching***
  Bursitis is an inflammation of the bursa, a fluid-filled sac or sac-like cavity that works as a cushion to reduce friction between body tissue. Bursitis in the shoulder can result from repetitive work with the arms stretched out or reaching. Reaching also puts stress on the back even when lighter items are lifted repetitively. Always place tools and items close that are used most. In the same respect, place heavier items close and nearer to the body's mid-range. This practice reduces stress on the back and shoulders when lifting. An ergonomically-arranged workstation can alleviate many shoulder and upper back injuries.

- ***Control environmental factors***
  Employees working in cold environments, such as meatpacking plants or refrigerated warehouses, should receive personal protective equipment (PPE) at no cost and training on its proper use. It is also critical in cold environments that employees are provided with appropriate tools for the climate, such as those with slip-resistant handles. Control the environmental factors where possible and supply the proper equipment to operate safely where the factors cannot be controlled.

- ***Reduce eye strain***
  Having too little or too much light can cause eyestrain. Supply task lighting to areas and offices with poor lighting. Extra lighting can also reduce slips, trips, and falls. Let eyes rest regularly, especially if staring at a computer screen for hours. Looking at a digital screen for long periods each day can lead to headaches, blurred vision, and dry eyes. Use the 20-20-20 rule to relieve digital eye strain: every 20 minutes, look 20 feet away for 20 seconds. Use natural light when possible. Position the monitor so that the employee neither faces the sunlight nor has it directly from behind.

- ***Lift properly***

There are two basic types of back injuries. The first type, which is not typically classified as an MSDs, results from slips, trips, and falls. The second type includes back strains caused by improper lifting. These MSDs are caused when employees do not use proper lifting techniques or do not properly use equipment to lift heavy loads. Many companies have a Back Injury Prevention Program. Still, steps such as using containers that hold smaller amounts of product or boxes with grips can help put less stress on the back. Often suppliers and distributors prefer packages in smaller containers to keep their employees' backs safer, too. Also, always provide lots of hand trucks, carts, and dollies, along with the training on safe lifting and proper load handling when using industrial trucks.



- ***Take time to recover***

Recovery is an essential part of preventing MSDs. One method of prevention is to give the body recovery time by taking advantage of any scheduled breaks. Performing even little stretches makes the blood flow back to parts of the body that have been stationary. Stretching also increases mobility and flexibility in the joints.

Micro-breaks are short 20 to 30-second pauses where employees can stop tasks and stretch. They are recommended about every 15 minutes, especially in jobs with repetitive tasks. Micro-breaks allow the body to rest from repetitive or strenuous work without taking the employee away from the task. Even in small amounts, breaks allow the body to start healing itself from the stress and minor injuries of the day.

Emotional stress, which also causes muscle tightness, can result in MSDs. Company incentives designed to modify individual behaviors, such as employee exercise and stretching programs, help relieve stress. Getting plenty of sleep also allows the body time to heal and can be an effective means of reducing MSDs.

- ***Understand the risk factors***

The first step in reducing MSDs is finding problems before they become issues. Knowing the risk factors discussed earlier -- excessive vibration, repetitive motions, awkward postures, extreme temperatures, heavy lifting, and overexertion – can make it easier to spot the dangers. Train employees to minimize these hazards and think ergonomically.

- ***Know the signs***
  Understand the signs and symptoms of common MSDs: numbness and tingling in the extremities, especially in the fingers, that lasts more than 24 hours, or discomfort that prohibits restful sleep. Ensure employees understand the importance of seeking medical attention early and not to disregard the pain as the usual aches of working. By catching MSDs in the initial stages, employers can avoid costly workers' compensation claims; and employees can steer clear of long, painful recovery times.

How can employers protect workers?

Employers are responsible for providing a safe and healthful workplace for their workers. In the workplace, the number and severity of MSDs resulting from physical overexertion, and their associated costs, can be substantially reduced by applying ergonomic principles.

Implementing ergonomic processes reduces the risk of developing MSDs, especially in high-risk industries such as construction, food processing, firefighting, office jobs, health care, transportation, and warehousing. The following are important elements of an ergonomic process:

- ***Provide management support***
  A strong commitment by management is critical to the overall success of an ergonomic process. Management should define clear goals and objectives, discuss them with their workers, assign responsibilities to designated staff members, and communicate clearly with the workforce.

