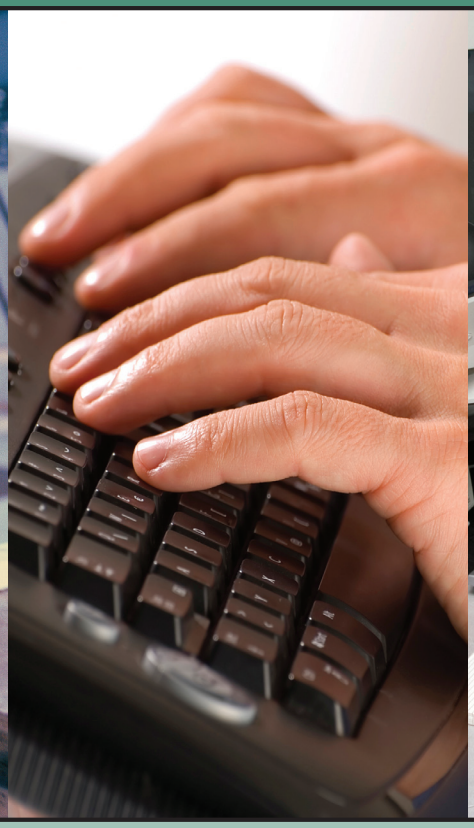
Ergonomics Safety Program



This comprehensive guide will help you establish an ergonomics safety program in order to prevent ergonomic injuries (MSDs) in the workplace and comply with OSHA requirements.

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Contents

Chapter 3 – NIOSH Ergonomics Primer (continued)

Chapter 4 – Sample Ergonomics Program

Chapter 5 – Basic Screening Tools

Introduction and Implementation Procedures

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As many as 80% of workplace injuries fit into OSHA's broad definition of ergonomic or musculoskeletal disorders. Ergonomics is the science of fitting workplace conditions and job demands to the capabilities of the working population. Effective and successful "fits" assure high productivity, avoidance of illness and injury risks, and increased satisfaction among the workforce. Although the scope of ergonomics is much broader, the term here refers to assessing those work-related factors that may pose a risk of musculoskeletal disorders and recommendations to alleviate them.

Common examples of ergonomic risk factors are found in jobs requiring repetitive, forceful, or prolonged exertions of the hands; frequent or heavy lifting, pushing, pulling, or carrying of heavy objects; and prolonged awkward postures. Vibration and cold may add risk to these work conditions. Jobs or working conditions presenting multiple risk factors will have a higher probability of causing a musculoskeletal problem. The level of risk depends on the intensity, frequency, and duration of the exposure to these conditions and the individuals' capacity to meet the force of other job demands that might be involved.

This guidebook provides information about ergonomic safety, important elements in mitigating exposure to musculoskeletal injuries, and important screening tools. It also discusses the steps employers must take to implement their own Ergonomic Safety Program. A program as outlined herein can only be effective if taken seriously and followed through. Each organization is unique. The needs of your organization should be examined and implemented into the program in order to make it successful. It is essential that the employer demonstrate at all times their personal concern for their employees and the priority placed on them in your workplace. The policy must be clear. The employer shows its importance through their own actions.

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Ergonomics

Overview

Although the principles of ergonomics affect virtually all workers in nearly every occupational setting, few areas of compliance are as greatly underestimated. Ergonomics is a truly impressive, flexible system of balancing job demands with employees' capabilities. When merged with your company health and safety program, applied ergonomics can dramatically reduce certain OSHA 300 Log recordable injuries, minimize worker absenteeism, and cut down on costly accidents.

In addition to preventing injury, infusing ergonomics practices within your company offers the added benefits of improving efficiency and productivity, as well as significantly boosting overall company morale. By reducing physical and environmental stress, it makes sense that employees perform job tasks more effectively and develop greater company satisfaction.

Ergonomics isn't a "one size fits all" health and safety program or an immediate fix. It's a continual and company specific process. Finding solutions within your workplace will require addressing your facility's unique circumstances and challenges.

Looking at a few examples of the many ergonomic success stories, you'll see the broad range of applications and potential.

- Through implementing a range of positive and proactive methods –from training employees to executing ergonomic committees and modifying equipment- Gold Kist, a poultry processing company, achieved an 80 percent reduction in musculoskeletal claims[i].
- When clothing manufacturer, L.L. Bean, redesigned workstations, the company's lost-time incidents involving work-related musculoskeletal disorders dropped by 79 percent.
- California based Hensel Phelps Construction, logged in over 104,000 labor hours completely free of work-related musculoskeletal disorders claims due to establishing a customized job and employee specific stretching and strengthening program. [ii]
- Adjustments to height tables in a Washington state metrology lab resulted in an injury-free environment and a 10 percent increase in productivity time. [iii]

Ergonomics is a powerful tool to perpetuate widespread positive company changes when employers adopt a holistic approach and begin analyzing the entire system of physical and environmental working conditions. Like all other aspects of safety and compliance, your program's success depends on employee involvement, management support and periodic assessments and revisions.

Definition
Ergonomics: "The application of scientific information concerning humans, such as behavioral and biological information, to the design of objects, systems and environment to ensure their safe, efficient and convenient use by people." – International Organization for Standardization (adapted from the definition used by the Ergonomics Society)[iv].

Quite simply, ergonomics is the science of adapting the working environment and job performance methods to fit the employee. A multi-disciplinary field, combining engineering, architecture, psychology and biology, the scope and application of ergonomics in the working population is broad.

Ergonomics addresses means to create safer, more efficient and error-free working methods by modifying workstations, tools or equipment - as well as the working environment and job process- to match the worker's capabilities and comfort level.

Scope
Nearly every employee can benefit through the use of applied ergonomics, from office staff to forklift operators to warehouse workers. All employees experience certain types of work-related physical, physiological or emotional stress that often can be relieved through an ergonomic assessment and corrective actions.

In many cases, workers may not be conscious of these stress-factors, yet they are none-the-less enduring chronic strain on mental or physical wellbeing in the workplace which can result in errors and injury.

Examples:

- Office staff experiencing tired, itchy, dry, or burning eyes or who have persistent headaches might not be aware that these symptoms can be due to eyestrain caused by computer screen glare. Reducing glare or modifying lighting can provide relief for these workers, as well as improve efficiency.

- Employees whose job requires lifting can benefit from modifications in bins, shelves or workstations that eliminate above the shoulder lifting, which is a common source of strain and injury[v]. Simple modifications in bins, workstations or shelving that keep lifting to the mid-thigh or chest level (lifting strike zone) and minimize extended reaching can reduce physical stress and prevent a significant amount of injury.

Fit the Worker
Fundamental to ergonomics is the principle that employers are to match the job to the worker- as such there this no "universal" product that simultaneously applies to all employees. This is why I advise against wholesale purchases of "ergonomic" tools, chairs or other equipment, until employees have an opportunity to test items.

Comfort level of the individual employee, is a telling factor in developing ergonomic criteria. Your left-handed employees may favor certain products or practices that differ from right-handed co-workers. Ergonomic factors are also affected by height, weight, medical conditions and personal preference. Neutral position – a stress reducing working posture which where the joints are naturally aligned[vi]- may vary slightly for individuals.

Establishing ergonomic programs require flexibility and employee input to achieve success.

- Example: Eye strain for some workers develops when a computer monitor is out of visual range. Although proximity for monitors of 18 to 30 inches from the user is recommended, allowing employees to select distance according to personal comfort levels is in keeping with ergonomic dynamics.

Risk Factors
To implement your ergonomic program, you must be aware of risk factors that present hazards to employees. Preventing types of musculoskeletal disorders (MSD), which are the most common forms of lost-time injuries and illnesses in the workplace, is a key dynamic of ergonomics.

Physical Hazards
According to OSHA, physical ergonomic hazards are associated with jobs requiring, "repetitive, forceful, or prolonged exertions of the hands; frequent or heavy lifting, pushing, pulling, or carrying of heavy objects; and prolonged awkward postures. Vibration and cold may add risk to these work conditions." [vii]

Of these, repetition or prolonged activities are crucial factors to evaluate. If your employee performs a task multiple times, he's more likely to develop an injury.

When working conditions expose employees to several risk factors, OSHA notes, there is a greater potential for developing injury.

- Example: Poultry processing employees often perform work in cold or refrigerated facilities, and may do repetitive tasks, typically involving lifting or carrying. Workers in this industry have a higher than normal potential for developing musculoskeletal injuries, as many known physical hazards are involved concurrently.

Environmental Factors
Implementing your ergonomic program effectively requires a balanced look at all conditions. In addition to physical factors of the job, environmental factors must be surveyed.

Environmental factors include:

- Excessive Noise
- Indoor Air Quality
- Lighting
- Temperature

Obviously, excessive noise- above 85 -90 dBA, for employees with standard threshold shifts or for environments of 90 dBA eight hour TWA (time weighted average) - requires hearing protection according to OSHA[viii]. But, even steady noise below the requirements can become environmentally stressful to workers, resulting in potential injuries due to employee error.

Common issues with indoor air are mold, chemical exposure, and improperly cleaned duct work that re-circulates dust or allergens. Along with poorly illuminated areas, these environmental factors lead to reduced employee efficiency and workplace related illnesses.

Since ergonomics involves not only preventing injury, but also enhancing job performance, indoor air temperature is a factor of consideration. Employers, in my experience, often neglect this factor when performing ergonomic assessments. Yet the merits of workplace temperature conditions are elemental for workers comfort, which in turn does affect productivity and generates a positive attitude.

Some studies, such as a 2004 study conducted by researchers from Cornell University, have shown a link in temperature and efficiency of workers. The month long study, which demonstrates the impact environmental ergonomics have on employees, tested keyboarding skills of workers at the Florida headquarters of the Insurance Office of America.

According to Cornell University Professor Alan Hedge, of the Department of Design and Environmental Analysis[ix], who led the study, "A temperature increase from 68 to 77 degrees Fahrenheit, prompted 44 percent fewer errors and an increase in typing output by 150 percent."

Across the board, all risk factors are exacerbated by the following:

1. Frequency
2. Intensity
3. Duration
4. Individual capabilities or limitations (i.e. A worker who has had a previous back surgery may be at greater risk for developing a workplace injury)
5. Poor Posturing – either static posturing, which holds the body in one position for lengthy periods, limiting oxygen and blood flow to muscles or awkward posturing which prevents relaxed, neutral positioning.

OSHA Guidelines: "Can I be cited for ergonomic issues?"

As many employers are aware, there is not yet a standard (law) regarding ergonomics. OSHA has developed ergonomic guidelines for tasks and industries such as poultry processing industries, retail grocery stores, nursing homes and shipyard employment, and continues to monitor and develop additional guidelines if mandated. OSHA regards implementing guidelines voluntary and more flexible than mandatory compliance of standards. However, even without an existing regulation, all employers are required to provide a safe and healthy workplace and to protect workers from serious hazards.

According to OSHA, "Even if there are no guidelines specific to your industry, as an employer you still have an obligation under the General Duty Clause, Section 5(a)(1) to keep your workplace free from recognized serious hazards, including ergonomic hazards. OSHA will cite for ergonomic hazards under the General Duty Clause or issue ergonomic hazard letters where appropriate as part of its overall enforcement program. OSHA encourages employers where necessary to implement effective programs or other measures to reduce ergonomic hazards and associated MSDs." [x]

Bottom line*: You can be cited for exposing employees to any serious hazard- including ergonomic hazards.*

Through National Emphasis Programs, such as the one issued in 2009 on recordkeeping and reporting[xi], OSHA will continue to scrutinize the need for advanced directives, further ergonomic guidelines or possibly implementing a comprehensive ergonomic standard.

Ergonomic Related Injuries and Cost

The impact of work-related musculoskeletal disorders is staggering. Conservative estimates, according to an early NIOSH report, place the annual cost at more than $13 billion[xii]. With more than 100 separate work-related musculoskeletal disorders, some states such as Washington attribute MSD's for 26.9 percent of all state funded workers' compensation claims, *with an average of 123 days lost time per compensable claim[xiii].*

Musculoskeletal disorders of the back, neck and upper extremities are among the most commonly associated with workplace hazards and often present years of chronic or debilitating pain for workers. Employers must be especially watchful for hazards associated with these injuries in their workplace as they develop ergonomic programs.

If you'd like to see the potential fiscal advantages generated by implementing an ergonomic program, Cornell University's Return on Investment Estimator is a handy tool. By entering the average salary of workers, number of affected employees, expected productivity increase, you can calculate possible savings for your company.

You find it here: http://ergo.human.cornell.edu/CUROIEstimator.htm

Tips for Starting Your Ergonomics Program

Using your 300 Logs to discover departments or specific jobs that have patterns of ergonomic-related injuries, is extremely beneficial. Review at least three years of these reports, along with workers compensation claims, and look for any repeat or chronic accounts of musculoskeletal injuries.

Do a job hazard analysis, beginning with most hazardous areas or work that involves lifting, repetition, force or vibration. Though it can seem daunting to begin this procedure in a large company, remember ergonomics is a *process* and it takes time to spot- much less eliminate- ergonomic hazards. Don't expect to make all corrections immediately.

Be familiar with known ergonomic hazards in other industries similar to yours. Network with other companies or consult your local OSHA education and training office for more information.

Employee Involvement
You'll gain tremendous knowledge about company ergonomic issues through employees and management involvement. Workers may be aware of specific hazards or they may exhibit symptoms of physical or environmental workplace stress. OSHA recommends taking an employee survey of symptoms to help discern ergonomic hazards. Conducting a job hazard analysis with a supervisor and a worker from that department frequently gives vital details.

Consider All Factors
While conducting your job hazard analysis, don't forget to note environmental hazards, which may be the "missing" or hidden factors easily overlooked. Consider the lighting, noise and temperature, along with air quality of working conditions as you make your inspection.

A good rule of thumb that may indicate poor air quality is the 85 percent rule. Acceptable indoor air quality defined by the American Society for Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) satisfies 85 percent of the building occupants. If 2 out of 10 workers in a department exhibit signs of headaches or work-related allergic symptoms, you may have poor air quality. While you should **always** have chemical testing to evaluate concerns about air quality, using the ASHRAE guidelines can indicate possible problem areas.

If you notice areas with high levels of noise and you've not performed an evaluation previously, you'll also want to evaluate this for compliance, as exposure to high noise can cause permanent hearing loss in workers.

Correcting Issues
Once you find ergonomic hazards, the first line of defense is to completely eliminate the hazard. Can processes be performed differently that removes the hazard? In some cases this is viable through engineering controls. Modifications in workstations, tools, equipment or any other physical changes are examples of engineering controls. You may raise a workstation, tilt bins or lower shelving racks to accommodate for eliminating posturing or lifting that presents a hazard.

Risk management techniques that use procedural changes or alterations are known as administrative control methods. To reduce exposure to forklift vibrations, your company might rotate operators or mandate frequent rest breaks. Training employees to lift properly, redesigning work duties or offering stretching and strengthening exercises are other examples of administrative controls.

Both administrative and engineering controls can be use in conjunction. When combined as corrective actions are often the most effective answer to preventing ergonomic related- injuries.

Company-wide Commitment
Follow-up investigation of ergonomic injuries and incident reports, are critical to establishing your program successfully and minimizing injuries. It's most advantageous to use a safety committee or

train a specific ergonomic intervention group to investigate incidents and establish corrective actions.

Maintain regular input of employees via open plant meetings and a dedicated hazard reporting system. Ask for suggestions for corrective measures from employees. The greater the involvement of your workers and supervisors in the ergonomic program and its applications and management, the more effective it will become.

Written by Leanne Coffman. With a professional career in public health, industrial safety and OSHA compliance, Ms. Coffman uses her extensive technical knowledge and engaging writing style for developing articles that are factual, well-researched and applicable to a broad scope of readers. As a 6 year Senior Consultant and Vice President of a national safety and compliance firm, Coffman trained more than 6,000 individuals in government required trainings for general industry and developed over 60 site-specific compliance programs for clients, including forklift and powered industrial trucks, ergonomic assessments and procedure development, hazard communication, emergency action plans, bloodborne pathogens, MRSA, respiratory protection, walking and working surfaces, combustible dust training, electrical safe practices and pandemic response.

Coffman received authorization to conduct federal OSHA 10 & 30 Hour voluntary compliance trainings from the US Department of Labor, Great Lakes Regional OSHA Training Institute (OTI) and certification from the American Red Cross to teach CPR and first aid. Ms. Coffman has been an expert witness for two northern Indiana law firms representing client litigation and a member of the Lawrence County, Indiana Safety Committee. She has been an invited presenter on topics of combustible dust and hazard mitigation. On behalf of numerous clients, Coffman has participated in mediation of OSHA citations, through corrective actions and informal and formal conferences across the Midwest.

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[i] http://www.osha.gov/dcsp/success_stories/ergonomics/goldkist.html
[ii] http://www.osha.gov/dcsp/success_stories/ergonomics/hensel.html
[iii] http://www.lni.wa.gov/Safety/Topics/Ergonomics/pdfs/ErgonomicsCaseStudyMetrologyLab.pdf
[iv] http://www.iso.org/sites/ConsumersStandards/en/5-glossary-terms.htm
[v] http://ergo.berkeley.edu/research/
[vi] http://www.osha.gov/SLTC/etools/computerworkstations/positions.html
[vii] http://www.osha.gov/SLTC/ergonomics/index.html
[viii] http://www.asha.org/public/hearing/disorders/noise.htm
[ix] http://ergo.human.cornell.edu/Conferences/EECE_IEQ%20and%20Productivity_ABBR.pdf
[x] http://www.osha.gov/ergonomics/FAQs-external.html
[xi] http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=DIRECTIVES&p_id=4074
[xii] http://www.cdc.gov/niosh/nioshfin.html
[xiii] http://www.lni.wa.gov/safety/research/occhealth/muscdis/default.asp

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Picture 3: http://en.wikipedia.org/wiki/File:Ergonomic_Docking_Station.jpg

Ergonomics Administrator's Duties

The Administrator is responsible for implementing, documenting, and successfully maintaining this program. The minimum duties required of the Administrator are listed below:

1. Establish safe ergonomic standards, rules and practices and ensure employees are aware of these practices.

2. Oversee ergonomics awareness and safety training programs for all employees; including supervisor training.

3. Stimulate employee interest and participation in safe practices through incentives, group meetings, posters, etc.

4. Ascertain that safe practices and conditions are established.

5. Review all supervisor's reports of accidents, inspections, and warnings to identify necessary corrective actions or improvements.

6. Establish a safety bulletin board or area for posting required ergonomics material and pertinent safety topics.

7. Coordinate all ergonomic training and MSD prevention activities.

8. Act as liaison between management, employees and/or outside safety agencies.

9. Ensure that documentation of all aspects of this program is kept up-to-date and current with State-specific laws.

Frequently Asked Questions

Q: What is ergonomics?
A: Ergonomics is a discipline that involves arranging the environment to fit the person in it. When ergonomics is applied correctly in the work environment, visual and musculoskeletal discomfort and fatigue are reduced significantly.

In recent years, CDC's Office of Health and Safety has identified repetitive motion injuries as a factor in employee injuries. These injuries are caused by excessive and repeated physical stress on the musculoskeletal system - the hands, wrists, elbow, shoulders, neck, and back.

Following ergonomic principles helps reduce stress and eliminate many potential injuries and disorders associated with the overuse of muscles, bad posture, and repeated tasks. This is accomplished by designing tasks, work spaces, controls, displays, tools, lighting, and equipment to fit the employee's physical capabilities and limitations.

Ergonomic injuries are often described by the term "musculoskeletal disorders" or "MSDs." This is the term of art in scientific literature that refers collectively to a group of injuries and illnesses that affect the musculoskeletal system; there is no single diagnosis for MSDs.

Q: What causes MSDs?
A: Workplace MSDs are caused by exposure to the following risk factors:

Repetition. Doing the same motions over and over again places stress on the muscles and tendons. The severity of risk depends on how often the action is repeated, the speed of the movement, the number of muscles involved and the required force.

Forceful Exertions. Force is the amount of physical effort required to perform a task (such as heavy lifting) or to maintain control of equipment or tools. The amount of force depends on the type of grip, the weight of an object, body posture, the type of activity and the duration of the task.

Awkward Postures. Posture is the position your body is in and affects muscle groups that are involved in physical activity. Awkward postures include repeated or prolonged reaching, twisting, bending, kneeling, squatting, working overhead with your hands or arms, or holding fixed positions.

Contact Stress. Pressing the body against a hard or sharp edge can result in placing too much pressure on nerves, tendons and blood vessels. For example, using the palm of your hand as a hammer can increase your risk of suffering an MSD.

Vibration. Operating vibrating tools such as sanders, grinders, chippers, routers, drills and other saws can lead to nerve damage.

Q: How do you determine whether MSDs are work-related?
A: The determination of whether any particular MSD is work-related may require the use of different approaches tailored to specific workplace conditions and exposures. Establishing the work-relatedness of a specific case may include:

- Taking a careful history of the patient and the illness
- Conducting a thorough medical examination
- Characterizing factors on and off the job that may have caused or contributed to the MSD.

Q: What are signs and symptoms of MSDs?
A: Workers suffering from MSDs may experience less strength for gripping, less range of motion, loss of muscle function and inability to do everyday tasks. Common symptoms include:

Painful joints
Pain in wrists, shoulders, forearms, knees
Pain, tingling or numbness in hands or feet
Fingers or toes turning white
Shooting or stabbing pains in arms or legs
Back or neck pain
Swelling or inflammation
Burning sensation
Stiffness

Q: What medical conditions are associated with MSDs?
A: Muscle strain or fatigue
Tendonitis
Epicondylitis or “tennis elbow”
Carpal tunnel syndrome
Other “pinched” nerve entrapment syndrome
Nerve injury/irritation from external compression
Arthritis and other rheumatological disorders

Q: What factors may contribute to symptoms?
A: Factors that can contribute or worsen symptoms include:

- Furniture or a work area arrangement which produces bad postures
- Physically demanding work you are not accustom to doing
- Home or recreational activities which produce stresses on the body similar to those at work
- Being “out of shape”
- Diminished muscle strength or joint flexibility
- Underlying arthritis

Q: How can MSDs be prevented?
A: Prevention is the most important strategy for dealing with work-related musculoskeletal problems. Preventing work-related musculoskeletal problems rests on an ergonomically sound work environment, good work practices, and employee awareness. Other helpful strategies include:

- Examining how a workspace could be modified to better accommodate specific daily activities.
- Arranging workspace to prevent awkward postures, contact stress, and repetition.
- Encouraging stretch breaks between activities and on rest periods to help stretch and rest muscles.

- Making improvements to furniture, equipment, and work arrangement.
- Cutting back on all repetitive or strenuous activities if symptoms develop.
- Working smarter to avoid unnecessary repetition

Q: Is OSHA planning on introducing an Ergonomic standard?
A: OSHA's current position is to issue guidelines on ergonomics in the workplace to prevent MSDs. Industry and task specific guidelines can be developed more quickly and are more flexible, and can provide specific and helpful guidance for abatement to assist employees and employers in minimizing injuries. OSHA feels that their guidelines are the most effective method available for reducing injuries quickly.

However, Dr. David Michaels, the newly appointed head of OSHA, is an outspoken proponent of ergonomics. With Michaels at the helm, it may be that the ergonomics standard that was previously rejected, would be resurrected.

Q: **What if I am an employer in an industry for which OSHA does not have industry-specific guidelines?**
A: Even if there are no guidelines specific to your industry, as an employer you still have an obligation under the General Duty Clause, Section 5(a)(1) to keep your workplace free from recognized serious hazards, including ergonomic hazards. OSHA will cite for ergonomic hazards under the General Duty Clause or issue ergonomic hazard letters where appropriate as part of its overall enforcement program. OSHA encourages employers where necessary to implement effective programs or other measures to reduce ergonomic hazards and associated MSDs.

Implementation Procedures

The following implementation procedures are intended to provide specific instructions for correctly utilizing the various components of our Ergonomic Safety Program. If you have additional questions about this manual or other system component, please contact Personnel Concepts at 800-333-3795.

The following procedures should be followed:

1. Review "Ergonomics Overview" and "Frequently Asked Questions" in Section 1 of this manual to gain a better understanding of ergonomics and your role in mitigating injury in the workplace.

2. Review Section 2 of this manual ("OSHA Requirements) and pay close attention to ways in which to mitigate musculoskeletal disorders in the workplace.

3. Review the NIOSH Primer in Section 3 of this manual for helpful tips on recognizing ergonomic risks in your workplace. We have included a useful chart in the last part of Section 6 ("Basic Screening Tools") that describes specific ergonomic hazards by industry group to better help you understand your company's potential hazard areas.

4. Review and adapt to your company the Sample Program contained in Section 4 of this manual. Make any necessary changes that will make the program more specific to your company operations, or use the Sample Program as is by administering the program as written.

5. After you have thoroughly reviewed this program and adapted the Sample Program to your operations, you should then post the All-On-One Ergonomics Poster (entitled "Ergonomics Safety Information") enclosed with this manual. Please post in areas frequented by your employees during the normal course of the workday (i.e. in your break room or next to your time clock).

6. Recommendation (1) - We suggest you use the forms included in the "Basic Screening Tools" section and the forms included in the "Evaluation Form" section, to determine any possible ergonomic risk factors that may be present in your workplace. It is highly suggested that you make a good faith effort to correct any possible areas that pose a hazard. This will help in eliminating or, at a minimum, deterring a possible MSD Incident or complaint.

7. Recommendation (2) - We suggest that you schedule a formal safety meeting with your employees prior to a complaint to discuss your ergonomics program and to encourage employees to give suggestions on ways to make your workplace more ergonomically friendly. **Always document the times and attendees of your safety meetings. This documentation is helpful in proving your compliance with OSHA's employee notification requirements.**

8. If an employee makes a verbal complaint regarding a possible MSD injury, use the enclosed Employee Complaint Form and refer to your program for guidelines to walk you through the complaint-handling process.

OSHA Requirements

Ergonomics

Ergonomics can be defined simply as the study of work. More specifically, ergonomics is the science of designing the job to fit the worker, rather than physically forcing the worker's body to fit the job. Adapting tasks, work stations, tools, and equipment to fit the worker can help reduce physical stress on a worker's body and eliminate many potentially serious, disabling work related musculoskeletal disorders (MSDs). Ergonomics draws on a number of scientific disciplines, including physiology, biomechanics, psychology, anthropometry, industrial hygiene, and kinesiology.

Who Needs to Know about Ergonomics
You need to know about ergonomics if you are an employer or an employee in the manufacturing, construction, maritime, and agricultural industries and you or your employees' work activities and job conditions include:

- Repeating the same motion throughout your workday,
- Working in awkward or stationary positions,
- Lifting heavy or awkward items,
- Using excessive force to perform tasks, and
- Being exposed to excessive vibration or
- Extreme temperatures.

Why Ergonomics is Important
Industries increasingly require higher production rates and advances in technology to remain competitive and stay in business. As a result, jobs today can involve:

- Frequent lifting, carrying, and pushing or pulling loads without help from other workers or devices;
- Increasing specialization that requires the worker to perform only one function or movement for a long period of time or day after day;
- Working more than 8 hours a day;
- Working at a quicker pace of work, such as faster assembly line speeds; and
- Having tighter grips when using tools.

These factors—especially if coupled with poor machine design, tool, and workplace design or the use of improper tools—create physical stress on workers' bodies, which can lead to injury.

A dramatic increase in MSDs began in the 1970s when these disorders increasingly appeared on companies' injury and illness logs. OSHA cited companies for hazardous workplace conditions that caused problems such as tendinitis, carpal tunnel syndrome, and back injuries.

The Bureau of Labor Statistics, an agency of the U.S. Department of Labor, recognizes MSDs as a serious workplace health hazard. These injuries now account for more than one third of all lost—workday case.

Get a Grip!

Problem: Pharmaceutical technicians hand-tighten dozens of vaccine jug lids daily. If not adequately tightened, the jugs could leak and spoil products worth thousands of dollars. Testing revealed, however, that most operators are poor judges of cap torque—resulting in significant unwarranted hand and wrist stress. Operators also were marginally capable of using the proper torque required to tighten caps adequately.

Solution: The company purchased a dial torque wrench, made a special cap torque attachment, and trained the technicians to use the new equipment.

Cost: About $8 per worker.

If work tasks and equipment do not include ergonomic principles in their design, workers may have exposure to undue physical stress, strain, and overexertion, including vibration, awkward postures, forceful exertions, repetitive motion, and heavy lifting. Recognizing ergonomic risk factors in the workplace is an essential first step in correcting hazards and improving worker protection.

Ergonomists, industrial engineers, occupational safety and health professionals, and other trained individuals believe that reducing physical stress in the workplace could eliminate up to half of the serious injuries each year. Employers can learn to anticipate what might go wrong and alter tools and the work environment to make tasks safer for their workers.

Musculoskeletal Disorders

MSDs, or musculoskeletal disorders, are injuries and disorders of the soft tissues (muscles, tendons, ligaments, joints, and cartilage) and nervous system. They can affect nearly all tissues, including the nerves and tendon sheaths, and most frequently involve the arms and back. Occupational safety and health professionals have called these disorders a variety of names, including cumulative trauma disorders, repeated trauma, repetitive stress injuries, and occupational overexertion syndrome.

These painful and often disabling injuries generally develop gradually over weeks, months, and years. MSDs usually result from exposure to multiple risk factors that can cause or exacerbate the disorders, not from a single event or trauma such as a fall, collision, or entanglement. MSDs can cause a number of conditions, including pain, numbness, tingling, stiff joints, difficulty moving, muscle loss, and sometimes paralysis. Frequently, workers must lose time from work to recover; some never regain full health. These disorders include carpal tunnel syndrome, tendinitis, sciatica, herniated discs, and low back pain. MSDs do not include injuries resulting from slips, trips, falls, or similar accidents.

Parts of the Body Affected by MSDs:

- Arms
- Hands
- Fingers
- Neck
- Back
- Wrists
- Legs
- Shoulders

Causes of Work-related MSDs

Work-related MSDs occur when the physical capabilities of the worker do not match the physical requirements of the job. Prolonged exposure to ergonomic risk factors can cause damage a worker's body and lead to MSDs. Conditions that are likely to cause MSD problems include the following:

- Exerting excessive force;
- Excessive repetition of movements that can irritate tendons and increase pressure on nerves;
- Awkward postures, or unsupported positions that stretch physical limits, can compress nerves and irritate tendons;
- Static postures, or positions that a worker must hold for long periods of time, can restrict blood flow and damage muscles;
- Motion, such as increased speed or acceleration when bending and twisting, can increase the amount of force exerted on the body;
- Compression, from grasping sharp edges like tool handles, can concentrate force on small areas of the body, reduce blood flow and nerve transmission, and damage tendons and tendon sheaths;
- Inadequate recovery time due to overtime, lack of breaks, and failure to vary tasks can leave insufficient time for tissue repair;
- Excessive vibration, usually from vibrating tools, can decrease blood flow, damage nerves, and contribute to muscle fatigue.
- Whole-body vibration, from driving trucks or operating subways, can affect skeletal muscles and cause low-back pain; and
- Working in cold temperatures can adversely affect a worker's coordination and manual
- Dexterity and cause a worker to use more force than necessary to perform a task.

These risk factors, either alone or in combination, can subject workers' shoulders, arms, hands, wrists, backs, and legs to thousands of repetitive twisting, forceful, or flexing motions during a typical workday. To contribute to MSDs, however, these risk factors must be present for a sufficient duration, frequency, or magnitude.

Non-work related factors can also cause MSDs. Risk factors not related to your job can cause or contribute to MSDs. These factors include:

- Physical conditioning;
- Medical conditions, such as obesity, diabetes, and arthritis;
- Pregnancy;

- Hobbies that are hand intensive or require manual handling. In these instances, however, because one can control the duration and exposures, hobbies usually are not primary risk factors; and
- Psychological or social workplace stress.

MSDs affect workers in almost every occupation and industry in the nation and in workplaces of all sizes. The disorders occur most frequently in jobs that involve:

- Manual handling,
- Manufacturing and production,
- Heavy lifting,
- Twisting movements, and
- Long hours of working in awkward positions.

MSD Risk Factors

- Force
- Repetition
- Awkward postures
- Static postures
- Quick motions
- Compression or contact stress
- Vibration
- Cold temperatures

Understanding MSDs

You could have a work-related MSD if you experience any of the following:

Numbness in your fingers,

- Numbness in your thighs,
- Difficulty moving your finger,
- Stiff joints, or
- Back pain.

MSDs can affect nearly all tissues in the human body: the nerves, tendons, tendon sheaths, and muscles. The most frequently affected areas of the body are the arms and the back.

Tendon disorders such as tendinitis, tenosynovitis, De Quervain's disease, trigger finger, and carpal tunnel syndrome are the most common occupational MSDs associated with the arm. Tendon disorders are very common and often occur at or near the joints where the tendons rub against other tendons, ligaments, or bones. The most frequently noted symptoms of tendon disorders are a dull aching sensation over the tendon, discomfort with specific movements, and tenderness to touch. Recovery is usually slow, and the condition may easily become chronic if the physical stresses causing the problem are not eliminated or reduced.

Another MSD that has received increased attention in recent years is carpal tunnel syndrome, or CTS, which affects the hands and wrists. CTS is the compression and entrapment of the median

nerve where it passes through the wrist into the hand—in the carpal tunnel. The median nerve is the main nerve that extends down the arm to the hand and provides the sense of touch in the thumb, index finger, middle finger, and half of the fourth, or ring, finger.

When irritated, tendons housed inside the narrow carpal tunnel swell and press against the nearby median nerve. The pressure causes tingling, numbness, or severe pain in the wrist and hand—often felt while sleeping. The pressure also results in a lack of strength in the hand and an inability to make a fist, hold objects, or perform other manual tasks. If the pressure continues, it can damage the nerve, causing permanent loss of sensation and even partial paralysis.

CTS develops in the hands and wrists from repetitive and forceful manual tasks performed without time to recover. Any worker whose job demands a lot of repetitive wrist, hand, and arm motion—not necessarily forceful—could develop CTS.

Another MSD that accounts for a significant loss of productivity and large compensation costs to industry is back injury. Workers cite back disorders most often, after the common cold and flu, as reasons for missing work. The most common back problems are pulled or strained muscles, ligaments, and tendons. More serious disorders involve spinal discs. More than half the work force experience back pain at least once during a lifetime. When repetitive pulling and straining injures back muscles or ligaments, the back muscles, discs, and ligaments can become scarred and weakened and lose their ability to support the back. This makes additional injuries more likely.

Preventing MSDs

Many solutions to ergonomic problems in the workplace are simple and inexpensive. For example, awkward and uncomfortable positions can be eliminated by:

- Adjusting the height of working surfaces,
- Providing telephone headsets,
- Supplying anti-fatigue mats,
- Varying tasks,
- Providing short breaks,
- Reducing the weight and size of items workers must lift,
- Putting supplies and equipment within easy reach of the worker,
- Providing ergonomic chairs or stools, and
- Supplying the right tool for the job and the right handle for the worker.

The High Cost of MSDs - Good ergonomics is good economics.

- MSDs account for 34 percent of all lost-workday injuries and illnesses.
- Employers report nearly 600,000 MSDs requiring time away from work every year.
- MSDs account for $1 of every $3 spent for workers' compensation.
- MSDs each year account for more than $15 billion to $20 billion in workers' compensation costs. Total direct costs add up to as much as $50 billion annually.
- On average, it takes workers 28 days recover from carpal tunnel syndrome, longer than the time needed to recover from amputation or fractures.
- Workers with severe injuries can face permanent disability that prevents them from returning to their jobs or handling simple, everyday tasks.

Providing a workplace free of ergonomic hazards can do the following:

- Lower injury rates as MSD incidences go down;
- Increase productivity by making jobs easier and more comfortable for workers;
- Improve product quality because fewer errors will be made when using automated processes that demand less physical effort;
- Reduce absences because workers will be less likely to take time off to recover from muscle soreness, fatigue, and MSD-related problems;
- Reduce turnover as new hires are more likely to find an ergonomically designed job within their physical capacity;
- Lower costs as workers' compensation and other payments for illness and replacement workers go down;
- Improve worker safety;
- Increase worker comfort;
- Reduce worker fatigue; and
- Improve worker morale.

MSDs are often easy to prevent. If you are an employer whose workplace poses ergonomic risk factors or whose workers report MSDs, you can address this problem by:

- Establishing an ergonomics program, and
- Providing and encouraging employees to participate in the ergonomics program and in decisions affecting their safety and health.

If you are an employee who is exposed to ergonomic risk factors, you should:

- Participate in your employer's ergonomics program; and
- Provide feedback to supervisors and employers through available channels, such as an established employee safety and health committee.

Effective ergonomic programs should include the following elements:

- Management commitment and employee participation,
- Job hazard analysis,
- Controlling ergonomic risk,
- MSD management, and
- Training and education.

Examples of Musculoskeletal Disorders

Body Parts Affected	Symptoms	Possible Causes	Workers Affected	Disease Name
thumbs	pain at the base of the thumbs	twisting and gripping	butchers, housekeepers, packers, seamstresses, cutters	De Quervain's disease
fingers	difficulty moving finger; snapping and jerking movements	repeatedly using the index fingers	meatpackers, poultry workers, carpenters, electronic assemblers	trigger finger
shoulders	pain, stiffness	working with the hands above the head	power press operators, welders, painters, assembly line workers	rotator cuff tendinitis
hands, wrists	pain, swelling	repetitive or forceful hand and wrist motions	core making, poultry processing, meatpacking	tenosynovitis
fingers, hands	numbness, tingling; ashen skin; loss of feeling and control	exposure to vibration	chain saw, pneumatic hammer, and gasoline-powered tool operators	Raynaud's syndrome (white finger)
fingers, wrists	tingling, numbness, severe pain; loss of strength, sensation in the thumbs, index, or middle or half of the ring fingers	repetitive and forceful manual tasks without time to recover	meat and poultry and garment workers, upholsterers, assemblers, VDT operators, cashiers	carpal tunnel syndrome
back	low back pain, shooting pain or numbness in the upper legs	whole body vibration	truck and bus drivers, tractor and subway operators; warehouse workers; nurses aides; grocery cashiers; baggage handlers	back disability

Ergonomics for Computer Workstations

A common area that employers can focus their efforts in order to mitigate MSDs is to set up computer workstations so that they are appropriate for the person that is using them. This includes making sure that monitors are positioned properly, chairs are adjusted, desks are the right height, keyboard and mouse are correctly placed and lighting is suited for the environment.

Monitors

With regard to the monitor, one must take in to consideration how the placement and maintenance of the monitor can effect both the eyes and the musculoskeletal system. The following suggestions can help prevent the development of eye strain, neck pain and shoulder fatigue while using a computer workstation:

- Make sure the surface of the viewing screen is clean.
- Adjust brightness and contrast to optimum comfort.
- Position the monitor directly in front of user to avoid excessive twisting of the neck.
- Position the monitor approx. 20-26 inches (arm's length) from user.
- Tilt top of the monitor back 10 to 20 degrees.
- Position monitors at right angles from windows to reduce glare.
- Position monitors away from direct lighting which creates excessive glare or use a glare filter over the monitor to reduce glare.

The top of the viewing screen should be at eye level when the user is sitting in an upright position (NOTE: Bifocal wearers may need to lower monitor a couple of inches).

Adjusting Your Chair

Contrary to popular belief, sitting, which most people believe is relaxing, is hard on the back. Sitting for long periods of time can cause increased pressure on the intervertebral discs— the springy, shock-absorbing part of the spine. Sitting is also hard on the feet and legs. Gravity tends to pool blood in the legs and feet and create a sluggish return to the heart.

