Office Ergonomics

Practical solutions for a safer workplace

Prepared by
WISHA Services Division
Washington State Department of Labor and Industries

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Preface

Notice

The recommendations in this document are **voluntary**. They are intended to educate business owners and employees about the benefits of an ergonomics program aimed at reducing and preventing musculoskeletal disorders. They do not impose any new mandatory obligations on employers. They will not be used as the basis for a citation during safety and health compliance inspections by the Washington State Department of Labor and Industries.

Failure to implement the recommendations in this document is not in itself a violation of any safety and health administrative codes; however, employers are obligated to tailor their accident prevention program to the type of hazards present in their facility†.

† WAC 296-24-040 - Each employer shall develop a formal accident-prevention program, tailored to the needs of the particular plant or operation and to the type of hazards involved.

Acknowledgments

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Acknowledgments

IMPORTANT!
Please read the information on Washington State's ergonomics rule at the end of this book.

Introduction

Office work is rapidly changing, as new developments in computer technology come along which can make our jobs easier, but which also can present new problems for both management and employees. This booklet provides you with the information and tools necessary to analyze office jobs, find problems and develop solutions for them. There is enough information contained here to allow a single employee to set up their own workstation to suit the way they work, and for a small-to-medium sized company to evaluate all of their office jobs and begin a comprehensive ergonomics program. Larger companies may require assistance from an ergonomics consultant, or may wish to hire an in-house ergonomist.

Scope of the document

Office managers, safety and health personnel, claims and risk managers, health care providers, facilities and purchasing personnel, and anyone else involved in planning office work will find this document to be useful. It has a dual focus, with information for both employers and employees. Employers are encouraged to read the entire booklet and to photocopy and distribute the pages which are intended for employee use. These pages are listed separately in the Table of Contents and are marked by a border in the document itself. Employees who are involved in safety committees or ergonomics teams will also benefit from reading the entire booklet.

Other Labor and Industries (L&I) ergonomics publications which you may find helpful:

- *Fitting the Job to the Worker: An ergonomics program guideline.*
- *Commonly asked questions about ergonomics.*
- *Cumulative trauma disorders and your job - Carpal Tunnel Syndrome: A preventable disease.*
- *Lessons for lifting and moving materials*
- *Back belt fact sheet*
- *Work-related musculoskeletal disorders: Washington state summary 1992-1994*

For copies of these publications contact your local L&I office (see **Resources** in **Appendix C**).

Ergonomics and the prevention of injury

Ergonomics is the scientific study of human work. It considers the physical and mental capabilities and limits of the worker as he or she interacts with tools, equipment, work methods, tasks and the working environment. ***Office Ergonomics*** is the branch of ergonomics dealing specifically with the office environment. In recent years the main focus of office ergonomics has been on computer work due to the rapid increase in computer use in the modern office and the associated increase in injuries.

People are an essential part of every business process and critical to delivering quality products and services. It is especially costly when a person becomes injured or ill given both these direct costs and the loss of the valuable services provided by the person. Ergonomics is a tool which business owners and managers can use to help prevent these injuries in the office. Ergonomics reduces the risk of injury by adapting the work to fit the person instead of forcing the person to adapt to the work. In addition to injury prevention, ergonomics is also concerned with enhancing work performance, by removing the barriers that exist in many work places that prevent employees from performing to the best of their abilities. Therefore, another benefit of applying ergonomics to office work is that it helps people work more effectively, efficiently, and productively at their jobs. The application of ergonomics in your workplace is a creative process, and to be successful it may require all of the available expertise within your company. You will therefore want to ask for input from all staff levels, including management, supervision and employees, when dealing with ergonomics issues.

Benefits of ergonomics

While ergonomic improvements to the work environment are primarily used to create a safer and more healthful work environment, your company may experience other benefits, including:

- increased productivity
- increased work quality
- reduced turnover
- reduced absenteeism
- increased morale.

Sources of injury in the office

If your workers are required to adapt to a job that exceeds their body's physical limitations, they can become injured. The single largest class of injury claims in the office are ***Work-related Musculoskeletal Disorders*** **(WMSD's)**, which account for over 40% of all Washington State Fund workers' compensation claims among office workers.