- ***Involve workers***
  Directly involve workers in ergonomic assessments, solution development, and implementation. Workers can:

  ◊ identify and provide important information about hazards in their workplaces;

  ◊ assist in the ergonomic process by voicing their concerns and suggestions for reducing exposure to risk factors; and

  ◊ evaluate the effectiveness of the changes made.

- ***Provide training***
  Training is an essential element in the ergonomic process. It ensures that workers are aware of ergonomics and its benefits, informed about ergonomics-related concerns in the workplace, and understand the importance of reporting early symptoms of MSDs.

- ***Identify problems***
  An important step in the ergonomic process is identifying and assessing ergonomic problems in the workplace before resulting in MSDs.

- ***Encourage early reporting of MSDs symptoms***
  Early reporting can speed the job assessment and improvement process, help prevent future injuries, and reduce the amount of lost time and workers' compensation claims.

- ***Implement solutions to control hazards***
  Many possible solutions can be implemented to reduce, control, or eliminate workplace MSDs. Implementing changes to the workplace, establishing efficient processes, and using PPE reduces exposure to ergonomics-related risk factors.

- ***Evaluate progress***
  Evaluation and corrective action procedures are required periodically to assess the ergonomic process's effectiveness and ensure its long-term success. As an ergonomic process is developing, assessments should include determining whether goals have been met and the implemented ergonomic solutions reduce injuries.

Appendix A: Industry-Specific Ergonomic Guidelines and Resources

The resources below are compiled from various government agencies, organizations, and industry associations. While there is no single, all-encompassing ergonomics standard, many organizations have joined to provide information, tools, and guidelines to advance the practice of ergonomics in the workplace. ***Click the blue links to learn more***.

I. Agriculture

- **Ergonomics for Farm Workers (NIOSH Simple Solutions)**
  Farming is hard work. This booklet created by NIOSH offers ergonomics tips and early intervention strategies to reduce injuries in farm-related work.

- **Manual Handling in Agriculture**
  This page on the Health and Safety Executive website provides information on manual handling in the agriculture industry.

II. Construction

- **Concrete Construction, LHSFNA Ergonomic Tip Sheets**
  This resource from the Laborers Health and Safety Fund of North America provides handouts and tip sheets for construction and various trades. (Also includes Spanish versions!)

- **Construction Industry Ergonomics Best Practices**
  Construction is an industry with a high rate of musculoskeletal disorders (MSDs). This guide from the Ohio Bureau of Worker's Compensation provides ergonomics best practices for construction.

- **Electrical Contractors, OSHA eTool**
  OSHA's eTool describes common hazards that electrical contractors may encounter and possible solutions for these hazards.

- **Ergonomics for Construction Workers (NIOSH Simple Solutions)**
  Created by the National Institute for Occupational Safety and Health (NIOSH), this booklet is intended for construction workers, unions, supervisors, contractors, safety specialists, human resources managers-anyone with an interest in safe construction sites.

- **Guide to Selecting Non-powered Hand Tools**
  This booklet is a joint effort between the California Occupational Safety and Health Administration (Cal/OSHA) and the National Institute for Occupational Safety and Health (NIOSH), Centers for Disease Control and Prevention (CDC). It is designed to help

company's select or purchase the best available ergonomically designed non-powered hand tools.

- **Reducing Sprains and Strains in Construction through Worker Participation**
  This is a manual provided by The Center for Construction Research and Training to guide contractors in using worker input to design a program for reducing strains and sprains on the job and uses examples from scaffold erection.

III. Health Care

Laboratories

- **Laboratory Ergonomics**
  All work environments require a person to interact with their surroundings. In a laboratory, good ergonomics is often sacrificed for experimental efficiency. These articles from UCLA Ergonomics discuss ergonomic topics related directly to the laboratory setting.

- **Laboratory Ergonomics Training Slides**
  This interactive training program from the University of California San Diego provides a practical approach for improving comfort in research environments.

- **UCLA Laboratory Ergonomics**
  This page on the UCLA website contains articles that discuss ergonomic topics related directly to laboratory settings.