The following recommendations can help increase comfort for computer users:

- "Dynamic sitting", don't stay in one static position for extended periods of time.
- When performing daily tasks, alternate between sitting and standing.
- Adjust height of backrest to support the natural inward curvature of the lower back.
    - It may be useful to use a rolled towel or lumbar pad to support the low back.
    - The backrest angle is set so that your hip-torso angle is 90 degrees or greater.
- Adjust height of chair so feet rest flat on floor (use footrest if necessary).
    - Sit upright in the chair with the low back against the backrest and the shoulders touching the backrest.
    - Thighs should be parallel to the floor and knees at about the same level as the hips.

    - Back of knees should not come in direct contact with the edge of the seat pan (there should be 2-3 inches between the edge of the seat and the back of the knee).
- Don't use armrests to slouch.
- Adjust height and/or width of armrests so they allow the user to rest arms at their sides and relax/drop their shoulders while keyboarding.
- Where armrests are used, elbows and lower arms should rest lightly so as not to cause circulatory or nerve problems.

Desktops for Computer Workstations

If you are like many computer users, your computer, keyboard, and mouse are resting on your desk or a portable computer workstation. There is no specific height recommended for your desktop; however, the working height of the desk should be approximately elbow height for light duty desk work.

To allow for proper alignment of the arms a user's keyboard should be approximately 1 inch to 2 inches above their thighs (see Keyboard & Mouse). Most times this requires a desk which is 25 inches to 29 inches in height (depending upon size of individual) or the use of an articulating keyboard tray. The area underneath the desk should always be clean to accommodate the user's legs and allow for stretching.

The desktop should be organized so frequently used objects are close to the user to avoid excessive extended reaching. If a document holder is used, it should be placed at approximately the same height as the monitor and at the same distance from the eyes to prevent frequent eye shifts between the screen and reference materials.

Keyboard and Mouse

Many ergonomic problems associated with computer workstations occur in the forearm, wrist, and hand. Continuous work on the computer exposes soft tissues in these areas to repetition, awkward postures, and forceful exertions.

The following adjustments should be made to a workstation to help prevent the development of an ergonomic problem in the upper extremities:

- Adjust keyboard height so shoulders can relax and allow arms to rest at sides (an articulating keyboard tray is often necessary to accommodate proper height and distance).
- Keyboard should be close to the user to avoid excessive extended reaching.
- Forearms parallel to the floor (approximately 90 degree angle at elbow).
- Mouse should be placed adjacent to keyboard and at the same height as the keyboard (use articulating keyboard tray if necessary).
- Avoid extended and elevated reaching for keyboard and mouse. Wrist should be in neutral position (not excessively flexed or extended).

Do not rest the hand on the mouse when you are not using it. Rest hands in your lap when not entering data**.**

Lighting for Computer Workstations

Lighting not suited to working with a Video Display Terminal is a major contributing factor in visual discomforts including eyestrain, burning or itching eyes, and blurred or double vision. Typical office environments have illumination levels of 75 to 100 foot-candles, but according to the American National Standards Institute (ANSI), computer workstations require only 18 to 46 foot-candles.

Use the following recommendations to reduce eyestrain and eye fatigue:

- Close drapes/blinds to reduce glare. Adjust lighting to avoid glare on screen (light source should come at a 90 degree angle, with low watt lights rather than high.) Place monitor at 90 degree angle to windows (where possible). Reduce overhead lighting (where possible). Use indirect or shielded lighting where possible. Walls should be painted medium or dark color and not have reflective finish.
- Use a glare screen to reduce glare (alternatively, place a large manila folder on top of the monitor and let it hang over the monitor 2 inches -3 inches to reduce glare from overhead lighting).

Job Hazard Analysis

Job hazard analysis identifies problem jobs and risk factors associated with them.
This step helps employers determine what jobs and work stations are the source of the greatest problems. The most effective worksite analyses include all jobs, operations, and work activities where there are ergonomic risk factors, regardless of whether the employer's medical records indicate that workers have developed MSDs.

A thorough job analysis is important to successfully prevent or reduce the various MSD hazards at a work site. Workers exposed to ergonomic risk factors may develop a variety of symptoms. Moreover, a combination of factors in a single job or work station may cause MSDs. For example, research has shown that various symptoms among VDT operators result from problems in equipment, work stations, the office environment, and job design, or a combination of these. In addition, VDT operators experience not just one simple MSD, but often eyestrain, headaches, and excessive fatigue as well as neck, back and muscle pain, and stress. A comprehensive analysis of the worksite will identify the interplay of how various ergonomic risk factors affect workers.

Top Fifteen Occupations for MSDs

Laborers and Freight- Stock- and Material Movers- Hand
Nursing Aides- Orderlies- and Attendants
Truck Drivers- Heavy and Tractor-Trailer
Truck Drivers- Light or Delivery Services
Retail Salespersons
Stock Clerks and Order Fillers
Janitors and Cleaners- Except Maids and Housekeeping
Cleaners
Construction Laborers
Registered Nurses
Carpenters
Cashiers
Maids and Housekeeping Cleaners
Maintenance and Repair Workers- General
First-Line Supervisors/Managers of Retail Sales Workers
Automotive Service Technicians and Mechanics

Source: U.S. Department of Labor, Bureau of Labor Statistics, News Release, "Lost-work time Injuries and Illnesses; Characteristics and Resulting Time Away from Work, 2004,"

Employers can prevent MSD hazards by properly designing the job or work station and selecting the appropriate tools or equipment for that job. Based on information from the job analysis, an employer can establish procedures to correct or control risk factors by using:

- Appropriate engineering controls, such as work station, tool, and equipment design or redesign;
- Work practices, such as proper lifting techniques and keeping work areas clean;
- Administrative controls, such as worker rotation, more task variety, and increased rest breaks, and if necessary;
- Personal protective equipment, such as knee pads, vibration gloves, and similar devices.

CTS and Repetitive Motion

The meatpacking industry is one of the most hazardous industries in the United States because workers can make as many as several thousand repetitive motions per day in assembly line processes, such as deboning meats, with no variation in motion. The motions place physical stress and strain on the wrists and hands, resulting in CTS.

In manufacturing, garment makers, who often perform fast-paced piecework operations involving excessive repetitive tasks, increase their risk of developing CTS. Garment industry jobs often require workers to push large amounts of materials through machinery while sitting on unadjustable metal stools. Workers doing these jobs can sustain disabling wrist, back, and leg injuries.

The National Institute for Occupational Safety and Health recommends using the following guidelines in jobs requiring manual handling:

- Minimize the distance between the load and the body.
- Lift loads from knuckle height.
- Keep the travel distance for the lift to less than 10 feet.
- Minimize twisting.
- Provide good handles for grasping loads.

It is also important that work tools and equipment be ergonomically designed. Most hand tools are designed for only occasional use, not for repetitive use over prolonged periods.
When acquiring tools for regular use in an industrial setting, an employer should consider the following ergonomic features:

- Tools should be light-weight and handles designed to allow a relaxed grip so the wrists can remain straight.
- Tools should be designed for use with either hand and be of various sizes so they are appropriate for all workers.
- Tool handles should be shaped so that they contact the largest possible surface of the inner hand and fingers. Avoid tool handles with sharp edges and corners.
- Use power tools to reduce the amount of human force and repetition required.
- Purchase low-vibration tools to reduce tool vibration, and, if necessary, fit absorbent rubber sleeves over the tool handle.

Video display terminals (VDTS) should be equipped with adjustable and detachable keyboards, display screens that tilt up and down, brightness and contrast controls, and flexible copy holders that reduce the distance between the screen and the source material.

Maintenance of tools and equipment also is essential in preventing or reducing ergonomic hazards. Keep tools sharp and maintain them according to the manufacturer's specifications. Proper maintenance also can help reduce vibration resulting from prolonged equipment operation.

MSD management is another important element of an effective ergonomics program.
Proper MSD management focuses on early identification and evaluation of signs and symptoms of MSDs and helps eliminate or reduce the risk of developing MSDs.

Employers should include the following elements in any MSD management program:

- Injury and illness recordkeeping;
- Early recognition and reporting of MSD symptoms;
- Systematic evaluation and referral to a qualified health care provider;
- Conservative treatment, such as restricted duty jobs, when necessary;
- Conservative return to work;
- Systematic monitoring, including periodic workplace walkthroughs;
- Adequate staffing and facilities where employers provide on-site evaluation;
- Employee training and education;-

- Access to health care providers for each work shift; and
- No barriers to early reporting.

An Uplifting Solution

Problem: At a glass ceramic cooktop plant, workers manually lift uncut plates of glass onto a waist-high conveyor belt, where it is then stacked vertically on a nearby L-shaped holder. A forklift handles the strapped holder carrying the glass. The holder, however, presents the glass at knee-height, making workers bend each time to pick up the glass.

Solution: The workers devised a stand made from a wooden shipping crate and placed it beneath the L-holder to raise the glass to waist height.

Cost: A little labor.

Training and Education Programs

Training programs will go a long way toward increasing safety awareness among managers and supervisors, designers, buyers, mechanics, and workers who perform the jobs. Training and education ensure that employers sufficiently inform workers about ergonomic risk factors at their worksites so they are better able to participate actively in their own protection. Suggestions and input from workers aware of ergonomic risk factors can be very helpful in designing improved workplaces to reduce MSD hazards.

A good ergonomics training program will teach employees how to properly use equipment, tools, and machine controls as well as the correct way to perform job tasks. For example, employers should encourage work methods that allow workers to keep their joints in a neutral position (wrists straight and elbows bent at a right angle) while using tools requiring manual force to prevent excessive force on joints and tendons. Employers also should tell workers to avoid all side-to-side twisting and quick motions of their wrists and to keep their hands in line with their forearms while using tools or operating equipment. Employers should provide the appropriate controls or tools, as necessary, to reduce or eliminate awkward positions.

To minimize or prevent back disorders, employers should teach workers to avoid long reaches, maintain neutral postures, and use proper lifting techniques. Using correct posture is important whether an employee is sitting, standing, pulling, pushing, lifting, or using tools or equipment. Training workers in general lifting techniques also can help reduce the strain leading to back disorders. For example, employees should use their leg muscles and bend their knees to pick up and lower heavy loads. Providing appropriate equipment, such as conveyors or carts, lift tables and list assists, can also reduce load weight, minimizing incorrect lifting and potential injury.

Arm Them with Knowledge!

Problem: Employees in many different offices experience pain from their daily tasks.

Solution: Train workers to properly use the adjustments already provided in their chairs, computer monitors, and furniture systems. Changes in the placement of telephones, printers, and in-boxes can lead to better working posture. In addition, training and encouraging employees to take micro-breaks help overused parts of the body rest and recuperate.

Cost: Nothing.

In addition to training an employee to perform a job in an ergonomically correct manner, it is important to educate employees to take breaks, practice stretches and alternate positioning from time to time. The following exercises are examples of easy stretches that can be performed by an employee periodically throughout the day:

Eye Exercises and Stretches

Eye Comfort Exercises

A. Blinking (produces tears to help moisten and lubricate the eyes)
B. Yawning (produces tears to help moisten and lubricate the eyes)
C. Expose eyes to natural light

Palming

A. while seated, brace elbows on the desk and close to the desk edge
B. let weight fall forward
C. cup hands over eyes
D. close eyes
E. inhale slowly through nose and hold for 4 seconds
F. continue deep breathing for 15-30 seconds

Eye Movements

A. close eyes
B. slowly and gently move eyes up to the ceiling, then slowly down to the floor
C. repeat 3 times
D. close eyes
E. slowly and gently move eyes to the left, then slowly to the right
F. repeat 3 times

Focus Change

A. hold one finger a few inches away form the eye
B. focus on the finger
C. slowly move the finger away

D. focus far into the distance and then back to the finger
E. slowly bring the finger back to within a few inches of the eye
F. focus on something more than 8 feet away
G. repeat 3 times

Musculoskeletal System Exercises and Stretches

Deep Breathing

A. while standing, or in an otherwise relaxed position
B. place one hand on the abdomen and one on the chest
C. inhale slowly through the nose
D. hold for 4 seconds
E. exhale slowly through the mouth
F. repeat

Cable Stretch

A. while sitting with chin in, stomach in, shoulders relaxed, hands relaxed in lap, and feet flat on the floor, imagine a cable pulling the head upward
B. hold for 3 seconds and relax
C. repeat 3 times

Sidebend: Neck Stretch

A. tilt head to one side (ear towards shoulder)
B. hold for 15 seconds
C. relax
D. repeat 3 times on each side

Diagonal Neck Stretch

A. turn head slightly and then look down as if looking in your pocket
B. hold for 15 seconds
C. relax
D. repeat 3 times on each side

Shoulder Shrug

A. slowly bring shoulders up to the ears and hold for approx 3 seconds
B. rotate shoulders back and down
C. repeat 10 times

Executive Stretch

A. while sitting, lock hands behind head

B. bring elbows back as far as possible
C. inhale deeply while leaning back and stretching
D. hold for 20 seconds
E. exhale and relax
F. repeat 1 time

Foot Rotation

A. while sitting, slowly rotate each foot from the ankle
B. rotate 3 times in one direction, then 3 times in the opposite direction
C. relax
D. repeat 1 time

Hand Shake

A. while sitting, drop arms to the side
B. shake hands downward gently
C. repeat frequently

Hand Massage (Note: Perform very gently!)

A. massage the inside and outside of the hand using the thumb and fingers
B. repeat frequently (including before beginning work)

Finger Massage (Note: Perform very gently!)

A. massage fingers of each hand individually, slowly, and gently
B. move toward nail gently
C. massage space between fingers
D. perform daily

Wrist Stretch

A. hold arm straight out in front of you
B. pull the hand backwards with the other hand, then pull downward
C. hold for 20 seconds
D. relax
E. repeat 3 times each

Where to Find More Information

If you are an employer who has identified the need for an ergonomics program at your worksite, start by planning the program and the goals, and then put it into action.

You also may want to contact the ergonomics coordinator at the nearest OSHA Regional Office for further information and assistance. You can also find out about programs such as OSHA's a free consultation program, which can help you find out about potential hazards at your worksite, improve your occupational safety and health management systems, or qualify for a 1-

year exemption from routine OSHA inspections. If you are in a state that operates its own OSHA-approved safety and health plan, please contact your state plan office. State plans and consultation programs are listed on OSHA's website under Outreach.

A Perfect Fit

Problem: Employees in a poultry processing plant complained that ill-fitting protective gloves did not provide adequate protection.

Solution: The poultry processing company bought workers protective gloves from several manufacturers to provide a wide range of sizes for better fit.

Cost: Negligible.

For more information about ergonomics, contact the ergonomics coordinator at your OSHA Regional Office, visit the Ergonomics Page on OSHA's website at www.osha.gov, or call 1 (800) 321-OSHA.

OSHA publishes booklets and fact sheets detailing agency policy and regulations. Publications are listed on OSHA's website, or you also may contact:

OSHA Publications Office,
P.O. Box 37535,
Washington, DC 20012-7535,
(202) 693-1888

A wide range of publications on ergonomics are available from the National Institute for Occupational Safety and Health by calling 1-800-35-NIOSH, or through the link on OSHA's website.

Some OSHA-approved state plans also have materials available on ergonomics, such as CAL-OSHA's, Easy Ergonomics: A Practical Approach for Improving the Workplace, at http://www.dir.ca.gov/dosh/dosh_publications/EasErg2.pdf.

Really Turning It Around...

Problem: Workers pack items into rectangular boxes, positioned so they must reach repeatedly across the long axis of the boxes, exposing their backs, shoulders, and arms to physical stress.

Solution: Rotating the boxes allows workers to reach across the shorter axis of the box, reducing the length of reach and the risk of injury.

Cost: Nothing.

NIOSH Ergonomics Primer

Introduction

What are Work-Related Musculoskeletal Disorders (WMSDs)?

Although definitions vary, the general term "musculoskeletal disorders" describes the following:

Disorders of the muscles, nerves, tendons, ligaments, joints, cartilage, or spinal discs

Disorders that are not typically the result of any instantaneous or acute event (such as a slip, trip, or fall) but reflect a more gradual or chronic development (nevertheless, acute events such as slips and trips are very common causes of musculoskeletal problems such as low back pain)

Disorders diagnosed by a medical history, physical examination, or other medical tests that can range in severity from mild and intermittent to debilitating and chronic

Disorders with several distinct features (such as carpal tunnel syndrome) as well as disorders defined primarily by the location of the pain (i.e., low back pain)

The term "WMSDs" refers to (1) musculoskeletal disorders to which the work environment and the performance of work contribute significantly, or (2) musculoskeletal disorders that are made worse or longer lasting by work conditions. These workplace risk factors, along with personal characteristics (e.g., physical limitations or existing health problems) and societal factors, are thought to contribute to the development of WMSDs [Armstrong et al. 1993]. They also reduce worker productivity or cause worker dissatisfaction. Common examples are jobs requiring repetitive, forceful, or prolonged exertions of the hands; frequent or heavy lifting, pushing, pulling, or carrying of heavy objects; and prolonged awkward postures. Vibration and cold may add risk to these work conditions. Jobs or working conditions presenting multiple risk factors will have a higher probability of causing a musculoskeletal problem. The level of risk depends on the intensity, frequency, and duration of the exposure to these conditions and the individual s capacity to meet the force or other job demands that might be involved. These conditions are more correctly called "ergonomic risk factors for musculoskeletal disorders" rather than "ergonomic hazards" or "ergonomic problems." But like the term "safety hazard," these terms have popular acceptance.

Why are WMSDs a Problem?

Many reasons exist for considering WMSDs a problem, including the following:

- WMSDs are among the most prevalent lost-time injuries and illnesses in almost every industry [Bureau of Labor Statistics 1995, 1996; National Safety Council 1995; Tanaka et al. 1995].
- WMSDs, specifically those involving the back, are among the most costly occupational problems [National Safety Council 1995; Webster and Snook 1994; Guo et al. 1995; Frymoyer and Cats-Baril 1991].
- Job activities that may cause WMSDs span diverse workplaces and job operations (see Table 1).
- WMSDs may cause a great deal of pain and suffering among afflicted workers.

- WMSDs may decrease productivity and the quality of products and services. Workers experiencing aches and pains on the job may not be able to do quality work.

Because musculoskeletal disorders have been associated with non work activities (e.g., sports) and medical conditions (e.g., renal disease, rheumatoid arthritis), it is difficult to determine the proportion due solely to occupation. For example, in the general population, non occupational causes of low back pain are probably more common than workplace causes [Liira et al. 1996]. However, even in these cases, the musculoskeletal disorders may be aggravated by workplace factors.

What is Ergonomics?

Ergonomics is the science of fitting workplace conditions and job demands to the capabilities of the working population. Effective and successful "fits" assure high productivity, avoidance of illness and injury risks, and increased satisfaction among the workforce. Although the scope of ergonomics is much broader, the term in this primer refers to assessing those work-related factors that may pose a risk of musculoskeletal disorders and recommendations to alleviate them.

What is the Purpose of this Primer?

Many organizations have published primers and manuals describing programs and techniques to control ergonomic hazards [National Safety Council 1988; Canadian Center for Occupational Health and Safety 1988; Putz-Anderson 1988; UAW-GM Center for Health and Safety 1990; Oxenburgh 1991; American Meat Institute and ErgoTech, Inc. 1990; Occupational Safety and Health Administration 1993]. Some primers are tailored to particular industries; others are more general.

This primer outlines the approach most commonly recommended for identifying and correcting ergonomic problems. This document offers practical information (based on NIOSH experience in a variety of settings) for applying elements of this approach in workplaces. The steps typically used to describe ergonomics programs are used here to tap and organize the NIOSH database of relevant experience.

Information about the techniques, instruments, and methods mentioned in examples of NIOSH work and other reference materials appear in the appendix, referred to as a Toolbox. Included in the Toolbox is a master chart listing details of NIOSH evaluations involving WMSDs reported over the past 15 years. Finding work settings or jobs in this chart that are related to the readers jobs may help the reader capitalize on the information contained in these reports, which are available from the National Technical Information Service (NTIS).

This primer is geared to those who need knowledge of ergonomics because of their roles as employers or as persons responsible for ensuring safe and healthful work conditions in their companies. Use of numerous examples from real workplaces emphasizes practical approaches.

Step 1: Looking for Signs of Work-Related Musculoskeletal Problems

What are clues or tip-offs to WMSDs as a real or possible workplace problem? Some signs are obvious while others are more subtle. The first step is to look for these signs or clues.

Recognizing Signs That May Indicate a Problem

Company OSHA Form 200 logs or workers compensation claims show cases of WMSDs such as carpal tunnel syndrome, tendinitis, tenosynovitis, epicondylitis, and low back pain. Sometimes these records contain nonspecific entries like "hand pain," which (while not a specific diagnosis) may be an indicator of a significant health problem if severe or persistent.

- Certain jobs or work conditions cause worker complaints of undue strain, localized fatigue, discomfort, or pain that does not go away after overnight rest.
- Workers visiting the clinic make frequent references to physical aches and pains related to certain types of work assignments.
- Job tasks involve activities such as repetitive and forceful exertions; frequent, heavy, or overhead lifts; awkward work positions; or use of vibrating equipment.

Signs like these have triggered requests for NIOSH evaluations of possible ergonomic problems and risks of WMSDs. Some examples of reasons that have been given for requesting NIOSH ergonomic evaluations are described in Exhibit 1. These examples show that WMSDs can occur in a variety of workplaces.

Other signals that could alert employers to potential problems include the following:

- Trade publications, employers insurance communications, or references in popular literature indicating risks of WMSDs connected with job operations in the employer's business
- Cases of WMSDs found among competitors or in similar businesses
- Proposals for increasing line speed, retooling, or modifying jobs to increase individual worker output and overall productivity

Table 1 illustrates a variety of industries and job tasks in which NIOSH evaluations found evidence of WMSDs.

Table 1: Selected work settings from NIOSH investigations showing evidence of WMSDs

Meat packing	Cleaning Metal tubs, shank trimming, removing lard and internal organs
Warehousing	Lifting and carrying containers of assorted weights
Metal fabrication	Cutting, threading, shaping bar stock, and coupling parts to form product
Electronics assembly	Coil winding or trimming wire, circuit board wiring, fastening parts and packing products
Supermarket	Express checkout operations
VDT office & clerical	Sustained data entry and nonadjustable workstations

Clothing manufacture	Sewing tasks
Glass products	Decorating or etching glass
Plumbing fixtures	Lifting and moving toilet bowls weighing 45 to 70 lb
Sheet metal products	Riveting, seaming, assembly work
Plastic products	Parts molding, trimming excess material, filing, and reaming and sanding to finish product
Logging	Extended driving of log stackers or haulers over rough terrain
Film & paper products	Repackaging larger bulk materials into smaller units for distribution
Day care	Lifting and bending in tending to infant needs
Jewelry manufacturing	Waxing, cutting, finishing tasks
Cabinetmaking	Lifting and push-pull tasks
Auto products	Lifting and handling parts weighing 36 to 78 lb
Tool and die making	Grinding, polishing, deburring tasks

Determining a Level of Effort

Clues that indicate ergonomic problems may also suggest the scope of the effort required to correct them. For example, signs implicating multiple jobs in various departments and involving a large percentage of the workforce would indicate the need for a full-scale, company-wide program. Alternatively, signs that the suspected problems are confined to isolated tasks and relatively few workers may suggest starting with a more limited, focused activity.

The program elements offered in this primer describe the development of a full-scale ergonomics program for use in a company-wide approach. All companies may benefit from such an approach. However, the intensity of the program may need to be calibrated to the magnitude of the problem. For smaller-scale efforts that are directed at specific problems or situations in which problem jobs or affected workers are quite limited, selected elements of the overall program may be useful. Exhibits in this primer cover a range of efforts and will clarify aspects of both full-scale and more limited approaches. Understandably, a company's initial efforts in ergonomics will be directed toward fixing the most obvious problem jobs. The program elements described here offer a framework for an orderly undertaking of such activities. Moreover, even if the evidence for WMSDs is not clear, implementing the program can have value by enabling early detection of (and more timely interventions in) potential ergonomic problems. Also, an ergonomics program can influence the design of future changes in work processes to reduce the possibility of WMSDs. In these instances, the envisioned efforts have proactive benefits that will help prevent WMSDs.

Exhibit 1: Triggers for NIOSH Evaluations

Manufacturing Work Setting
A plumbing-ware manufacturing company asked NIOSH to assist in an ergonomics evaluation of their production operations after an OSHA inspection found a high number of back injuries at the facility relative to the rates at other manufacturing plants in the same industrial classification. This industry as a whole had the tenth highest OSHA reportable incidence rate in the United States for 1986. The work areas where most back injuries had occurred were identified by the plant's safety director, and the jobs believed most stressful to the workers' backs became the main targets of the evaluation that ensued [HETA 88–237–L1960].

Office Work Setting
NIOSH received a request from a local union representing office and professional employees of a health insurance company to evaluate potential hazards from the use of video display terminals (VDTs) in data entry operations. Numerous, wide-ranging symptomatic complaints had been voiced by the terminal operators, including headaches, general malaise, eyestrain and other visual problems, back pain, and stiffness and soreness in the neck and shoulder areas and upper extremities. A questionnaire used for data gathering during the evaluation verified more complaints of this nature among VDT users than nonusers, and environmental and workstation measurements suggested that certain ergonomic factors contributed to these differences [HETA 79–060–843].

Service Work Setting
The owner and employees of a preschool day care center asked NIOSH to identify possible causes of musculoskeletal problems, chiefly back pain and lower extremity (knee) pain and discomfort, reported by the teachers and aides at the school. Subsequent data collected on symptomatic complaints and observations and analyses of work activities indicated that factors such as frequent lifting of infants and sustained periods of kneeling, stooping, squatting, and trunk bending were responsible for the problems [HETA 93–0995–242].

Step 2: Setting the Stage for Action

As with other workplace safety and health issues, managers and employees both play key roles in developing and carrying out an ergonomics program. Ergonomics as Part of a Company Safety & Health Program

Ergonomics as Part of a Company Safety & Health Program

Ergonomics programs should not be regarded as separate from those intended to address other workplace hazards. Aspects of hazard identification, case documentation, assessment of control options, and health care management techniques that are used to address ergonomic problems use the same approaches directed toward other workplace risks of injury or disease. Although many of the technical approaches described in this primer are specific to ergonomic risk factors

and work-related musculoskeletal disorders, the core principles are the same as efforts to control other workplace hazards.

The financial benefits of comprehensive safety and health programs have been well documented. Workplaces safe from hazardous conditions have lower costs due to decreased lost time, absenteeism, worker compensation premiums, etc. [Office of Technology Assessment 1995]. Ergonomics programs have been shown to be cost effective for similar reasons [McKenzie et al. 1985; Lapore et al. 1984]. In addition, ergonomic improvements may result in increased productivity and higher product quality [McKenzie et al. 1985; LaBar 1994; LaBar 1989].

The ergonomics program elements outlined in this primer and the cases used to illustrate them follow a course that is mainly reactive in nature. The steps offer a plan to identify current problems that need to be addressed and actions aimed at resolution or control of such problems. This approach recognizes that management s first efforts to deal with ergonomic problems will probably be reactive. However, proactive approaches that seek to anticipate and prevent problems should be the ultimate goal. More will be said about proactive ergonomic approaches later in this document.

Expressions of Management Commitment

Occupational safety and health literature stresses management commitment as a key and perhaps controlling factor in determining whether any work site hazard control effort will be successful [Cohen 1977; Peters 1989; Hoffman et al. 1995]. Management commitment can be expressed in a variety of ways. Lessons learned from NIOSH case studies of ergonomic hazard control efforts in the meat packing industry [Gjessing et al. 1994] emphasize the following points regarding evidence of effective management commitment:

- Policy statements are issued that
    - treat ergonomic efforts as furthering the company s goals of maintaining and preserving a safe and healthful work environment for all employees,
    - expect full cooperation of the total workforce (managers, supervisors, employees, and support staff) in working together toward realizing ergonomic improvements,
    - assign lead roles to designated persons who are known to "make things happen,"
    - give ergonomic efforts priority with other cost reduction, productivity, and quality assurance activities, and
    - have the support of the local union or other worker representatives.
- Meetings between employees and supervisors allow full discussion of the policy and the plans for implementation.
- Goals are set that become more concrete as they address specific operations. Goals give priority to the jobs posing the greatest risk.
- Resources are committed to
    - training the workforce to be more aware of ergonomic risk factors for work-related musculoskeletal disorders,
    - providing detailed instruction to those expected to assume lead roles or serve on special groups to handle various tasks,

  - bringing in outside experts for consultations about start-up activities and difficult issues at least until in-house expertise can be developed, and
  - implementing ergonomic improvements as may be indicated.
- Release time or other compensatory arrangements are provided during the workday for employees expected to handle assigned tasks dealing with ergonomic concerns.
- Information is furnished to all those involved in or affected by the ergonomic activities to be undertaken. Misinformation or misperceptions about such efforts can be damaging: If management is seen as using the program to gain ideas for cutting costs or improving productivity without equal regard for employee benefits, the program may not be supported by employees. For example, management should be up-front regarding possible impacts of the program on job security and job changes. All injury data, production information, and cost considerations need to be made available to those expected to make feasible recommendations for solving problems.
- Evaluative measures track the results of the ergonomic efforts to indicate both the progress that has been made and the plans that need to be revised to overcome apparent problems. Reporting results of the program and publicizing notable accomplishments also emphasize the program s importance and maintain the interest of those immediately involved and responsible.

Benefits and Forms of Worker Involvement

Promoting worker involvement in efforts to improve workplace conditions has several benefits [Lawler III 1991; Cascio 1991; Schermerhorn et al. 1985; LaBar 1994; Noro and Imada 1991]. They include

- enhanced worker motivation and job satisfaction,
- added problem-solving capabilities,
- greater acceptance of change, and
- greater knowledge of the work and organization.

Worker involvement in safety and health issues means obtaining worker input on several issues. The first input is defining real or suspected job hazards. Another is suggesting ways to control suspected hazards. A third involves working with management in deciding how best to put controls into place. One NIOSH experience of worker involvement with ergonomic issues is illustrated in Exhibit 2.

Employee participation in an organization s efforts to reduce work-related injury or disease in general, and ergonomic problems in particular, may take the form of direct or individual input as described in Exhibit 2. A more common form is participation through a joint labor-management safety and health committee, which may be company-wide or department-wide in nature. Membership on company-wide committees includes union leaders or elected worker representatives, department heads, and key figures from various areas of the organization. At this level, typical committee functions consist of (1) discussing ways to resolve safety and health issues, (2) making recommendations for task forces or working groups to plan and carry out specific actions, and (3) approving use of resources for such actions and providing oversight. Committee make-up and function at the department level are more localized, since they are directed to issues specific to the operations found therein. Composition here can be limited to workers from the department or area engaged in similar jobs who, with their supervisors and

select others (e.g., maintenance), propose ways for reducing work-related problems, including those posing injury or disease risks. Because of their smaller size and opportunities for closer contacts among members, such committees may be referred to as a work group [Davis and Newstrom 1985].

The department or area work group approach appears to be a popular one in addressing ergonomic problems. Factors identified in the literature that are influential to success in these efforts are identified in Table 2. Also shown in Table 2 are factors that can enhance direct worker inputs in workplace problem solving.

Table 2. Factors affecting worker participation in workplace problem solving

Committee or work group approach	Direct worker input
Work group sizes of 7 to 15 afford ample interaction and cohesive actions. Work group leaders committed to the process of group problem solving increase chances of success, as does prompt recognition and rewards from higher-level management. Precautions need to be taken to prevent supervisors, managers, or other team members from dominating discussions or intimidating workers. Adoption of orderly procedures in (1) defining problems, (2) data gathering and analysis, and (3) developing proposed remedies and plans for implementation ensure likely acceptance and support. Training is needed in the technical aspects of the target problems as well as group interaction. For the latter, workers need training in communication skills; supervisors, in feedback and listening skills. Work group expectations and goals need to be realistic; solving easier problems first can build confidence to overcome later frustrations	Procedures are in place that facilitate worker direct reporting to responsible officials on real or alleged problems. Both formal and informal channels can be used. Campaigns are undertaken to solicit worker reports of potential problems and suggestions for improvement in job operations or conditions. Periodic surveys are undertaken to obtain worker reactions to workplace conditions that may suggest that may suggest or confirm problems. Timely feedback and indications of actions taken in response to worker inputs have motivating qualities. Publicizing suggestions implemented and results in newsletters are similarly reinforcing. Workers are most likely to detect hazards having physical, structural features or distinct environmental characteristics. They tend to be less aware or more accepting of risks posed by functional or procedural practices. More hazard awareness training is needed.

Committees that oversee work groups engaged in problem solving should not overextend their roles in dictating or implementing solutions. A top-down approach sends the wrong signal in efforts to promote worker participation.	

NIOSH assistance to the work of a joint labor-management safety committee is noted in Exhibit 3, which describes the actions of a plant-wide committee dealing with ergonomic hazards and work-related musculoskeletal problems in a piston manufacturing plant. Exhibit 4 outlines the results of work group efforts in a NIOSH study of meat packing operations that focused on participatory approaches to control ergonomic and musculoskeletal problems. A direct worker input approach was described in Exhibit 2, but another example is offered in Exhibit 5 to reveal a limitation.

As noted in Exhibits 3, 4, and 5 and in Table 2, two factors are critical to the different forms of worker involvement. One is the need for training both in hazard recognition and control and in group problem solving. The second is that management must share information and knowledge of results with those involved.

No single form or level of worker involvement fits all situations or meets all needs. Much depends on the nature of the problems to be addressed, the skills and abilities of those involved, and the company's prevailing practices for participative approaches in resolving workplace issues.

Who Should Participate?

Ergonomic problems typically require a response that cuts across a number of organizational units. Hazard identification through job task analyses and review of injury records or symptom surveys, as well as the development and implementation of control measures, can require input from

- safety and hygiene personnel,
- health care providers,
- human resource personnel,
- engineering personnel,
- maintenance personnel, and
- ergonomics specialists.

In addition, worker and management representatives are considered essential players in any ergonomics program effort.

In small businesses, two or more of the functions noted on this list may be merged into one unit, or one person may handle several of the listed duties. Regardless of the size of the organization, persons identified with these responsibilities are crucial to an ergonomics program. Purchasing personnel in particular should be included, since the issues raised can dictate new or revised specifications on new equipment orders.

How best to fit these different players into the program could depend on the company s existing occupational safety and health program practices. Integrating ergonomics into the company's current occupational safety and health activities while giving it special emphasis may have the most appeal.

Exhibit 2: Worker Involvement

NIOSH was asked to evaluate musculoskeletal pain and discomfort in the upper neck and shoulder areas as well as the lower back, buttocks, and legs of cashiers. The pain was thought to result from operating registers at express checkout counters in a supermarket. In analyzing workstation design and job task factors that could account for the above problems, the investigators interviewed a number of cashiers. The cashiers related their musculoskeletal complaints specifically to certain design characteristics of the checkout counters. They indicated that

- the far corner of the checkout counter required extended reaching for items, resulting in excessive trunk flexion and bending,
- the register keyboard height and distance induced static stress and shoulder flexion, and
- other tasks performed at the workstations required constant twisting because of the layout.

At a meeting with management and workers, initial interventions that gave priority to these problematic factors were agreed upon. A barrier was placed at the far corner of each checkout counter to reduce the extended reaching and bending for groceries, and height-adjustable keyboards were installed to relieve the static stress and shoulder flexion. Reductions in the number of symptoms associated with these active areas of the intervention were found following the implementation of these measures [HETA 88–345–2031; Orgel et al. 1992].

Exhibit 3: A Joint Labor-Management Committee Approach

The ergonomics committee at a plant that manufactured pistons and piston sleeves asked NIOSH to conduct an ergonomics evaluation to further their efforts at reducing cases of musculoskeletal disorders. This committee had been formed as a result of contract negotiations with the local union and in recognition of excessive cases of musculoskeletal disorders and increased production demands. The committee consisted of one hourly and one salaried person from each of six plant departments, one industrial engineer, three manufacturing engineers, three department superintendents, and one secretary, who provided input on office ergonomics. The plant manager chaired the committee, which met for 1 to 2 hours each month. Education and training in ergonomics were provided through viewing videotapes and reading literature received from the State safety councils. Selected workers in the plant workforce also viewed this material.

The committee focused on problem areas identified through examining safety logs, talking with the equipment operators, and observing job operations. Linkages between injury patterns, operator reports, and observations served to target major problem areas for priority attention. In one instance, a cluster of upper-limb problems was reported by the milling machine operators who had to open and close the machine doors manually for each piston sleeve being milled. The committee decided to install automatic door openers and closers. Workers suggested these and other ergonomic solutions to apparent problems, and the controls were fabricated in the plant's maintenance department. However, because of their limitations in addressing the less obvious ergonomic problems, the committee asked for NIOSH assistance.

NIOSH recommended specific control measures on the basis of its investigators' observations and acknowledged the need for more on-site training of workers in recognizing ergonomic hazards and risks of musculoskeletal injury in their jobs. In light of the plant safety data and observations of job operations, guidance was offered to create a more proactive effort in preventing WMSDs. A limitation of the committee approach used in this plant was that most of the input came from management. Their preoccupation with production demands could override the time and effort needed to resolve job tasks presenting risks of WMSDs. On the other hand, the committee benefited from their increased knowledge and experience in dealing with ergonomic hazards. One result was that decisions about future procurements of machines and proposed changes in manufacturing processes were to include ergonomic considerations [HETA 94–0040–2496].

Exhibit 4: A Work Group Approach

In 1992, NIOSH commissioned three case studies to demonstrate the efficacy of using "ergonomics teams" in addressing hazards in meat packing plants. The studies, conducted at three different sites, depicted a variety of contexts and opportunities for observing the merits of this form of worker involvement. The studies showed the following:

- Sustained participatory efforts in ergonomics problem solving require strong in-house direction and support plus significant staff expertise in both team building and ergonomics. In one of the three cases in which the effort was largely driven by an outside investigator, there were indications the program would not be sustained.

- Accomplishments, in terms of number of tasks or jobs analyzed and solutions offered and implemented, were most apparent in those cases showing significant training efforts in both team building (group techniques in task analyses, interpersonal processes, developing consensus) and ergonomics (defining risk factors related to musculoskeletal disorders and techniques for job analyses). The case indicating the least progress had limited formal training in ergonomics and used the team simply to brainstorm possible solutions to problems without much other background preparation.

- Most team progress was evident if teams were kept small and included production workers engaged in the jobs under study, area supervisors, and maintenance and engineering staff who could effect proposed job improvements. In two cases, higher personnel served on second-level groups providing oversight to the team activities and approval of actions as needed.

- Team members in the three case studies shared information (injury and production data) bearing on job problems. In addition, reports about the teams' objectives, progress, and accomplishments were circulated to keep the plant workforce informed. Problem-solving goals, as established by the teams, took more time than anticipated to attain. More realistic goals may need to be set [Gjessing et al. 1994].

Note: In two of the three plants in which these case studies were conducted, worker members were chosen by the unions to serve on the work team. The formation of these teams did not violate the existing collective bargaining process.

Exhibit 5: An Individual Input Approach

NIOSH sponsored a study at a major hospital site in which a plan was followed based on employee hazard recognition and problem solving. A special committee was developed to encourage workers to report unsafe conditions and to make suggestions for corrective measures. The committee provided prompt feedback about actions taken through the hospital-wide posting of bulletins on progress, as well as other forms of publicity.

Measurements taken before and 12 months after the program was implemented showed a 33% increase in the number of hazards reported by workers, with a corresponding drop in injury rates of 25%. These rates suggested an increased safety consciousness among the workers and a consequent reduction in injuries. Relevant to the subject of ergonomics were results found in comparing the content of the hazard reports with the actual agent or injury data. Workers tended to detect more physical hazards (slip and trip hazards, struck by or against hazards) than were accounted for in terms of actual injury, but they clearly underestimated those involving overexertion, such as in patient lifting or other procedural-type situations. These data suggested the need for more worker training devoted to these kinds of concerns [Lin and Cohen 1983].