These injuries result in medical and time loss costs of over $12 million per year to State Fund employers, and are responsible for over 70,000 lost work days per year. Due to the nature and severity of WMSD's, they account for more than their share of injury costs - about 60% of overall claim costs.

WMSD's may worsen over time and therefore become more costly when compared to injuries resulting from a sudden event such as a slip and fall. This also means that it can take a long time to get an employee back to work, resulting in higher medical and time loss payments. In addition, there can be higher hidden costs when workers use more sick leave or slow their work pace during the period before a claim is filed when WMSD symptoms are beginning to develop.

Work-related Musculoskeletal Disorders (WMSD's)

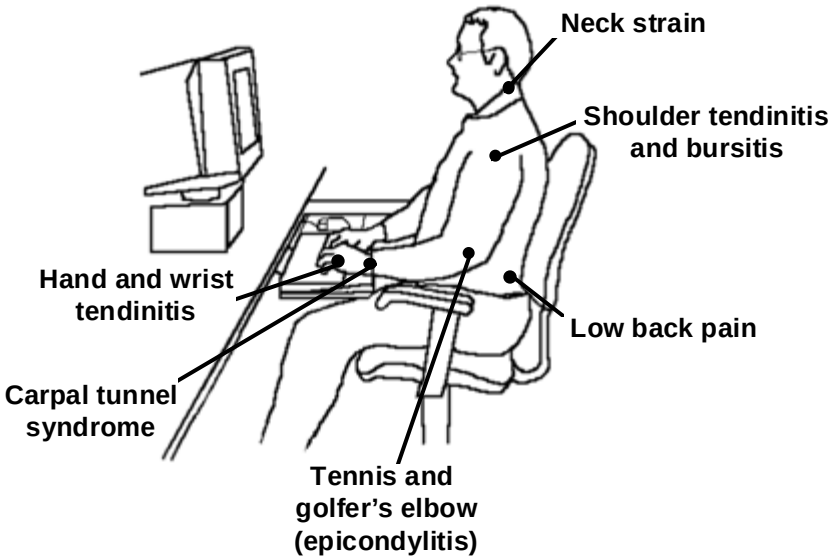
Injuries to the soft tissues in the body:

- muscles
- tendons
- ligaments
- nerves
- blood vessels

Symptoms include:

- discomfort
- pain
- fatigue
- swelling
- stiffness
- numbness and tingling

Examples of WMSD's



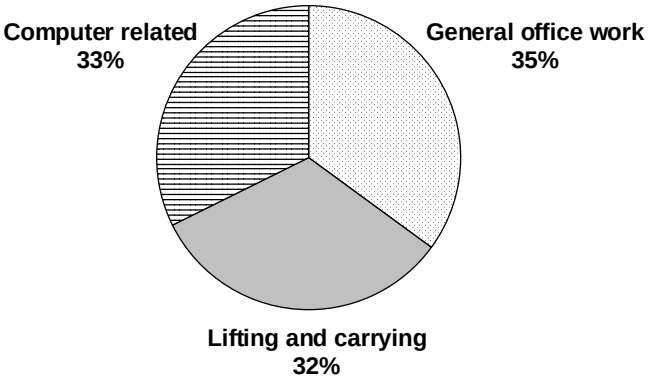
Other terms for WMSD's

- Cumulative trauma disorders (CTD's)
- Repetitive trauma disorders
- Repetitive strain injuries (RSI's)
- Repeated motion disorders
- Overuse syndromes