Long Term Care

- **Nursing Homes OSHA eTool**
  Many nursing home tasks require considerable lifting and other strenuous physical labor. Historically the injury rate for workers in these facilities is double the injury rate for all full-time workers in other occupations. This eTool from OSHA is designed to help employers and employees identify and control the hazards associated with nursing homes and residential care facilities.

- **Nursing Homes OSHA Guidelines**
  OSHA issued an ergonomics guideline for the nursing home industry on March 13, 2003. To develop the guidelines, OSHA reviewed existing ergonomics practices and programs, State OSHA programs, and available scientific information. OSHA also met with stakeholders to gather information on the ergonomic problems present in the nursing home environment and the practices that have been used successfully in the industry.

- **Safe Lifting and Movement of Nursing Home Residents**
  This guide from OSHA is intended for nursing homeowners, administrators, nurse managers, safety and health professionals, and workers interested in establishing a safe resident lifting program.

- **Extended Care, Ergonomics Best Practices**
  This guide from the Ohio Bureau of Worker's Compensation provides ergonomics best practices for an extended care facility.

IV. Manufacturing

- **Manufacturing, Ergonomics Best Practices**
  This booklet from the Ohio Bureau of Worker's Compensation provides ergonomics best practices for manufacturing.

- **Manufacturing Industry, Manual Handling**
  This guide from WorkSafe New Zealand gives specific advice and well-illustrated examples of how manual handling injuries can be avoided in the manufacturing industry.

- **Manufacturing: Preventing Musculoskeletal Injuries**
  This publication from WorkSafe BC was produced for workers and health and safety professionals as a guide in their daily work routines or for their inspections on the job site. They may also refer to or use the information in this document to assist them in carrying out their occupational health and safety roles and responsibilities.

Apparel

- **Ergonomic Handbook for the Clothing Industry**
  Research shows that sewing machine operators face a substantially higher risk of muscle pain and injury than workers in other jobs. Studies also show that the frequency of persistent neck and shoulder injuries increases with years of employment. This handbook from the Union of Needle trades, Industrial and Textile Employees, the Institute for Work & Health, and the Occupational Health Clinics for Ontario Workers, Inc, provides ergonomics information for the clothing industry.

- **Sewing, OSHA eTool**
  Workers involved in sewing activities, such as manufacturing garments, shoes, and airplane or car upholstery, may be at risk of developing musculoskeletal disorders (MSDs). Sewing-related injuries have been documented in the areas of sewing stations, performing fine work or scissor work, and material handling, among others. This eTool from OSHA provides example ergonomics solutions specific to sewing.

- **Textiles Industry, Manual Handling**
  This guide from the Health and Safety Executive is aimed at manufacturers and workers in the textile industry, including warehouse and delivery staff. It highlights some common problems with manual handling and suggests possible solutions.

Food Processing

- **Ergonomics Program Management Guidelines for Meatpacking Plants**
  This comprehensive document from OSHA gives ergonomics program guidelines for Meatpacking Plants.

- **Food Processing, Ergonomics in Action**
  Ergonomics in Action: A Guide to Best Practices for the Food-Processing Industry from Cal/OSHA Consultation Service, Research and Education Unit, Division of Occupational Safety and Health, California Department of Industrial Relations was written to give management, "front-line" supervisors, and facility/maintenance personnel general guidance on how to reduce work-related musculoskeletal disorders.

- **Poultry Processing OSHA eTool**
  This eTool from OSHA provides common ergonomic risk factors and control methods for the poultry processing industry.

- **Prevention of Musculoskeletal Injuries in Poultry Processing**
  This comprehensive document from OSHA gives ergonomics program guidelines for poultry processing plants.

- **Red Meat Industry, Manual Handling**
  WorkSafe Victoria's resource provides practical guidance on a range of risk control solutions currently used at workplaces in Victoria. WorkSafe encourages everyone involved in the red meat processing industry to read this publication and take action to implement solutions to control risk wherever reasonably practicable.

Foundries

- **Solutions for the Prevention of Musculoskeletal Injuries in Foundries**
  This OSHA publication presents ergonomic solutions for foundry workers to reduce musculoskeletal disorders caused by the physically demanding tasks performed during foundry operations.