Step 3: Training – Building In-house Expertise

Identifying and solving workplace WMSD problems require some level of ergonomic knowledge and skills. Recognizing and filling different training needs is an important step in building an effective program.

Training in Job Analyses and Control Measures

Training is recognized as an essential element for any effective safety and health program [Colligan 1994]. For ergonomics, the overall goal of training is to enable managers, supervisors, and employees to identify aspects of job tasks that may increase a worker s risk of developing WMSDs, recognize the signs and symptoms of the disorders, and participate in the development of strategies to control or prevent them [Kuorinka and Forcier 1995]. Training employees ensures that they are well informed about the hazards so they can actively participate in identifying and controlling exposures. Common forms of ergonomics training are noted below, along with their objectives. Table 3 lists the categories of employees who should receive the indicated instructions, especially if a team approach is used to analyze job risk factors and develop control measures. Employers may opt to have outside experts conduct these tasks. If so, the outside instructors should first become familiar with company operations and relevant policies and practices before starting to train. Tailoring the instruction to address specific concerns and interests of the worker groups can enhance learning.

Table 3. Ergonomics training for various categories of employees

	All employees	Every employee in suspect problem jobs	Every supervisor of jobs with suspect problems	Every employee involved in job analysis and control development	Ergonomics team or work group members[1]
General ergonomics awareness information[2]	X	X	X	X	X
Formal awareness instruction and job specific training		X	X	X	X
Training in job analysis and controlling risk factors				X	X
Training in problem solving and the team approach					X

[1]If ergonomics teams are formed, added instruction is needed in team-building and consensus development processes, apart from application of ergonomics techniques.
[2]General ergonomics awareness information for all employees need not require class instruction; it can be disseminated via handouts and all-hands meetings.

Ergonomics Awareness Training

The objectives for ergonomics awareness training are as follows:

- Recognize workplace risk factors for musculoskeletal disorders and understand general methods for controlling them.
- Identify the signs and symptoms of musculoskeletal disorders that may result from exposure to such risk factors, and be familiar with the company s health care procedures.
- Know the process the employer is using to address and control risk factors, the employee s role in the process, and ways employees can actively participate.
- Know the procedures for reporting risk factors and musculoskeletal disorders, including the names of designated persons who should receive the reports.
- Training in Job Analyses and Control Measures

The objectives for training in job analyses and control measures are as follows:

- Demonstrate the way to do a job analysis for identifying risk factors for musculoskeletal disorders
- Select ways to implement and evaluate control measures.

Training in Problem Solving

The objectives for training in problem solving are as follows:

- Identify the departments, areas, and jobs with risk factors through a review of company reports, records, walk-through observations, and special surveys.
- Identify tools and techniques that can be used to conduct job analyses and serve as a basis for recommendations.
- Develop skills in team building, consensus development, and problem solving.
- Recommend ways to control ergonomic hazards based on job analyses and pooling ideas from employees, management, and other affected and interested parties.

Special Considerations and Precautions

Materials for offering awareness training to the workforce are available, including videotapes and pamphlets from NIOSH. Employers may prefer to generate their own informational materials tailored to their particular job operations. Persons or groups assigned to or expected to play a key role in ergonomic hazard control work will require added instruction in problem identification, job analyses, and problem-solving techniques. This training is available through short courses publicized in many occupational safety and health publications or through a consultant.

Training objectives are not intended to have workers, supervisors, or managers diagnose or treat WMSDs. Rather, the purpose is to instill an understanding of what type of health problems may be work related and when to refer employees for medical evaluation. The training should

include what is known about work and non work causes of musculoskeletal disorders and the current limitations of scientific knowledge.

Training should be understandable to the target audience. Training materials used should consider the participants educational levels, literacy abilities, and language skills. This may mean, for example, providing materials, instruction, or assistance in Spanish rather than English.

Open and frank interactions between trainers and trainees, especially those in affected jobs, are especially important. Employees know their own jobs better than anyone else and often are the source of good ideas for ways to improve them. At a minimum, employees must be given an opportunity to discuss ergonomic problems in their jobs as they see them and engage in relevant problem-solving exercises during the training.

One NIOSH experience in direct work site training included a demonstration study in which a work group or team approach was adopted for problem solving. Training efforts to prepare the team to perform this function are described in Exhibit 6.

Exhibit 6: Team Training in Ergonomic Problem Solving

University investigators, in partnership with NIOSH, undertook a case study of an ergonomics team approach in implementing control measures to reduce WMSDs at a meat packing plant. In all, five joint management-labor teams representing different departments, each consisting of 7 to 9 members, were formed. Team-building training consisted of sessions designed to enhance the members' abilities to work together. Team-building activities included:

- defining a team,
- determining the goals of an ergonomics team,
- establishing group meeting rules and team roles,
- reviewing guidelines for effective group discussion and constructive feedback, and
- practicing brainstorming exercises and techniques for consensus building.

Consistent with the approaches advocated by experts in team building, the training emphasis throughout was about the way to develop task-oriented skills and positive, interpersonal processes. Forms for documenting team members' responsibilities, records of meetings and actions taken, and other handouts served to reinforce these points.

The ergonomics training given to the teams included using videotaped instruction and practice in job analysis techniques to identify and prioritize jobs needing intervention. The video analysis used a rating technique to determine the extent of hand, wrist, arm, and shoulder movements, as well as the positions of the backs and necks of workers while they performed tasks in their departments. Job analyses used OSHA log entries, observations of job tasks, and worker input about ways to ease the difficulty of those job operations presenting the most stressful problems [Gjessing et al. 1994].

Step 4: Gathering & Examining Evidence of WMSDs

Once a decision has been made to initiate an ergonomics program, a necessary step is to gather information to determine the scope and characteristics of the problem or potential problem. A variety of techniques and tools have been used; many provide the basis for developing solutions to identified problems.

Health and Medical Indicators

Following up of worker reports

Assuring that employees feel free to report, as early as possible, symptoms of physical stress is a key component of any ergonomics program. Early reporting allows corrective measures to be implemented before the effects of a job problem worsen. As mentioned earlier, individual worker complaints that certain jobs cause undue physical fatigue, stress, or discomfort may be signs of ergonomic problems. Following up on these reports, particularly reports of WMSDs, is essential. Such reports indicate a need to evaluate the jobs to identify any ergonomic risk factors that may contribute to the cause of the symptoms or disorders. Techniques to evaluate jobs are described later.

Reviewing OSHA Logs and Other Existing Records

Inspecting the logs of injuries and illnesses required by OSHA and plant medical records can yield information about the nature of WMSDs, as can workers compensation claims, insurance claims, absentee records, and job transfer applications. Finding workers in certain departments or operations presenting more of these problems than others (and exhibiting the same types of musculoskeletal disorders) would suggest some immediate areas for study with regard to possible risk factors. Jobs with elevated rates of low back musculoskeletal disorders often also have higher risks for acute injuries due to slips and trips or other safety hazards. In these cases, acute musculoskeletal injuries may also be an important problem. NIOSH evaluations of alleged work-related musculoskeletal problems begin with an examination of OSHA and medical records to understand the magnitude and seriousness of such problems. These records may also offer leads to jobs or operations that may cause or contribute to musculoskeletal disorders. Exhibits 7 and 8 illustrate the kind of data one might find, the evaluations made to judge the significance of the data, and their use in targeting jobs for ergonomic risk analysis.

Conducting Symptom Surveys

In Exhibit 8, entries from OSHA records and other medical reports documented worker disorders, and information from interviews with workers linked the disorders to workplace factors. Interviews or symptom surveys have been used to identify possible WMSDs that might otherwise go unnoticed. In addition to questions about the type, onset, and duration of symptoms, symptom survey forms may include a body map [Corlett and Bishop 1976; Hales and Bertsche 1992] wherein the respondent is asked to locate and rate the level of discomfort experienced in different areas of his or her body. The assumption is that any discomfort or symptoms may be associated with some increased risk for WMSDs. Compared with OSHA logs, symptom surveys provide a more sensitive way to determine who has symptoms and who does

not. A disadvantage of symptom questionnaires is their reliance on self-reports. Other factors besides the presence or absence of WMSDs may influence the reporting of symptoms, and the analysis and interpretation of questionnaire data can be complex. Hales and Bertsche [1992] offer one example of a symptom survey form. Such data collection can help identify specific jobs or job elements deserving an ergonomic analysis. Also needed are other questions dealing with the worker s perception of job tasks that induce the discomfort. Exhibit 9 describes a NIOSH health hazard evaluation that used a questionnaire to gather relevant symptom data.

Exhibit 7: Reviewing OSHA Logs

NIOSH was asked to conduct a health hazard evaluation at a plant that fabricates wheels for trucks and busses. Major plant processes involved forming steel stock into the rims and center cores of the wheels, welding them together, and finishing and painting the welded product which was then crated for shipment. One objective of the evaluation was to verify the company's concerns about musculoskeletal problems that seemed related to operations in assembly and disc forming work. NIOSH reviewed the company's OSHA log entries for injuries and illnesses for the past 2 years and found about half (291 of a total of 588 entries) were cases of strains and sprains, carpal tunnel syndrome, tendinitis, bursitis, and other musculoskeletal problems. The musculoskeletal injury rate for the plant was 26.1 injuries per 100 employees. This rate exceeded the expected rate of 10.6 injuries per 100 employees based on the Bureau of Labor Statistics' reports that were then available for the motor vehicle parts industry. Back injury (primarily low back strain) constituted the largest proportion of injuries in the strain and sprain category; the total plant rate for back disorders was 11.3 injuries per 100 workers per year which was 5 times the rate for the industrial workforce as a whole. The rate of back disorders was highest in the Assembly Department (23.7 injuries per 100 workers per year) followed by the Disc Forming Department (20.0 injuries per 100 workers per year). Consequently, job tasks in these two departments became the primary targets for analyzing and controlling risk factors (predominantly repeated, heavy lifting) that could account for the observed musculoskeletal problems [HETA 88-277-2069].

Exhibit 8: Using OSHA Logs and Worker Interviews

On the recommendation of a State occupational safety and health agency and on the basis of their inspection of certain work conditions, the management of a window manufacturing plant asked NIOSH to evaluate the risk of carpal tunnel syndrome among workers engaged in assembling window units. As part of a medical evaluation, NIOSH investigators reviewed OSHA Form 200 logs and pertinent company medical records and held confidential interviews with workers doing the assembly work. Questions asked during the interviews sought information about the symptoms workers experienced since beginning work at the plant, including the date of onset, location, type, severity and timing (during day or night, steady or intermittent), duration, medical and surgical treatment, past medical history, most difficult job tasks, and hobbies. They also asked for suggestions for changes in assembly procedures or tools used to alleviate apparent problems.

The following case definition of work-related carpal tunnel syndrome was adopted in assessing these data:

- During the interview, the worker reported pain, numbness, or tingling affecting the median nerve distribution of the hand(s).
- Symptoms lasted at least 1 week or occurred on multiple occasions.
- Symptoms were severe enough to waken the person from sleep.
- Evidence existed of work relatedness in that the symptoms began after starting work at a job involving recognized risk factors for carpal tunnel syndrome (e.g., repetitive hand movements, excessive force, awkward hand positions, pinch grips, etc.).

A medically confirmed case of probable work-related carpal tunnel syndrome was said to exist if the above criteria were met, and the employee had sought medical care and was diagnosed as having carpal tunnel syndrome. Medical records were reviewed to confirm the diagnosis.

A review of OSHA Form 200 logs from over a 3-year period indicated no hand/wrist disorder entries the first year, two entries for hand/wrist pain in the second year, and nine entries for either hand/wrist pain or carpal tunnel syndrome in the third year. As the size of the assembly workforce over the 3-year period remained the same (27 to 28 workers), these data suggested a worsening problem. The medical interviews of all 28 assembly workers indicated five confirmed cases of carpal tunnel syndrome (three surgically treated at the time of the evaluation) and five other possible carpal tunnel syndrome cases. Other health effects included numbness in the ulnar nerve (three workers), ganglionic cysts (two workers), tendinitis (three workers), elbow pain (one worker), neck pain (one worker), and shoulder pain (one worker).

The ensuing ergonomics evaluation of assembly work tasks revealed repetitive hand/wrist manipulations (8 of 12 job tasks requiring 20,000+ movements per shift) with varying degrees of force and bent wrist positions—all risk factors commonly associated with carpal tunnel syndrome. The pressure to increase production and working with defective materials which necessitate using added force to assemble parts were believed to worsen the problem [HETA 88-361-2091].

Exhibit 9: Symptom Surveys

NIOSH was asked to evaluate the incidence of upper limb disorders among workers engaged in sewing tasks at a uniform manufacturing company. The request was prompted by employee complaints that included aching, numbness, clumsiness, and swelling of the wrists and hands. OSHA log data were nonexistent in this plant at the time of this 1983 investigation. A medical questionnaire was specially designed to gather data on upper limb symptoms, with particular emphasis on hand/wrist problems. Sections of the questionnaire covered the usual background information (age, sex, occupational history), the present job at the plant, the nature of hand motions (lifting and lowering, pushing and pulling, twisting and turning, screwing, bending and rotating wrists, pinching and grasping with fingers), pain and discomfort areas (neck, shoulders, arms, elbows), the nature of symptoms in hands or wrists (swelling, stiffness, cramping burning, tingling), the time of onset (late night awakenings), and any

difficulties with hands and fingers in some everyday tasks (e.g., buttoning shirt, turning key in lock or doorknob, holding tools) plus medical history asking about any injury, surgery, or pre-existing diagnostic problem (e.g., arthritis) that could account for apparent problems. A section of the questionnaire also included a picture of both surfaces of the right and left hands with the instruction to shade in those areas where most of the discomfort or difficulty occurs. A total of 64 of 90 sewing machine operators completed this form. Neck, shoulder, and arm pain were commonly reported by these operators, with the symptom reports rarely dropping below 36% and ranging as high as 80%. The most numerous hand/wrist symptoms were numbness, cramping, and tingling sensations (varying from 43% to 60%). Despite the frequent occurrence among sewers of symptoms suggestive of upper limb musculoskeletal disorders, jobs rated high and low in ergonomic risk factors showed only small differences in the rate of the symptoms reported. Possible reasons for the lack of differentiation are given in the report [HETA 83–205–1702].

Using Periodic Medical Examinations

A disadvantage of using OSHA logs or company medical information to identify possible cases of WMSDs is the lack of specific or uniform medical information. This limitation may make the identification of WMSDs difficult. One optional approach to overcome this limitation is to have each worker undergo a periodic standardized examination that includes a history and physical examination. Such an examination program should be designed and administered by a health care provider. NIOSH has undertaken studies in which physical examinations were given to workers to establish the prevalence of upper extremity musculoskeletal disorders and to establish whether evidence of excessive numbers of cases could be related to certain working conditions. One such study is described in Exhibit 10.

Exhibit 10: Use of Diagnostic Tests

In response to a union request, NIOSH conducted a study to evaluate whether cashiers in a major supermarket chain were developing upper extremity musculoskeletal disorders because of their jobs. The evaluation had two major components.

- The first component compared the rate of upper extremity musculoskeletal disorders in the cashiers with the rate in other supermarket workers. For this purpose, physical exams were given to both groups of workers, including range of motion, limb bending, and stretching tests. The workers rated the pain experienced for the maneuvers. Positive responses on these tests for a particular part of the body, together with questionnaire data indicating recurring or prolonged discomfort in the same area (which began after starting work at the supermarket) were defined as a WMSD. To ensure objectivity, these determinations were made by a physician who had no prior knowledge of either the existing disease state or the job titles of the workers.

- The second component consisted of direct observation and a videotape analysis of the cashier's job, measuring the number of items processed, the number of scans, and the number of keyboard entries required of the cashier. These data were used to gauge task repetitiveness, posture factors, the force required, and efficiency of movement for different checkout counter designs.

The study results indicated that the cashiers had a higher rate of upper extremity disorders than other supermarket workers for all parts of the upper body and that those cashiers with longer employment or who spent more hours per week in checkout tasks showed more evidence of such problems. Further analyses in this study sought to isolate certain checkout counter design features, tasks, and work practices as possible stress factors in light of the pattern of musculoskeletal problems noted [HETA 88–344–2092].

Identifying Risk Factors in Jobs

Screening Jobs for Risk Factors

Health records or medical examinations and symptom surveys may indicate the nature and extent of musculoskeletal problems in the workforce. Efforts to identify jobs or tasks having known risk factors for musculoskeletal problems can provide the groundwork for changes aimed at risk reduction. Even without clear medical evidence, screening jobs for musculoskeletal risk factors can offer a basis for early interventions.

A great deal of ergonomic research has been conducted to identify workplace factors that contribute to the development of musculoskeletal disorders [Kourinka and Forcier 1995; Riihmaki 1991; Garg and Moore 1992; Silverstein et al. 1986; Salvendy and Smith 1981]. NIOSH has recently summarized the epidemiological scientific studies that show a relationship between specific work activities and the development of musculoskeletal disorders [NIOSH 1997]. A variety of nonepidemiological research, including clinical, biomechanical, and psychophysical studies, supports these findings [Pope et al. 1991; Ranney et al. 1995; Szabo and Chidgey 1989; Waters et al. 1993; Chaffin and Andersson 1984; Fransson-Hall et al. 1995; Ulin et al. 1993].

According to the scientific literature, the following are recognized as important risk factors for musculoskeletal disorders, especially when occurring at high levels and in combination. Figure 1 provides illustrations of some of these risk factor conditions. In general, knowledge of the relationships between risk factors and the level of risk is still incomplete. Also, individuals vary in their capacity to adjust to the same job demands. Some may be more affected than others.

Figure 1. Selected risk factor conditions. (Illustrations adapted from UAW-GM Center for Health & Safety [1990]; Putz-Anderson V [1988]; Grant et al. [1995]; Canadian Center of Occupational Safety and Health [1988]; American Meat Institute and Ergo Tech, Inc. [1990].)

- **Awkward postures** Body postures determine which joints and muscles are used in an activity and the amount of force or stresses that are generated or tolerated. For example, more stress is placed on the spinal discs when lifting, lowering, or handling objects with the back bent or twisted, compared with when the back is straight. Manipulative or other tasks requiring repeated or sustained bending or twisting of the wrists, knees, hips, or shoulders also impose increased stresses on these joints. Activities requiring frequent or prolonged work over shoulder height can be particularly stressful.

- **Forceful exertions (including lifting, pushing, and pulling)** Tasks that require forceful exertions place higher loads on the muscles, tendons, ligaments, and joints. Increasing force means increasing body demands such as greater muscle exertion along with other physiological changes necessary to sustain an increased effort. Prolonged or recurrent experiences of this type can give rise to not only feelings of fatigue but may also lead to musculoskeletal problems when there is inadequate time for rest or recovery. Force requirements may increase with increased weight of a load handled or lifted,

    - increased bulkiness of the load handled or lifted,
    - use of an awkward posture,
    - the speeding up of movements, increased slipperiness of the objects handled (requiring increased grip force),
    - the presence of vibration (e.g., localized vibration from power handtools leads to use of an increased grip force),
    - use of the index finger and thumb to forcefully grip an object (i.e., a pinch grip compared with gripping the object with your whole hand), and
    - use of small or narrow tool handles that lessen grip capacity.

- **Repetitive motions** If motions are repeated frequently (e.g., every few seconds) and for prolonged periods such as an 8-hour shift, fatigue and muscle-tendon strain can accumulate. Tendons and muscles can often recover from the effects of stretching or forceful exertions if sufficient time is allotted between exertions. Effects of repetitive motions from performing the same work activities are increased when awkward postures and forceful exertions are involved. Repetitive actions as a risk factor can also depend on the body area and specific act being performed.

Table 4. Reference levels used in rating job risk factors for musculoskeletal disorders

Risk factor or risk condition	Reference levels used in NIOSH evaluations
Excessive reach	Based on body measurement data indicating comfortable or normal seated and standing arm reach distances for the majority of the male and female population.
Lifting loads	NIOSH Work Practices Guide first used in defining acceptable loads to be lifted [NIOSH 1981]. Revised NIOSH lifting equation for recommended weight limits proposed in 1993 [Waters et al. 1993; Waters et al. 1994]. Applies to standing,

	two-handed, smooth lifting and lowering of stable objects in unrestricted spaces. Calculations take account of the horizontal distance of load from the body, vertical locations of hands at the beginning and end of lift, vertical distance of the load moved, frequency rate of lifting, balance, and coupling factors. Michigan 2- and 3-Dimensional Static Strength Prediction Program which estimates, for lifting tasks, the amount of compressive force at the lumbo-sacral disc [Chaffin and Andersson 1991]. Model of risk of low back disorders as a function of workplace characteristics and trunk motion characteristics (e.g., lift rate, trunk bending, twisting motion) [Marras et al. 1993, 1995].
Pushing or Pulling loads	Initial and sustained forces of loads pushed or pulled at variable rates that are judged acceptable for 90% of the female work population [Snook and Ciriello 1991].
Whole-body vibration	International Standards Organization (ISO) Dose System for Whole Body Vibration indicating vibration levels in three dimensions with limiting times for fatigue decreased proficiency [ISO 2631/1, 1985].
Hand/arm vibration	American National Standards Institute (ANSI) daily exposure limits [ANSI S3.34. 1986] and American Conference of Governmental Industrial Hygienists (ACGIH) [ACGIH 1996] values for judging whether estimated worker task exposure levels are excessive.
Repletion rate	Both the number of hand manipulations per 8-hour work shift and the task cycle time have been used to rate this factor. Task cycle times of 30 sec or less were defined as high repetition; cycle times greater than 30 sec as low repetition. For hand manipulations, high repetitiveness was described as more than 20,000 manipulations per 8-hour work shift; medium repetitiveness as between 10,000 and 20,000 manipulations per 8-hour work shift, and low repetitiveness as less than 10,000 manipulations per 8-hour work shift [HETA 88 361 2091; HETA 88 180 1958]. A recent proposed repetition guideline believed to be more protective is cited by Kilbom [1994]. This guideline also considers other areas of the upper extremity. Each area may have a different ability to tolerate repetitious activity. At the same rate of repetitions some specific acts such as pinching may be less well tolerated than others. This is an example of complexities that current guidelines may not address adequately.
Force and energy demands of work tasks	Relative ratings on a 5-point scale used to classify task performance as requiring high, medium, and low levels of force [HETA 88 180 1958; HETA 88 361 2091]. Criterion of 5.0 kcal/min as measured by oxygen consumption used as a limit for energy expenditure [Astrand and Rodahl 1986].

- **Duration** refers to the amount of time a person is continually exposed to a risk factor. Job tasks that require use of the same muscles or motions for long durations increase the likelihood of both localized and general fatigue. In general, the longer the period of

continuous work (e.g., tasks requiring sustained muscle contraction), the longer the recovery or rest time required.

- **Contact stresses** Repeated or continuous contact with hard or sharp objects such as non-rounded desk edges or unpadded, narrow tool handles may create pressure over one area of the body (e.g., the forearm or sides of the fingers) that can inhibit nerve function and blood flow.

- **Vibration** Exposure to local vibration occurs when a specific part of the body comes in contact with a vibrating object, such as a power handtool. Exposure to whole-body vibration can occur while standing or sitting in vibrating environments or objects, such as when operating heavy-duty vehicles or large machinery.

- **Other conditions** Workplace conditions that can influence the presence and magnitude of the risk factors for WMSDs can include cold temperatures,

    - insufficient pauses and rest breaks for recovery,
    - machine paced work, and
    - unfamiliar or unaccustomed work.

In addition to the above conditions, other aspects of organization of work may not only contribute to physical stress but psychological stress as well. Scientific research is examining work factors such as performance monitoring, incentive pay systems, or lack of control by the worker to determine whether these factors have a negative effect on the musculoskeletal system [Moon and Sauter 1996]. Another related area of research is to determine which personal, work, or societal factors contribute to acute musculoskeletal disorders developing into chronic or disabling problems.

Screening jobs for these risk factors may involve the following:

- Walk-through observational surveys of the work facilities to detect obvious risk factors
- Interviews with workers and supervisors to obtain the above information and other data not apparent in walk-through observations, such as time and workload pressures, length of rest breaks, etc.
- Use of checklists for scoring job features against a list of risk factors

Of the above three methods, the checklist procedure provides the most formal and orderly procedure for screening jobs. Numerous versions of checklists exist in ergonomics manuals. When checklist data are gathered by persons familiar with the job, task, or processes involved, the quality of the data is generally better. Checklist procedures are also typically used in more complete job analyses. While screening tools such as checklists have been widely and successfully used in many ergonomics programs, most have not been scientifically validated. Combining checklist observations with symptoms data offers a means of overcoming uncertainty.

Integrating efforts to identify risk factors for musculoskeletal disorders with efforts to identify common safety hazards such as slips and trips should be considered. Jobs with risk factors for musculoskeletal disorders also may have safety hazards.

Performing Job Analyses

Job analysis breaks a job into its various elements or actions, describes them, measures and quantifies risk factors inherent in the elements, and identifies conditions contributing to the risk factors [Putz-Anderson 1988; Keyserling et al. 1993; Grant et al. 1995; ANSI 1996].

Job analyses are usually done by persons with considerable experience and training in these areas. While most job analyses have common approaches, such as a focus on the same set of risk factors described above, no "standard" protocol exists for conducting a job analysis to assess ergonomic hazards.

Most job analyses have several common steps. A complete description of the job is obtained. Employees are often interviewed in order to determine if the way the job is done changes over time. During the job analysis, the job is divided into a number of discrete tasks. Each task is then studied to determine the specific risk factors that occur during the task. Sometimes each risk factor is evaluated in terms of its magnitude, the number of times it occurs during the task, and how long the risk factor lasts each time it occurs.

The tasks of most jobs can be described in terms of (1) the tools, equipment, and materials used to perform the job, (2) the workstation layout and physical environment, and (3) the task demands and organizational climate in which the work is performed. Job screening, as described above, provides some of these data. More definitive procedures for collecting information on these components can include the following:

- Observing the workers performing the tasks in order to furnish time-activity analysis and job or task cycle data; videotaping the workers is typically done for this purpose
- Still photos of work postures, workstation layouts, tools, etc., to illustrate the job
- Workstation measurements (e.g., work surface heights, reach distances)
- Measuring tool handle sizes, weighing tools and parts, and measuring tool vibration and part dimensions
- Determining characteristics of work surfaces such as slip resistance, hardness, and surface edges
- Measuring exposures to heat, cold, and whole body vibration
- Biomechanical calculations (e.g., muscle force required to accomplish a task or the pressure put on a spinal disc based on the weight of a load lifted, pulled, or pushed)
- Physiological measures (e.g., oxygen consumption, heart rate)
- Special questionnaires, interviews, and subjective rating procedures to determine the amount of perceived exertion and the psychological factors influencing work performance

Exhibits 11, 12, 13, and 14 illustrate the varied approaches that NIOSH has taken in analyzing and evaluating jobs for apparent risk factors.

While a job analysis enables a person to characterize ergonomic risk factors, the question of what level or amount of exposure is harmful to the musculoskeletal system is a difficult one. Some have argued against the overuse of simple guidelines [Buckle et al. 1992; Leamon 1994], while others have recognized that, despite the limitations of current guidelines, many contain

sufficiently useful information to identify potentially risky work activities [Karwowski 1993; Waters et al. 1993; Winkel et al. 1992]. While acknowledging the limitations of current knowledge, NIOSH and others conducting job analyses have used a variety of approaches to provide answers best suited for the specific workplaces under study. One approach calculates the muscle strength required to perform a certain job task and estimates the fraction of the working population that possesses the required strength. A second approach asks workers in the laboratory to judge acceptable work conditions by engaging them in tasks that impose different physical demands. A third method compares the forces generated in a part of the body when performing specific work tasks and compares it with a level believed to be harmful.

NIOSH recommends the use of the NIOSH lifting equation as one useful approach in both the design of new lifting tasks and in the evaluation of existing lifting tasks [Waters et al. 1993; Waters et al. 1994]. Other assessment tools are also available for evaluating such tasks [Chaffin and Andersson 1991; Marras et al. 1993, 1995; Hidalgo et al. 1995]. Population data depicting human strength capacities can be helpful in designing and evaluating jobs [Snook and Ciriello 1991]. Tables indicating standing and seated height and reach distances that can accommodate various proportions of the worker population [Kroemer and Kroemer-Elbert 1994] can also be helpful. Comparing job analysis results with such references can yield estimates of the percentage of the population that may be especially affected by these job conditions. In some NIOSH evaluations, efforts have been made to duplicate the specific stresses observed in the job to calculate forces on joints and limbs and to arrive at risk determinations [Habes and Grant, in press]. Computerized 2- and 3-dimensional biomechanical models can predict the percentage of males and females capable of exerting static forces in certain postures [Chaffin and Andersson 1991]. Westgaard and Winkel [1996, p. 87] recently summarized the strengths and weaknesses of current guidelines by concluding that "at present, guidelines to prevent musculoskeletal disorders can only give directions, not absolute limits." These authors believe the best guidelines must consider the level, duration, and frequency of exposure.

Table 4 presents the reference levels or limiting conditions used by NIOSH to rate risk factors of consequence to the musculoskeletal problems under investigation. (For the scientific justification of each guideline or approach, the reader is referred to the references indicated in Table 4.) In some instances these determinations were based on more than one rating procedure. For example, judgments of problematic lifting conditions in many NIOSH investigations have been derived both from use of the NIOSH lifting equation [Waters et al. 1993; Waters et al. 1994] as well as the Michigan computerized 2- and 3-dimensional analyses [Chaffin and Andersson 1991].

The entries in Table 4 are offered as illustrative examples of reference levels or guidelines. The actual risk to each worker depends not only on the current level of exposure to risk factors, but also on their physical capability, their past medical history, concurrent non work exposures, and many other factors. These reference levels have varying degrees of scientific justification. Each was useful in a specific NIOSH workplace investigation aimed at reducing WMSDs.

Setting Priorities

In Exhibits 11 to 14, certain job tasks were targeted for more intensive analysis to verify the existence of risk factors for musculoskeletal disorders.

- In Exhibits 11 and 12, finding cases of musculoskeletal disorders prompted the follow up analysis.
- In Exhibit 14, complaints of musculoskeletal discomfort, established through questionnaires, were the basis for sorting out possible work-related causes.
- The physical demands or risk factors of the job described in Exhibit 13, even without medical or symptom data, presented strong risk implications for potential WMSDs, thus triggering the analysis.

These three scenarios offer a basis for setting priorities for undertaking risk factor analyses and implementing control measures. Specifically, jobs associated with cases of musculoskeletal problems deserve the highest consideration in follow up efforts to identify risk factors and implement control actions. Jobs in which current cases have been identified should receive immediate attention, followed by those in which past records have noted a high incidence or severity of WMSDs despite the lack of current cases. Priority for job analysis and intervention should be given to those jobs in which most people are affected or in which work method changes are going to be taking place anyway.

Jobs associated with worker complaints of fatigue and discomfort should be ranked next in deciding needs for follow up job analysis and possible interventions.

Finally, where screening efforts suggest the presence of significant risk factors for musculoskeletal disorders, more detailed job analyses should be done to assess the problem potential. Ratings of high or extreme levels of risk factors, especially occurring in combination, may indicate a need for control actions. While appearing last in the priority order, taking steps to reduce apparent risk factors for musculoskeletal disorders is a preventative approach.

Table 5 summarizes the priority considerations in deciding about the need for job analyses and consequent control interventions for addressing WMSDs.

Table 5. Determining priorities for job analyses and control actions

Nature of available information				
Priority and action	**Current cases of WMSDs for persons in selected jobs**	**No current cases, but past plant records indicate WMSDs in select jobs or departments that have not changed**	**No current or past cases, but worker complaints and symptom surveys suggest WMSDs in select jobs or departments**	**No cases, reports of WMSDs, or complaints, but job screening and checklists suggest high risk factor potential in select jobs**
Priority for follow up analyses and control	Immediate need	Priority is second only to the need to address more current cases	Third in priority; resolving problems at an early stage is commendable	While last in priority, this effort is preventive; most positive of all actions

actions				
Type of follow up job analyses needed	Perform job analyses to sort out and rate job risk factors for observed cases	Perform job analyses to sort out and rate risk factors for jobs with highest number or severity of past WMSDs and largest work group at risk	Perform job analyses to sort out and rate risk factors for jobs having frequent WMSD complaints and symptoms	Perform job analyses to sort out and rate risk factors for jobs with the highest problem potential (based on screening observations)
Focus needed for control actions	Control actions should be focused on reducing the highest rated risk factors in current jobs linked with the greatest number of cases	Control actions should be focused on reducing the highest rated risk factors in jobs with the highest number or greatest severity of past WMSDs for the largest work group at risk	Control actions should be focused on reducing the highest rated risk factors in jobs having frequent WMSD complaints and symptoms	Control actions should be focused on reducing the highest rated risk factors for WMSDs before any are reported

Exhibit 11: Cabinet Manufacturing Work Setting

The site was a cabinet manufacturing company in which basic work processes involved sawing rough lumber, planning cabinet panels and parts, sanding and painting, assembly, and packing and shipping. A total of 17 jobs representing one full production of a kitchen cabinet were first screened on the basis of job descriptions and walk-through observations for risk of both musculoskeletal disorders and traumatic injury. Five job tasks (three lifting tasks and two pushing and pulling tasks) were selected for more in-depth analyses because of their linkage with excessive back strain and sprain reports among the workers. Videotapes and still photos were taken of the job tasks, along with workstation measurements. Frequencies, weights, and heights of loads lifted were noted together with measurements of initial and sustained push forces. Applying the NIOSH lifting equation formula for defining lift weight limits and the Michigan 2-dimensional static strength prediction program showed that the three lifting jobs presented conditions warranting control actions to reduce risk of overexertion or back injury. Initial and sustained push forces for the other two jobs were rated against maximal acceptable values reported in the literature for 50% of the male and female population. One of these two tasks (pushing stacking bunks) exceeded these values and was judged potentially hazardous; recommendations for risk reduction were offered [HETA 88–384–2062].

Exhibit 12: Window Balance Systems Manufacturing Work Setting

The site was a plant that produced window balance systems. The product was made from either stamped, roll-formed aluminum or extruded vinyl. Both metal fabrication and extrusion operations were performed at the plant. All 12 jobs in the assembly department were targeted for analyses on the basis of earlier State inspection reports describing conditions associated with the development of carpal tunnel syndrome. These jobs were observed in a plant walk-through and videotaped for later analyses. Information was collected concerning the number of employees engaged, the task elements, the number of pieces assembled per work shift, the tools used, the difficulties workers perceived in the job, and worker suggestions for improvements. Measurements were also taken of work surface heights (both worktable and conveyor). A review of the videotape in real time and slow motion yielded data on repetitiveness of movements, awkward hand/wrist and shoulder postures, and indicators of muscular force requirements. The task cycle times were derived from these observations, along with the number of hand/wrist motions (flexion, extension, ulnar and radial deviation, pinching) and the number of unnatural shoulder positions. Particularly extreme postures were noted in the videotape analyses as one means for rating muscular force exerted. Other bases for rating force were the number of forceful manipulations in a given job cycle, the size and type of tool used, and the weight of the product handled.

Jobs were rated for ergonomic stress to prioritize interventions needed to eliminate the stress. The job ratings were determined by combining the observed level of repetitiveness or movements per day with the level of force. Three levels of repetitiveness were defined and assigned values. A value of "1" was given for jobs with low (fewer than 10,000) movements per day, "2" for jobs with medium (10,000–20,000) movements per day, or "3" for high (more than 20,000) movements per day. Average and peak levels of force were also judged by the investigators and given ratings of "1" or "2" (low force), "3" (medium force), or "4" or "5" (high force).

The total stress score for each job was determined by adding the assigned values for the repetition and force. Two jobs (pulling springs to attach them to window liners and hooking springs into window liners) were found to represent the greatest musculoskeletal stress when rated in this way. However, all of the assembly jobs were found to pose problems requiring ergonomic hazard control actions [HETA 88–361–2091].

Exhibit 13: Grocery Warehouse Setting

The site was a large grocery warehouse with the focus on order selector jobs. Order selectors load cases of grocery items from warehouse shelves to pallets according to a "picking order" (a listing of the items and quantities to be picked), the order of picking the items, and their locations (aisle and slot numbers) in the warehouse. In terms of job tasks, the order selector routine is to drive a pallet jack to the location of the items in the warehouse, lift the items from the shelves, carry them to the pallet, and lift or lower the items onto the pallet and place labels on the items. The order selector then proceeds to the next item on the order list, and the procedure is repeated. After the entire list of orders is picked, the order selector wraps or tapes the stacked cases together and places the loaded pallet on the loading dock for transport from the warehouse.

Order selection is known as a physically demanding job. One objective of the NIOSH evaluation was to assess the potential risk associated with the manual lifting tasks just described. Before the evaluation, a standard incentive program was installed at this warehouse to establish a "fair amount of time" for order selecting activities. Achieving 100% of the standard was considered a "day's work." Order selector performance was averaged over a week, and employees were disciplined for performance that fell below 95% of the standard. Workers who exceeded the standard were rewarded with additional pay or paid time off.

Techniques used to assess the potential risk associated with the manual lifting tasks performed by the order selectors included the following:

- Weight measurements of the objects lifted
- Videotape, still photos, and angular measurements of the body postures of workers carrying out the lifting tasks
- Use of a motion monitor to record the motion of the trunk as it may affect the forces on the intervertebral joints of the spinal column
- Time activity analysis of the manual lifting routines of the order selectors, including work-rest cycles
- Use of portable heart monitors and oxygen consumption meters to measure the energy expenditure in the course of carrying out regular order selector activities

Information on load weights and body postures were systematically recorded for five representative lifting tasks that workers and the NIOSH investigators judged as having a high risk of potential for injury. These data served as input to the Michigan 3-Dimensional Static Strength Prediction Program for estimating compressive forces on the lower back and muscle strength requirements for designated lifts. The data were also used in the NIOSH revised lifting formula for recommending weight limits based on the characteristics of a specific lifting task. The evaluations for the five tasks by both the Michigan and NIOSH procedures found all loads to be clearly excessive. In addition, the lumbar movements constituting these tasks, as analyzed and measured in terms of flexion angle of the trunk and lateral and twisting velocity, combined with lifting rate and other factors, indicated a high risk of low back injury based on the models developed by Marras [Marras et al. 1993].

The mean metabolic rates as measured by oxygen consumption were above the value (5.0 kcal/min) recommended in the literature as an upper limit for young male workers during an 8-hour workday. Observed heart rates were also high. Two of the three workers had average heart rates exceeding 110 beats/min, the suggested maximum acceptable for the majority of healthy workers [Astrand and Rodahl 1986].

Time-motion analyses of the data collected indicated that the average frequency of lifts during the normal activities of the selectors was 4.1 lifts/min. This lifting rate, coupled with observed loads averaging 30.4 lb, would probably result in fatigued muscles, especially since a high percentage (53%) of the lifts required extreme trunk flexion and reaches above shoulder height.

Calculations for these lifting conditions were well above the upper limits recommended by the NIOSH lifting equation [Waters et al. 1993].

Data collected in this evaluation provided for workers' perceptions of the physical effort required by their jobs and the job demand versus the control they felt they had in their work routines. Findings here indicated "hard physical effort" as the average response, which correlated well with the heart rate and oxygen consumption monitoring already described. Responses to the job demand and control questions, when compared with other worker groups, showed order selecting to be a high demand and low control job. Informal interviews with workers revealed their concern over the work standards and their inability to control the pace of their jobs. The literature associates this combination of job attributes with increased stress and job dissatisfaction [HETA 91–405–2340].