Furniture Manufacturing

- **Furniture Manufacturing Voluntary Ergonomics Guideline**
  Many companies in the furniture manufacturing industry have made a substantial effort to reduce work-related injuries due to heavy lifting, repetitive motion, awkward and static work postures, vibration, and other recognized ergonomic stressors. The results achieved by these companies demonstrate that there are effective, affordable ways to protect furniture industry employees from injury while maintaining productivity, quality, and employee morale. The Voluntary Ergonomics Guideline for the Furniture Manufacturing Industry is designed to guide furniture manufacturers through the process of developing an effective ergonomics program.

Plastics Manufacturing

- **Ergonomics Best Practices for Plastics Manufacturing**
  This resource by the Ohio Bureau of Worker's Compensation provides best practices for plastics manufacturing.

Pharmaceuticals

- **Ergonomics in the Pharmaceutical Industry**
  This resource page from the Health and Safety Executive website provides a wealth of information and resources for the pharmaceutical industry.

Printing Industry

- **Manual Handling in the Printing Industry**
  This page on the Health and Safety Executive website provides a host of resources for manual handling in the printing industry.

- **Printing Industry OSHA eTool**
  Workers involved in printing processes may be at risk of developing MSDs from workplace activities, forcing them to work outside their physical capacities. MSDs are a serious problem as they can increase the number of employee lost workdays, increase insurance costs, increase training and staffing costs, and reduce operational efficiency and quality. Ergonomic improvements are often simple and obvious, but they generally justify the resources spent even if they require significant effort. Good ergonomics is good business. This eTool from OSHA is a product of the OSHA and Graphics Arts Coalition Alliance.

Shipyards

- **Ergonomic Interventions in Shipyards**
  Due to the high injury and illness rates in the shipbuilding, ship repair, and ship dismantling industries, a research study was undertaken to understand the relationship between these high rates noted in the OSHA 200 logs and the associated job risk factors. Once this association was better understood, effective ergonomic intervention strategies were developed to reduce these injuries and illnesses in the form of best industrial practices. The purpose of this OSHA website page is to present effective ergonomic solutions from various shipyards that were implemented to address specific ergonomic concerns.

- **Shipyard Guidelines (OSHA)**
  This document from OSHA provides ergonomics and injury prevention guidelines for shipyards.

Wood Products

- **Wood Products Sawmills eTool: Log Handling, Sorting, and Storing**
  This manual is a working tool developed through labor, business, and the Department of Labor and Industries. It was created to help mill operators, supervisors, and workers find risk factors within sawmill jobs known to cause MSDs. It can help mills reduce worker exposure once these risk factors have been found.

V. Offices and Computer Workstations

- **Ergonomics in the Office**
  This publication provided by the Texas Department of Insurance, Division of Workers' Compensation-Workplace Safety provides ergonomic guidelines for the office to reduce injuries caused by improperly designed workstations, working procedures, and other factors decrease the effectiveness of an organization.

- **OSHA Computer Workstation Ergonomics eTool**
  Millions of people work with computers every day. This eTool from OSHA illustrates simple, inexpensive principles that can create a safe and comfortable computer workstation. There is no single "correct" posture or arrangement of components that fit everyone. However, there are basic design goals, some of which are shown in the accompanying figure, to consider when setting up a computer workstation or performing computer-related tasks.

- **Office Ergonomics Interactive Guide**
  This course provided by the Washington State Department of Labor and Industry is an interactive guide for adjusting computer workstation and mobile computer.

- **Ergonomics Guidelines for Arranging a Computer Workstation**
  Creating a good ergonomic working arrangement is important to protect employees' health. The following 10 steps from the Cornell University Ergonomics Web summarize those things that most ergonomists agree are important. Following the 10 steps can help improve working arrangement.

- **Workstation Adjustments for Comfort and Safety**
  This publication provided by the Texas Department of Insurance, Division of Workers' Compensation-Workplace Safety provides ergonomic guidelines for the office to work more comfortably and effectively.

VI. Public Administration

- **Ergonomics Best Practices for Public Employers**
  This guide provided by the Ohio Bureau of Worker's Compensation provides a set of ergonomics best practices for public employers.

VII. Services

Automotive Repair

- **Automotive Workshop Safety**
  Manual handling injuries are the most common type of injury occurring in automotive workshops. The injuries occur from handling heavy or awkward objects, heavy lifting, and prolonged or sustained work in awkward postures. This guide from WorkSafe Victoria is a guide to automotive workshop safety.

Food Services Industry

- **Ergonomics for the Food Services Industry**
  This publication provided by the Texas Department of Insurance, Division of Workers' Compensation-Workplace Safety provides ergonomic guidelines for waitstaff, restaurant cooks, food preparation workers, bartenders, dishwashers, and food services managers.

Janitorial Services

- **Working Safer and Easier for Janitors, Custodians, and Housekeepers**
  This booklet published by the California Department of Industrial Relations provides guidelines for working safer and easier for janitors, custodians, and housekeepers.

- **Safe Work Practices for Custodians**
  The purpose of this guide from WorkSafe BC is to show ways of making custodial work safer and easier so that the risks of sprain and strain injuries are reduced.

Landscaping Services

- **Landscaping and Horticulture Services**
  The purpose of this guide from OSHA illustrates common ergonomic risk factors and control methods in the landscaping industry.

VIII. Transportation and Warehousing

Air Transportation

- **Baggage Handling OSHA eTool**
  This eTool from OSHA was developed as part of the OSHA-Airlines Industry and National Safety Council's International Air Transport Section Alliance. This tool describes many of the common hazards associated with the baggage handling process. It provides possible solutions that are ranked according to their feasibility to the operations.

- **Baggage Handling**
  The manual handling of baggage and cargo onto and off aircraft presents a risk of manual handling injury to the ground handlers involved in these tasks. This page on the Health and Safety Executive website provides resources and case studies for reducing ergonomic risk in baggage handling.

- **Ergonomic Solutions: Baggage Handling**
  This publication provided by the Texas Department of Insurance, Division of Workers' Compensation-Workplace Safety provides ergonomic guidelines for airline employees who handle customer baggage. This safety module describes common hazards and possible solutions to reduce risks associated with baggage handling.

Trucking and Warehousing

- **Manual Material Handling: An Ergonomic Approach**
  This publication provided by the Texas Department of Insurance, Division of Workers' Compensation-Workplace Safety provides ergonomic guidelines for safe lifting programs in warehouses.

- **Road Transport: Eliminating Manual Handling Injuries**
  This comprehensive report by WorkSafe provides a set of guidelines and recommendations for eliminating manual handling injuries in road transport.

IX. Wholesale/Retail

- **Beverage Delivery**
  This eTool from OSHA describes ergonomic hazards and possible solutions for workers in the Beverage Delivery Industry.

- **Grocery Warehousing**
  This page on the U.S. Department of Labor website describes example ergonomic hazards and solutions with an emphasis on Traditional Order Picking, which accounts for many musculoskeletal disorders.

- **Retail Grocery**
  OSHA's publication, Ergonomics for the Prevention of Musculoskeletal Disorders: Guidelines for Retail Grocery Stores, provides practical recommendations to help grocery store employers and employees reduce the number and severity of injuries in their workplaces.

- **Soft Drink Beverage Delivery Industry**
  The National Institute for Occupational Safety and Health (NIOSH) conducted an ergonomic study to investigate, identify, and reduce risk factors that may cause musculoskeletal disease and injury in the soft drink beverage delivery industry.

Appendix B: Glossary of Ergonomic Terminology

The field of ergonomics is full of various terms, such as "carpal tunnel syndrome" and "cumulative trauma disorder." Here is a short guide to everything from "accommodation" to "work reach envelope."

Accommodation: any modification or adjustment to a work environment that enables an operator to perform essential job functions.

Administrative controls: procedures and methods, set up by the employer, that significantly reduce exposure to risk factors by altering the way in which work is performed. Examples include job rotation and adjustment of work pace.

Anthropometry: the science of studying human body dimensions. It is used to design ergonomic standards, assembly procedures and workstations. The goal of anthropometry is to minimize design incompatibility and maximize human performance.

Awkward posture: deviation from the ideal working posture of elbows at the side of the torso, with the wrists neutral. It is associated with an increased risk for injury. Awkward postures typically include reaching behind, twisting, forward or backward bending, pinching, and squatting.

Biomechanics: a field of study that uses the laws of physics and engineering concepts to describe the motions of body parts and the forces acting upon them during normal daily activities.