Exhibit 14: Office Setting

The sites were offices in two State governmental agencies in which more than 500 workers performed data entry tasks using VDTs. Questionnaires administered to the total sample of workers indicated a significant prevalence of constant musculoskeletal discomfort, with the greatest number localized to the trunk area, followed by the neck, buttocks, arm/shoulders (particularly on the right side), and, lastly, the lower legs. The specific design features of 40 workstations, representing a subsample of those used by this worker group, were analyzed to determine the extent to which they could account for the complaints. In all cases, the keyboard in these units was positioned immediately in front of the worker, with the document placed either to the left or right or between the keyboard and the display. Documents were manipulated mostly with the left hand, with the right hand used exclusively for keyboard operation. Wrist rests were not available, and flexibility in keyboard and video display placements was limited. Work tables and chairs lacked adjustable features. Various measurements and observations were made at these workstations during actual VDT work, including seat pan heights and compression seat back height, keyboard height, seated postures of the workers, upper arm angles, document distances, head tilt, gaze angle, and chair tilt and swivel. Statistical techniques were used to predict the amount of musculoskeletal discomfort from the aforementioned ergonomic variables. This analysis was performed by the region of the body affected and indicated the ergonomic factors, both singly and in combination, that could account for significant amounts of the reported discomfort in that area. The results showed, for example, that leg discomfort increased when the lower leg length exceeded the seat pan height and when the seat pan was soft. With regard to arm/shoulder discomfort, height discrepancy between the positions of the elbow and the keyboard proved to be a significant predictor as did long reaches to documents with the left arm. Less neck and trunk discomfort was found for erect sitting postures compared with stooped or slouched positions and as the height of the backrest was lowered in relation to the length of the operator's back. These and other findings served as the basis for offering suggestions about workstation configurations that could alleviate the discomfort problems [Sauter et al. 1991].

Step 5: Developing Controls

Analyzing jobs to identify factors associated with risks for WMSDs, as discussed in Step 4, lays the groundwork for developing ways to reduce or eliminate ergonomic risk factors for WMSDs. A variety of approaches can help to control these risk factors.

Types of Controls

A three-tier hierarchy of controls is widely accepted as an intervention strategy for controlling workplace hazards, including ergonomic hazards. The three tiers are as follows:

- Reducing or eliminating potentially hazardous conditions using engineering controls
- Changes in work practices and management policies, sometimes called administrative controls
- Use of personal equipment

Engineering Controls

The preferred approach to prevent and control WMSDs is to design the job including (1) the workstation layout, (2) selection and use of tools, and (3) work methods to take account of the capabilities and limitations of the workforce. A good match (meaning that the job demands pose no undue stress and strain to the working population as a whole) helps ensure a safe work situation. On the other hand, the presence of risk factors as described in Step 4 represents departures from this goal and would indicate the need for control measures. Engineering control strategies to reduce ergonomic risk factors include the following:

- Changing the way materials, parts, and products can be transported for example, using mechanical assist devices to relieve heavy load lifting and carrying tasks or using handles or slotted hand holes in packages requiring manual handling
- Changing the process or product to reduce worker exposures to risk factors; examples include maintaining the fit of plastic molds to reduce the need for manual removal of flashing, or using easy-connect electrical terminals to reduce manual forces Modifying containers and parts presentation, such as height-adjustable material bins
- Changing workstation layout, which might include using height-adjustable workbenches or locating tools and materials within short reaching distances
- Changing the way parts, tools, and materials are to be manipulated; examples include using fixtures (clamps, vise-grips, etc.) to hold work pieces to relieve the need for awkward hand and arm positions or suspending tools to reduce weight and allow easier access
- Changing tool designs—for example, pistol handle grips for knives to reduce wrist bending postures required by straight-handle knives or squeeze-grip-actuated screwdrivers to replace finger-trigger-actuated screwdrivers
- Changes in materials and fasteners (for example, lighter-weight packaging materials to reduce lifting loads)
- Changing assembly access and sequence (e.g., removing physical and visual obstructions when assembling components to reduce awkward postures or static exertions)

Figure 2 applies a number of these options for controlling the risk factor situations illustrated earlier in Figure 1. Exhibits 15 and 16 illustrate NIOSH efforts to advise companies about engineering control strategies to reduce WMSDs.

Figure 2. Basic methods for controlling selected risk factor conditions.

Exhibit 15: Engineering Controls—Beverage Delivery

NIOSH staff conducted an ergonomic study of soft beverage driver-sales jobs. Such job tasks as handling beverage cases for delivery were problematic for two reasons: the stacking of cases in the truck bay exceeded the normal reach limit of workers, and most of the beverage lifting tasks also exceeded the recommended weight limit of the 1993 NIOSH lifting equation. Heart rate measurements, as an indicator of the physical effort required for this work, were found to be high among the driver-sales workers, especially during peak periods. Estimates indicate that more than 35,000 lb of beverage products were handled daily by these driver-sales workers. The rate of musculoskeletal injuries for the affected workforce, in terms of days lost, was twice that of workers in general manufacturing jobs.

To relieve the above-mentioned problems, the following engineering controls were implemented:

- Pullout platform steps in the bay floors enabling the drivers to step up and work at bay level
- External handles between the bays for workers to grab to give them better mechanical leverage during removal of the beverage product
- Multilevel shelving units that provided compartments for different products, gave easier direct access, and eliminated the problem of having to lift or move different products around to find the ones slated for delivery to a customer
- Lubricated two-wheel hand trucks with proper tire pressure maintained to make pushing and controlling the load easier
- Plastic beverage containers instead of glass ones to reduce package weight
- Improved beverage cartons designed with larger handles and smooth, contoured bases that make them easier to handle when removing stacked cartons from the truck

Changes in work risk factors were documented through videotaping, modeling the stresses imposed on the body by the materials handling tasks, continuous monitoring of heart rate, and analyzing discomfort surveys. Data were compared before, during, and after the ergonomic interventions were implemented.

The benefits of the ergonomic interventions were in proportion to the amount of time such controls were used. Reductions in stressors for the back and shoulders were observed when pullout steps, external handles, and multilevel shelving were used. Heart rates decreased for six of nine driver-sales workers during the study period, despite an increase in the product volume handled. The ergonomic interventions reduced the multiple handling of beverage cases and the awkward postures during beverage handling, resulting in a reduced number of reports of fatigue [McGlothlin 1995; NIOSH 1996].

Exhibit 16: Engineering Controls—Motorcycle Manufacturing

NIOSH researchers conducted initial and follow-up evaluations of musculoskeletal disorders of the upper limbs and back at a motorcycle manufacturing company. The objectives of this evaluation were to identify the job tasks in the flywheel milling department thought to cause musculoskeletal injuries and to provide recommendations to decrease and prevent such injuries. NIOSH researchers reviewed OSHA Form 200 logs and workers' compensation data and conducted an ergonomic evaluation of four jobs in this department (two flywheel milling jobs, one flywheel truing job, and one flywheel balancing job). Data gathered on the initial site visit in the flywheel milling area showed that repeated manual transport, placement, and removal of the flywheels between milling processes resulted in more than 28,000 lb handled per 8-hour shift. In addition, repeated use of a handheld power grinder to remove metal burrs from milled flywheels proved to be inefficient and presented other accident risks. Analysis of data from the flywheel truing job showed that impact forces from the 5-lb brass hammer repeatedly striking the flywheel ranged from 25,000 to 92,000 lb. Using the NIOSH 1993 lifting equation to analyze the flywheel balancing job showed potential risk for back injury. NIOSH recommended engineering controls to reduce risk factors for musculoskeletal disorders, and the company effected a number of them through establishment of a management/labor ergonomic committee. The engineering controls included the following:

- Upgrading forging and milling machine processes and improving product flow to reduce the burden of flywheel handling from 28,000 to 17,500 lb per 8-hour shift
- Installing a customized 40-ton press to eliminate the use of brass hammers for truing the flywheels
- Using an overhead lift to eliminate manual handling of the 35-lb assembled flywheel unit, further reducing the total weight that had to be handled each day

During a 5-year period from 1989 through 1993, the efforts of the plant's management, engineers, and workers resulted in a reduction of WMSDs involving lost or restricted workdays from 27.6 per 100 workers in 1989 to 12.5 per 100 workers in 1993. The severity of musculoskeletal disorders decreased from 610 lost or restricted-activity workdays per 100 workers in 1989 to 190 workdays in 1993 [HETA 91-0208-2422].

Administrative Controls

Administrative controls are management-dictated work practices and policies to reduce or prevent exposures to ergonomic risk factors. Administrative control strategies include (1) changes in job rules and procedures such as scheduling more rest breaks, (2) rotating workers through jobs that are physically tiring, and (3) training workers to recognize ergonomic risk factors and to learn techniques for reducing the stress and strain while performing their work tasks.

Although engineering controls are preferred, administrative controls can be helpful as temporary measures until engineering controls can be implemented or when engineering controls are not technically feasible. Since administrative controls do not eliminate hazards,

management must assure that the practices and policies are followed. Common examples of administrative control strategies for reducing the risk of WMSDs are as follows:

- Reducing shift length or curtailing the amount of overtime
- Rotating workers through several jobs with different physical demands to reduce the stress on limbs and body regions
- Scheduling more breaks to allow for rest and recovery
- Broadening or varying the job content to offset certain risk factors (e.g., repetitive motions, static and awkward postures)
- Adjusting the work pace to relieve repetitive motion risks and give the worker more control of the work process
- Training in the recognition of risk factors for WMSDs and instruction in work practices that can ease the task demands or burden

Two examples of administrative measures are described in Exhibits 17 and 18.

Exhibit 17: Administrative Controls—Jewelry Manufacturing

NIOSH investigators were asked by a jewelry manufacturer to evaluate upper extremity musculoskeletal disorders among employees. Questionnaire surveys of employees indicated that 66% reported work-related upper extremity musculoskeletal symptoms. In the 2 years before the NIOSH evaluation, physicians diagnosed seven employees with carpal tunnel syndrome.

Besides making numerous specific engineering control recommendations, the NIOSH investigators also suggested the following administrative control strategies:

- Training new employees in proper craftsmanship, tool use, and maintenance—for example, emphasizing the need to keep cutting tools sharp to reduce force requirements and the need to keep power tools balanced and lubricated to minimize vibration
- For new employees, providing more frequent rest breaks at the outset to relieve fatigue and overexertion
- Rotating employees to jobs that require the use of different muscle or tendon groups (for example, NIOSH investigators suggested that employees using small handtools be rotated to inspection tasks)
- Providing more frequent breaks for those employees doing polishing, buffing, etching, and engraving tasks because they are engaged in manual tasks for long periods [HETA 90-273-2130]

Exhibit 18: Administrative Controls—Meat packing

In one meat packing case, an administrative control approach was used to address ergonomic problems in boning and trimming tasks. Physical stressors of this job included awkward wrist postures, high grip forces, and a high workload. Observations showed that the total boning task workload was 96% of the total task cycle, allowing 4% for rest. In contrast, the trimming task workload was 80% of the total task cycle, allowing 20% for rest. One suggestion was that the trimmers could trim more of the lean shank, reducing the boners' workload. A better balance was struck between these two tasks, and an increase in lean shank yield from this modified job was documented [Gjessing et al. 1994].

Personal Equipment: Is It Effective?

One of the most controversial questions in the prevention of WMSDs is whether the use of personal equipment worn or used by the employee (such as wrist supports, back belts, or vibration attenuation gloves) are effective. Some consider these devices to be personal protective equipment (PPE). In the field of occupational safety and health, PPE generally provides a barrier between the worker and the hazard source. Respirators, ear plugs, safety goggles, chemical aprons, safety shoes, and "hard hats" are all examples of PPE. Whether braces, wrist splints, back belts, and similar devices can be regarded as offering personal protection against ergonomic hazards remains open to question. Although these devices may, in some situations, reduce the duration, frequency, or intensity of exposure, evidence of their effectiveness in injury reduction is inconclusive. In some instances they may decrease one exposure but increase another because the worker has to "fight" the device to perform his or her work. An example is the use of wrist splints while engaged in work that requires wrist bending. In the health care management section (Step 6), the use of wrist splints or immobilization devices is also briefly discussed.

On the basis of a review of the scientific literature completed in 1994, NIOSH concluded that insufficient evidence existed to prove the effectiveness of back belts in preventing back injuries related to manual handling job tasks [NIOSH 1994]. A recent epidemiological study credits mandatory use of back belts in a chain of large retail hardware stores in substantially reducing the rate of low back injuries [Kraus 1996]. Although NIOSH believes this study provides evidence that back belts may be effective in some settings for preventing back injuries, NIOSH still believes that evidence for the effectiveness of back belts is inconclusive. This area is being researched, and the questions about the effectiveness of most personal equipment remain open. Less controversial types of personal equipment are vibration attenuation gloves [NIOSH 1989] and knee pads for carpet layers [Bhattacharya et al. 1985]. But even here, there can be concerns. For example, do the design and fit of the gloves make it harder to grip tools?

Implementing Controls

Ideas for controls can be derived from a variety of sources:

- Trade associations may have information about good control practices for addressing different problem operations within an industry
- Insurance companies that offer loss control services to their policyholders

- Consultants and vendors who deal in ergonomic specialty services and products
- Visits to other worksites known to have dealt with similar problem operations

Ideas from these sources are in addition to those ideas gained from brainstorming with employees who perform the jobs or from work teams engaged in such problem solving.

Implementing controls normally consists of

- trials or tests of the selected solutions,
- making modifications or revisions,
- full-scale implementation, and
- follow up on evaluating control effectiveness.

Testing and evaluation verify that the proposed solution actually works and identifies any additional enhancements or modifications that may be needed. Employees who perform the job can provide valuable input into the testing and evaluation process. Worker acceptance of the changes put into place is important to the success of the intervention.

After the initial testing period, the proposed solution may need to be modified. If so, further testing should be conducted to ensure that the correct changes have been made, followed by full-scale implementation. Designating the personnel responsible, creating a timetable, and considering the logistics necessary for implementation are elements of the planning needed to ensure the timely implementation of controls.

A good idea in general is that ergonomic control efforts start small, targeting those problem conditions which are clearly identified through safety and health data and job analysis information. Moreover, the control actions can be directed to those conditions which appear easy to fix. Early successes can build the confidence and experience needed in later attempts to resolve more complex problems.

Evaluating Control Effectiveness

A follow up evaluation is necessary to ensure that the controls reduced or eliminated the ergonomic risk factors and that new risk factors were not introduced. This follow up evaluation should use the same risk factor checklist or other method of job analysis that first documented the presence of ergonomic risk factors. If the hazards are not substantially reduced or eliminated, the problem-solving process is not finished.

The follow up may also include a symptom survey, which can be completed in conjunction with the risk-factor checklist or other job analysis method. The results of the follow up symptom survey can then be compared with the results of the initial symptom survey (if one was performed) to determine the effectiveness of the implemented solutions in reducing symptoms.

Because some changes in work methods (and the use of different muscle groups) may actually make employees feel sore or tired for a few days, follow up should occur no sooner than 1 to 2 weeks after implementation, and a month is preferable. Recognizing this fact may help avoid discarding an otherwise good solution.

In addition to the short-term evaluations using job analysis methods and symptom surveys, long-term indicators of the effectiveness of an ergonomics program can include

- reduction in the incidence rate of musculoskeletal disorders,
- reduction in the severity rate of musculoskeletal disorders,
- increase in productivity or the quality of products and services, or
- reduction in job turnover or absenteeism.

The above-mentioned indicators offer bottom-line results in evaluating interventions that have been put into place. Other indicators may also be used that represent in-process or interim accomplishments achieved on the path to building an ergonomic program for example, the extent of the ergonomic training given the workforce, the number of jobs analyzed for potential problems, and the number of workplace solutions being implemented. While bottom-line results are most telling in terms of defining a successful program, the interim measures allow the total development to be monitored.

Exhibit 19 describes evaluation techniques used in ergonomic programs at meat packing plants.

Exhibit 19: Evaluating Ergonomics Programs in Meat packing Plants

A variety of techniques were used in meat packing plant ergonomic case studies to evaluate and gauge the effectiveness and benefits of the ergonomic hazard control efforts:

- **Symptom surveys** Two of the case studies described administering symptom surveys to workers before implementation of the demonstration ergonomics programs. The symptom surveys were used to confirm findings from records, help identify problem jobs, and establish baseline data. These baseline data were compared with data from identical surveys administered after controls were implemented. Reductions in the number and severity of symptoms identified during the time period between the first and second survey would be expected if the controls implemented are effective.

  In one case, symptom surveys indicated a decline in the number of people reporting pain and a decline in pain severity. In the other case, symptom surveys showed an increase in the number of reported discomfort areas over the project period. The investigator in this case attributed the rise to increased employee knowledge of ergonomic hazards and WMSDs, as well as to seasonal increases in production.

- **OSHA Form 200 Logs** As with symptom surveys, two of the case studies referred to company-maintained OSHA Form 200 logs to identify problem jobs and establish incidence rates of WMSDs. Data maintained in these logs were used to gauge the plant-wide effects of the ergonomic interventions on overall and job-specific incidence rates of reportable WMSDs. In one case, plant-wide rates were calculated for the two 1-year periods before the study and for two 6-month periods after the interventions. The rates per 200,000 work hours were 55, 75, 80, and 59, respectively. The incidence rates continued to rise in the first 6 months of the post-intervention period, but they fell more than 27% in the second post-intervention period. Reductions in rates of 19%, 33%, and 42% for the second 6-month period were shown in three of the four departments, whereas the rate in the fourth department remained the same.

- **Other records** In these meat packing case studies, employee absenteeism rates, employee turnover rates (both overall and job-specific), and workers' compensation costs were used to judge ergonomics program effectiveness. In one of the cases, the investigators studied a plant for 7 years. During this period, workers' compensation costs declined to 20% of the pre-ergonomic program costs.

- **Productivity and quality** In one case study, an administrative control for a trimming job resulted in a $14,000 increase in product yield over 6 months. In the same case study, changes in the hog shackling task to reduce back injuries in workers were calculated to yield a $436,000 annual savings from reduced product (hog) loss.

- **Task analysis and checklists** The same techniques used to identify and evaluate the ergonomic risk factors of jobs and tasks were used to gauge the benefits of implemented controls. These were analyzed in terms of the risk factors that were reduced or eliminated from the original, unmodified job. In one case, risk factors such as awkward postures and heavy lifting were reduced or eliminated when mechanized lifts were installed to handle the 250-lb metal tubs while they were being washed [Gjessing et al. 1994].

Step 6: Health Care Management

Company health care management strategies and policies and health care providers can be an important part of the overall ergonomics program.

In general, health care management emphasizes the prevention of impairment and disability through early detection, prompt treatment, and timely recovery [Hales and Bertsche 1992; Parker and Imbus 1992; American National Standards Institute 1996]. Medical management responsibilities fall on employers, employees, and health care providers.

Employer Responsibilities

The employer can create an environment that encourages early evaluation by a health care provider by taking the following steps:

- Providing education and training to employees regarding the recognition of the symptoms and signs of WMSDs (see Step 3, Training Building In-House Expertise) and the employers procedures for reporting WMSDs
- Encouraging employees early reporting of symptoms and prompt evaluation by an appropriate health care provider
- Giving health care providers the opportunity to become familiar with jobs and job tasks
- Modifying jobs or accommodating employees who have functional limitations secondary to WMSDs as determined by a health care provider
- Ensuring, to the extent permitted by law, employee privacy and confidentiality regarding medical conditions identified during an assessment

Employee Responsibilities

Employees should participate in the health care management process by

- following applicable workplace safety and health rules,
- following work practice procedures related to their jobs, and
- reporting early signs and symptoms of WMSDs.

Employees may be faced with conflicting job demands or requirements. Safe work practices or rules may conflict with pressures or incentives to be more productive.

Health Care Provider Responsibilities

The health care provider should do the following:

- Acquire experience and training in the evaluation and treatment of WMSDs.
- Seek information and review materials regarding employee job activities.
- Ensure employee privacy and confidentiality to the fullest extent permitted by law.
- Evaluate symptomatic employees including:
- medical histories with a complete description of symptoms,
- descriptions of work activities as reported by the employees,
- physical examinations appropriate to the presenting symptoms and histories,
- initial assessments or diagnoses, opinions as to whether occupational risk factors caused, contributed to, or exacerbated the conditions, and
- examinations to follow up symptomatic employees and document symptom improvements or resolutions.

Issues

Job Familiarity and Job Placement Evaluations

Health care providers who evaluate employees, determine employees' functional capabilities, and prepare opinions regarding work relatedness should be familiar with employee jobs and job tasks. With specific knowledge of the physical demands involved in various jobs and the physical capabilities or limitations of employees, the health care provider can match the employees' capabilities with appropriate jobs. Being familiar with employee jobs not only assists the health care provider in making informed case management decisions but also assists with the identification of ergonomic hazards and alternative job tasks.

One of the best ways for a health care provider to become familiar with jobs and job tasks is by periodic plant walk-throughs. Once familiar with plant operations and job tasks, the health care provider should periodically revisit the facility to remain knowledgeable about changing working conditions. Other approaches that may help the health care provider to become familiar with jobs and job tasks include reviewing job analysis reports, detailed job descriptions, job safety analyses, and photographs or videotapes that are accompanied by narrative or written descriptions of the jobs.

Early Reporting and Access to Health Care Providers

Employees reporting symptoms or signs of potential WMSDs should have the opportunity for prompt evaluation by a health care provider. In general, the earlier that symptoms are identified and treatment is initiated, the less likely a more serious disorder will develop. Employers should not establish policies that discourage employees from reporting symptoms. For example, programs that link a manager's earnings to the number of employees reporting symptoms may discourage supervisors from allowing symptomatic employees to be evaluated by the health care provider. Employees should not fear discipline or discrimination on the basis of such reporting.

Treatment

- Health care providers are responsible for determining the physical capabilities and work restrictions of the affected workers.
- The employer is responsible for giving an employee a task consistent with these restrictions.
- Until effective controls are installed, employee exposure to ergonomic stressors can be reduced through restricted duty and/or temporary job transfer.
- Complete removal from the work environment should be avoided unless the employer is unable to accommodate the prescribed work restrictions.
- Immobilization devices, such as splints or supports, can provide relief to the symptomatic area in some cases. These devices are especially effective off-the-job, particularly during sleep. They should not be used as prophylactic PPE to prevent the development of WMSDs. Therefore, these devices should be dispensed to individuals with WMSDs only by health care providers who have knowledge of the benefits and possible negatives of these devices. Wrist splints, typically worn by patients with possible carpal tunnel syndrome, should not be worn at work unless the health care provider determines that the employee s job tasks do not require wrist bending. Employees who struggle to perform a task requiring wrist bending with a splint designed to prevent wrist bending can exacerbate symptoms in the wrist because of the increased force needed to overcome the splint. Splinting may also cause other joint areas (elbows or shoulders) to become symptomatic as work techniques are altered. Recommended periods of immobilization vary from several weeks to months depending on the nature and severity of the disorder. Any immobilization should be monitored carefully to prevent complications (e.g., muscle atrophy caused by nonuse).
- The health care provider should advise affected employees about the potential risk of continuing hobbies, recreational activities, or other personal habits that may adversely affect their condition as well as the risk of continuing work without job modifications.
- Oral medications such as aspirin or other nonsteroidal anti-inflammatory agents (NSAIA) are useful to reduce the severity of symptoms. However, their gastrointestinal and kidney side effects make their use among employees who have no symptoms inappropriate and may limit their usefulness among employees with chronic symptoms. In short, NSAIA should not be used preventively.

NIOSH activities in health care management of work-related health problems have included efforts to assess the implementation of such programs. One case is illustrated in Exhibit 20.

Exhibit 20: Medical Management—Poultry Processing Plants

At the request of a State labor department, NIOSH determined the prevalence of WMSDs of the neck and upper extremities in workers employed at two poultry processing plants. OSHA reports and symptom data obtained via questionnaires and physical exams found workers in jobs requiring highly repetitive, forceful motions and awkward postures to have significantly more hand and wrist disorders than those employed in less physically demanding work. In the course of this study, NIOSH also assessed the medical management practices in the two plants with regard to injured workers and the company's WMSD prevention program. Based largely on the questionnaire data and other sources of information, the following areas were suggested as needing improvement or change:

- **Increased nurse access:** From 23% to 29% of employees in one plant who met the various case definitions of upper extremity musculoskeletal symptoms indicated that their foreman or supervisor refused to allow them to leave their workstation to see the plant nurse at some point during the course of the year.

- **More efficient job rotation schemes:** Nearly 30% of the workers in the high exposure jobs in one plant and almost 27% in the second were involved in a job rotation plan. Both plant groups reported spending at least 2 days a week in jobs other than their base jobs. The rotation, however, did not necessarily place them in less ergonomically stressful tasks. Rather, the jobs they temporarily filled were often vacancies on the production line in the same high exposure area.

- **Questionable use of vitamins and anti-inflammatory drugs:** The policy of one plant required all new hires to take ibuprofen tablets and Vitamins E and C several times a day during their probationary periods. Although use of these substances has been advocated as a way to prevent WMSDs, valid, scientific evidence to establish their effectiveness is not available. More importantly, this approach does not substitute for effective engineering or administrative controls. Also, consumption of therapeutic amounts of these drugs (e.g., ibuprofen) can pose a risk of other adverse health effects [HETA 89-307–2009].

Step 7: Proactive Ergonomics

Proactive approaches to workplace ergonomics programs emphasize prevention of WMSDs through recognizing, anticipating, and reducing risk factors in the planning stages of new work processes.

Proactive Versus Reactive Approaches

To this point, the elements outlined in this primer and illustrated by NIOSH experiences have represented reactive approaches to dealing with workplace ergonomic problems. The steps have offered a plan for identifying problems, specifically WMSDs and job risk factors linked to them, and selecting and implementing measures for controlling them. In contrast, proactive approaches are geared to preventing these kinds of problems from developing in the first place.

Proactive ergonomics emphasize efforts at the design stage of work processes to recognize needs for avoiding risk factors that can lead to musculoskeletal problems (in effect, to design operations that ensure proper selection and use of tools, job methods, workstation layouts, and materials that impose no undue stress and strain on the worker).

Essential Considerations

Ergonomics issues are identified and resolved in the planning process. In addition, general ergonomic knowledge, learned from an ongoing ergonomics program, can be used to build a more prevention-oriented approach. Management commitment and employee involvement in the planning activity are essential. For example, management can set policy to require ergonomic considerations for any equipment to be purchased, and production employees can offer ideas on the basis of their past experiences for alleviating potential problems.

Decision-makers planning new work processes, especially those involved in the design of job tasks, equipment, and workplace layout, must become more aware of ergonomic factors and principles. Designers must have appropriate information and guidelines about risk factors for WMSDs and ways to control them. Studying past designs of jobs in terms of risk factors can offer useful input into their deliberations about needed improvements.

Design strategies emphasize fitting job demands to the capabilities and limitations of workers. Deciding which functions can be done best by machines and which by people is a primary objective. For example, for tasks requiring heavy materials handling and transport, ready use of mechanical assist devices to reduce the need for manual handling would be designed into the process. Large-sized units could be broken into smaller, more manageable ones, and equipment could be selected that most helps the workers using it.

Design strategies try to target the causes of potential musculoskeletal problems. For this reason, engineering approaches are preferred over administrative ones because they eliminate the risk factors as opposed to simply reducing exposure to them. For example, having machines do monotonous, repetitive, forceful work is better than subjecting workers to these risk factors. Administrative controls (such as worker rotation or allowing more rest breaks) remain stop-gap measures. They are not permanent solutions.

An example of a proactive approach to ergonomic concerns is illustrated in Exhibit 21.

Exhibit 21: Proactive Ergonomics at an Appliance Manufacturer

NIOSH, as a demonstration project, is assisting an appliance manufacturer in designing a new assembly line that, by incorporating ergonomic factors, can prevent musculoskeletal disorders without limiting production output. Steps in the project include the following:

- Evaluating musculoskeletal injury patterns associated with work on existing production lines, observing related risk factors, and determining engineering solutions for these risk factors
- In-house training of assembly line workers, engineers, and management to recognize, evaluate, and provide solutions to job risk factors
- Applying the above training information in the planning of a new assembly line with the goal of preventing musculoskeletal disorders
- Conducting a symptom survey of the assembly line workers at the beginning of the new line's production to establish baseline morbidity rates
- Fine tuning the production line with ergonomic controls as production increases and as workers become more knowledgeable and skilled in their jobs
- Conducting periodic follow-up symptom surveys to determine injury trends and outcomes

NIOSH interactions with the plant's design, manufacturing, and production engineers are aimed at shifting the engineers' thinking from just production issues to include ergonomic concerns. The following are some benefits resulting from these interactions:

- The design and use of a tool-balanced, in-line screw gun with torque control. The torque control is achieved by attaching an "L"-shaped handle called a "cheater bar" to the tool. This design allows the torque resulting from driving screws with this tool to be transferred to the bar, which is stabilized by holding it against the edge of the metal cabinet of the washer or dryer. In so doing, the torque force is not absorbed by the tool user.
- Using a pneumatic tool to open the hose clamps needed to attach hoses to the drain valves of washing machines. The original task was performed with a pair of pliers. This change reduces the static forces and awkward postures required for attaching the hose to the valve.
- Using height-adjustable worktables and height-adjustable shelving units, allowing workers of different heights and arm lengths to assemble parts with more ease and comfort.
- Using a pneumatic lift and rotation table to lift the washers to the desired standing height of the worker so they can drive in screws without stooping over, and rotating the tables so that all screws can be fastened from one workstation.
- Building an assembly line with these ergonomic workstation features may be less costly than retrofitting existing lines. Another advantage is that the worker is learning to do the job in ways that are more healthful and more productive [Estill and McGlothlin 1994].

Sample Ergonomics Program

I. Introduction

The Company takes all reasonable precautions to protect the health and safety of its employees, the public, and the environment. As part of this commitment, the Company has implemented this Ergonomics Program, which is intended to accomplish our primary objective of preventing injuries and illnesses in the workplace. Other components of the program include: work area evaluation, selection and use of appropriate equipment, and education and training.

This document describes the Company's Ergonomics Program and its components. Contained herein are precautions for preventing upper-extremity injuries and illnesses, roles and responsibilities for all workers, basic ergonomics principle and practices, and the resources available to workers and supervisors for identifying and resolving ergonomics problems. Additional precautions and requirements for preventing injuries from lifting are given in our company's written Injury and Illness Prevention Program.

The term "ergonomics" refers to the relationship between individuals and their work environment. The problems addressed by ergonomics include improper fit of the workplace, poorly designed or improper tools, and poor body mechanics when lifting or performing repetitive tasks (including computer keyboard use).

The Company's Ergonomics Program applies to all workers at the Company including contract employees, supplemental labor and labor-only workers. All Company employees are fully protected by the preventive measures of this program.

A. Program Effective Dates and General Compliance Information

Effective immediately, the following Ergonomics Awareness and Musculoskeletal Disorder Prevention elements will be implemented in our workplace:

1. We will provide each current and each new employee basic information about:

    a) Common musculoskeletal disorders (MSDs) and their signs and symptoms;

    b) The importance of reporting MSDs and their signs and symptoms early and the consequences of failing to report them early;

    c) How to report MSDs and their signs and symptoms in our workplace; and

    d) The kinds of risk factors, jobs and work activities associated with MSD hazards;

2. We will provide ergonomics information in written form to all current employees by using our Workplace Ergonomics handouts.

3. We will provide these handouts to all new employees upon hire.

4. We will post in our workplace a poster entitled "What You Need to Know About Musculoskeletal Disorders (MSDs)." This information will be posted in a conspicuous place in the workplace (e.g. employee bulletin board).

B. Company Response to Employee Report of MSD or MSD Symptoms

When an employee reports an MSD or signs of an MSD in our workplace:

1. We will promptly determine whether the reported MSD or MSD signs or symptoms qualify as an MSD incident. A report is considered to be an MSD incident in the following two cases:

    a) The MSD is work-related and requires days away from work, restricted work, or medical treatment beyond first aid; or

    b) The MSD signs or symptoms are work-related and last for 7 consecutive days after the employee reports them.

2. If the employee has experienced an MSD incident, we will determine whether the job meets our company's pre-defined Action Trigger as directed by part C of this section listed below.

3. If we determine the employee has not experienced an MSD incident, we will take no further action at that time.

C. Determinant of Action Trigger

We will consider a job to meet the Action Trigger if:

1. An MSD incident has occurred in that job, and

2. The employee's job routinely involves, on one or more days a week, exposure to one or more relevant risk factors at the levels described in the Basic Screening Tool (See Basic Screening Tool in the forms section of this program).

D. Actions to Be Taken When Action Trigger Is Met

1. We will immediately implement a "Quick Fix" for any job that yields an MSD incident when no previous MSD incident has occurred in that job. To ensure that we immediately address such injury, we will:

    a) Provide MSD management as appropriate, to the employee promptly after we determine that the employee's job meets the Action Trigger;

    b) Talk with the employees in the job and their representatives about the tasks the employees perform that may relate to the MSD incident;

c) Observe employees performing the job to identify which risk factors are likely to have caused the MSD incident;

d) Ask the employee(s) performing the job and their representatives to recommend measures to reduce exposure to the MSD hazards identified;

e) Within 90 days of our determination that the job meets the Action Trigger, we will implement controls in the job in accordance with our written ergonomics program that control the MSD hazards or reduce MSD hazards in accordance with or to the levels below those in the hazard identification tools in the "Appendices" section of this Manual and train the employee(s) in the use of these controls;

f) Within 30 days after we implement the controls, we will review the job to determine whether our controls have reduced the MSD hazards to acceptable levels; and

g) Keep a record of the Quick Fix process for each job to the levels specified in the OSHA standard. We will keep the record for 3 years.

2. If we determine that we have reduced the MSD hazards to the levels that will prevent future MSD incidents of a similar nature, we will then take no further action except to maintain all controls, all related training procedures, and all recordkeeping.

3. If we have not reduced MSD hazards to acceptable levels using our Quick Fix, we will then implement our full ergonomics program as specified in Part II of this program ("Controls For Minimizing Ergonomics Hazards").

II. Controls for Minimizing Ergonomic Hazards

A. Identifying a Possible Ergonomics Problem

Many ergonomic disorders are felt as strains and sprains. Acute or chronic muscle strain can be an indication that the capacity of the body to accommodate physical stressors has been exceeded. Acute muscle strain occurs when a concentrated episode has overstressed the musculoskeletal system. Chronic strain and cumulative trauma disorder (CTD, or as referred to in this program, "MSD/CTD") result from less-intense stresses that accumulate over time, reducing the rate of recovery of the musculoskeletal system.

1. Acute Muscle Strain

The signs and symptoms of acute muscle strain generally may include pain within 24 hours of an injury to the musculoskeletal system.

Most acute muscle strain injuries can be prevented. To prevent injuries:

a) Use mechanical devices or additional personnel when lifting and moving heavy loads.

b) Use proper body mechanics.

c) Establish limits for lifting heavy objects.

d) Avoid excessive fatigue from repeated forceful activities.

e) Be in good physical condition.

Workers should report symptoms of acute muscle strain to their work supervisor and then report to the Human Resources Department to determine if the pain is work related.

2. Cumulative Trauma Disorder

The signs and symptoms of MSD/CTD of the upper extremities include pain, numbness, and tingling of the fingers, wrist, elbow, or shoulder. Chronic back and neck problems may result in pain, numbness, or tingling that radiates to the arms or legs, as well as limited back motion. Doing the following usually can prevent these problems:

a) Use ergonomically designed tools and workspaces (e.g., furniture that has adjustment flexibility and allows for proper posture).

b) Educate workers to adhere to ergonomically appropriate work habits (e.g. maintaining the proper posture and using a light touch when doing keyboard work).

c) Vary physical activities appropriately to allow frequent, short rest periods during which tendons and muscles are not subjected to repetitive strain or sustained contraction (see "Alternate Work Periods" in Section C).

d) Assess, intervene, and evaluate symptoms early. Early intervention is essential to quick recovery and long-term prevention of MSD/CTD.

Note to Section A: It is extremely important for workers to report any recurrent symptoms of MSD/CTD (e.g. pain, numbness, tingling, or tenderness) to their work supervisor and the Human Resources Department.

B. Computer Workstation Evaluation Procedure

A work supervisor is responsible for ensuring that each worker's workspace is arranged properly. However, workers with concerns may request that their work supervisor provide a workstation evaluation.

In general, the work area ergonomic evaluator assigned by a manager should complete workstation evaluations. The duties required to fulfill the role of a work area ergonomic evaluator are defined in Part III of this Program ("Responsibilities") and should assist workers in identifying risk-related work habits (see Section C— "Ergonomic Design and Practices"—for more information).

The work area ergonomic evaluator completes an ergonomics evaluation form (see Section 6 of this Manual: "Workplace Evaluation Forms") or equivalent, reviews the form with the worker and his/her work supervisor, and provides both a copy of the form. The evaluator should also retain a copy. If a health problem is noted, the worker shall be referred to the Human Resources Department.

Workers and their supervisors shall make furniture adjustments or order furniture or other equipment to resolve problems identified during the evaluation. If the work area ergonomic evaluator is not available or cannot resolve a concern, the work supervisor should contact an outside consultant or industrial safety engineer. If a worker has medical symptoms, the work supervisor shall advise him/her to report to the Human Resources Department. The Human Resources Department can perform workstation evaluations for individuals who have an established injury or illness.

C. Ergonomic Design and Practices

1. Computer Ergonomics

A frequent contributor to MSD/CTD is improper configuration and use of computer workstations. Changes to a workstation may require simply repositioning furniture or equipment or purchasing ergonomically appropriate replacements. Figure 1 shows a well-designed computer workstation. In addition, some key items of a properly designed computer workstation are described in this section and should give workers a general idea of how to set up their workstations correctly. Plant

Engineering also is available to assist in the planning and design (or redesign) of work areas.

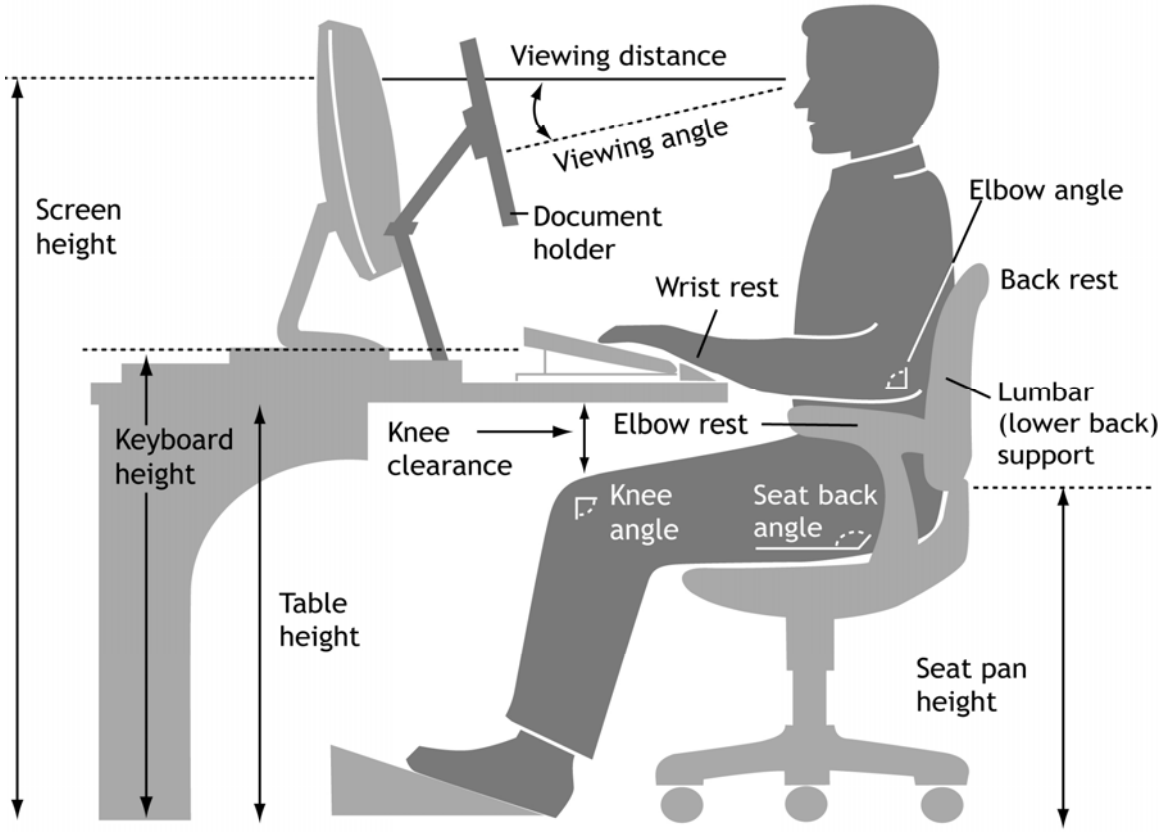


Figure 1. A well-designed computer workstation.

a) **Chair.** A chair should have an adjustable back that provides support for the lumbar region of the back and trunk. Each chair should also be easily adjustable in height to permit the feet to rest flat on the ground with the legs parallel to the floor. Some people may need a footrest to achieve this position. Chairs should have a five-star base and casters compatible with the floor surface. Armrests should be of a padded material and adjustable in height. The seat pan should be large enough to be comfortable.

b) **Work surface.** A work surface should be large enough to accommodate all computer equipment including a wrist rest in front of the keyboard and input device. A keyboard tray can be used to increase the depth of the workstation and viewing distance from the monitor. Sufficient room should be provided under a work surface to allow free leg movement. The height of

the work surface should allow the forearms to be parallel with the floor while working at the computer.

c) **Keyboard and input device.** A keyboard and input device (mouse or trackball) should be at the same level and in front of the operator. The height of the keyboard and input device should allow the operator to position his/her forearms and hands parallel to the floor during operation. This position can be achieved by adjusting the height of the chair, armrest, or table or by using an adjustable tray. A wrist rest for a keyboard and input device should be used to prevent the operator's wrists from coming in contact with the work surface when the arms are at rest.

d) **Terminal.** A terminal (i.e., monitor) should be located directly in front of the operator, and the top of the screen should be approximately at eye level or slightly lower.

e) **Vision.** Although often overlooked, vision is a critical part of the workstation composition. An annual eye examination is recommended to ensure that any changes in vision are detected and corrected. The viewing distance (i.e., the distance between an operator's eyes and a monitor) should be about an arm's length, and operators should periodically look away from the computer to a distant object to relax the eye muscles.

f) **Lighting and glare.** A monitor should be positioned in a location where outside or overhead light does not reflect off the screen. Blinds, drapes, or glare screens may be used to reduce glare. Light bulbs can be removed from light fixtures to reduce brightness or glare. Generally, a monitor should be placed at a right angle to a window.

2. Hand Tool Ergonomics

Below are some key points to remember when selecting or purchasing hand tools. Following such points can help prevent MSD/CTD.

a) Avoid tools that produce a bent wrist position. The ideal wrist position is neutral (i.e. straight). This position should be maintained while performing work. Figure 2 shows the correct position of the wrist when using hand tools.

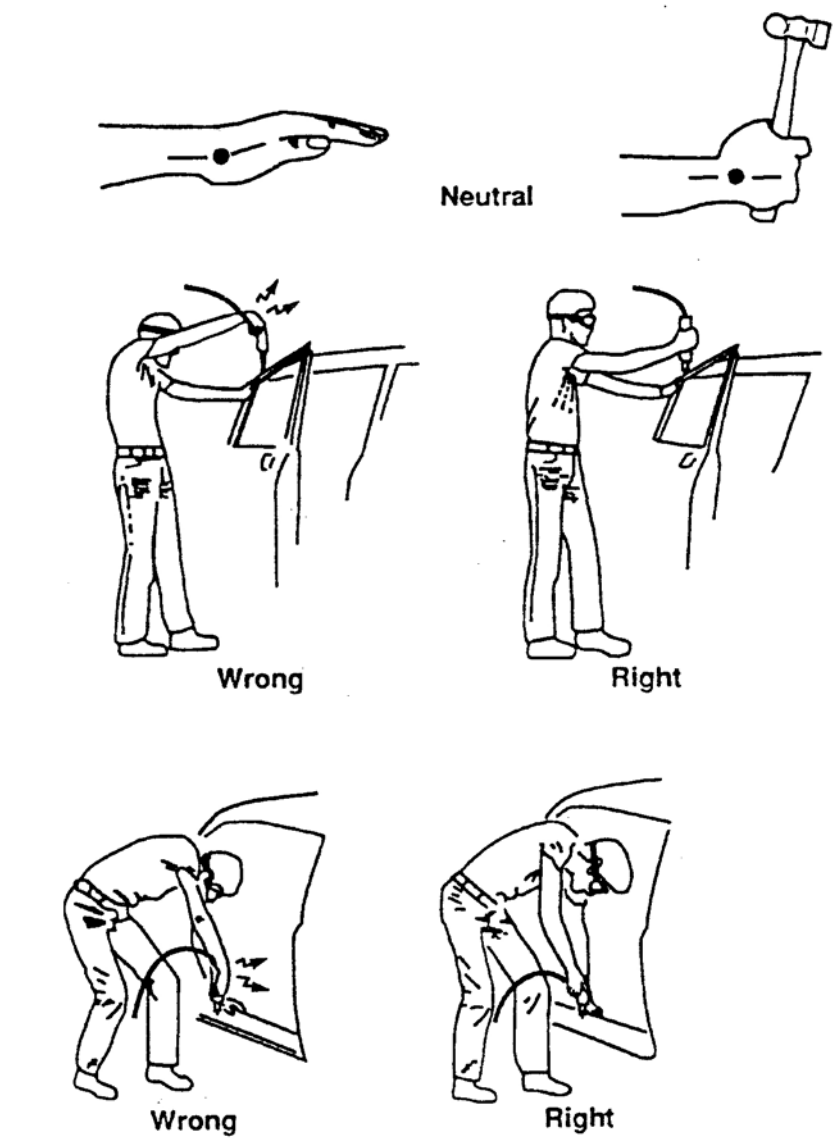


Figure 2. Correct positions for holding hand tools

b) Select hand tools that fit workers' hands (see Fig. 3). A tool that is too large or too small produces stresses in the hand and wrist. As a general rule, the ideal handle diameter is 1.5 inches for a man and 1.3 inches for a woman.

c) Do not select a tool so large as to be difficult to hold.

d) Select power or pneumatic tools with built-in vibration dampening (see Fig. 4).

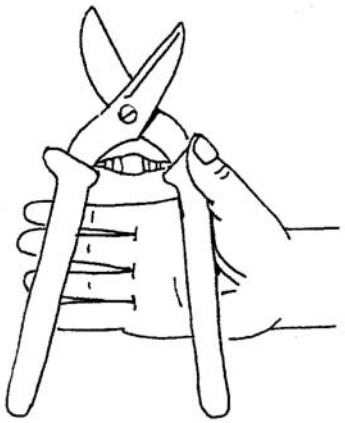
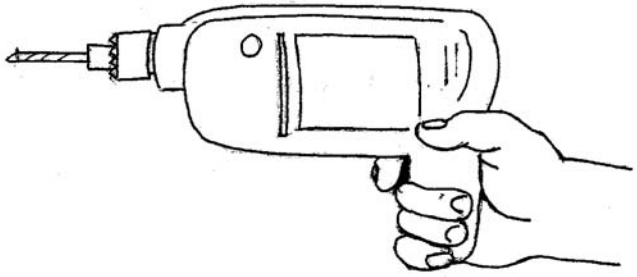


Figure 3. Reasonable hand grip for tool



Vibration dampening material can be designed into tool

Figure 4. Power or pneumatic tool with built-in vibration dampening.

e) For tools that are activated by a trigger, choose a grip size that allows activation with the middle part of the fingers. Activation with the fingertips can create nodules on nerve sheaths and cause a type of MSD/CTD known as trigger finger.

f) Use a soft covering on a tool handle to protect the hands from heat and cold and to help reduce pressure points, vibration, and slipperiness of the grip. Such covering encourages a more relaxed hold on the tool (see Fig. 5).

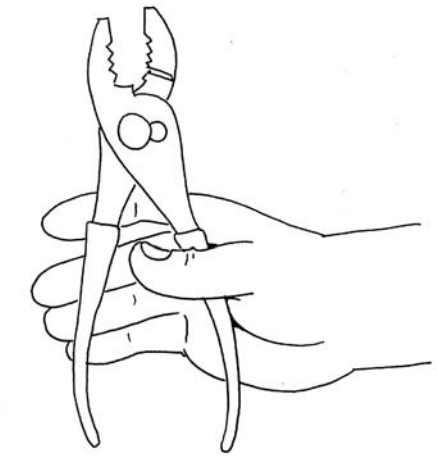


Figure 5. Soft covering for tool handle.

For more information on hand tools please ask your supervisor or the safety manager for help.

3. Other Workplace Ergonomics

In addition to computer workspaces, there are many other work settings (e.g., material fabrication, circuit-board fabrication, painting, gardening, office moves, custodial work etc.) where ergonomic practices are important and the effects of MSD\CTD are evident. The basic ergonomic guidance provided below may help avoid MSD\CTD.

a) Respect pain. If an activity causes pain or discomfort, stop and evaluate the activity to look for alternative approaches. Change positions if the activity is causing pain or discomfort.

b) Alternate tasks during the workday to interrupt repetitive activities.

c) Keep the wrists in the neutral position whenever possible.

d) Use two hands whenever possible, even when handling light objects or doing small tasks.

e) Make several trips with lighter loads. Use a cart or dolly if necessary.

f) To avoid the use of a sustained, forceful grip, use a vice, clamp, or jig to stabilize objects.

Back injuries represent a significant number of MSD\CTD cases. Therefore, a review of our companies back injury prevention program will be helpful in preventing this serious type of injury. For workspace evaluations, contact our Safety Manager.

4. Alternate Work Periods

Workers who have the highest risk of developing MSD\CTD include those who perform continuous, high-intensity, repetitive tasks that cause stress on the same body parts. An alternate work activity totaling five minutes for every 30 minutes of work is necessary for such individuals.

Alternate activities allow the muscles and tendons time to recover from repetitive motion tasks and do not include repetitive motion activities, such as keyboarding, use of hand tools or floor buffers, material handling, or other similar work. If necessary, hazards control industrial safety engineers or other types of safety consultants are available to assist supervisors in determining which workers fit into this high-risk category (Please see guidance for evaluating these types of work assignments).

D. Ergonomic Management by the Human Resources Department

Company employees with symptoms of MSD\CTD or acute injuries to the musculoskeletal system (including early signs of MSD\CTD) are required to report promptly to the Human Resources Department for an evaluation and, if needed, treatment.

The Human Resources Department provides the following services through outside consultants, medical clinics and health care providers:

1. Diagnosis, treatment, and management of acute musculoskeletal injuries and MSD\CTD, including return-to-work evaluations.

2. Worksite evaluations for workers with ergonomics-related injuries or illnesses.

3. Consultation on complex ergonomic problems and ergonomic program development.

For more information about the medical services offered for ergonomic injuries, contact the Human Resources Department

E. Recordkeeping

Records of workplace evaluations performed by a work area ergonomic evaluator or industrial safety engineer shall be retained in accordance with OSHA regulations and for a period of at least three years from date of report.

The Human Resource Department maintains a database that includes information relevant to ergonomic injuries and illnesses (including the injury and illness logs required by OSHA). The Human Resources Department also maintains the Company’s employees' medical records which are confidential.

F. Program Evaluation

The Company's Ergonomics Program is evaluated periodically to determine whether established objectives are being met and if revisions to the program are necessary. The program's primary objective is to reduce ergonomic injuries and illnesses in the workplace. The relevant indicators are monitored and evaluated.

G. Education and Training

Education and training are key aspects of the Company's Ergonomic Program. Supervisors and workers should receive sufficient information and education to recognize ergonomic risk factors, to understand the nature of ergonomic injuries and illnesses, and to be aware of potential corrective measures and the resources available.

The Company has placed posters outlining our ergonomics prevention program throughout our facility and other notices as required by OSHA regulations that summarize workplace safety and health requirements under OSHA's General Duty Clause.

The Company will set aside each year in it's fiscal budget an amount it deems necessary to help train supervisors and other company personnel in the proper techniques to evaluate and prevent workplace ergonomic hazards and MSDs.

The following video educational courses are recommended for supervisors:

1. Back Care
2. Video Display Terminal (VDT) Ergonomics
3. Working With Hand Tools
4. Preventing Repetitive Motion Injuries
5. How to Prevent Musculoskeletal Disorders (MSDs)

For more specific details on the availability of the above courses, please contact Personnel Concepts at (800) 333-3795.

III. Responsibilities

General responsibilities for all workers are described in the "Company's Safety and Health Policies," "General Worker Responsibilities," and "Safety Management" sections in our Company Injury and Illness Prevention Program.

Specific responsibilities with regard to the Company's Ergonomics Program are listed under each title below.

A. Management Representative

1. Implement ergonomic-related health and safety programs.

2. Ensure that ergonomics are considered when conducting hazard or risk assessments and root-cause analyses.

3. Support corrections to ergonomic problems by ensuring that the proper education and resources are available to supervisors and workers.

4. Ensure that programs are in place to evaluate the workplace for proper ergonomic practices and conditions.

5. Maintain a sufficient number of trained ergonomic evaluators to conduct workstation evaluations. The availability of a trained individual in a work area makes it possible to perform simple workstation evaluations and resolve complicated problems in a timely and cost effective manner.

6. Ensure that new furniture or equipment purchased for workstations has adjustment flexibility.

B. Supervisors

1. Payroll Supervisor
Ensure that workers receive appropriate ergonomics education this including giving each employee our company ergonomics pamphlet and summary at time of hire and at least once a year with each employees payroll check (see Part II, Section G of this Program: "Education & Training").

2. Work Supervisor
Note that the following responsibilities apply to the work supervisor. However, the payroll supervisor also may be responsible for these activities. In some cases the work supervisor may also be the payroll supervisor.

a) Respond to workers' concerns regarding ergonomic problems.

b) Seek assistance from the Human Resources Department

c) Ensure that computer workstation evaluations are conducted, as necessary.

d) Implement ergonomic recommendations in consultation with the Human Resources Department and provide follow-up.

e) Promptly refer all injured or ill employees to the Human Resources Department.

f) Ensure that workers who engage in intensive, highly repetitive work (as defined in Part II, Section C, Paragraph #4: "Alternate Work Periods") have the opportunity for frequent, short, alternate work activities.

g) Ensure that the work environment is appropriately evaluated for proper ergonomic practices and conditions.

h) Make ergonomic evaluations a part of ongoing workplace assessments.

i) Apply ergonomic principles when workplace changes are being considered.

j) Coordinate workspace furniture purchasing with personnel qualified in ergonomics planning.

3. Plant Manager or Office Manager

We will engage the services of competent safety and health professionals whenever necessary to ensure our ergonomics program is effective and to facilitate our company in areas we are not qualified to administer. The following is a list of general responsibilities for front-line managers:

a) Conduct workstation evaluations in specific work areas as assigned.

b) Refer complicated workstation evaluations to a Hazards Control industrial safety engineer (outside consultant) or the Human Resources Department.

c) Provide educational materials to workers and serve as a work-area informational resource person.

d) Refer employees complaining of pain or discomfort to the Human Resources Department.

e) Retain copies of workstation evaluations in accordance with OSHA record-keeping laws.

f) Make recommendations for ergonomic improvements in the workplace.

4. Workers

a) Promptly report ergonomic problems or concerns to your work supervisor. Prompt implementation of workplace changes can significantly reduce the potential for severe injuries or illness.

b) Follow ergonomic work practices and guidance provided by the Company.

5. Safety Manager

a) Provide guidance in modifying the workspace to minimize the potential for injuries and illnesses.

b) Provide information about ergonomic issues to increase the awareness of workers, supervisors, and managers.

c) Analyze injuries and illnesses to determine potential ergonomic causes.

d) Maintain Department-generated workstation evaluations and ergonomics records in accordance with OSHA Requirements

e) Evaluate individual workstations as requested.

f) Evaluate and advise workers and supervisors on the selection of ergonomically sound workstation furniture and equipment.

g) Assist supervisors, if necessary, in determining which workers require education (see Section G of Part II – "Training and Education") or alternate work activities.

6. Human Resources Department

a) Provide diagnosis, treatment, and medical management of MSD\CTD and acute strains to the musculoskeletal system.

b) Evaluate the workstations of individuals with injury or illness.

c) Provide consultation and analysis for complex ergonomics problems.

d) Work with our Workers Compensation Carrier to help reduce injuries

7. Plant Engineering

Our Vendors usually provide Plant Engineering Furniture/Interior Design Services or advice on the selection of ergonomically sound workstation furniture and processes of furniture purchases.

8. Workers Comp Carriers, Risk Management Office, Human Resources Department

The Risk Management Office of our workers compensation carrier helps provide management oversight of the Company's Workers Compensation Program,

including costs for medical treatment and services and other related workers compensation costs.

IV. Resources for More Information

A. Recommended Web Sites

The following internet web sites provide additional information on workplace ergonomics.

1. www.osha.gov - The Occupational Safety and Health Administration.

2. www.cdc.gov/niosh/homepage.html - The National Institute for Occupational Safety & Health (NIOSH)

3. www.personnelconcepts.com - Personnel Concepts

B. Recommended Distributors of Ergonomics Products

Personnel Concepts
3200 East Guasti Road
Suite 300
Ontario, CA 91767
Phone: (800) 333-3795

C. Recommended Safety Consultation Services

State Compliance & Safety
Phone: (800) 766-8192

Basic Screening Tools

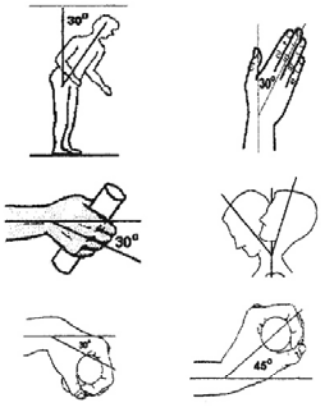
Basic Screening Tool

You need only review risk factors for those areas of the body affected by the MSD incident.

		Body Part Associated With MSD Incident			
Risk Factors This Standard Covers	**Performing job or tasks that involve:**	**Neck/ Shoulder**	**Hand/ Wrist/ Arm**	**Back/ Trunk/ Hip**	**Leg/ Knee/ Ankle**
Repetition	(1) Repeating the same motions every few seconds or repeating a cycle of motions involving the affected body part more than twice per minute for more than 2 consecutive hours in a workday.	✔	✔	✔	✔
	(2) Using an input device, such as a keyboard and/or mouse, in a steady manner for more than 4 hours total in a workday.	✔	✔		
Force	(3) Lifting more than 75 pounds at any one time; more than 55 pounds more than 10 times per day; or more than 25 pounds below the knees, above the shoulders, or at arms' length more than 25 times per day;	✔	✔	✔	✔
	(4) Pushing/polling with more than 20 pounds of initial force (e.g., equivalent to pushing a 65 pound box across a tile floor or pushing a shopping cart with five 40 pound bags of dog food) for more than 2 hours total per day;	✔	✔	✔	✔
	(5) Pinching an unsupported object weighing 2 or more pounds per hand or use of an equivalent pinching force (e.g., holding a small binder clip open) for more than 2 hours total per day;		✔		
	(6) Gripping an unsupported object weighing 10 pounds or more per hand, or use of an equivalent gripping force (e.g., crushing the sides of an aluminum soda can with one hand), for more than 2 hours total per day.		✔		

Basic Screening Tool—continued

You need only review risk factors for those areas of the body affected by the MSD incident.

Risk Factors This Standard Covers	Performing job or tasks that involve:	Body Part Associated With MSD Incident: Neck/ Shoulder	Hand/ Wrist/ Arm	Back/ Trunk/ Hip	Leg/ Knee/ Ankle
Awkward Postures	(7) Repeatedly raising or working with the hands) above the head or the elbow(s)) above the shoulder(s)) for more than 2 hours total per day;	✔	✔	✔	
	(8) Kneeling or squatting for more than 2 hours total per day;			✔	✔
	(9) Working with the back, neck or wrists bent or twisted for more than 2 hours total per day (see figures:) 	✔	✔	✔	
Contact Stress	(10) Using the hand or knee as a hammer more than 10 times per hour for more than 2 hours total per day;		✔		✔
Vibration	(11) Using vibrating tools or equipment that typically have high vibration levels (such as chainsaws, jack hammers, percussive tools, riveting or chipping hammers) for more than 30 minutes total per day;	✔	✔	✔	
	(12) Using tools or equipment that typically have moderate vibration levels (such as jig saws, grinders, or sanders) for more than 2 hours total per day.	✔	✔		

General Ergonomic Inspection Checklist

Company Name: _____

Address _____

City _____ State _____ Zip_____

Department _____

Potential Hazards - ✔ Indicates attention required

Manual Material Handling

1. ❑ Is there lifting of loads, tools, or parts?
2. ❑ Is there lowering of tools, loads, or parts?
3. ❑ Is there twisting at the waist to handle tools, loads, or parts?
4. ❑ Is there overhead reaching for tools, loads, or parts?
5. ❑ Is there bending at the waist to handle tools, loads, or parts?

For further analysis, refer to checklist in section 6

Physical Energy Demands

6. ❑ Do tools and parts weigh more than 10 lb?
7. ❑ Is reaching greater than 20 in.?
8. ❑ Is bending, stooping, or squatting a primary task activity?
9. ❑ Is walking or carrying loads a primary task activity?
10. ❑ Is lifting or lowering loads a primary task activity?
11. ❑ Is stair or ladder climbing with loads a primary task activity?
12. ❑ Is pushing or pulling loads a primary task activity?
13. ❑ Is reaching overhead a primary task activity?
14. ❑ Do any of the above tasks require five or more complete work cycles to be done within a minute?
15. ❑ Do workers complain that rest breaks and fatigue allowances are insufficient?

For further analysis refer to checklist in section 6

Other Musculoskeletal Demands

16. ❑ Do manual jobs require frequent, repetitive motions?
17. ❑ Is the worker unable to change his or her position often?
18. ❑ Does the work involve forceful, quick, or sudden motions?
19. ❑ Does the work involve shock or rapid buildup of forces?
20. ❑ Is finger-pinch gripping used?
21. ❑ Do job postures involve sustained muscle contraction of any limb?
22. ❑ Do work postures require frequent bending of the neck, shoulder, elbow, wrist, or finger joints?
23. ❑ For seated work, do reaches for tools and materials exceed 15 in. from the worker's position?

For further analysis, refer to checklists in section 6

Computer Workstation

24. ❑ Do operators use computer workstations for more than 4 hours a day?
25. ❑ Are there complaints of discomfort from those working at these stations?
26. ❑ Is the chair or desk nonadjustable?
27. ❑ Is the display monitor, keyboard, or document holder nonadjustable?
28. ❑ Does lighting cause glare or make the monitor screen hard to read?
29. ❑ Is the room temperature too hot or too cold?
30. ❑ Is there irritating vibration or noise?

For further analysis, refer to checklist in section 6

Environment

31. ❑ Is the temperature too hot or too cold?
32. ❑ Are the worker's hands exposed to temperatures less than 70 degrees Fahrenheit?
33. ❑ Is the workplace poorly lit?
34. ❑ Is there glare?

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Environment (continued)

35. ❑ Is there excessive noise that is annoying, distracting, or producing hearing loss?
36. ❑ is there upper extremity or whole body vibration?
37. ❑ Is air circulation too high or too low?

General Workplace

38. ❑ Are walkways uneven, slippery, or obstructed?
39. ❑ Is housekeeping poor?
40. ❑ Is there inadequate clearance or accessibility for performing tasks?
41. ❑ Are stairs cluttered or lacking railings?
42. ❑ Is proper footwear worn?

Tools

43. ❑ Is the handle too small or too large?
44. ❑ Does the handle shape cause the operator to bend the wrist in order to use the tool?
45. ❑ Is the tool hard to access?
46. ❑ Does the tool weigh more than 9 lb?
47. ❑ Does the tool vibrate excessively?
48. ❑ Does the tool cause excessive kickback to the operator?
49. ❑ Does the tool become too hot or too cold?

For further analysis, refer to checklist.

Gloves

50. ❑ Do the gloves require the worker to use more force when performing job tasks?
51. ❑ Do the gloves provide inadequate protection?
52. ❑ Do the gloves present a hazard of catch points on the tool or in the workplace?

Administration

53. ❑ Is there little worker control over the work process?
54. ❑ Is the task highly repetitive and monotonous?
55. ❑ Does the job involve critical tasks with high accountability and little or no tolerance for error?
56. ❑ Are work hours and breaks poorly organized?

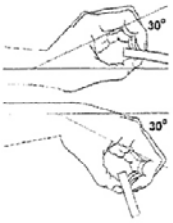
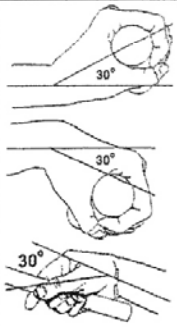
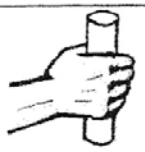
Item#	Priority Rating	Unsafe Conditions/ Procedures/ Behavior	Corrective Action	Target Date	Completion Date

NOTE: All hazardous situations should be corrected as soon as possible. The priority system is a suggested quideline to correct the more serious situations first. Hazard priority: 1. Serious 2. Moderate 3. Minor.

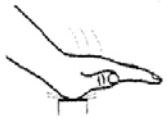
Conducted by _____ Title _____ Date _____

Conducted by _____ Title _____ Date _____

Forward completed form to safety manager and retain for 3 years.

High Hand Force					
Body Part	**Physical Risk Factor**	**Combined with**	**Duration**	**Visual Aid**	Check (✓) here if this is a WMSD hazard
Arms, wrists, hands	Pinching an object(s) weighing more than 2 lbs. per hand	Highly repetitive motions	More than 3 hours total per workday		❑
		Wrists bent 30° or more	More than 3 hours total per workday		❑
		No other risk factors	More than 4 hours total per workday		❑
Arms, wrists, hands	Gripping an object(s) weighing more than 6 lbs. per hand	Highly repetitive motions	More than 3 hours total per workday		❑
		Wrists bent 30° or more	More than 3 hours total per workday		❑
		No other risk factors	More than 4 hours total per workday		❑

Highly Repetitive Motions				
Body Part	**Physical Risk Factor**	**Combined with**	**Duration**	Check (✓) here if this is a WMSD hazard
Neck, shoulders, elbows, wrists, hands	Using the same motion with little or no variation every few seconds (excluding keying activities)	No other risk factors	More than 6 hours total per workday	❑
	Using the same motion with little or no variation every few seconds (excluding keying activities)	Wrists bent 30° or more **AND** High, forceful exertions with the hand(s)	More than 2 hours total per workday	❑
	Intensive keying (for example, data entry)	Awkward postures	More than 4 hours total per workday	❑
		No other risk factors	More than 7 hours total per workday	❑

Repeated Impact				
Body Part	**Physical Risk Factor**	**Duration**	**Visual Aid**	Check (✓) here if this is a WMSD hazard
Hands	Using the hand as a hammer more than once per minute	More than 2 hours total per workday		❑
Knees	Using the knee as a hammer more than once per minute	More than 2 hours total per workday		❑

Vibration

Use the instructions below to determine if a vibration hazard exists.

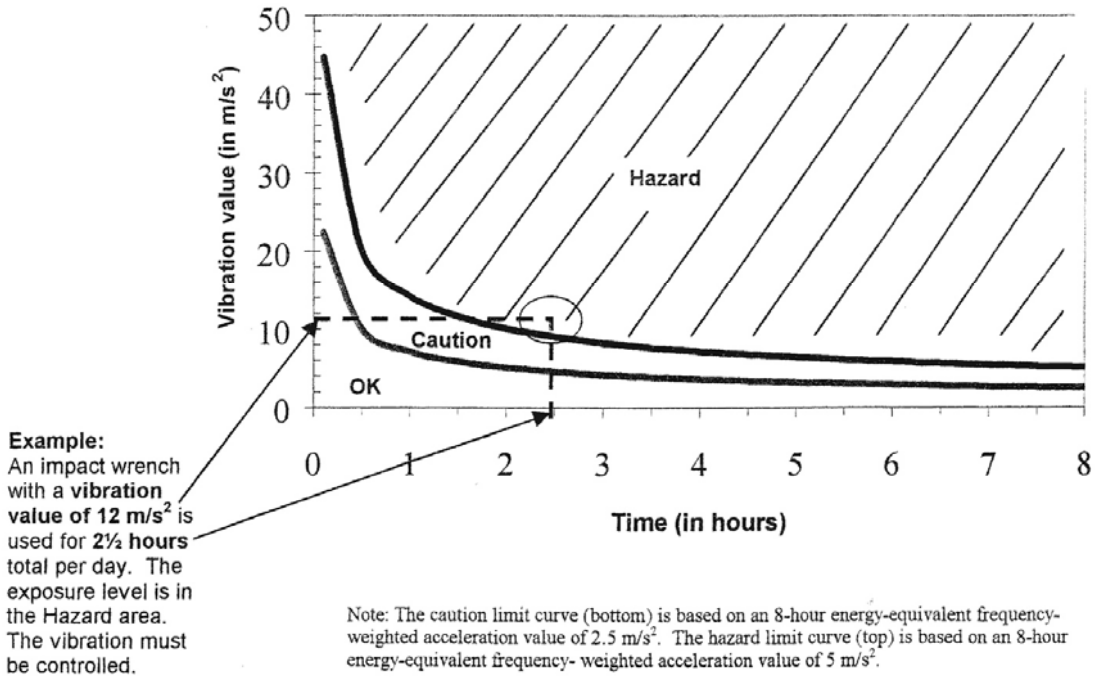
Step 1. Find the vibration value for the tool. (Get it from the manufacturer, look it up at this website: http://umetech.niwl.se/vibration/HAVHome.html, or you may measure the vibration yourself). The vibration value will be in units of meters per second squared (m/s^2). On the graph below find the point on the left side that is equal to the vibration value.

Note: You can also link to this website through the L&I WISHA Services Ergonomics website: http://www.lni.wa.gov/wisha/ergo

Step 2. Find out how many total hours per workday the employee is using the tool and find that point on the bottom of the graph.

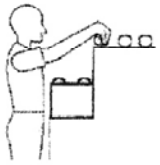
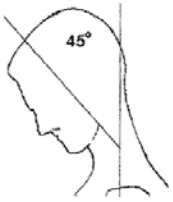
Step 3. Trace a line in from each of these two points until they cross.

Step 4. If that point lies in the cross-hatched "Hazard" area above the upper curve, then the vibration hazard must be controlled. If the point lies between the two curves in the "Caution" area, then the job remains as a "Caution Zone Job." If it falls in the "OK" area below the bottom curve, then no further steps are required.



Example:
An impact wrench with a **vibration value of 12 m/s^2** is used for **2½ hours** total per day. The exposure level is in the Hazard area. The vibration must be controlled.

Note: The caution limit curve (bottom) is based on an 8-hour energy-equivalent frequency-weighted acceleration value of 2.5 m/s^2. The hazard limit curve (top) is based on an 8-hour energy-equivalent frequency- weighted acceleration value of 5 m/s^2.

Awkward Postures				Check (✓) here if this is a WMSD hazard
Body Part	**Physical Risk Factor**	**Duration**	**Visual Aid**	
Shoulders	Holding the hand(s) above the head or the elbow(s) above the shoulder(s)	More than 4 hours total per workday		❑
	Repetitively raising the hand(s) above the head or the elbow(s) above the shoulder(s) more than once per minute	More than 4 hours total per workday		❑
Neck	Bending the neck, without added support, 45° or more	More than 4 hours total per workday		❑
Back	Bending the back forward to work, without added support, more than 30°	More than 4 hours total per workday		❑
	Bending the back forward to work, without added support, more than 45°	More than 2 hours total per workday		❑

Awkward Postures (continued)				Check (✓) here if this is a WMSD hazard
Body Part	**Physical Risk Factor**	**Duration**	**Visual Aid**	
Knees	Squatting	More than 4 hours total per workday		❑
	Kneeling on hard surfaces	More than 2 hours total per workday		❑
	Kneel on soft or padded surfaces	More than 4 hours total per workday		❑

Tray 1-A. NIOSH Investigations of WMSDs in Work Settings.

Standard Industrial Classification (SIC)	Work setting and tasks	Work-related musculoskeletal problems found	Ergonomic risk factors found	Recommendations	HETA/NTIS Reference no.
0171 Agriculture (Berry crops)	Harvesting wild blueberries. Task involves combing through bushes with a hand-held rake to scoop up berries.	Upper extremities (hand/wrist and elbow) and back.	Awkward (stooped) postures, repetitive deviations of the wrist, and repetitive and forceful motions of the hand/arm and shoulder.	Recommended engineering controls included using mechanized harvesting where feasible, and redesigning the rake (substitute material to make the rake lighter). Better work practices, work conditioning, and reducing the loads in buckets were also recommended.	HETA 93-1031-2521 NTIS order no. PB-96-115-472
1752 Construction (Floor work)	Carpet Installation. Tasks include use of the “knee kicker” to stretch carpet.	Lower limb	Forceful exertions and contact stress	Control recommendations included using knee pads and more use of a hand-operated power stretcher.	HETA 82-065-1664 NTIS order no. PB-86-225-661

Tray 1-A. NIOSH Investigations of WMSDs in Work Settings (Contined).

Standard Industrial Classification (SIC)	Work setting and tasks	Work-related musculoskeletal problems found	Ergonomic risk factors found	Recommendations	HETA/NTIS Reference no.
2011 Manufacturing (meat products)	Plant processing beef and pork products. Tasks studied were cutting and dissecting cattle and hogs with saws, straight knives, clippers, and hooks.	Upper extremity disorders (mainly hand/wrist but also elbows, shoulder, and neck).	Vibration and force found to correlate highest with problem cases. Data on repetitive actions and awkward postures were judged insufficient for analysis.	Engineering changes included reorientation of tools, adjustable fixtures, better layout of workstations and delivery bins, and automating aspects of the work process to relieve workload demands. Train new employees in proper work methods, use of job rotation, and rest breaks suggested along with better maintenance of cutting knives to reduce vibrations. Improved medical management stressed, such as educating workers to report early signs of problems, allowing adequate time off for symptomatic cases to heal and a slower paced return to work policy after surgery.	HETA 88-180-1958 NTIS order no. PB-90-128-992
2015 Manufacturing (Poultry processing)	Turkey processing. Jobs include eviscerating and boning tasks.	Upper limb and neck	Repetitive and forceful exertions, awkward postures, low temperature	Engineering control recommendations include use of better designed knives and adjustable workstations. Also recommended were a comprehensive knife and scissor sharpening program and improving the work load distribution throughout the plant. Administrative control recommendations were work practice training and decreasing line speeds.	HETA 86-505-1885 NTIS order no. PB-89-106-546

Tray 1-A. NIOSH Investigations of WMSDs in Work Settings (Contined).

Standard Industrial Classification (SIC)	Work setting and tasks	Work-related musculoskeletal problems found	Ergonomic risk factors found	Recommendations	HETA/NTIS Reference no.
2016 Manufacturing (Poultry products)	Poultry processing plant. Focus on workers engaged in tasks of cutting, eviscerating, and deboning carcasses as compared with those in lesser manual stress jobs.	Upper extremity (hand/wrist and elbow) disorders as well as tension neck problems.	Repetitive and forceful motions extreme and awkward postures of the upper extremities. Machine-paced work.	Engineering controls included restructuring jobs, use of mechanical devices to aid deboning and cutting tasks, and workstation changes to accommodate workers of varying sizes. New worker training, practice in proper cutting techniques, use of job rotation, and rest breaks to relieve fatigue were underscored. Suggested ways to improve medical management practices included better medical surveillance, employee education in symptom recognition, and cautions on treatment regarding use of drug therapy, splints, and restricted duty.	HETA 89-307-2009 NTIS order no. PB-91-104-620
Manufacturing (Fish products)	Filleting, fillet trimming, and “slimming” fish at a packing plant.	Upper limb and neck	Repetitive and forceful exertions, awkward postures	Engineering control recommendations include workstation modifications to adjust work table height to fit workers and to reduce reach distances, texturing cutting table to reduce the force needed to hold fish, and modifying knife handle design. As administrative controls, work practice training and reduced emphasis on speed were recommended for new hires.	HETA 83-251-1685 NTIS order no. PB-87-108-312

Tray 1-A. NIOSH Investigations of WMSDs in Work Settings (Contined).

Standard Industrial Classification (SIC)	Work setting and tasks	Work-related musculoskeletal problems found	Ergonomic risk factors found	Recommendations	HETA/NTIS Reference no.
2328 Manufacturing (clothing, furnishings)	Various sewing tasks at a uniform maker.	Upper limb and neck	Repetitive and forceful exertions, awkward postures	Plant-wide workstation modifications were suggested such as providing foot rails, floor mats, adjustable chairs, and padding the edges of tables to reduce contact stress. Improvement in work layout also noted to facilitate access to materials or parts. Job specific engineering control recommendations were also made.	HETA 83-205-1702 NTIS order no. PB-87-106-498
2421 Manufacturing (sawmills)	Driving and operating highway and off-highway logging trucks and stackers.	Upper limb, neck, and back	Whole body vibration	Replacing truck seats with seats offering greater vibration isolation was recommended. Work practice changes, such as driving slower and not lifting loads that are so heavy as to lift the rear wheels off the ground, were recommended. Job rotation and shorter work shifts were suggested to reduce exposures to whole body vibration.	HETA 83-349-1901 NTIS order no. PB-89-107-239

Tray 1-A. NIOSH Investigations of WMSDs in Work Settings (Contined).

Standard Industrial Classification (SIC)	Work setting and tasks	Work-related musculoskeletal problems found	Ergonomic risk factors found	Recommendations	HETA/NTIS Reference no.
2653 Manufacturing (paperboard containers)	Corrugating, finishing operations in producing cardboard boxes.	Upper extremity disorders, low back problems.	Repetitive, forceful hand/wrist movements, localized contact stresses, awkward back and upper extremity postures.	Furnish lift tables or load leveling systems to feeder and stacking machines and raise conveyor height to ease materials handling tasks. Add padding to edges and sharp corners of workstations to relieve contact stress. Consider options for reducing travel distance for materials access and disposal and more efficient stacking. Train total workforce on reporting early signs of WMSDs and one person or each shift in risk factor analysis and control.	HETA 96-0062-2588 NTIS order no. (in process)
2711 Manufacturing (Periodicals)	Information processing jobs using VDTs at a newspaper.	Upper limb and neck, lower limb, eyestrain	Repetitive exertions, awkward postures, glare	Engineering controls recommended included adjustable workstations (chairs, keyboard position) and controlling glare. For administrative controls, a work break schedule was recommended. Vision testing was suggested.	HETA 79-061-844 NTIS order no. PB-84-241-801
2711 Manufacturing (Periodicals)	Multiple departments of a newspaper. Computer terminal tasks included writing, editing, communicating through e-mail, and developing graphics.	Upper extremities (e.g., hand/wrist, elbow, forearm, shoulder, and neck).	Repetition, sustained awkward postures, extended work periods at computer keyboard, and job pressures.	Establish and train a joint ergonomics committee to develop and implement interventions. Furnish adjustable chairs and other workstation equipment, and train employees in its proper use. Institute appropriate health care management.	HETA 79-061-844 NTIS order no. PB-91-116-251

Tray 1-A. NIOSH Investigations of WMSDs in Work Settings (Contined).