Boundary values: a guideline used to design for the 5th to 95th percentile, which means designing for about 90 percent of a given population. The range of sizes dictates the range of flexibility necessary for new workstations, material handling equipment or assembly tools in order to accommodate the full range of employees. Usually, boundary values are obtained from large existing databases.

Carpal tunnel syndrome: a wrist disorder often associated with repetitive hand work. Symptoms include burning, itching, prickling or tingling feelings in the wrist or first three fingers and thumb. Carpal tunnel syndrome is more prevalent in women than in men. It is one example of a cumulative trauma disorder.

Chronobiology: the science of investigating and objectively quantifying phenomena and mechanisms of the biologic time structure, such as circadian rhythms. It is a new and rapidly developing specialty.

Cumulative injury (overuse injury): cumulative injuries develop from repeated loading of

body tissues over time. Such injuries include overuse sprains/strains, herniated discs, tendonitis, and carpal tunnel syndrome.

Cumulative trauma disorder (CTD): premature wear and tear damage to specific body structures. CTD injuries are mostly caused by low-intensity forces applied over a long period, with motions repeated over and over-concentrated on specific muscles and joints. Common examples of CTD include carpal tunnel syndrome and tendinitis. Cumulative trauma disorder is also called "repetitive motion injury."

DeQuervain's disease: an inflammation of the tendon sheath of the thumb attributed to excessive friction between two thumb tendons and their common sheath. It is usually caused by twisting and forceful gripping motions with the hands. The disorder is named after a French doctor who first described it.

Disorder: a medical condition that occurs when a body part fails to function properly. Duration: the length of exposure to a risk factor. It can be measured as the minutes or hours per day that an operator is exposed to a risk. Typically, the greater the duration of exposure to a risk factor, the greater the degree of risk.

Engineering controls: physical changes to a job that reduce musculoskeletal disorders. Examples of engineering controls include changing or redesigning workstations, tools, equipment, or processes.

Ergonomist: an individual who analyzes work environments and recommends administrative, engineering and work practice controls. Ergonomists attempt to remove barriers to quality, productivity and safe human performance by fitting products, tasks, and environments to people.

Exposure: a concept used to describe the particular risk factor experienced by a worker, with a profile of modifying factors, such as intensity, time characteristics, and duration.

Fatigue: a condition that results when the human body cannot provide enough energy for the muscles to perform a task. There is a reduction in the ability to exert force in response to voluntary effort.

Fatigue failure: the weakening or breakdown of material subjected to stress, especially a repeated series of stresses.

Force: the amount of muscular effort required to perform a task. Generally, the greater the force, the greater the degree of risk. High force has been associated with work-related musculoskeletal disorders at the shoulder, neck, forearm, wrist, hand, and lower back.

Frequency: the number of cycles occurring per time unit.

Global boundaries: the working population used to generate boundary values. If global boundaries are not considered, data can easily be misrepresented. For instance, a 95th percentile male at an auto parts assembly plant in Michigan will be different in height and arm length from individuals working at similar plants in China and Mexico.

Human factors: a branch of ergonomics that focuses on cognitive performance of humans.

Inline grip: a hand tool with a straight handle that is parallel with the direction of the applied energy.

Job rotation: a practice in which operators are rotated through several different assembly tasks during a shift. While two or more tasks may require repetitive motion, a different group of muscles or tendons will be worked. Job rotation is a common type of work practice control. But it is often misused--workers get rotated into similar jobs, and so rotation has no effect.

Kinesiology: a field of study that focuses on the principles of mechanics and anatomy in relation to human movement.

Moment (torque): the tendency to produce motion about an axis.
Moment arm: the perpendicular distance between an applied force and the axis of rotation. For muscles, this is the perpendicular distance between the line of action of the muscle and the center of rotation at the joint.

Musculoskeletal disorder (MSD): an injury or illness of soft tissues of the upper extremity (fingers through upper arm), shoulders and neck, low back, and lower extremity (hips through toes). It is primarily caused or exacerbated by workplace risk factors, such as sustained and repeated exertions or awkward postures and manipulations. Included are disorders of the muscles, nerves, tendons, ligaments, joints, cartilage, and spinal disks. Medical conditions generally develop gradually over a period of time and do not typically result from a single instantaneous event. Injuries arising from slips, trips, falls and similar accidents are not considered to be an MSD.