Standard Industrial Classification (SIC)	Work setting and tasks	Work-related musculoskeletal problems found	Ergonomic risk factors found	Recommendations	HETA/NTIS Reference no.
2711 Manufacturing (Periodicals)	Printing layout work in a newspaper composing room. Tasks involve long periods of standing and walking.	Lower Limb	Static standing postures	Recommendations were made to reduce static standing requirements through the installation of footrests and to provide the option to sit. Added recommendations to pad edges of surfaces that workers lean against , install floor mats, and provide well-cushioned shoes.	HETA 90-251-2128 NTIS order no. PB-92-124-437
2711 Manufacturing (Periodicals)	VDT tasks at a newspaper company.	Upper limb and neck, eyestrain, headaches	Poor illumination, glare, poor workstation layout	Survey conducted that sought to define relationships between VDT-user symptoms and ergonomic aspects of VDT use. Main finding --increasing reports of being bothered by glare, brightness of screen, flicker, fuzziness of characters related to postural discomfort, headaches, and blurred vision.	HETA 80-127-1337 NTIS order no. PB-94-207-776
2711 Manufacturing (Periodicals)	A major newspaper setting with tasks involving use of video display terminals (VDT).	Upper extremity disorders (neck, hand/wrist, shoulder, and elbow).	Increased hours typing at a VDT keyboard, job deadline pressures, and varying workload demands.	Emphasized that a control plan must address job design, work organization, and psychosocial factors which were all correlated with symptoms reported. Employer's beginning efforts to use work breaks and document workload factors were acknowledged as a start.	HETA 90-013-2277 NTIS order no. PB-93-188-456

Tray 1-A. NIOSH Investigations of WMSDs in Work Settings (Contined).

Standard Industrial Classification (SIC)	Work setting and tasks	Work-related musculoskeletal problems found	Ergonomic risk factors found	Recommendations	HETA/NTIS Reference no.
3069 Manufacturing (Fabricated rubber products)	Various tasks such as cutting, cementing, and finishing rubber and nylon fabrics in a plant manufacturing fuel cells for aircraft	Upper limb and neck	Repetitive and forceful exertions, static exertions, contact stress, awkward postures, vibration	Engineering controls recommended include use of power scissors for cutting fabrics, modifying workstations, reducing vibration of powered handtools, providing footrests and floor mats, and securing razor blades used for cutting in handles.	HETA 90-246-2314 NTIS order no. PB-93-234-037
3070 Manufacturing (Plastics, metal products)	Manufacturer of plastic and metal pails. Tasks include inserting gaskets into lids, trimming, attaching handles.	Upper limb and neck	Repetitive and forceful exertions	Numerous specific engineering and work practice controls were suggested, ranging from workstation modification and automation to assuring trim knives are sharp. Job rotation and identification of light duty jobs were recommended as administrative controls, plus close medical monitoring of workers in identified high risk jobs.	HETA 89-146-2049 NTIS order no. PB-91-115-758
3079 Manufacturing (Fabricated rubber products)	Manufacturer of industrial, automotive, and garden hoses, Tasks include loading and unloading hoses into molds, trimming, and attaching couplings.	Upper extremity (e.g., hand/wrist disorders)	High repetition and force.	Redesign parts delivery bins for easier access, adjust height of work surfaces, and provide easier access to machine controls. Develop job rotation schemes and assign an additional worker to supply and load materials.	HETA 87-428-2063 NTIS order no. PB-91-151-720

Tray 1-A. NIOSH Investigations of WMSDs in Work Settings (Contined).

Standard Industrial Classification (SIC)	Work setting and tasks	Work-related musculoskeletal problems found	Ergonomic risk factors found	Recommendations	HETA/NTIS Reference no.
3079 Manufacturing (Fabricated fibrous products)	Press operations and finishing and assembly tasks in a plant manufacturing thermo-formed fibrous glass reinforced products.	Upper limb and neck	Repetitive and forceful exertions, contact stress, awkward postures	Engineering controls were suggested for using fixtures to hold work, modifying tools (such as adding handles on files), and using power shears for cutting. Worker and supervisor training in the recognition of risk factors for WMSDs was recommended. Textured gloves were recommended for operators of hand sanders to minimize the grasping forces required.	HETA 81-143-1041 NTIS order no. PB-83-201-426
3089 Manufacturing (Plastic products)	Operating presses and finishing parts in a plant manufacturing plastic and fibrous glass products.	Upper limb and neck	Static and forceful exertions, awkward postures	Provide stool or sit or stand bar, foot rail to relieve back and foot fatigue in jobs requiring standing work. Reposition press control buttons and tilt material bins to reduce reach distances. Furnish rounded, properly sized handles to finishing tools to distribute grip forces.	HETA 91-003-2232 NTIS order no. PB-93-119-360

Tray 1-A. NIOSH Investigations of WMSDs in Work Settings (Contined).

Standard Industrial Classification (SIC)	Work setting and tasks	Work-related musculoskeletal problems found	Ergonomic risk factors found	Recommendations	HETA/NTIS Reference no.
3134 Manufacturing (Leather products)	Shoe Manufacturer. Tasks investigated included nailing heels, trimming, hand application of inks and dyes, and waxing.	Upper extremities (hand/wrist and elbow), shoulder, back, and neck.	Awkward postures of the trunk, shoulder, and wrist; repetition; static exertions; and use of pinch grip.	Engineering ideas to augment ongoing efforts to reduce ergonomic stressors were offered. These included (1) installation of height-adjustable swivel chairs and anti-fatigue mats, (2) use of air-powered shears instead of scissors, (3) raising and tilting machinery with added fixtures to relieve extreme work postures, and (4) improve lighting.	HETA 94-0245-2577 NTIS order no. PB-96-209-747
3231 Manufacturing (Glass products)	Specialty glass and mirrors. Grinding, buffing, polishing, and buffing tasks.	Upper limb and neck	Repetitive and forceful exertions, awkward postures	Engineering control recommendations ranged from automating aspects of certain jobs to using special fixtures to hold the products. Continued job rotation for workers involved in certain tasks was suggested as an administrative control.	HETA 89-137-2005 NTIS order no. PB-91-108-134
3261 Manufacturing (Pottery products)	Ceramic plumbing fixture manufacturing. The machine-paced tasks include repeated lifting and moving of toilet bowls weighing up to 70 lb.	Back	Repetitive and forceful exertions, awkward postures, heavy lifting, and paced work	Arrange for two-worker lifts of heavy product loads. Modify height of conveyor and adjoining workstations to facilitate access, case transfer of product in the course of the manufacturing process. Consider alternatives to the paced work and incentive system's that would moderate and more evenly distribute the physical effort.	HETA 88-237-L1960 NTIS order no. PB-89-230-270

Tray 1-A. NIOSH Investigations of WMSDs in Work Settings (Contined).

Standard Industrial Classification (SIC)	Work setting and tasks	Work-related musculoskeletal problems found	Ergonomic risk factors found	Recommendations	HETA/NTIS Reference no.
3261 Manufacturing (Pottery products)	Lifting and loading jobs (as much as 73 lb.)in a plant manufacturing ceramic plumbing fixtures.	Back	Repetitive exertions, awkward postures, heavy lifting	Furnish mechanical lift devices to relieve manual handling of heavy product loads. Redesign carts and workstations to facilitate transfer of product in course of manufacturing process.	HETA 82-229-1286 NTIS order no. PB-84-209-741
3291 Manufacturing (Nonmetal mineral products)	Abrasive products manufacture with focus on press operating tasks.	Limited to evaluation of potential ergonomic risk factors.	Repetition, sustained awkward postures, forceful exertions, and contact forces.	Guardrails should be adjustable and padded. Prohibit use of hand as “hammer” . Modify press to reduce awkward postures. Furnish training to employees about ergonomic hazards. Establish a medical surveillance program.	HETA 92-0001-2444 NTIS order no. PB-95-146-429
3442 Manufacturing (Fabricated structures)	Assembly tasks at a window balance system manufacturer.	Upper limb and neck	Repetitive and forceful exertions, awkward postures, paced work.	Engineering controls are recommended including work layout improvements to facilitate parts assembly tasks, and assuring the fit parts to reduce assembly forces required. New employees should be given adequate “break-in” times.	HETA 88-361-2091 NTIS order no. PB-91-197-368

Tray 1-A. NIOSH Investigations of WMSDs in Work Settings (Contined).

Standard Industrial Classification (SIC)	Work setting and tasks	Work-related musculoskeletal problems found	Ergonomic risk factors found	Recommendations	HETA/NTIS Reference no.
3442 Manufacturing (Fabricated structural products)	Various production jobs such as welding, grinding and press operations in an automobile components fabrication plant.	Upper limb, neck, and back	Repetitive and forceful exertions, static exertions, awkward postures, vibration.	Engineering controls are recommended including adjustments to workstations, using larger wheels on part carts to reduce pushing forces, and using light beam controls to activate machinery. Vibration-absorbing gloves were recommended as personal equipment.	HETA 91-086-2235 NTIS order no. PB-93-119-915
3444 Manufacturing (Fabricated structural products)	Sheet metal forming (riveting, swedging, seaming, assembly) tasks in a plant manufacturing combustion exhaust systems.	Upper limb and neck	Repetitive and forceful exertions, contact stress, awkward postures	General engineering control recommendations included finding ways to reduce pinch grips and reach distances. Suggestions made to implement an employee awareness program and encourage early reporting of WMSD symptoms.	HETA 80-109-974 NTIS order no. PB-83-157-933
3463 Manufacturing (Metal forging and stamping)	Aluminum forging operations, Focus on tasks performed in pressing area.	Musculoskeletal strain and tendinitis dominated injury reports.	Repetitive lifting and pulling actions from awkward positions in handling aluminum pieces. Deviated wrist in use of tools (tongs), hand/wrist strains from extended holding, and kickback of lubrication guns when activated.	Engineering controls were suggested to (1) improve conveyor systems and lift devices to ease heavy load handling, (2) add adjustable height features to presses to relieve awkward postures, and (3) redesign tong handles and use counterbalanced suspension of lubrication guns to reduce upper extremity strains. Job rotation, added training, and medical monitoring also proposed for risk reduction.	HETA 95-0109-2520 NTIS order no. PB-96-115-415

Tray 1-A. NIOSH Investigations of WMSDs in Work Settings (Contined).

Standard Industrial Classification (SIC)	Work setting and tasks	Work-related musculoskeletal problems found	Ergonomic risk factors found	Recommendations	HETA/NTIS Reference no.
3483 Manufacturing (Ordinance)	Inspection of charges in a munitions plant. Tasks involve lifting and manipulation of charges weighing as much as 40 lb.	Upper limb, neck, and back	Repetitive and forceful exertions and heavy lifting	Engineering controls were suggested to provide adjustable chairs and fixtures to minimize load handling. Administrative and work practices proposals made to improve lifting methods, extend training in ergonomic risk factors, and improve medical monitoring by logging location and type of work performed.	HETA 83-142-1431 NTIS order no. PB-85-184-125
3499 Manufacturing (Fabricated metal products)	Various metal forming jobs such as cutting, shaping, and threading, and assembly tasks at a manufacturer of hand-held lubrication equipment.	Upper limb and neck, back	Repetitive and forceful exertions, awkward postures, heavy lifting.	Engineering controls were suggested for better presentation of stock and parts to eliminate excessive reaches (by using power lifts and better positioned racks), redesign of workstations, and repositioning of machine tools. It was recommended that the company continue to alert workers to ergonomic hazards and encourage early reporting of WMSD complaints.	HETA 81-375-1277 NTIS order no. PB-84-209-717
3544 Manufacturing (Metalworking machinery)	Grinding, polishing, and deburring tasks at a manufacturer of molds used in glass container production.	Upper limb and neck	Vibration	Recommendations for a medical monitoring program to identify early signs of hand-arm vibration syndrome. Rest breaks, job rotation, and use of gloves were also recommended.	HETA 93-0510-2462 NTIS order no. PB-95-171-294

Tray 1-A. NIOSH Investigations of WMSDs in Work Settings (Contined).

Standard Industrial Classification (SIC)	Work setting and tasks	Work-related musculoskeletal problems found	Ergonomic risk factors found	Recommendations	HETA/NTIS Reference no.
3592 Manufacturing (Industrial machinery)	Machine shop and foundry of a piston manufacturing company. Piston sleeve and piston machining and casting operations studied.	Upper limbs and back.	Repetitive, awkward postures in manual handling of products in machining. Awkward postures and static loading in casting tasks.	Suggested use of rotating/lifting devices, gravity feed racks, and positioning palletizers to reduce manual handling risks and back problems in machinists. Use a support device to hold ladle and relieve static strain in molding operations.	HETA 94-0040-2496 NTIS order no. PB-96-106-448
3612 Manufacturing (Electric distribution equipment)	Manufacture of high voltage and instrument transformers. Winding, wrapping, taping, and paper pulling operations were tasks under study.	Upper extremities (hand/wrist, shoulder, neck), low back and hip.	Awkward postures causing extreme bending and reaching, static standing, and forceful pulling actions.	Provide more height adjustable features to equipment and adjustable fixtures to relieve postural stresses. Reconfigure work areas to ease materials access and handling tasks.]Design job rotation and rest break schedules to relieve most fatiguing work tasks. Educate workers in early signs of WMSDs.	HETA 93-0233-2498 NTIS order no. PB-95-269-973
3621 Manufacturing (Electrical industrial)	The tasks include hammering, crimping, wrapping, winding, soldering, painting, and various assembly operations at an electric motor and generator plant.	Upper limb and neck	Repetitive and forceful exertions, awkward postures, contact stress	Engineering controls were suggested such as a raised standing surface, a modified mallet handle, and low-force clamps. Job rotation and training programs were suggested as administrative controls. Early reporting of symptoms was recommended.	HETA 81-369-1591 and HETA 81-466-1591 NTIS order no. PB-86-133-758

Tray 1-A. NIOSH Investigations of WMSDs in Work Settings (Contined).

Standard Industrial Classification (SIC)	Work setting and tasks	Work-related musculoskeletal problems found	Ergonomic risk factors found	Recommendations	HETA/NTIS Reference no.
3631 Manufacturing (Household appliances)	Producing microwave ovens, Jobs of grinding and mounting parts, wiring, leakage testing along a moving assembly line.	Hand/wrist and shoulder tendinitis, epicondylitis, and carpal tunnel syndrome.	Repetitive, forceful work (cycle time of 20 seconds), awkward postures, pinch grips, static muscle loading in use of handtools, time pressures, hand/arm vibration, and lifting.	Engineering controls proposed for reducing forces were to use low insertion terminals, screws needing less push force in mounting, and tools with nonmetal handles, sized to minimize overgripping. Also recommended were adjustments to conveyor height and realignments in work flow to ease lifting. Administrative measures offered to slow down the line and adopt more job rotation and work changes that can broaden worker skills. Ergonomics training of all workers suggested as first step in meeting needs.	HETA 94-0214-2508 NTIS order no. PB-95-270-013
3699 Manufacturing (Electrical equipment)	Manufacturer of garage door openers, antenna rotors, and motorized remote control switches. The many tasks included various hand-intensive assembly jobs, press operations, and use of pneumatic hand tools.	Upper limb and neck	Repetitive, static, and forceful exertions, awkward postures, paced work.	Numerous specific engineering controls were recommended to reduce manual handling of parts and ways to adapt foot pedals to assembly equipment.	HETA 85-480-1771 NTIS order no. PB-87-205-951

Tray 1-A. NIOSH Investigations of WMSDs in Work Settings (Contined).

Standard Industrial Classification (SIC)	Work setting and tasks	Work-related musculoskeletal problems found	Ergonomic risk factors found	Recommendations	HETA/NTIS Reference no.
3699 Manufacturing (Electrical)	Manufacturing electrical cords. Tasks include winding and trimming wire, assembly of cord sets, and packing.	Upper limb and neck	Repetitive and forceful exertions, static exertions, and awkward postures	Numerous task specific engineering, administrative, and work practices controls were suggested. Recommendations were made for implementing an ergonomics awareness program for workers and early reporting of injuries and symptoms.	HETA 81-217-1086 NTIS order no. PB-83-202-119
3714 Manufacturing (Motor vehicles)	Assembly tasks at a bus and truck wheel manufacturer.	Back, upper limb, and neck	Repetitive and forceful exertions, static exertions, awkward postures, heavy lifting	Install tilt, lift, and rotating tables in select jobs to ease manual materials handling tasks. Redesign work methods and workstation layout to minimize pulling and pushing tasks, handling loads, above shoulder height.	HETA 88-277-2069- NTIS order no. PB-91-184-523
3721 Manufacturing (Aircraft parts)	Manufacture and assembly of jet aircraft. Use of air-driven, hand-held tools (drills, routers, sanders, rivet guns, screw guns).	Limited to evaluation of tool properties.	Vibration levels in use of tools exceeded recommended exposure limits for typical work shift durations.	Continue effort to purchase new vibration reduced pneumatic tools. Maintain or replace tools producing high vibration levels due to wear and tear. Institute health care management practices ensuring early detection of hand/arm vibration disorders. Allow more rest breaks when using tools with highest vibrations levels.	HETA 94-0425-2513 NTIS order no. PB-961-106-943

Tray 1-A. NIOSH Investigations of WMSDs in Work Settings (Contined).

Standard Industrial Classification (SIC)	Work setting and tasks	Work-related musculoskeletal problems found	Ergonomic risk factors found	Recommendations	HETA/NTIS Reference no.
3751 Manufacturing (Motorcycles)	Flywheel milling and assembly tasks in a motorcycle manufacturing plant.	Upper limb, neck, and back	Repetitive, static, and forceful exertions, contact stress, awkward postures, heavy lifting, vibration	Specific engineering control recommendations include reducing the weight of the flywheel forging to reduce milling time and the weight handles, and improving the work layout to reduce manual material handling and excessive reaches. Work practice controls include training in better lifting techniques. Administrative controls, specifically job rotation, were recommended until engineering controls can be implemented.	HETA 90-134-2064 NTIS order no. PB-91-184-531
3751 Manufacturing (Motor vehicle parts)	Manufacture of flywheels in motorcycle plant. Milling, assembly, truing, and balancing jobs were focus of evaluation.	Hand/arm, back, and shoulder musculoskeletal disorders.	Excessive manual materials handling and lifting, awkward postures, hand/arm vibration, and repetitive, forceful hammering.	Pre-post evaluations show that engineering controls recommended earlier have reduced risk factors and the number and severity of WMSD cases. Further controls include gravity conveyors, added hoists, and optimal workstation layouts to further reduce manual materials handling loads. Enhance efforts for early detection, awareness training of WMSDs, and risk factors.	HETA 91-0208-2422 NTIS order no. PB-95-147-294

Tray 1-A. NIOSH Investigations of WMSDs in Work Settings (Contined).

Standard Industrial Classification (SIC)	Work setting and tasks	Work-related musculoskeletal problems found	Ergonomic risk factors found	Recommendations	HETA/NTIS Reference no.
3843 Manufacturing (Medical instruments)	Grinding, buffing, polishing, and lifting of metal assemblies in a plant manufacturing dental equipment.	Upper limb and neck, back.	Repetitive and forceful exertions, awkward postures, increased production with reduced manpower.	Use of added fixtures to relieve need to hold product items in different positions in finishing process. Installation of movable crane to assist in lifting and handling heavier loads. Use of pedestals under machines and platforms under workers to accommodate varying body sizes of workers and reduce need for undue stretching and bending.	HETA 83-233-1410 NTIS order no. PB-85-179-158
3861 Manufacturing (Photo supplies)	Wrapping, packing, and lifting tasks in a plant that converts bulk photographic products into consumer-size packages.	Upper limb and neck	Repetitive and forceful exertions, production quotas.	A variety of engineering controls were suggested including tool redesign, workstation modification, and the use of new mechanical devices. Job rotation and work practice training, as well as clarification of expected production goals, were recommended as administrative measures.	HETA 76-93 NTIS order no. PB-96-115-431
3911 Manufacturing (Miscellaneous)	Jewelry manufacturing where tasks include soldering, grinding, casting, stamping, and packing.	Upper limb and neck	Static and forceful exertions, awkward postures, and vibration.	Recommended engineering controls include adjustable workstations and chairs, added and improved fixtures, and tool redesign. Suggested administrative controls include training, job rotation, and rest pauses, plus a medical management program.	HETA 90-273-2130 NTIS order no. PB-92-133-321

Tray 1-A. NIOSH Investigations of WMSDs in Work Settings (Contined).

Standard Industrial Classification (SIC)	Work setting and tasks	Work-related musculoskeletal problems found	Ergonomic risk factors found	Recommendations	HETA/NTIS Reference no.
4311 Public utilities (Postal service)	Large sack sorting and small parcel bundle sorting operations at a major airport mail facility.	Back and leg discomfort; injuries from being struck with mail exiting chutes; overexertion.	Prolonged standing, heavy lifting, extended reach.	Furnish floor mats, step rails, and sit and stand stools to relieve prolonged standing postures. Design loading procedures and utility carts to eliminate unassisted manual lifts of mail sacks weighing up to 70 lb. Add diverters in chutes to funnel packages within easy reach of worker.	HETA 93-1145-2592 NTIS order no. PB-96-191-770
4311 Public utilities (Postal service)	The work setting was a mail processing facility. Job tasks were those involved with feeding mail to several automated mail processing machines and removing such mail once it has been sorted.	Limited to study of ergonomic risk factors in job tasks.	Frequent stooping to retrieve mail trays for feeding the machines, extended reach, and trunk flexion in sweeping and stacking sorted mail. High volume capacity of sorting machines makes these actions more repetitive.	Automated options for relieving manual operations with the processing machines need consideration. Examples would be a weight sensitive stacker bin that would eject its contents into a container either below or beside the bin where a moving conveyor could carry the mail away. Another would be spring-controlled leveling systems that raise the feeder trays as others are removed. Other measures would be to limit the time spent on these machine tasks or to provide added breaks.	HETA 92-0073-2337 NTIS order no. PB-94-133-824

Tray 1-A. NIOSH Investigations of WMSDs in Work Settings (Contined).

Standard Industrial Classification (SIC)	Work setting and tasks	Work-related musculoskeletal problems found	Ergonomic risk factors found	Recommendations	HETA/NTIS Reference no.
4311 Public utilities (Postal service)	Mail processing facility with workers engaged in loading mail into automated sorting machines and transferring the sorted mail once it is collected in bins.	Limited to an assessment of ergonomic risk factors in job tasks.	Prolonged standing postures and walking on hard floor surfaces.	Provide for a sit/stand option for those operating the loader and furnish foot rests to rest one leg while standing. Install cushioned mats to run the length and width of the loading and sweeping areas. Mats should have a beveled edge to reduce a tripping hazard and should be kept in place by velcro or some other method.	HETA 92-019-2188 NTIS order no. PB-92-193-887
4441 Transportation (Water)	Operation, repair and maintenance tasks at river locks and dams.	None reported	Repetitive and forceful exertions, awkward postures, heavy lifting, vibration.	The major recommendation is to develop and ergonomics program. Three jobs were analyzed, yet these represent only a fraction of the jobs performed at the various sites. Specific engineering control recommendations for the jobs studied include adjustable workstations, use of hoists and lifts for shop work and extending the height of rope tie-off posts for lock operation work.	HETA 90-385-2173 NTIS order no. PB-92-176-809
4510 Transportation (Air)	Key entry all computer workstations at a central airline reservation office.	Posture, muscular discomfort	Cramped work areas, noise interference, poor lighting, heat	Suggested engineering controls included improved workstations and lighting. Suggested administrative control included 15-min breaks every 2 hours for workers.	HETA 78-134-630 NTIS order no. PB-80-193-030

Tray 1-A. NIOSH Investigations of WMSDs in Work Settings (Contined).

Standard Industrial Classification (SIC)	Work setting and tasks	Work-related musculoskeletal problems found	Ergonomic risk factors found	Recommendations	HETA/NTIS Reference no.
4813 Public utilities (Communi-cators)	Telecommunica-tions work setting; directory assistance operators, using VDTs.	Upper extremities (hand/wrist, elbow, shoulder, and neck).	Use of bifocal glasses were associated with neck disorders. Work organization and psychosocial factors (e.g., fear of being replaced by computers, lack of supervisor support, and increasing work pressure) linked with musculo-skeletal disorders. Workstation and postural measurements were taken but not analyzed due to methodological limitations.	Continue joint ergonomics committee and consider equipment purchases based on their recommendations. Conduct visual testing of employees to ensure adequate corrected vision. Address concerns of job security and provide job diversity. Reduce information processing loads. Require prompt examinations of employees with musculoskeletal symptoms.	HETA 89-299-2230 NTIS order no. PB-93-119-329
5411 Retail trade (Food stores)	Grocery store cashiers working at express checkout stands that involve frequent reaching, scanning, and keying tasks.	Neck, upper back, shoulder, lower back, buttocks, and legs.	Repetition, awkward postures, excessive reach, and trunk flexion.	Changes made included adding a barrier at the far corner of the checkstand to reduce excessive reach and trunk flexion and providing an adjustable keyboard to relieve other postural stress. Videotape training was provided. Follow up showed a decrease in some symptoms after implementing these changes based in part on employee input. Other checkstand modifications recommended.	HETA 88-345-2031 NTIS order no. PB-91-117-234

Tray 1-A. NIOSH Investigations of WMSDs in Work Settings (Contined).

Standard Industrial Classification (SIC)	Work setting and tasks	Work-related musculoskeletal problems found	Ergonomic risk factors found	Recommendations	HETA/NTIS Reference no.
5411 Wholesale trade (Food stores)	Grocery warehouse setting with jobs involving order selecting (i.e., locating orders for selection, manual handling, and loading of orders for delivery).	Back injuries and back pain.	Repeated lifting of heavy loads requiring extended reach. Need to meet incentive standards. Thermal stress further aggravated problems.	Design of storage racks and physical layout should be rearranged to allow ready access to orders, and the grocery items (cases) should be restricted in size to ease handling. Performance standards should be reexamined or worker rotation and restrictions on overtime provisions to minimize risks of overexertion. Measures to reduce heat stress should be considered (e.g., cooling fans, ample, easily accessible cool drinking water, and increasing rest breaks in cool locations).	HETA 91-405-2340 NTIS order no. PB-94-131-638
5411 Trade (Food stores)	Check-out tasks at a grocery store.	Ergonomics evaluation only.	Repetitive and forceful exertions, awkward postures.	The major recommendation was to eliminate the practice of having the checker unload the grocery cart by proposing design changes to facilitate customer unloading of the grocery cart in checkout. In the interim, other engineering and work practice recommendations were made ranging from improving the mating between the grocery cart and the checkout counters or grocery carts to discourage customers from placing items on the bottom shelf of the cart. Improved training of cashiers was recommended.	HETA 92-294-2301 NTIS order no. PB-94-110-376

Tray 1-A. NIOSH Investigations of WMSDs in Work Settings (Contined).

Standard Industrial Classification (SIC)	Work setting and tasks	Work-related musculoskeletal problems found	Ergonomic risk factors found	Recommendations	HETA/NTIS Reference no.
5712 Wholesale Trade (Furniture)	Wood kitchen cabinet manufacturer. Jobs include sanding, planing, painting, packing, shipping, and lifting, pushing, and pulling tasks.	Upper limb, neck, back, and lower limb.	Repetitive, static, and forceful exertions, awkward postures, and heavy lifting	Numerous specific engineering control recommendations were made to minimize or eliminate risk factors associated with sustained postures, lifting and carrying, and repetitive exertions. In addition, it was recommended that new employees start at slower rates so they can be conditioned and that frequent rest breaks be allowed.	HETA 88-384-2060 NTIS order no. PB-91-152-082
7349 Services (Business services)	Janitorial employees using a back-pack vacuum cleaner in typical office cleaning work.	Shoulder, back, and neck discomfort.	Increased muscle force and disc compression owing to weight of unit and typical forward leaning postures assumed when working with the vacuum unit.	Train the workers in proper use of the vacuum unit, and periodically monitor its use and fit and any complaints. Allow the workers some flexibility in choice of equipment for a cleaning task. Use of the unit can prove difficult in a confined space. An upright unit can resolve such problems.	HETA 93-0805-2387 NTIS order no. PB-94-176-450
7699 Services (Repair)	Missile and aircraft guidance system maintenance and repair work conducted using low power microscopes at an Air Force facility.	Upper limb and neck, back	Awkward postures	Engineering controls recommended included using improved adjustable chairs, tables, and work jigs. Work practice suggestions included better microscope use techniques such as more frequent lens cleaning and looking away from the lens frequently. Reducing the time spent at the microscope each day by job enlargement and work practices training were suggested as administrative controls.	HETA 84-082-2387 NTIS order no. PB-94-176-450

Tray 1-A. NIOSH Investigations of WMSDs in Work Settings (Contined).

Standard Industrial Classification (SIC)	Work setting and tasks	Work-related musculoskeletal problems found	Ergonomic risk factors found	Recommendations	HETA/NTIS Reference no.
8351 Services (Child care)	Caring for children at a day care facility. Tasks involve lifting children and frequent kneeling and squatting.	Upper limb, neck, back, and lower limb	Repetitive exertions, static exertions, awkward postures, and heavy lifting.	Suggested engineering controls were to provide furniture and fixtures at appropriate adult heights. Proposed administrative and work practices controls included use of lifting techniques to minimize back stresses.	HETA 93-0995-2442 NTIS order no. PB-95-129-235
8731 Services (Biological research)	Research laboratory conducting anticancer research. Numerous laboratory tasks.	Upper extremities	Sustained awkward and static postures of the hand/arm, repetition, use of pinch grips, contact with sharp edges of workstations.	Engineering controls included retrofitting pipettes with finger trigger strips and pipette foot switches and modifying biosafety cabinets (e.g., padding sharp edges, providing height-adjustable turntable for easier access). Administrative controls were changing job protocols to reduce repetitions, job rotation, and frequent micro-breaks.	HETA 95-0294-2594 NTIS order no. (in process)
9190 Services (Government)	Data entry and other tasks involving video-display units at a Federal government office.	Upper limb and neck, back, eyestrain.	Repetitive exertions, awkward postures, glare and poor illumination.	Various recommendations were made to improve lighting and reduce glare and to improve workstation design (keyboard height, viewing distance and angle, chair features, wrist rests, detachable keyboards). A visual testing program and a rest-break schedule were recommended.	HETA 83-463-1642 NTIS order no. PB-86-206-059

Tray 1-A. NIOSH Investigations of WMSDs in Work Settings (Contined).

Standard Industrial Classification (SIC)	Work setting and tasks	Work-related musculoskeletal problems found	Ergonomic risk factors found	Recommendations	HETA/NTIS Reference no.
9999 Non-classifiable	Sign language interpreters for the deaf.	Upper extremities (e.g., shoulder, elbow, fingers, neck, and hand) disorders and back problems.	Repetition and awkward and static postures.	Include rest breaks in interpreting sessions. Maintain signing motions between the shoulders and within the area bounded by the chest and wrist. Avoid forceful contacts between the hands.	HETA 92-0268-2447 NTIS order no. PB-95-219-465

Workplace Evaluation Forms

General Ergonomic Inspection Checklist

Company Name: _____

Address _____

City _____ State _____ Zip_____

Department _____

Potential Hazards - ✔ Indicates attention required

Manual Material Handling

1. ❑ Is there lifting of loads, tools, or parts?
2. ❑ Is there lowering of tools, loads, or parts?
3. ❑ Is there twisting at the waist to handle tools, loads, or parts?
4. ❑ Is there overhead reaching for tools, loads, or parts?
5. ❑ Is there bending at the waist to handle tools, loads, or parts?

For further analysis, refer to checklist in section 6

Physical Energy Demands

6. ❑ Do tools and parts weigh more than 10 lb?
7. ❑ Is reaching greater than 20 in.?
8. ❑ Is bending, stooping, or squatting a primary task activity?
9. ❑ Is walking or carrying loads a primary task activity?
10. ❑ Is lifting or lowering loads a primary task activity?
11. ❑ Is stair or ladder climbing with loads a primary task activity?
12. ❑ Is pushing or pulling loads a primary task activity?
13. ❑ Is reaching overhead a primary task activity?
14. ❑ Do any of the above tasks require five or more complete work cycles to be done within a minute?
15. ❑ Do workers complain that rest breaks and fatigue allowances are insufficient?

For further analysis refer to checklist in section 6

Other Musculoskeletal Demands

16. ❑ Do manual jobs require frequent, repetitive motions?
17. ❑ Is the worker unable to change his or her position often?
18. ❑ Does the work involve forceful, quick, or sudden motions?
19. ❑ Does the work involve shock or rapid buildup of forces?
20. ❑ Is finger-pinch gripping used?
21. ❑ Do job postures involve sustained muscle contraction of any limb?
22. ❑ Do work postures require frequent bending of the neck, shoulder, elbow, wrist, or finger joints?
23. ❑ For seated work, do reaches for tools and materials exceed 15 in. from the worker's position?

For further analysis, refer to checklists in section 6

Computer Workstation

24. ❑ Do operators use computer workstations for more than 4 hours a day?
25. ❑ Are there complaints of discomfort from those working at these stations?
26. ❑ Is the chair or desk nonadjustable?
27. ❑ Is the display monitor, keyboard, or document holder nonadjustable?
28. ❑ Does lighting cause glare or make the monitor screen hard to read?
29. ❑ Is the room temperature too hot or too cold?
30. ❑ Is there irritating vibration or noise?

For further analysis, refer to checklist in section 6

Environment

31. ❑ Is the temperature too hot or too cold?
32. ❑ Are the worker's hands exposed to temperatures less than 70 degrees Fahrenheit?
33. ❑ Is the workplace poorly lit?
34. ❑ Is there glare?

Environment (continued)

35. ❑ Is there excessive noise that is annoying, distracting, or producing hearing loss?
36. ❑ is there upper extremity or whole body vibration?
37. ❑ Is air circulation too high or too low?

General Workplace

38. ❑ Are walkways uneven, slippery, or obstructed?
39. ❑ Is housekeeping poor?
40. ❑ Is there inadequate clearance or accessibility for performing tasks?
41. ❑ Are stairs cluttered or lacking railings?
42. ❑ Is proper footwear worn?

Tools

43. ❑ Is the handle too small or too large?
44. ❑ Does the handle shape cause the operator to bend the wrist in order to use the tool?
45. ❑ Is the tool hard to access?
46. ❑ Does the tool weigh more than 9 lb?
47. ❑ Does the tool vibrate excessively?
48. ❑ Does the tool cause excessive kickback to the operator?
49. ❑ Does the tool become too hot or too cold?

For further analysis, refer to checklist.

Gloves

50. ❑ Do the gloves require the worker to use more force when performing job tasks?
51. ❑ Do the gloves provide inadequate protection?
52. ❑ Do the gloves present a hazard of catch points on the tool or in the workplace?

Administration

53. ❑ Is there little worker control over the work process?
54. ❑ Is the task highly repetitive and monotonous?
55. ❑ Does the job involve critical tasks with high accountability and little or no tolerance for error?
56. ❑ Are work hours and breaks poorly organized?

Item#	Priority Rating	Unsafe Conditions/ Procedures/ Behavior	Corrective Action	Target Date	Completion Date

NOTE: All hazardous situations should be corrected as soon as possible. The priority system is a suggested quideline to correct the more serious situations first. Hazard priority: 1. Serious 2. Moderate 3. Minor.

Conducted by _____ Title _____ Date _____

Conducted by _____ Title _____ Date _____

Forward completed form to safety manager and retain for 3 years.

General Ergonomic Inspection Checklist

Company Name: _____

Address _____

City _____ State _____ Zip_____

Department _____

Potential Hazards - ✔ Indicates attention required

Manual Material Handling

1. ❑ Is there lifting of loads, tools, or parts?
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3. ❑ Is there twisting at the waist to handle tools, loads, or parts?
4. ❑ Is there overhead reaching for tools, loads, or parts?
5. ❑ Is there bending at the waist to handle tools, loads, or parts?

For further analysis, refer to checklist in section 6

Physical Energy Demands

6. ❑ Do tools and parts weigh more than 10 lb?
7. ❑ Is reaching greater than 20 in.?
8. ❑ Is bending, stooping, or squatting a primary task activity?
9. ❑ Is walking or carrying loads a primary task activity?
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12. ❑ Is pushing or pulling loads a primary task activity?
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14. ❑ Do any of the above tasks require five or more complete work cycles to be done within a minute?
15. ❑ Do workers complain that rest breaks and fatigue allowances are insufficient?

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Other Musculoskeletal Demands

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Environment (continued)

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37. ❑ Is air circulation too high or too low?

General Workplace

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Environment (continued)

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General Workplace

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Administration

53. ❑ Is there little worker control over the work process?
54. ❑ Is the task highly repetitive and monotonous?
55. ❑ Does the job involve critical tasks with high accountability and little or no tolerance for error?
56. ❑ Are work hours and breaks poorly organized?

Item#	Priority Rating	Unsafe Conditions/ Procedures/ Behavior	Corrective Action	Target Date	Completion Date

NOTE: All hazardous situations should be corrected as soon as possible. The priority system is a suggested quideline to correct the more serious situations first. Hazard priority: 1. Serious 2. Moderate 3. Minor.

Conducted by _____ Title _____ Date _____

Conducted by _____ Title _____ Date _____

Forward completed form to safety manager and retain for 3 years.

General Ergonomic Inspection Checklist

Company Name: _____

Address _____

City _____ State _____ Zip_____

Department _____

Potential Hazards - ✔ Indicates attention required

Manual Material Handling

1. ❑ Is there lifting of loads, tools, or parts?
2. ❑ Is there lowering of tools, loads, or parts?
3. ❑ Is there twisting at the waist to handle tools, loads, or parts?
4. ❑ Is there overhead reaching for tools, loads, or parts?
5. ❑ Is there bending at the waist to handle tools, loads, or parts?

For further analysis, refer to checklist in section 6

Physical Energy Demands

6. ❑ Do tools and parts weigh more than 10 lb?
7. ❑ Is reaching greater than 20 in.?
8. ❑ Is bending, stooping, or squatting a primary task activity?
9. ❑ Is walking or carrying loads a primary task activity?
10. ❑ Is lifting or lowering loads a primary task activity?
11. ❑ Is stair or ladder climbing with loads a primary task activity?
12. ❑ Is pushing or pulling loads a primary task activity?
13. ❑ Is reaching overhead a primary task activity?
14. ❑ Do any of the above tasks require five or more complete work cycles to be done within a minute?
15. ❑ Do workers complain that rest breaks and fatigue allowances are insufficient?

For further analysis refer to checklist in section 6

Other Musculoskeletal Demands

16. ❑ Do manual jobs require frequent, repetitive motions?
17. ❑ Is the worker unable to change his or her position often?
18. ❑ Does the work involve forceful, quick, or sudden motions?
19. ❑ Does the work involve shock or rapid buildup of forces?
20. ❑ Is finger-pinch gripping used?
21. ❑ Do job postures involve sustained muscle contraction of any limb?
22. ❑ Do work postures require frequent bending of the neck, shoulder, elbow, wrist, or finger joints?
23. ❑ For seated work, do reaches for tools and materials exceed 15 in. from the worker's position?

For further analysis, refer to checklists in section 6

Computer Workstation

24. ❑ Do operators use computer workstations for more than 4 hours a day?
25. ❑ Are there complaints of discomfort from those working at these stations?
26. ❑ Is the chair or desk nonadjustable?
27. ❑ Is the display monitor, keyboard, or document holder nonadjustable?
28. ❑ Does lighting cause glare or make the monitor screen hard to read?
29. ❑ Is the room temperature too hot or too cold?
30. ❑ Is there irritating vibration or noise?

For further analysis, refer to checklist in section 6

Environment

31. ❑ Is the temperature too hot or too cold?
32. ❑ Are the worker's hands exposed to temperatures less than 70 degrees Fahrenheit?
33. ❑ Is the workplace poorly lit?
34. ❑ Is there glare?

Environment (continued)

35. ❑ Is there excessive noise that is annoying, distracting, or producing hearing loss?
36. ❑ is there upper extremity or whole body vibration?
37. ❑ Is air circulation too high or too low?

General Workplace

38. ❑ Are walkways uneven, slippery, or obstructed?
39. ❑ Is housekeeping poor?
40. ❑ Is there inadequate clearance or accessibility for performing tasks?
41. ❑ Are stairs cluttered or lacking railings?
42. ❑ Is proper footwear worn?

Tools

43. ❑ Is the handle too small or too large?
44. ❑ Does the handle shape cause the operator to bend the wrist in order to use the tool?
45. ❑ Is the tool hard to access?
46. ❑ Does the tool weigh more than 9 lb?
47. ❑ Does the tool vibrate excessively?
48. ❑ Does the tool cause excessive kickback to the operator?
49. ❑ Does the tool become too hot or too cold?

For further analysis, refer to checklist.

Gloves

50. ❑ Do the gloves require the worker to use more force when performing job tasks?
51. ❑ Do the gloves provide inadequate protection?
52. ❑ Do the gloves present a hazard of catch points on the tool or in the workplace?

Administration

53. ❑ Is there little worker control over the work process?
54. ❑ Is the task highly repetitive and monotonous?
55. ❑ Does the job involve critical tasks with high accountability and little or no tolerance for error?
56. ❑ Are work hours and breaks poorly organized?

Item#	Priority Rating	Unsafe Conditions/ Procedures/ Behavior	Corrective Action	Target Date	Completion Date

NOTE: All hazardous situations should be corrected as soon as possible. The priority system is a suggested quideline to correct the more serious situations first. Hazard priority: 1. Serious 2. Moderate 3. Minor.

Conducted by _____ Title _____ Date _____

Conducted by _____ Title _____ Date _____

Forward completed form to safety manager and retain for 3 years.

Workstation Checklist

Name: _____ Title: _____ Date: _____

Workstation #: _____ Supervisor: _____

Evaluation Requested by: ❑ Supervisor ❑ Employee ❑ Medical **Reason for Evaluation:** ❑ Preventive ❑ Reactive

The checklists are written so that "no" responses indicate potential problem areas that should receive further investigation.

	Yes	No	
1.	❑	❑	Does the working space allow for a full range of movement?
2.	❑	❑	Are mechanical aids and equipment available?
3.	❑	❑	Is the height of the work surface adjustable?
4.	❑	❑	Can the work surface be tilted or angled?
5.			Is the workstation designed to reduce or eliminate:
a)	❑	❑	bending or twisting at the waist?
b)	❑	❑	reaching above the shoulder?
c)	❑	❑	static muscle loading?
d)	❑	❑	extending the arms?
e)	❑	❑	bending or twisting the wrists?
f)	❑	❑	raised elbows?
6.	❑	❑	Is the employee able to vary posture?
7.	❑	❑	Are hands and arms free from pressure form sharp edges on work surfaces?
8.	❑	❑	Is there an adjustable document holder?
9.	❑	❑	Are arm rests provided where needed?
10.	❑	❑	Is the screen clean and free of flickering?
11.	❑	❑	Is the top line of the screen slightly below eye level?
12.	❑	❑	Does the monitor have brightness and contrast controls?
13.	❑	❑	Is the monitor 18-30 inches form the worker for viewing?
14.	❑	❑	Is there sufficient lighting without causing glare?
15.	❑	❑	Is an anti-glare screen used if necessary?
16.	❑	❑	Are adequate rest breaks provided for task demands?
17.			Are high stroke rates avoided by:
a)	❑	❑	job rotation?
b)	❑	❑	self pacing?
c)	❑	❑	adjusting the job to the skill of the worker?
d)	❑	❑	adequate rest pauses?
18.			Are employees trained in:
a)	❑	❑	proper postures?
b)	❑	❑	proper work methods?
c	❑	❑	when and how to adust their workstations?
d)	❑	❑	how to seek assistance with concerns?

Office Use Only

Recommendations _____

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Workstation Checklist

Name: _____ Title: _____ Date: _____

Workstation #: _____ Supervisor: _____

Evaluation Requested by: ❑ Supervisor ❑ Employee ❑ Medical **Reason for Evaluation:** ❑ Preventive ❑ Reactive

The checklists are written so that "no" responses indicate potential problem areas that should receive further investigation.

	Yes	No	
1.	❑	❑	Does the working space allow for a full range of movement?
2.	❑	❑	Are mechanical aids and equipment available?
3.	❑	❑	Is the height of the work surface adjustable?
4.	❑	❑	Can the work surface be tilted or angled?
5.			Is the workstation designed to reduce or eliminate:
a)	❑	❑	bending or twisting at the waist?
b)	❑	❑	reaching above the shoulder?
c)	❑	❑	static muscle loading?
d)	❑	❑	extending the arms?
e)	❑	❑	bending or twisting the wrists?
f)	❑	❑	raised elbows?
6.	❑	❑	Is the employee able to vary posture?
7.	❑	❑	Are hands and arms free from pressure form sharp edges on work surfaces?
8.	❑	❑	Is there an adjustable document holder?
9.	❑	❑	Are arm rests provided where needed?
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a)	❑	❑	job rotation?
b)	❑	❑	self pacing?
c)	❑	❑	adjusting the job to the skill of the worker?
d)	❑	❑	adequate rest pauses?
18.			Are employees trained in:
a)	❑	❑	proper postures?
b)	❑	❑	proper work methods?
c	❑	❑	when and how to adust their workstations?
d)	❑	❑	how to seek assistance with concerns?

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Recommendations _____

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Workstation Checklist

Name: _____ Title: _____ Date: _____

Workstation #: _____ Supervisor: _____

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	Yes	No	
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2.	❑	❑	Are mechanical aids and equipment available?
3.	❑	❑	Is the height of the work surface adjustable?
4.	❑	❑	Can the work surface be tilted or angled?
5.			Is the workstation designed to reduce or eliminate:
a)	❑	❑	bending or twisting at the waist?
b)	❑	❑	reaching above the shoulder?
c)	❑	❑	static muscle loading?
d)	❑	❑	extending the arms?
e)	❑	❑	bending or twisting the wrists?
f)	❑	❑	raised elbows?
6.	❑	❑	Is the employee able to vary posture?
7.	❑	❑	Are hands and arms free from pressure form sharp edges on work surfaces?
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17.			Are high stroke rates avoided by:
a)	❑	❑	job rotation?
b)	❑	❑	self pacing?
c)	❑	❑	adjusting the job to the skill of the worker?
d)	❑	❑	adequate rest pauses?
18.			Are employees trained in:
a)	❑	❑	proper postures?
b)	❑	❑	proper work methods?
c	❑	❑	when and how to adust their workstations?
d)	❑	❑	how to seek assistance with concerns?

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Recommendations _____

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Workstation Checklist

Name: _____ Title: _____ Date: _____

Workstation #: _____ Supervisor: _____

Evaluation Requested by: ❑ Supervisor ❑ Employee ❑ Medical **Reason for Evaluation:** ❑ Preventive ❑ Reactive

The checklists are written so that "no" responses indicate potential problem areas that should receive further investigation.

	Yes	No	
1.	❑	❑	Does the working space allow for a full range of movement?
2.	❑	❑	Are mechanical aids and equipment available?
3.	❑	❑	Is the height of the work surface adjustable?
4.	❑	❑	Can the work surface be tilted or angled?
5.			Is the workstation designed to reduce or eliminate:
a)	❑	❑	bending or twisting at the waist?
b)	❑	❑	reaching above the shoulder?
c)	❑	❑	static muscle loading?
d)	❑	❑	extending the arms?
e)	❑	❑	bending or twisting the wrists?
f)	❑	❑	raised elbows?
6.	❑	❑	Is the employee able to vary posture?
7.	❑	❑	Are hands and arms free from pressure form sharp edges on work surfaces?
8.	❑	❑	Is there an adjustable document holder?
9.	❑	❑	Are arm rests provided where needed?
10.	❑	❑	Is the screen clean and free of flickering?
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12.	❑	❑	Does the monitor have brightness and contrast controls?
13.	❑	❑	Is the monitor 18-30 inches form the worker for viewing?
14.	❑	❑	Is there sufficient lighting without causing glare?
15.	❑	❑	Is an anti-glare screen used if necessary?
16.	❑	❑	Are adequate rest breaks provided for task demands?
17.			Are high stroke rates avoided by:
a)	❑	❑	job rotation?
b)	❑	❑	self pacing?
c)	❑	❑	adjusting the job to the skill of the worker?
d)	❑	❑	adequate rest pauses?
18.			Are employees trained in:
a)	❑	❑	proper postures?
b)	❑	❑	proper work methods?
c	❑	❑	when and how to adust their workstations?
d)	❑	❑	how to seek assistance with concerns?

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Recommendations _____

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Workstation Checklist

Name: _____ Title: _____ Date: _____

Workstation #: _____ Supervisor: _____

Evaluation Requested by: ❑ Supervisor ❑ Employee ❑ Medical **Reason for Evaluation:** ❑ Preventive ❑ Reactive

The checklists are written so that "no" responses indicate potential problem areas that should receive further investigation.

	Yes	No	
1.	❑	❑	Does the working space allow for a full range of movement?
2.	❑	❑	Are mechanical aids and equipment available?
3.	❑	❑	Is the height of the work surface adjustable?
4.	❑	❑	Can the work surface be tilted or angled?
5.			Is the workstation designed to reduce or eliminate:
a)	❑	❑	bending or twisting at the waist?
b)	❑	❑	reaching above the shoulder?
c)	❑	❑	static muscle loading?
d)	❑	❑	extending the arms?
e)	❑	❑	bending or twisting the wrists?
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6.	❑	❑	Is the employee able to vary posture?
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a)	❑	❑	job rotation?
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c)	❑	❑	adjusting the job to the skill of the worker?
d)	❑	❑	adequate rest pauses?
18.			Are employees trained in:
a)	❑	❑	proper postures?
b)	❑	❑	proper work methods?
c	❑	❑	when and how to adust their workstations?
d)	❑	❑	how to seek assistance with concerns?

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Recommendations _____

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Task Analysis Checklist

Name:_____ Title: _____ Date:_____

Workstation #:_____ Supervisor: _____

Evaluation Requested by: ❑ Supervisor ❑ Employee ❑ Medical **Reason for Evaluation:** ❑ Preventive ❑ Reactive

The checklists are written so that "no" responses indicate potential problem areas that should receive further investigation.

	Yes	No	
1.			Does the design of the task reduce or eliminate:
a)	❑	❑	bending or twisting?
b)	❑	❑	crouching?
c)	❑	❑	bending or twisting the wrists?
d)	❑	❑	extending the arms?
e)	❑	❑	raising elbows?
f)	❑	❑	static muscle loading?
g)	❑	❑	clothes-wringing motions?
h)	❑	❑	finger pinch grip?
2.	❑	❑	Are mechanical devices used when necessary?
3.	❑	❑	Can the task be done with either hand?
4.	❑	❑	Can the task be done with two hands?
5.	❑	❑	Are pushing and pulling forces reduced or eliminated?
6.	❑	❑	Are the required forces acceptable?
7.			Are the materials
a)	❑	❑	able to be held without slipping?
b)	❑	❑	easy to grasp?
c)	❑	❑	free from sharp edges or comers?
8.	❑	❑	Do containers have good handholds?
9.	❑	❑	Are jigs, fixtures and vises used where needed designed?
10.	❑	❑	If gloves are needed, do they fit properly, and are they made of the proper fabric?
11.	❑	❑	Does the task avoid contact with sharp edges?
12.	❑	❑	When needed, are push buttons designed properly?
13.	❑	❑	Does personal protective equipment keep from getting in the way of the task?
14.	❑	❑	Are high rates of repetitive motion avoided by:
a)	❑	❑	job rotation?
b)	❑	❑	self pacing?
c)	❑	❑	sufficient rest pauses?
d)	❑	❑	adjusting the job to the skill level of the worker?
15.			Is the employee trained in:
a)	❑	❑	proper work practices?
b)	❑	❑	when and how to make adjustments?
c)	❑	❑	signs and symptoms of potential physical problems?

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Recommendations _____

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Task Analysis Checklist

Name:_____ Title: _____ Date:_____

Workstation #:_____ Supervisor: _____

Evaluation Requested by: ❑ Supervisor ❑ Employee ❑ Medical **Reason for Evaluation:** ❑ Preventive ❑ Reactive

The checklists are written so that "no" responses indicate potential problem areas that should receive further investigation.

	Yes	No	
1.			Does the design of the task reduce or eliminate:
a)	❑	❑	bending or twisting?
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c)	❑	❑	bending or twisting the wrists?
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8.	❑	❑	Do containers have good handholds?
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a)	❑	❑	job rotation?
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c)	❑	❑	sufficient rest pauses?
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a)	❑	❑	proper work practices?
b)	❑	❑	when and how to make adjustments?
c)	❑	❑	signs and symptoms of potential physical problems?

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Task Analysis Checklist

Name:_____ Title: _____ Date:_____

Workstation #:_____ Supervisor: _____

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	Yes	No	
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12.	❑	❑	When needed, are push buttons designed properly?
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14.	❑	❑	Are high rates of repetitive motion avoided by:
a)	❑	❑	job rotation?
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c)	❑	❑	sufficient rest pauses?
d)	❑	❑	adjusting the job to the skill level of the worker?
15.			Is the employee trained in:
a)	❑	❑	proper work practices?
b)	❑	❑	when and how to make adjustments?
c)	❑	❑	signs and symptoms of potential physical problems?

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Recommendations _____

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Task Analysis Checklist

Name:_____ Title: _____ Date:_____

Workstation #:_____ Supervisor: _____

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c)	❑	❑	bending or twisting the wrists?
d)	❑	❑	extending the arms?
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12.	❑	❑	When needed, are push buttons designed properly?
13.	❑	❑	Does personal protective equipment keep from getting in the way of the task?
14.	❑	❑	Are high rates of repetitive motion avoided by:
a)	❑	❑	job rotation?
b)	❑	❑	self pacing?
c)	❑	❑	sufficient rest pauses?
d)	❑	❑	adjusting the job to the skill level of the worker?
15.			Is the employee trained in:
a)	❑	❑	proper work practices?
b)	❑	❑	when and how to make adjustments?
c)	❑	❑	signs and symptoms of potential physical problems?

Office Use Only

Recommendations _____

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Task Analysis Checklist

Name:_____ Title: _____ Date:_____

Workstation #:_____ Supervisor: _____

Evaluation Requested by: ❑ Supervisor ❑ Employee ❑ Medical **Reason for Evaluation:** ❑ Preventive ❑ Reactive

The checklists are written so that "no" responses indicate potential problem areas that should receive further investigation.

	Yes	No	
1.			Does the design of the task reduce or eliminate:
a)	❑	❑	bending or twisting?
b)	❑	❑	crouching?
c)	❑	❑	bending or twisting the wrists?
d)	❑	❑	extending the arms?
e)	❑	❑	raising elbows?
f)	❑	❑	static muscle loading?
g)	❑	❑	clothes-wringing motions?
h)	❑	❑	finger pinch grip?
2.	❑	❑	Are mechanical devices used when necessary?
3.	❑	❑	Can the task be done with either hand?
4.	❑	❑	Can the task be done with two hands?
5.	❑	❑	Are pushing and pulling forces reduced or eliminated?
6.	❑	❑	Are the required forces acceptable?
7.			Are the materials
a)	❑	❑	able to be held without slipping?
b)	❑	❑	easy to grasp?
c)	❑	❑	free from sharp edges or comers?
8.	❑	❑	Do containers have good handholds?
9.	❑	❑	Are jigs, fixtures and vises used where needed designed?
10.	❑	❑	If gloves are needed, do they fit properly, and are they made of the proper fabric?
11.	❑	❑	Does the task avoid contact with sharp edges?
12.	❑	❑	When needed, are push buttons designed properly?
13.	❑	❑	Does personal protective equipment keep from getting in the way of the task?
14.	❑	❑	Are high rates of repetitive motion avoided by:
a)	❑	❑	job rotation?
b)	❑	❑	self pacing?
c)	❑	❑	sufficient rest pauses?
d)	❑	❑	adjusting the job to the skill level of the worker?
15.			Is the employee trained in:
a)	❑	❑	proper work practices?
b)	❑	❑	when and how to make adjustments?
c)	❑	❑	signs and symptoms of potential physical problems?

Office Use Only

Recommendations _____

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Materials Handling Checklist

Name: _____ Title: _____ Date: _____

Workstation #:_____ Supervisor: _____

Evaluation Requested by: ❑ Supervisor ❑ Employee ❑ Medical **Reason for Evaluation:** ❑ Preventive ❑ Reactive

The checklists are written so that "no" responses indicate potential problem areas that should receive further investigation.

	Yes	No	
1.	❑	❑	Has excessive weight lifting been reduced?
2.	❑	❑	Are materials moved over minimum distances?
3.	❑	❑	Is the distance between the object and the body minimized?
4.	Are walking surfaces:		
a)	❑	❑	level?
b)	❑	❑	wide enough?
c)	❑	❑	clean and dry?
d)	❑	❑	well lit?
5.	Are objects:		
a)	❑	❑	easy to grasp?
b)	❑	❑	stable?
c)	❑	❑	able to be held without slipping?
6.	❑	❑	Are there handholds on these objects?
7.	❑	❑	When required, do gloves fit properly?
8.	❑	❑	Is the proper footwear worn?
9.	❑	❑	Is there enough room to maneuver?
10.	❑	❑	Are mechanical aids easily available and used whenever possible?
11.	❑	❑	Are working surfaces adjustable to the best handling heights?
12.	Does material handling avoid:		
a)	❑	❑	movements below knuckle height and above shoulder height?
b)	❑	❑	static muscle loading?
c)	❑	❑	sudden movements during handling?
d)	❑	❑	twisting at the waist?
e)	❑	❑	excessive reaching?
13.	❑	❑	Is help available for heavy or awkward lifts?
14.	Are high rates of repetition avoided by:		
a)	❑	❑	job rotation?
b)	❑	❑	self pacing?
c)	❑	❑	sufficient rest pauses?
15.	❑	❑	Are pushing and pulling forces reduced or eliminated?
16.	❑	❑	Does the employee have an unobstructed view of the handling task?
17.	❑	❑	Is there a preventive maintenance program for equipment?
18.	❑	❑	Are workers trained in correct handling and lifting procedures?

Office Use Only

Recommendations_____

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Materials Handling Checklist

Name: _____ Title: _____ Date: _____

Workstation #:_____ Supervisor: _____

Evaluation Requested by: ❑ Supervisor ❑ Employee ❑ Medical **Reason for Evaluation:** ❑ Preventive ❑ Reactive

The checklists are written so that "no" responses indicate potential problem areas that should receive further investigation.

	Yes	No	
1.	❑	❑	Has excessive weight lifting been reduced?
2.	❑	❑	Are materials moved over minimum distances?
3.	❑	❑	Is the distance between the object and the body minimized?
4.	Are walking surfaces:		
a)	❑	❑	level?
b)	❑	❑	wide enough?
c)	❑	❑	clean and dry?
d)	❑	❑	well lit?
5.	Are objects:		
a)	❑	❑	easy to grasp?
b)	❑	❑	stable?
c)	❑	❑	able to be held without slipping?
6.	❑	❑	Are there handholds on these objects?
7.	❑	❑	When required, do gloves fit properly?
8.	❑	❑	Is the proper footwear worn?
9.	❑	❑	Is there enough room to maneuver?
10.	❑	❑	Are mechanical aids easily available and used whenever possible?
11.	❑	❑	Are working surfaces adjustable to the best handling heights?
12.	Does material handling avoid:		
a)	❑	❑	movements below knuckle height and above shoulder height?
b)	❑	❑	static muscle loading?
c)	❑	❑	sudden movements during handling?
d)	❑	❑	twisting at the waist?
e)	❑	❑	excessive reaching?
13.	❑	❑	Is help available for heavy or awkward lifts?
14.	Are high rates of repetition avoided by:		
a)	❑	❑	job rotation?
b)	❑	❑	self pacing?
c)	❑	❑	sufficient rest pauses?
15.	❑	❑	Are pushing and pulling forces reduced or eliminated?
16.	❑	❑	Does the employee have an unobstructed view of the handling task?
17.	❑	❑	Is there a preventive maintenance program for equipment?
18.	❑	❑	Are workers trained in correct handling and lifting procedures?

Office Use Only

Recommendations_____

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Materials Handling Checklist

Name: _____ Title: _____ Date: _____

Workstation #:_____ Supervisor: _____

Evaluation Requested by: ❑ Supervisor ❑ Employee ❑ Medical **Reason for Evaluation:** ❑ Preventive ❑ Reactive

The checklists are written so that "no" responses indicate potential problem areas that should receive further investigation.

	Yes	No	
1.	❑	❑	Has excessive weight lifting been reduced?
2.	❑	❑	Are materials moved over minimum distances?
3.	❑	❑	Is the distance between the object and the body minimized?
4.	Are walking surfaces:		
a)	❑	❑	level?
b)	❑	❑	wide enough?
c)	❑	❑	clean and dry?
d)	❑	❑	well lit?
5.	Are objects:		
a)	❑	❑	easy to grasp?
b)	❑	❑	stable?
c)	❑	❑	able to be held without slipping?
6.	❑	❑	Are there handholds on these objects?
7.	❑	❑	When required, do gloves fit properly?
8.	❑	❑	Is the proper footwear worn?
9.	❑	❑	Is there enough room to maneuver?
10.	❑	❑	Are mechanical aids easily available and used whenever possible?
11.	❑	❑	Are working surfaces adjustable to the best handling heights?
12.	Does material handling avoid:		
a)	❑	❑	movements below knuckle height and above shoulder height?
b)	❑	❑	static muscle loading?
c)	❑	❑	sudden movements during handling?
d)	❑	❑	twisting at the waist?
e)	❑	❑	excessive reaching?
13.	❑	❑	Is help available for heavy or awkward lifts?
14.	Are high rates of repetition avoided by:		
a)	❑	❑	job rotation?
b)	❑	❑	self pacing?
c)	❑	❑	sufficient rest pauses?
15.	❑	❑	Are pushing and pulling forces reduced or eliminated?
16.	❑	❑	Does the employee have an unobstructed view of the handling task?
17.	❑	❑	Is there a preventive maintenance program for equipment?
18.	❑	❑	Are workers trained in correct handling and lifting procedures?

Office Use Only

Recommendations_____

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Materials Handling Checklist

Name: _____ Title: _____ Date: _____

Workstation #:_____ Supervisor: _____

Evaluation Requested by: ❑ Supervisor ❑ Employee ❑ Medical **Reason for Evaluation:** ❑ Preventive ❑ Reactive

The checklists are written so that "no" responses indicate potential problem areas that should receive further investigation.

	Yes	No	
1.	❑	❑	Has excessive weight lifting been reduced?
2.	❑	❑	Are materials moved over minimum distances?
3.	❑	❑	Is the distance between the object and the body minimized?
4.	Are walking surfaces:		
a)	❑	❑	level?
b)	❑	❑	wide enough?
c)	❑	❑	clean and dry?
d)	❑	❑	well lit?
5.	Are objects:		
a)	❑	❑	easy to grasp?
b)	❑	❑	stable?
c)	❑	❑	able to be held without slipping?
6.	❑	❑	Are there handholds on these objects?
7.	❑	❑	When required, do gloves fit properly?
8.	❑	❑	Is the proper footwear worn?
9.	❑	❑	Is there enough room to maneuver?
10.	❑	❑	Are mechanical aids easily available and used whenever possible?
11.	❑	❑	Are working surfaces adjustable to the best handling heights?
12.	Does material handling avoid:		
a)	❑	❑	movements below knuckle height and above shoulder height?
b)	❑	❑	static muscle loading?
c)	❑	❑	sudden movements during handling?
d)	❑	❑	twisting at the waist?
e)	❑	❑	excessive reaching?
13.	❑	❑	Is help available for heavy or awkward lifts?
14.	Are high rates of repetition avoided by:		
a)	❑	❑	job rotation?
b)	❑	❑	self pacing?
c)	❑	❑	sufficient rest pauses?
15.	❑	❑	Are pushing and pulling forces reduced or eliminated?
16.	❑	❑	Does the employee have an unobstructed view of the handling task?
17.	❑	❑	Is there a preventive maintenance program for equipment?
18.	❑	❑	Are workers trained in correct handling and lifting procedures?

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Recommendations_____

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Materials Handling Checklist

Name: _____ Title: _____ Date: _____

Workstation #:_____ Supervisor: _____

Evaluation Requested by: ❑ Supervisor ❑ Employee ❑ Medical **Reason for Evaluation:** ❑ Preventive ❑ Reactive

The checklists are written so that "no" responses indicate potential problem areas that should receive further investigation.

	Yes	No	
1.	❑	❑	Has excessive weight lifting been reduced?
2.	❑	❑	Are materials moved over minimum distances?
3.	❑	❑	Is the distance between the object and the body minimized?
4.	Are walking surfaces:		
a)	❑	❑	level?
b)	❑	❑	wide enough?
c)	❑	❑	clean and dry?
d)	❑	❑	well lit?
5.	Are objects:		
a)	❑	❑	easy to grasp?
b)	❑	❑	stable?
c)	❑	❑	able to be held without slipping?
6.	❑	❑	Are there handholds on these objects?
7.	❑	❑	When required, do gloves fit properly?
8.	❑	❑	Is the proper footwear worn?
9.	❑	❑	Is there enough room to maneuver?
10.	❑	❑	Are mechanical aids easily available and used whenever possible?
11.	❑	❑	Are working surfaces adjustable to the best handling heights?
12.	Does material handling avoid:		
a)	❑	❑	movements below knuckle height and above shoulder height?
b)	❑	❑	static muscle loading?
c)	❑	❑	sudden movements during handling?
d)	❑	❑	twisting at the waist?
e)	❑	❑	excessive reaching?
13.	❑	❑	Is help available for heavy or awkward lifts?
14.	Are high rates of repetition avoided by:		
a)	❑	❑	job rotation?
b)	❑	❑	self pacing?
c)	❑	❑	sufficient rest pauses?
15.	❑	❑	Are pushing and pulling forces reduced or eliminated?
16.	❑	❑	Does the employee have an unobstructed view of the handling task?
17.	❑	❑	Is there a preventive maintenance program for equipment?
18.	❑	❑	Are workers trained in correct handling and lifting procedures?

Office Use Only

Recommendations_____

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VDT Workstation Checklist

Name: _____ Title: _____ Date: _____

Workstation #: _____ Supervisor: _____

Evaluation Requested by: ❑ Supervisor ❑ Employee ❑ Medical **Reason for Evaluation:** ❑ Preventive ❑ Reactive

Working Conditions—The workstation is designed or arranged for doing VDT tasks so it allows the employee's . . .

Yes	No	
❑	❑	A. **Head** and **neck** to be about upright (not bent down/back).
❑	❑	B. **Head, neck** and **trunk** to face forward (not twisted).
❑	❑	C. **Trunk** to be about perpendicular to floor (not leaning forward/backward).
❑	❑	D. **Shoulders** and **upper arms** to be about perpendicular to floor (not stretched forward) and relaxed (not elevated).
❑	❑	E. **Upper arms** and **elbows** to be close to body (not extended outward).
❑	❑	F. **Forearms, wrists,** and **hands** to be straight and parallel to floor (not pointing up/down).
❑	❑	G. **Wrists** and **hands** to be straight (not bent up/down or sideways toward little finger).
❑	❑	H. **Thighs** to be about parallel to floor and lower legs to be about perpendicular to floor.
❑	❑	I. **Feet** to rest flat on floor or be supported by a stable footrest.
❑	❑	J. **VDT tasks** to be organized in a way that allows employee to vary VDT tasks with other work activities, or to take micro-breaks or recovery pauses while at the VDT workstation.

Seating—The chair . . .

❑	❑	1. **Backrest** provides support for employee's lower back (lumbar area).
❑	❑	2. **Seat width** and **depth** accommodate specific employee (seatpan not too big/small).
❑	❑	3. **Seat front** does not press against the back of employee's knees and lower legs (seatpan not too long).
❑	❑	4. **Seat** has cushioning and is rounded/ has "waterfall" front (no sharp edge).
❑	❑	5. **Armrests** support both forearms while employee performs VDT tasks and do not interfere with movement.

Keyboard/Input Device—The keyboard/input device is designed or arranged for doing VDT tasks so that . . .

❑	❑	6. **Keyboard/input device platform(s)** is stable and large enough to hold keyboard and input device.
❑	❑	7. **Input device** (mouse or trackball) is located right next to keyboard so it can be operated without reaching.
❑	❑	8. **Input device** is easy to activate and shape/size fits hand of specific employee (not too big/small).
❑	❑	9. **Wrists** and **hands** do not rest on sharp or hard edge.

Monitor—The monitor is designed or arranged for VDT tasks so that . . .

❑	❑	10. **Top line** of screen is at or below eye level so employee is able to read it without bending head or neck down/back. (For employees with bifocals/trifocals, see next item.)
❑	❑	11. **Employee with bifocals/trifocals** is able to read screen without bending head or neck backward.
❑	❑	12. **Monitor distance** allows employee to read screen without leaning head, neck or trunk if forward/backward.
❑	❑	13. **Monitor position** is directly in front of employee so employee does not have to twist head or neck.
❑	❑	14. **No glare** (e.g., from windows, lights) is present on the screen which might cause employee to assume an awkward posture to read screen.

Work Area—The work area is designed or arranged for doing VDT tasks so that . . .

❑	❑	15. **Thighs** have clearance space between chair and VDT table/keyboard platform (thighs not trapped).
❑	❑	16. **Legs and feet** have clearance space under VDT table so employee is able to get close enough to keyboard/input device.

Accessories

❑	❑	17. **Document holder,** if provided, is stable and large enough to hold documents that are used.
❑	❑	18. **Document holder,** if provided, is placed at about the same height and distance as monitor screen so there is little head movement when employee looks from document to screen.
❑	❑	19. **Wrist rest,** if provided, is padded and free of sharp and square edges.
❑	❑	20. **Wrist rest,** if provided, allows employee to keep forearms, wrists and hands straight and parallel to ground when using keyboard/input device.
❑	❑	21. **Telephone** can be used with head upright (not bent) and shoulders relaxed (not elevated) if employee does VDT tasks at the same time.

General

❑	❑	22. Workstation and equipment have sufficient adjustability so that the employee is able to be in a safe working posture and to make occasional changes in posture while performing VDT tasks.
❑	❑	23. VDT Workstation, equipment and accessories are maintained in serviceable condition and function properly.

Passing Score—"YES" answer on all "working postures" items (A-J) and no more than two "NO" answers on remainder of checklist (1-23).

To reorder call toll-free 800- 333-3795. Form # ERGF-005

VDT Workstation Checklist

Name: _____ Title: _____ Date: _____

Workstation #: _____ Supervisor: _____

Evaluation Requested by: ❑ Supervisor ❑ Employee ❑ Medical **Reason for Evaluation:** ❑ Preventive ❑ Reactive

Working Conditions—The workstation is designed or arranged for doing VDT tasks so it allows the employee's . . .

Yes	No	
❑	❑	A. **Head** and **neck** to be about upright (not bent down/back).
❑	❑	B. **Head, neck** and **trunk** to face forward (not twisted).
❑	❑	C. **Trunk** to be about perpendicular to floor (not leaning forward/backward).
❑	❑	D. **Shoulders** and **upper arms** to be about perpendicular to floor (not stretched forward) and relaxed (not elevated).
❑	❑	E. **Upper arms** and **elbows** to be close to body (not extended outward).
❑	❑	F. **Forearms, wrists,** and **hands** to be straight and parallel to floor (not pointing up/down).
❑	❑	G. **Wrists** and **hands** to be straight (not bent up/down or sideways toward little finger).
❑	❑	H. **Thighs** to be about parallel to floor and lower legs to be about perpendicular to floor.
❑	❑	I. **Feet** to rest flat on floor or be supported by a stable footrest.
❑	❑	J. **VDT tasks** to be organized in a way that allows employee to vary VDT tasks with other work activities, or to take micro-breaks or recovery pauses while at the VDT workstation.

Seating—The chair . . .

❑	❑	1. **Backrest** provides support for employee's lower back (lumbar area).
❑	❑	2. **Seat width** and **depth** accommodate specific employee (seatpan not too big/small).
❑	❑	3. **Seat front** does not press against the back of employee's knees and lower legs (seatpan not too long).
❑	❑	4. **Seat** has cushioning and is rounded/ has "waterfall" front (no sharp edge).
❑	❑	5. **Armrests** support both forearms while employee performs VDT tasks and do not interfere with movement.

Keyboard/Input Device—The keyboard/input device is designed or arranged for doing VDT tasks so that . . .

❑	❑	6. **Keyboard/input device platform(s)** is stable and large enough to hold keyboard and input device.
❑	❑	7. **Input device** (mouse or trackball) is located right next to keyboard so it can be operated without reaching.
❑	❑	8. **Input device** is easy to activate and shape/size fits hand of specific employee (not too big/small).
❑	❑	9. **Wrists** and **hands** do not rest on sharp or hard edge.

Monitor—The monitor is designed or arranged for VDT tasks so that . . .

❑	❑	10. **Top line** of screen is at or below eye level so employee is able to read it without bending head or neck down/back. (For employees with bifocals/trifocals, see next item.)
❑	❑	11. **Employee with bifocals/trifocals** is able to read screen without bending head or neck backward.
❑	❑	12. **Monitor distance** allows employee to read screen without leaning head, neck or trunk if forward/backward.
❑	❑	13. **Monitor position** is directly in front of employee so employee does not have to twist head or neck.
❑	❑	14. **No glare** (e.g., from windows, lights) is present on the screen which might cause employee to assume an awkward posture to read screen.

Work Area—The work area is designed or arranged for doing VDT tasks so that . . .

❑	❑	15. **Thighs** have clearance space between chair and VDT table/keyboard platform (thighs not trapped).
❑	❑	16. **Legs and feet** have clearance space under VDT table so employee is able to get close enough to keyboard/input device.

Accessories

❑	❑	17. **Document holder,** if provided, is stable and large enough to hold documents that are used.
❑	❑	18. **Document holder,** if provided, is placed at about the same height and distance as monitor screen so there is little head movement when employee looks from document to screen.
❑	❑	19. **Wrist rest,** if provided, is padded and free of sharp and square edges.
❑	❑	20. **Wrist rest,** if provided, allows employee to keep forearms, wrists and hands straight and parallel to ground when using keyboard/input device.
❑	❑	21. **Telephone** can be used with head upright (not bent) and shoulders relaxed (not elevated) if employee does VDT tasks at the same time.

General

❑	❑	22. Workstation and equipment have sufficient adjustability so that the employee is able to be in a safe working posture and to make occasional changes in posture while performing VDT tasks.
❑	❑	23. VDT Workstation, equipment and accessories are maintained in serviceable condition and function properly.

Passing Score—"YES" answer on all "working postures" items (A-J) and no more than two "NO" answers on remainder of checklist (1-23).

To reorder call toll-free 800- 333-3795. Form # ERGF-005

VDT Workstation Checklist

Name: _____ Title: _____ Date: _____

Workstation #: _____ Supervisor: _____

Evaluation Requested by: ❑ Supervisor ❑ Employee ❑ Medical **Reason for Evaluation:** ❑ Preventive ❑ Reactive

Working Conditions—The workstation is designed or arranged for doing VDT tasks so it allows the employee's . . .

Yes	No	
❑	❑	A. **Head** and **neck** to be about upright (not bent down/back).
❑	❑	B. **Head, neck** and **trunk** to face forward (not twisted).
❑	❑	C. **Trunk** to be about perpendicular to floor (not leaning forward/backward).
❑	❑	D. **Shoulders** and **upper arms** to be about perpendicular to floor (not stretched forward) and relaxed (not elevated).
❑	❑	E. **Upper arms** and **elbows** to be close to body (not extended outward).
❑	❑	F. **Forearms, wrists,** and **hands** to be straight and parallel to floor (not pointing up/down).
❑	❑	G. **Wrists** and **hands** to be straight (not bent up/down or sideways toward little finger).
❑	❑	H. **Thighs** to be about parallel to floor and lower legs to be about perpendicular to floor.
❑	❑	I. **Feet** to rest flat on floor or be supported by a stable footrest.
❑	❑	J. **VDT tasks** to be organized in a way that allows employee to vary VDT tasks with other work activities, or to take micro-breaks or recovery pauses while at the VDT workstation.

Seating—The chair . . .

❑	❑	1. **Backrest** provides support for employee's lower back (lumbar area).
❑	❑	2. **Seat width** and **depth** accommodate specific employee (seatpan not too big/small).
❑	❑	3. **Seat front** does not press against the back of employee's knees and lower legs (seatpan not too long).
❑	❑	4. **Seat** has cushioning and is rounded/ has "waterfall" front (no sharp edge).
❑	❑	5. **Armrests** support both forearms while employee performs VDT tasks and do not interfere with movement.

Keyboard/Input Device—The keyboard/input device is designed or arranged for doing VDT tasks so that . . .

❑	❑	6. **Keyboard/input device platform(s)** is stable and large enough to hold keyboard and input device.
❑	❑	7. **Input device** (mouse or trackball) is located right next to keyboard so it can be operated without reaching.
❑	❑	8. **Input device** is easy to activate and shape/size fits hand of specific employee (not too big/small).
❑	❑	9. **Wrists** and **hands** do not rest on sharp or hard edge.

Monitor—The monitor is designed or arranged for VDT tasks so that . . .

❑	❑	10. **Top line** of screen is at or below eye level so employee is able to read it without bending head or neck down/back. (For employees with bifocals/trifocals, see next item.)
❑	❑	11. **Employee with bifocals/trifocals** is able to read screen without bending head or neck backward.
❑	❑	12. **Monitor distance** allows employee to read screen without leaning head, neck or trunk if forward/backward.
❑	❑	13. **Monitor position** is directly in front of employee so employee does not have to twist head or neck.
❑	❑	14. **No glare** (e.g., from windows, lights) is present on the screen which might cause employee to assume an awkward posture to read screen.

Work Area—The work area is designed or arranged for doing VDT tasks so that . . .

❑	❑	15. **Thighs** have clearance space between chair and VDT table/keyboard platform (thighs not trapped).
❑	❑	16. **Legs and feet** have clearance space under VDT table so employee is able to get close enough to keyboard/input device.

Accessories

❑	❑	17. **Document holder,** if provided, is stable and large enough to hold documents that are used.
❑	❑	18. **Document holder,** if provided, is placed at about the same height and distance as monitor screen so there is little head movement when employee looks from document to screen.
❑	❑	19. **Wrist rest,** if provided, is padded and free of sharp and square edges.
❑	❑	20. **Wrist rest,** if provided, allows employee to keep forearms, wrists and hands straight and parallel to ground when using keyboard/input device.
❑	❑	21. **Telephone** can be used with head upright (not bent) and shoulders relaxed (not elevated) if employee does VDT tasks at the same time.

General

❑	❑	22. Workstation and equipment have sufficient adjustability so that the employee is able to be in a safe working posture and to make occasional changes in posture while performing VDT tasks.
❑	❑	23. VDT Workstation, equipment and accessories are maintained in serviceable condition and function properly.

Passing Score—"YES" answer on all "working postures" items (A-J) and no more than two "NO" answers on remainder of checklist (1-23).

To reorder call toll-free 800- 333-3795. Form # ERGF-005

VDT Workstation Checklist

Name: _____ Title: _____ Date: _____

Workstation #: _____ Supervisor: _____

Evaluation Requested by: ❑ Supervisor ❑ Employee ❑ Medical **Reason for Evaluation:** ❑ Preventive ❑ Reactive

Working Conditions—The workstation is designed or arranged for doing VDT tasks so it allows the employee's . . .