Neutral posture: a comfortable working posture that reduces the risk of musculoskeletal disorders. The joints are naturally aligned with elbows at the side of the body and wrists straight. The more a joint deviates from neutral posture, the greater the risk of injury.

Ninety-fifth percentile: a term commonly used to determine ergonomic boundary values. It means that the dimensions of an individual are greater than 95 percent of the male population, and 100 percent of the female population, since women are smaller than men as a population. At the 95th percentile, five out of every 100 individuals exceed the target value. Special accommodations may be required for these particularly short or tall individuals.

Optimal work zone: an area in front of the body defined by keeping the back straight, the shoulders neutral and the hands between hand rest and elbow height.

Personal protective equipment (PPE): special devices that operators wear to provide a

protective barrier between the employee and an MSD hazard. Examples include vibration-reduction gloves, wrist braces and back support belts.

Pinch grip: a grasp in which one presses the thumb against the fingers of the hand and does not involve the palm.

Pistol grip: a tool handle that resembles the handle of a pistol and is typically used when the tool axis must be elevated and horizontal or below waist height and vertical. Power grip. A grasp where the hand wraps completely around a handle, with the handle running parallel to the knuckles and protruding on either side.

Raynaud's syndrome: a medical condition where blood vessels of the hand are damaged from repeated exposure to vibration over a long period of time. The skin and muscles do not get the necessary oxygen from the blood and eventually die. Symptoms include intermittent numbness and tingling in the fingers; pale, ashen, and cold skin; and eventual loss of sensation and control in the hands and fingers. Raynaud's syndrome is also called "white finger."

Reaction torque: the force created when a threaded fastener forms a solid joint during the run-down phase.

Recovery time: the length of rest between exertions. Inadequate rest periods between exertions can decrease performance. As the duration of the uninterrupted work increases, so does the amount of recovery time needed. Short work pauses can reduce discomfort.

Repetition: the number of similar exertions performed during a task. Repetition is only one risk factor and must be evaluated in terms of other factors such as force, posture, cold, and vibration.

Repetitive motion injury: see "cumulative trauma disorder."

Repetitiveness: performing the same motions repeatedly. The severity of risk depends on the frequency of repetition, speed of the movement or action, the number of muscle groups involved, and the required force.

Risk factors: an aspect of a job that increases an operator's chance of getting a work-related musculoskeletal disorder. There are several basic risk factors, including force, posture, repetition, and vibration.

Segmental vibration: vibration applied to the hands and arms through a tool or piece of equipment. This can cause a reduction in blood flow to the hands and fingers. It can also interfere with sensory receptor feedback, leading to increased handgrip force to hold the tool. A strong association has been reported between carpal tunnel syndrome and segmental vibration.

Strain: an injury to a muscle or tendon.

Stress: demand (or —burden) on the human body caused by something outside of the body, such as a work task, the physical environment, work-rest schedules, and social relationships.

Tendinitis: a painful inflammation or swelling that occurs when a muscle or tendon is repeatedly tensed from overuse or unaccustomed use. The elbow, shoulder, and wrist are common locations for this injury. Tendinitis is one example of a cumulative trauma disorder.

Threshold limit value (TLV): an occupational exposure value to which nearly all workers can be exposed day after day for a working lifetime without ill effect.

Traumatic injury: injuries that are acute that may result from instantaneous events such as being struck by objects and that often require immediate medical attention. These types of injuries are often sustained through accidents.

Trigger finger: a tendon disorder that occurs when there is a groove in the flexing tendon of the finger. If the tendon becomes locked in the sheath, attempts to move the finger cause snapping and jerking movements. Trigger finger is usually associated with tools that have handles with hard or sharp edges.

Vibration: oscillation or periodic motion of a rigid or elastic body from equilibrium. Electric and pneumatic tools, such as screwdrivers, generate vibration that can cause injury over time.

White finger: see "Raynaud's syndrome."

Work practice controls: procedures for safe work that are used to reduce the duration, frequency, or severity of exposure to a hazard. They include work methods training, job rotation, and gradual introduction to work.

Working reach envelope: the space about a person created by the reach capabilities to grasp an object with the back straight and minimal deviation of the elbow and shoulder from a neutral position.