Yes	No	
❑	❑	A. **Head** and **neck** to be about upright (not bent down/back).
❑	❑	B. **Head, neck** and **trunk** to face forward (not twisted).
❑	❑	C. **Trunk** to be about perpendicular to floor (not leaning forward/backward).
❑	❑	D. **Shoulders** and **upper arms** to be about perpendicular to floor (not stretched forward) and relaxed (not elevated).
❑	❑	E. **Upper arms** and **elbows** to be close to body (not extended outward).
❑	❑	F. **Forearms, wrists,** and **hands** to be straight and parallel to floor (not pointing up/down).
❑	❑	G. **Wrists** and **hands** to be straight (not bent up/down or sideways toward little finger).
❑	❑	H. **Thighs** to be about parallel to floor and lower legs to be about perpendicular to floor.
❑	❑	I. **Feet** to rest flat on floor or be supported by a stable footrest.
❑	❑	J. **VDT tasks** to be organized in a way that allows employee to vary VDT tasks with other work activities, or to take micro-breaks or recovery pauses while at the VDT workstation.

Seating—The chair . . .

❑	❑	1. **Backrest** provides support for employee's lower back (lumbar area).
❑	❑	2. **Seat width** and **depth** accommodate specific employee (seatpan not too big/small).
❑	❑	3. **Seat front** does not press against the back of employee's knees and lower legs (seatpan not too long).
❑	❑	4. **Seat** has cushioning and is rounded/ has "waterfall" front (no sharp edge).
❑	❑	5. **Armrests** support both forearms while employee performs VDT tasks and do not interfere with movement.

Keyboard/Input Device—The keyboard/input device is designed or arranged for doing VDT tasks so that . . .

❑	❑	6. **Keyboard/input device platform(s)** is stable and large enough to hold keyboard and input device.
❑	❑	7. **Input device** (mouse or trackball) is located right next to keyboard so it can be operated without reaching.
❑	❑	8. **Input device** is easy to activate and shape/size fits hand of specific employee (not too big/small).
❑	❑	9. **Wrists** and **hands** do not rest on sharp or hard edge.

Monitor—The monitor is designed or arranged for VDT tasks so that . . .

❑	❑	10. **Top line** of screen is at or below eye level so employee is able to read it without bending head or neck down/back. (For employees with bifocals/trifocals, see next item.)
❑	❑	11. **Employee with bifocals/trifocals** is able to read screen without bending head or neck backward.
❑	❑	12. **Monitor distance** allows employee to read screen without leaning head, neck or trunk if forward/backward.
❑	❑	13. **Monitor position** is directly in front of employee so employee does not have to twist head or neck.
❑	❑	14. **No glare** (e.g., from windows, lights) is present on the screen which might cause employee to assume an awkward posture to read screen.

Work Area—The work area is designed or arranged for doing VDT tasks so that . . .

❑	❑	15. **Thighs** have clearance space between chair and VDT table/keyboard platform (thighs not trapped).
❑	❑	16. **Legs and feet** have clearance space under VDT table so employee is able to get close enough to keyboard/input device.

Accessories

❑	❑	17. **Document holder,** if provided, is stable and large enough to hold documents that are used.
❑	❑	18. **Document holder,** if provided, is placed at about the same height and distance as monitor screen so there is little head movement when employee looks from document to screen.
❑	❑	19. **Wrist rest,** if provided, is padded and free of sharp and square edges.
❑	❑	20. **Wrist rest,** if provided, allows employee to keep forearms, wrists and hands straight and parallel to ground when using keyboard/input device.
❑	❑	21. **Telephone** can be used with head upright (not bent) and shoulders relaxed (not elevated) if employee does VDT tasks at the same time.

General

❑	❑	22. Workstation and equipment have sufficient adjustability so that the employee is able to be in a safe working posture and to make occasional changes in posture while performing VDT tasks.
❑	❑	23. VDT Workstation, equipment and accessories are maintained in serviceable condition and function properly.

Passing Score—"YES" answer on all "working postures" items (A-J) and no more than two "NO" answers on remainder of checklist (1-23).

To reorder call toll-free 800- 333-3795. Form # ERGF-005

VDT Workstation Checklist

Name: _____ Title: _____ Date: _____

Workstation #: _____ Supervisor: _____

Evaluation Requested by: ❑ Supervisor ❑ Employee ❑ Medical **Reason for Evaluation:** ❑ Preventive ❑ Reactive

Working Conditions—The workstation is designed or arranged for doing VDT tasks so it allows the employee's . . .

Yes	No	
❑	❑	A. **Head** and **neck** to be about upright (not bent down/back).
❑	❑	B. **Head, neck** and **trunk** to face forward (not twisted).
❑	❑	C. **Trunk** to be about perpendicular to floor (not leaning forward/backward).
❑	❑	D. **Shoulders** and **upper arms** to be about perpendicular to floor (not stretched forward) and relaxed (not elevated).
❑	❑	E. **Upper arms** and **elbows** to be close to body (not extended outward).
❑	❑	F. **Forearms, wrists,** and **hands** to be straight and parallel to floor (not pointing up/down).
❑	❑	G. **Wrists** and **hands** to be straight (not bent up/down or sideways toward little finger).
❑	❑	H. **Thighs** to be about parallel to floor and lower legs to be about perpendicular to floor.
❑	❑	I. **Feet** to rest flat on floor or be supported by a stable footrest.
❑	❑	J. **VDT tasks** to be organized in a way that allows employee to vary VDT tasks with other work activities, or to take micro-breaks or recovery pauses while at the VDT workstation.

Seating—The chair . . .

❑	❑	1. **Backrest** provides support for employee's lower back (lumbar area).
❑	❑	2. **Seat width** and **depth** accommodate specific employee (seatpan not too big/small).
❑	❑	3. **Seat front** does not press against the back of employee's knees and lower legs (seatpan not too long).
❑	❑	4. **Seat** has cushioning and is rounded/ has "waterfall" front (no sharp edge).
❑	❑	5. **Armrests** support both forearms while employee performs VDT tasks and do not interfere with movement.

Keyboard/Input Device—The keyboard/input device is designed or arranged for doing VDT tasks so that . . .

❑	❑	6. **Keyboard/input device platform(s)** is stable and large enough to hold keyboard and input device.
❑	❑	7. **Input device** (mouse or trackball) is located right next to keyboard so it can be operated without reaching.
❑	❑	8. **Input device** is easy to activate and shape/size fits hand of specific employee (not too big/small).
❑	❑	9. **Wrists** and **hands** do not rest on sharp or hard edge.

Monitor—The monitor is designed or arranged for VDT tasks so that . . .

❑	❑	10. **Top line** of screen is at or below eye level so employee is able to read it without bending head or neck down/back. (For employees with bifocals/trifocals, see next item.)
❑	❑	11. **Employee with bifocals/trifocals** is able to read screen without bending head or neck backward.
❑	❑	12. **Monitor distance** allows employee to read screen without leaning head, neck or trunk if forward/backward.
❑	❑	13. **Monitor position** is directly in front of employee so employee does not have to twist head or neck.
❑	❑	14. **No glare** (e.g., from windows, lights) is present on the screen which might cause employee to assume an awkward posture to read screen.

Work Area—The work area is designed or arranged for doing VDT tasks so that . . .

❑	❑	15. **Thighs** have clearance space between chair and VDT table/keyboard platform (thighs not trapped).
❑	❑	16. **Legs and feet** have clearance space under VDT table so employee is able to get close enough to keyboard/input device.

Accessories

❑	❑	17. **Document holder,** if provided, is stable and large enough to hold documents that are used.
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❑	❑	21. **Telephone** can be used with head upright (not bent) and shoulders relaxed (not elevated) if employee does VDT tasks at the same time.

General

❑	❑	22. Workstation and equipment have sufficient adjustability so that the employee is able to be in a safe working posture and to make occasional changes in posture while performing VDT tasks.
❑	❑	23. VDT Workstation, equipment and accessories are maintained in serviceable condition and function properly.

Passing Score—"YES" answer on all "working postures" items (A-J) and no more than two "NO" answers on remainder of checklist (1-23).

To reorder call toll-free 800- 333-3795. Form # ERGF-005

Hand Tool Analysis Checklist

Name: _____ Title: _____ Date: _____

Workstation #: _____ Supervisor: _____

Evaluation Requested by: ❑ Supervisor ❑ Employee ❑ Medical **Reason for Evaluation:** ❑ Preventive ❑ Reactive

The checklists are written so that "no" responses indicate potential problem areas that should receive further investigation.

	Yes	No	
1.			**Are tools selected to avoid**:
a)	❑	❑	excessive vibration?
b)	❑	❑	excessive force?
c)	❑	❑	bending or twisting the wrist?
d)	❑	❑	finger pinch grip?
e)	❑	❑	problems associated with trigger finger?
2.	❑	❑	**Are tools powered where necessary and feasible?**
3.	❑	❑	**Are tools evenly balanced?**
4.	❑	❑	**Are heavy tools counterbalanced?**
5.	❑	❑	**Does the tool allow adequate visibility of the work?**
6.	❑	❑	**Does the tool grip/handle prevent slipping during use?**
7.			**Are tools equipped with handles:**
a)	❑	❑	of proper diameter?
b)	❑	❑	that do not end in the palm area?
c)	❑	❑	of textured non-conductive material?
8.	❑	❑	**Are different handle sizes available to fit a wide range of hand sizes?**
9.	❑	❑	**Is the tool handle designed to not dig into the palm of the hand?**
10.	❑	❑	**Can the tool be used safely with gloves?**
11.	❑	❑	**Can the tool be used by either hand?**
12.	❑	❑	**Is there a preventive maintenance program to keep tools operating as designed?**
13.			**Have employees been trained:**
a)	❑	❑	in the proper use of tools?
b)	❑	❑	when and how to report problems with tools?
c)	❑	❑	in proper tool maintenance?

Office Use Only

Recommendations _____

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Hand Tool Analysis Checklist

Name: _____ Title: _____ Date: _____

Workstation #: _____ Supervisor: _____

Evaluation Requested by: ❑ Supervisor ❑ Employee ❑ Medical **Reason for Evaluation:** ❑ Preventive ❑ Reactive

The checklists are written so that "no" responses indicate potential problem areas that should receive further investigation.

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c)	❑	❑	in proper tool maintenance?

Office Use Only

Recommendations _____

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Hand Tool Analysis Checklist

Name: _____ Title: _____ Date: _____

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c)	❑	❑	in proper tool maintenance?

Office Use Only

Recommendations _____

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Hand Tool Analysis Checklist

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b)	❑	❑	when and how to report problems with tools?
c)	❑	❑	in proper tool maintenance?

Office Use Only

Recommendations _____

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Hand Tool Analysis Checklist

Name: _____ Title: _____ Date: _____

Workstation #: _____ Supervisor: _____

Evaluation Requested by: ❑ Supervisor ❑ Employee ❑ Medical **Reason for Evaluation:** ❑ Preventive ❑ Reactive

The checklists are written so that "no" responses indicate potential problem areas that should receive further investigation.

	Yes	No	
1.			**Are tools selected to avoid**:
a)	❑	❑	excessive vibration?
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c)	❑	❑	in proper tool maintenance?

Office Use Only

Recommendations _____

_____

_____

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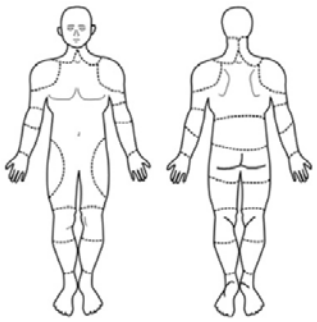
Musculoskeletal Disorder Injury Report

Company Name			Date
Employee Name Last First		Job Title	Shift
Occupation	Employment Date	Date Symptoms First Appeared	
Supervisor	Department		

Time on THIS job: ❑ Less than 3 months ❑ 3 months to 1 year
❑ Greater than 1 year to 5 years ❑ Greater than 5 years to 10 years ❑ Greater than 10 years

Have you had any pain or discomfort during the last year? ❑ Yes ❑ No (If NO, stop here)

If YES, carefully shade in the area of the drawings below which bothers you the MOST:



Check area:

❑ Neck ❑ Shoulder
❑ Elbow/ Forearm ❑ Hand/ Wrist
❑ Finger ❑ Upper Back
❑ Lower Back ❑ Thigh/ Knee
❑ Lower Leg ❑ Ankle

Please complete a separate page for each area that bothers you.

1. **Please put a check by the word(s) that best describe your problem:**
   ❑ Aching/ Cramp ❑ Numbness/ Tingling ❑ Stiffness ❑ Burning ❑ Pain
   ❑ Weakness ❑ Loss of Color ❑ Swelling ❑ Other
2. **When did you first notice the problem? _____number of months -or- _____years ago**
3. **How long does each episode last? (please check)**
   ❑ Less than 1 hour ❑ 24 hours to 1 week ❑ 1 month to 6 months
   ❑ 1 hour to 24 hours ❑ 1 week to 1 month ❑ more than 6 months
4. **How many separate episodes have you had in the last year?**
5. **What do you think caused the problem?** _____
6. **Have you had the problem in the last 7 days?** ❑ **Yes** ❑ **No**

OPTIONAL

7. **How would you rate this problem? Mark an X on the line.**
   RIGHT NOW: **None** _____ **Unbearable**
   AT ITS WORST: **None** _____ **Unbearable**
8. **Have you had medical treatment for this problem?** ❑ **Yes** ❑ **No**
   If yes, what was the diagnosis?_____
9. **How much time have you lost from work in the last year because of this problem? _____days**
10. **How many days in the last year were you on modified duty because of this problem? _____days**
11. **Have you changed jobs because of this problem?** ❑ **Yes** ❑ **No**
12. **Please comment on what you think would improve your symptoms:** _____

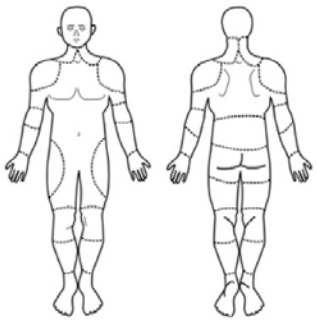
Musculoskeletal Disorder Injury Report

Company Name			Date
Employee Name Last First		Job Title	Shift
Occupation	Employment Date	Date Symptoms First Appeared	
Supervisor	Department		

Time on THIS job: ❑ Less than 3 months ❑ 3 months to 1 year
❑ Greater than 1 year to 5 years ❑ Greater than 5 years to 10 years ❑ Greater than 10 years

Have you had any pain or discomfort during the last year? ❑ Yes ❑ No (If NO, stop here)

If YES, carefully shade in the area of the drawings below which bothers you the MOST:



Check area:

❑ Neck ❑ Shoulder
❑ Elbow/ Forearm ❑ Hand/ Wrist
❑ Finger ❑ Upper Back
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Please complete a separate page for each area that bothers you.

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6. **Have you had the problem in the last 7 days?** ❑ **Yes** ❑ **No**

OPTIONAL

7. **How would you rate this problem? Mark an X on the line.**
   RIGHT NOW: **None** _____ **Unbearable**
   AT ITS WORST: **None** _____ **Unbearable**
8. **Have you had medical treatment for this problem?** ❑ **Yes** ❑ **No**
   If yes, what was the diagnosis?_____
9. **How much time have you lost from work in the last year because of this problem? _____days**
10. **How many days in the last year were you on modified duty because of this problem? _____days**
11. **Have you changed jobs because of this problem?** ❑ **Yes** ❑ **No**
12. **Please comment on what you think would improve your symptoms:** _____

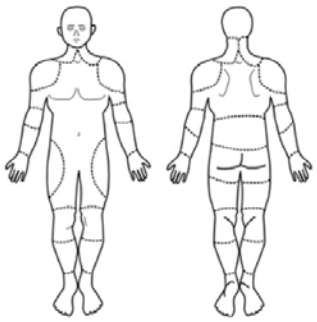
Musculoskeletal Disorder Injury Report

Company Name			Date
Employee Name Last First		Job Title	Shift
Occupation	Employment Date	Date Symptoms First Appeared	
Supervisor	Department		

Time on THIS job: ❑ Less than 3 months ❑ 3 months to 1 year
❑ Greater than 1 year to 5 years ❑ Greater than 5 years to 10 years ❑ Greater than 10 years

Have you had any pain or discomfort during the last year? ❑ Yes ❑ No (If NO, stop here)

If YES, carefully shade in the area of the drawings below which bothers you the MOST:



Check area:

❑ Neck ❑ Shoulder
❑ Elbow/ Forearm ❑ Hand/ Wrist
❑ Finger ❑ Upper Back
❑ Lower Back ❑ Thigh/ Knee
❑ Lower Leg ❑ Ankle

Please complete a separate page for each area that bothers you.

1. **Please put a check by the word(s) that best describe your problem:**
   ❑ Aching/ Cramp ❑ Numbness/ Tingling ❑ Stiffness ❑ Burning ❑ Pain
   ❑ Weakness ❑ Loss of Color ❑ Swelling ❑ Other
2. **When did you first notice the problem? _____number of months -or- _____years ago**
3. **How long does each episode last? (please check)**
   ❑ Less than 1 hour ❑ 24 hours to 1 week ❑ 1 month to 6 months
   ❑ 1 hour to 24 hours ❑ 1 week to 1 month ❑ more than 6 months
4. **How many separate episodes have you had in the last year?**
5. **What do you think caused the problem?** _____
6. **Have you had the problem in the last 7 days?** ❑ **Yes** ❑ **No**

OPTIONAL

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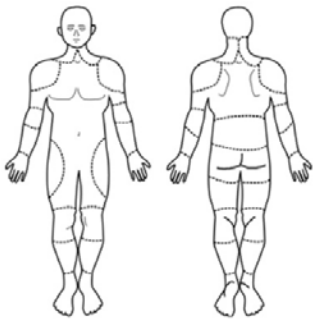

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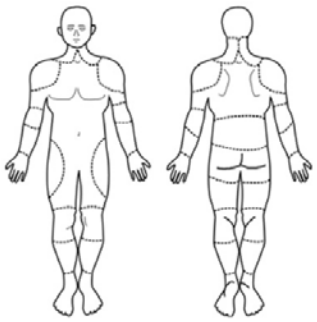

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12. **Please comment on what you think would improve your symptoms:** _____

Appendices

Ergonomics is the science of fitting jobs to the people who work in them. The goal of an ergonomics program is to reduce work-related musculoskeletal disorders (MSDs) developed by workers when a major part of their jobs involve reaching, bending over, lifting heavy objects, using continuous force, working with vibrating equipment and doing repetitive motions.

What You Need To Know About Musculoskeletal Disorders (MSDs)

MSDs

What are signs and symptoms of MSDs that you should watch out for?

Workers suffering from MSDs may experience less strength for gripping, less range of motion, loss of muscle function and inability to do everyday tasks. Common symptoms include:

- **Painful joints**
- **Pain in wrists, shoulders, forearms, knees**
- **Pain, tingling or numbness in hands or feet**
- **Fingers or toes turning white**
- **Shooting or stabbing pains in arms or legs**
- **Back or neck pain**
- **Swelling or inflammation**
- **Burning sensation**
- **Stiffness**

What are MSDs?

MSDs are injuries and illnesses that affect muscles, nerves, tendons, ligaments, joints or spinal discs. Your doctor might tell you that you have one of the following common MSDs.

- **Carpal tunnel syndrome**
- **Rotator cuff syndrome**
- **De Quervain's disease**
- **Trigger finger**
- **Sciatica**
- **Epicondylitis**
- **Tendinitis**
- **Raynaud's phenomenon**
- **Carpet layers knee**
- **Herniated spinal disc**
- **Low back pain**
- **Hand arm vibration syndrome**
- **Tension neck syndrome**

If you have signs or symptoms of MSDs . . .

If MSD signs and symptoms are not reported early, permanent disability may result. It is important that you report MSD signs and symptoms right away to avoid long-lasting problems. Please contact the following person to report MSDs, MSD signs or symptoms or MSD hazards:

Name _____

Phone _____

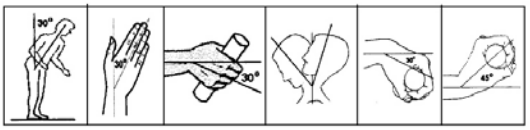
What causes MSDs?

Workplace MSDs are caused by exposure to the following risk factors:

Repetition. Doing the same motions over and over again places stress on the muscles and tendons. The severity of risk depends on how often the action is repeated, the speed of the movement, the number of muscles involved and the required force.

Forceful Exertions. Force is the amount of physical effort required to perform a task (such as heavy lifting) or to maintain control of equipment or tools. The amount of force depends on the type of grip, the weight of an object, body posture, the type of activity and the duration of the task.

Awkward Postures. Posture is the position your body is in and affects muscle groups that are involved in physical activity. Awkward postures include repeated or prolonged reaching, twisting, bending, kneeling, squatting, working overhead with your hands or arms, or holding fixed positions.



Contact Stress. Pressing the body against a hard or sharp edge can result in placing too much pressure on nerves, tendons and blood vessels. For example, using the palm of your hand as a hammer can increase your risk of suffering an MSD.

Vibration. Operating vibrating tools such as sanders, grinders, chippers, routers, drills and other saws can lead to nerve damage.

How to prevent MSDs

MSDs can be avoided by taking a common sense approach to your work area. Take time each day to reflect on areas of your workspace that could be modified to better accommodate your specific daily activities. Arrange your workspace as such to avoid the MSD causes listed above. Take stretching breaks between activities and on rest periods to help stretch and rest your muscles. We are committed to providing a workplace free from recognized hazards. If you observe a hazard in the workplace, please notify a supervisor or management representative immediately. It is this company's goal to prevent injuries and illnesses before they occur.

Talk to your supervisor or other responsible persons about your suggestions on how to minimize possible ergonomics problems in our workplace.

Remember—Safety First!

Job Hazard Analysis Tools

The Job Hazard Analysis Tools contained in this section provide employers with means to physically analyze the MSD risks associated with specific job duties in the workplace. The information contained in the following pages describes each analysis tool, cites the tool's source, lists the risk factors evaluated, notes the areas of the body addressed, and provides examples of jobs for which the corresponding tool is applicable.

JOB HAZARD ANALYSIS TOOLS

JOB HAZARD ANALYSIS TOOLS	SOURCE *	RISK FACTORS EVALUATED	AREAS OF BODY ADDRESSED	EXAMPLES OF JOBS TOOL APPLIES TO
Job Strain Index	"The Strain Index: A Proposed Method to Analyze Jobs For Risk of Distal Upper Extremity Disorders." Moore, J.S., and Garg, A, 1995; *AIHA Journal*, 56(5): 443–458. You may obtain a copy from: American Industrial Hygienists Association. 2700 Prosperity Ave Suite 250 Fairfax, VA 22031. Phone: (703) 849-8888 Web site: http://www.aiha.org/ See also: http://sg-www.satx.disa.mil/hscoemo/tools/strain.htm for a Web-based version of this tool.	• Repetition • Force • Awkward postures	• Hands • Wrists	• Small parts assembly • Inspecting • Meatpacking • Sewing • Packaging • Keyboarding • Data Processing • Jobs involving highly repetitive hand motions

JOB HAZARD ANALYSIS TOOLS

Revised NIOSH Lifting Equation	*Applications Manual for the Revised NIOSH Lifting Equation*, Waters, T.R., Putz-Anderson, V., Garg, A., National Institute for Occupational Safety and Health, January 1994 (DHHS, NIOSH Publication No. 94-110). You may obtain a copy from: U.S. Department of Commerce Technology Administration National Technical Information Service (NTIS) 5285 Port Royal Road Springfield, VA 22161 (NTIS Publication No. PB94-176930) Phone: (703) 487-4650 Web site: http://www.cdc.gov/niosh/ See also: http://www.industrialhygiene.com/calc/lift.html for a Web-based version of this tool.	• Repetition • Force • Awkward postures	• Lower back	• Package sorting, handling • Package delivery • Beverage delivery • Assembly work • Manual handling involving lifting weights >10 Lbs. • Production jobs involving forceful exertions • Stationary lifting

JOB HAZARD ANALYSIS TOOLS				
Snook Push/Pull Hazard Tables	"The Design of Manual Handling Tasks: Revised Tables of Maximum Acceptable Weights and Forces," Snook, S.H. and Ciriello, V.M., *Ergonomics*, 1991, 34(9): 1197-1213. You may obtain a copy from: Taylor & Francis Inc. 325 Chestnut Street Suite 800 Philadelphia, PA 19106, USA Phone: (800) 354-1420 Web site: http://www.tandf.co.uk/journals/	• Repetition • Force • Awkward postures	• Back • Trunk • Shoulders • Legs	• Food service • Laundry • Housekeeping • Janitorial • Package delivery • Garbage collection • Nursing homes • EMT, ambulance • Jobs involving pushing/pulling carts • Jobs involving carrying objects
Rapid Upper Limb Assessment (RULA)	"RULA: A Survey Method for the Investigation of Work-Related Upper Limb Disorders," McAtamney, L. and Corlett, E.N., *Applied Ergonomics*, 1993, 24(2): 91-99. You may obtain a copy from: Elsevier Science Regional Sales Office Customer Support Department P.O. Box 945 New York, N.Y. 10159 Phone: (212) 633-3730 Web site: http://www.elsevier.com/	• Repetition • Force • Awkward postures	• Wrists • Forearms • Elbows • Shoulders • Neck • Trunk	• Assembly work • Production work • Sewing • Janitorial • Maintenance • Meatpacking • Grocery cashier • Telephone operator • Ultrasound technicians • Dentists • Dental technicians

JOB HAZARD ANALYSIS TOOLS				
Rapid Entire Body Assessment (REBA)	"Rapid Entire Body Assessment (REBA)," Hignett, S. and McAtamney, L., *Applied Ergonomics*, 2000, 31: 201-205. You may obtain a copy from: Elsevier Science Regional Sales Office Customer Support Department P.O. Box 945 New York, N.Y. 10159 Phone: (212) 633-3730 Web site: http://www.elsevier.com/	• Repetition • Force • Awkward postures	• Wrists • Forearms • Elbows • Shoulders • Neck • Trunk • Back • Legs • Knees	• Patient lifting, transfer • Nurses • Nurses aides • Orderlies • Janitors • Housekeeping • Grocery warehouse • Grocery cashier • Telephone operator • Ultrasound technicians • Dentists • Dental technicians • Veterinarian

JOB HAZARD ANALYSIS TOOLS

ACGIH Hand/Arm (Segmental) Vibration TLV	1998 Threshold Limit Values for Physical Agents in the Work Environment, *1998 TLVs® and BEIs® Threshold Limit Values for Chemical Substances and Physical Agents Biological Exposure Indices*, pp. 109-131, American Conference of Governmental Industrial Hygienists. You may obtain a copy from: American Conference of Governmental Industrial Hygienists, Inc. 1330 Kemper Meadow Dr. Suite 600 Cincinnati, OH 45240 Phone: (513) 742-2020 Web site: http://www.acgih.org/	• Vibration	• Hands • Arms • Shoulders	• Grinding • Sanding • Chipping • Drilling • Sawing • Jigsawing • Chainsawing • Production work using vibrating or power hand tools • Regular use of vibrating hand tools
GM-UAW Risk Factor Checklist	"UAW-GM Ergonomics Risk Factor Checklist RFC2," United Auto Workers-General Motors Center for Human Resources, Health and Safety Center, 1998. You may obtain a copy from: UAW-GM Center for Human Resources Health and Safety Center 1030 Doris Road Auburn Hills, MI 48326	• Repetition • Force • Awkward postures • Contact stress • Vibration	• Hands • Wrists • Forearms • Elbows • Shoulders • Neck • Trunk • Back • Legs • Knees	• Assembly work • Production work • Small parts assembly

JOB HAZARD ANALYSIS TOOLS				
Washington State Appendix B	WAC 296-62-05174, "Appendix B: Criteria for analyzing and reducing WMSD hazards for employers who choose the Specific Performance Approach," Washington State Department of Labor and Industries, May 2000. You may obtain a copy from: Washington Department of Labor and Industries PO Box 44001 Olympia, Washington 98504 Phone: (360) 902-4200 Web site: http://www.lni.wa.gov/wisha/	• Repetition • Force • Awkward postures • Contact stress • Vibration	• Hands • Wrists • Forearms • Elbows • Shoulders • Neck • Trunk • Back • Legs • Knees	• Assembly work • Production work • Sewing • Meatpacking • Keyboarding • Data processing • Small parts assembly • Maintenance • Patient lifting • Package delivery • Package sorting • Garbage collection • Food service • Regular use of vibrating hand tools

* Appendix D-1 to §1910.900 incorporates the documents in this column by reference. The Director of the Federal Register approves this incorporation by reference in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. You may inspect a copy of any of these documents at the Occupational Safety and Health Administration, Technical Data Center, Room N2625, 200 Constitution Ave., N.W., Washington, DC, 20210, or at the Office of the Federal Register, 800 North Capitol Street, NW., Suite 700, Washington, DC.

Glossary

Glossary

Administrative controls

Changes in the way that work in a job is assigned or scheduled that reduce the magnitude, frequency or duration of exposure to ergonomic risk factors. Examples of administrative controls for MSD hazards include:

- Employee rotation
- Job task enlargement
- Alternative tasks
- Employer-authorized changes in work pace

Anthropometry

The study of human body measurements used in developing design standard and requirements for manufactured products to ensure they are suitable for the intended audience.

ANSI

American National Standards Institute. ANSI is a private, non-profit membership organization that coordinates voluntary standards in many fields. ANSI encourages the private sector and government to reach agreement on the need for standards and establish priorities.

Arthritis

Inflammation of a joint or joints in the body.

Awkward posture

Deviation from the natural or "neutral" position of a body part. A neutral position is one that puts minimal stress on the body part. Awkward postures typically include reaching above or behind, twisting, bending forward or backward, pinching, squatting, and kneeling. Working frequently in awkward postures can cause fatigue, pain, and musculoskeletal injury.

Biomechanics

A scientific and engineering field that explains the characteristics of a biological system, the human body, in mechanical terms.

Body mechanics education

Education that emphasizes how best to align the musculoskeletal system during work and other activities to reduce abnormal joint stress, muscle strain, and fatigue.

Bursa

Small, flat, fluid-filled sacs located in those areas of the body where repeated pressure is exerted during movement of body parts, such as the shoulder, elbow, and knee. Bursa allow these body parts to move more easily.

Bursitis

Inflammation or irritation of the bursa, resulting in swelling, stiffness, and pain.

Carpal tunnel

An opening inside the wrist through which the median nerve and several tendons pass. The tunnel is formed by the wrist bones and a dense ligament.

Carpal tunnel syndrome (CTS)

A condition in which there is pressure on the median nerve in the carpal tunnel. The nerve gets squeezed when the tendons swell. Symptoms can include pain, tingling, or numbness in the hand, wrist, or arm. These symptoms are often felt at night.

Cartilage

Thick, white connective tissue attached to the surfaces of bones where they contact other bones, forming a low-friction cushion. It is structurally more rigid than a tendon

Cervical vertebrae

Seven small irregular bones in the neck that support and allow head movement.

Contact stress

Pressure on one specific area of the body (such as the forearm or sides of the fingers) that can inhibit nerve function and blood flow in that area. It is caused by continuous or repeated contact with hard or sharp objects such as table edges or unpadded, narrow tool handles

Control MSD hazards

Means to reduce MSD hazards to the extent that they are no longer reasonably likely to cause MDSs that result in work restrictions or medical treatment beyond first aid

Cumulative trauma disorder (CTD)

An injury that develops over a period of time because of repeated stress on a specific body part, such as the back, hand, wrist, or forearm. Muscles and joints are stressed, tendons are inflamed, nerves are pinched, and/or the flow of blood is restricted. Similar to Repetitive stress injury.

De Quervain's disease

Inflammation of the tendon sheath of the thumb attributed to excessive friction between two thumb tendons and their common sheath. Usually caused by twisting and forceful gripping motions with the hands.

Discs

See Intervertebral discs.

Disorder

A medical condition in which some body function does not work as it should.

Engineering controls

Physical changes to a job that reduce MSD hazards. Examples of engineering controls include changing or redesigning workstations, tools, facilities, equipment, materials, or processes.

Epicondylitis

An inflammation of the tendons at the elbow. It is also called "tennis elbow" (lateral or outside part of the elbow), or "golfer's elbow" (medial or inside part of the elbow).

Ergonomics

The science of fitting workplace conditions and job demands to the capabilities of workers' bodies.

Ergonomics program

A systematic process, often spelled out in writing, for identifying, analyzing, and controlling ergonomic hazards at a particular workplace.

Fatigue

A condition that results when the body cannot provide enough energy for the muscles to perform a task.

Force

The amount of physical effort needed to do a task.

Gangrene

Death of body tissue as a result of a loss of blood flow to the area.

Grip force

Physical force applied by the hand when holding or gripping an object.

Hand-arm vibration

Vibration (generally from a hand tool) that goes through the hand and can travel to the arm and other areas of the body.

Hand-arm vibration syndrome (HAVS)

Numbness, tingling, and whitening of the fingers due to exposure to hand-arm vibration. It is often caused by using vibrating hand tools frequently or for long periods of time. It involves blood vessel damage, such as closure of the digital (finger) arteries.

Herniated disc

A condition where the soft inner part of an intervertebral disc pushes out through a tear in the disc.

In-line grip

A hand tool handle which is straight.

Industrial hygiene

The science of anticipating, recognizing, evaluating, and controlling workplace conditions that may cause worker injuries and illnesses.

Inflammation

A protective response of the body to infection and injury. Symptoms may include tissue swelling, redness, pain, and a feeling of warmth.

Intervertebral discs

Discs that sit between the bones of the spinal column (vertebrae) in the back and neck. The discs act as cushions or "shock absorbers" between the bones. Discs have a strong outer wall and a soft inner gel.

ISO

The International Organization for Standardization. This is a non-governmental organization, a network consisting of the national standards institutes of 157 countries.

Joint

The area where two bones are attached to allow body movement. A joint is usually formed of ligaments and cartilage.

Kinesiology

Study of the principles of mechanics and anatomy in relation to human movement.

Ligaments

Strong rope-like fibers that connect one bone to another to form a joint.

Manual material handling

Lifting, carrying, and moving materials without the help of mechanical equipment.

Median nerve

The main nerve passing through the carpal tunnel in the wrist.

Muscle force

Physical force applied with the muscles.

Musculoskeletal disorders (MSDs)

A group of conditions that involve the nerves, tendons, muscles, and supporting structures such as intervertebral discs. The various conditions can differ in severity from mild symptoms once in a while to severe chronic and disabling disorders. Examples include carpal tunnel syndrome, tenosynovitis, tension neck syndrome, and low back pain.

MSD hazard

The presence of risk factors in the job that occur at a magnitude, duration, or frequency that is reasonably likely to cause MSDs that can result in work restrictions or medical treatment beyond first aid.

MSD incident

An MSD that is work-related, and requires medical treatment beyond first aid, or MSD signs or MSD symptoms that last for 7 or more consecutive days after the employee reports them.

MSD signs

Objective physical findings that an employee may be developing an MSD. Examples of MSD signs are:

- Decreased range of motion
- Deformity
- Decreased grip strength
- Loss of function

MSD symptoms

Physical indications that an employee may be developing an MSD. Examples of MSD symptoms include:

- Pain
- Numbness
- Tingling
- Burning
- Cramping
- Stiffness

Musculoskeletal system

The soft tissues and bones in the body. The parts of the musculoskeletal system are bones, muscles, tendons, ligaments, cartilage, nerves, and blood vessels.

Nerves

Cordlike fibers that carry the signals controlling body movement and allowing senses like sight and touch to work.

Neutral body posture

The natural position of body parts, the best position to minimize stress. For example, when standing, the head should be aligned over the shoulders, shoulders aligned over hips, hips aligned over ankles, and elbows at the side of the body.

NIOSH

National Institute for Occupational Safety and Health. NIOSH, part of the Centers for Disease Control and Prevention (CDC) under the Department of Health and Human Services, is the federal government agency with a mandate to conduct and fund occupational safety and health research and training.

OSHA

Occupational Safety and Health Administration. OSHA is a federal government agency, part of the U.S. Dept. of Labor, whose mission is to help prevent workplace injuries and protect the health of workers. OSHA adopts and enforces workplace health and safety standards.

Personal protective equipment (PPE)

Equipment employees wear that provides a protective barrier between the employee and an MSD hazard. Examples of PPE are vibration-reduction gloves and carpet layer's knee pads.

Pistol grip

A hand tool handle which resembles the handle of a pistol and is typically used when the tool axis must be horizontal.

Power grip

A grasp in which the hand wraps completely around a handle. The handle runs parallel to the knuckles and protrudes on either side.

Raynaud's syndrome

Blood vessels of the hand are damaged from repeated exposure to vibration 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; eventual loss of sensation and control in the hands and fingers.

Repetitive stress injury (RSI)

An injury caused by working in the same awkward position, or repeating the same stressful motions, over and over. This is one type of Musculoskeletal disorder.

Risk factor

An action and/or condition that may cause an injury or illness, or make it worse. Examples related to ergonomics include forceful exertion, awkward posture, and repetitive motion.

Rotator cuff

The main source of stability and mobility for the shoulder. Four muscles and their tendons make up the rotator cuff. They wrap around the front, back, and top of the shoulder joint. They rotate the arm inward, outward, and away from the side.

Rotator cuff tear

A tear in the rotator cuff caused by stress on the shoulder. A tear can make routine activities difficult and painful.

Rotator cuff tendinitis

The most common shoulder disorder, involving inflammation, pain, and often swelling in one or more tendons of the rotator cuff. It is sometimes called "pitcher's shoulder."

Ruptured disc

See Herniated disc.

Soft tissues

Tissues that connect, support, or surround other structures and organs of the body.

Sprain

Overstretching or overexertion of a ligament, resulting in a tear or rupture of the fibers in the ligament.

Strain

An injury caused by a muscle, tendon, or ligament stretching.

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

Inflammation, fraying, or tearing of tendon fibers, resulting in pain and sometimes swelling.

Tendon

Tough rope-like material that connects the muscles to the bones. Tendons transfer forces and movements from the muscles to the bones. Tendons do not stretch, and excessive force or twisting may cause them to tear or fray like a rope.

Tenosynovitis

Inflammation of the lining of the sheath that surrounds a tendon. The wrists, hands, and feet are the areas commonly affected, although tenosynovitis may occur in any tendon sheath.

Tension neck syndrome (TNS)

Fatigue, stiffness, tenderness, swelling, weakness, or pain in the neck or shoulder area, or headache radiating from the neck. It is caused by strain on various neck and shoulder muscles, often from long periods of looking upward. The trapezius muscle is particularly affected and may develop a "knot."

Thoracic outlet syndrome

A cumulative trauma disorder of the nerves and blood vessels of the shoulder and upper arm. Symptoms are numbness in the fingers or arm. The pulse in the affected area may weaken.

Trapezius muscle

A large, thin muscle that runs from the upper back through the shoulder area to the neck. Straining this muscle can cause tension neck syndrome.

Trigger finger

A common term for tendinitis or tenosynovitis that causes painful locking of the finger(s) while flexing them. It can be caused by repeated pressure on a finger, such as when using the trigger on a power tool.

Trigger time

The length of time a person can safely use a vibrating power tool, based on its vibration level.

White finger

See Raynaud's syndrome

Whole body vibration (WBV)

Working conditions that involve sitting, standing, or lying on a vibrating surface. Excessive exposure may contribute to back pain.

Work practice controls

Changes in the way an employee performs the physical work activities of a job that reduce or control exposure to MSD hazards. Work practice controls involve procedures and methods for safe work. Examples of work practice controls for MSD hazards include:

- Use of neutral postures to perform tasks (straight wrists, lifting close to the body)
- Use of two-person lift teams
- Observance of micro breaks

Work-related musculoskeletal disorder (WMSD)

A musculoskeletal disorder caused or made worse by the work environment. WMSDs can cause severe symptoms such as pain, numbness, and tingling; reduced productivity; lost time from work; temporary or permanent disability; loss of motion; inability to perform job tasks; and an increase in workers' compensation costs.