Nature of injury

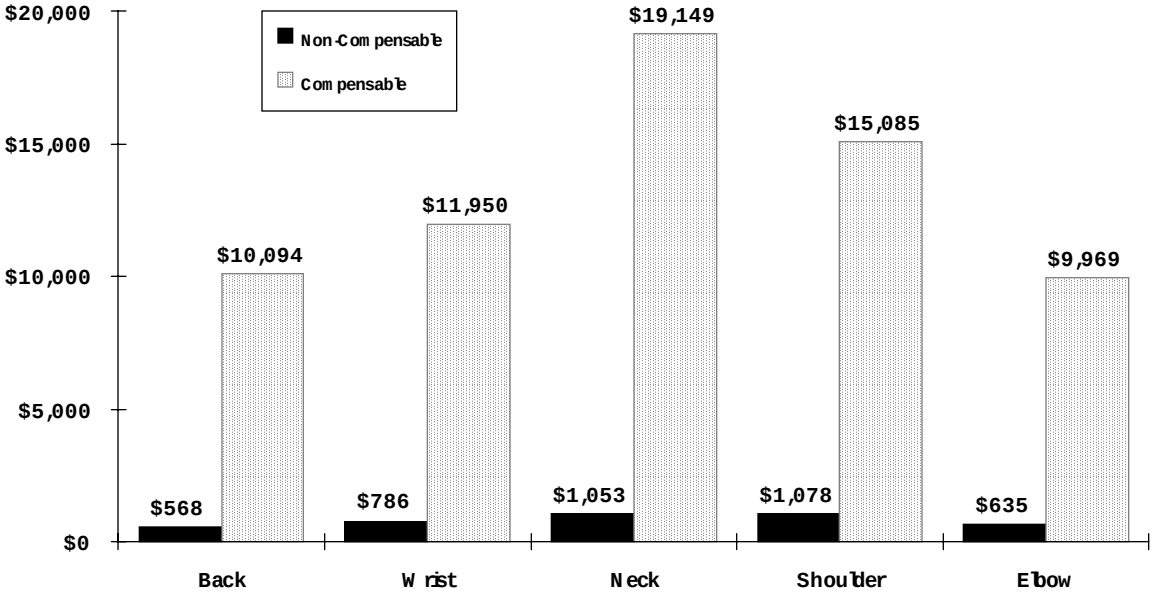
Worker's compensation claims for injuries that occur in the office environment come from three areas - computer work, materials handling (lifting and carrying) and general office work. A review of L&I's State Fund claims data for office workers shows that the number of injuries from each of these sources accounts for a roughly equal percentage of the total number of WMSD's:

WMSD's in the office (Source: 1993 WA State Fund claims data)*



Claims can also be divided based on whether or not the employee has to take time off work when recovering. *Non-compensable claims* are those claims with three or fewer days of recordable time loss, while *compensable claims* involve more than three days of time loss.

Costs of WMSD claims (Source: 1993 WA State Fund claims data)*



As you can see, compensable claims cost on average almost 20 times as much as non-compensable claims. In order to keep claim costs down, it will be important to address the causes of these injuries as early as possible in order to reduce or eliminate time loss.

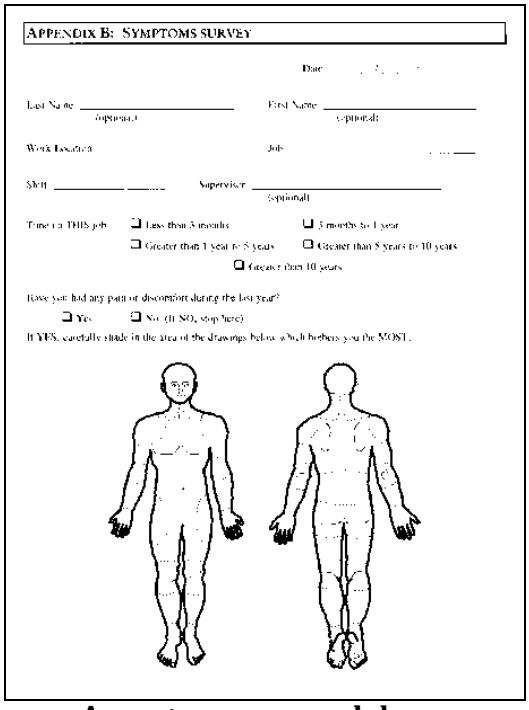
*** Data from 1993 are used in order to make sure that the cost figures are stable. Since the more severe WMSD claims usually involve considerable time loss, they can continue to accrue costs for years after the date of injury.**

Work related musculoskeletal disorder symptoms and claims

Work-related musculoskeletal disorders typically develop over a long period of time. The earlier that employees report symptoms and have them attended to, the better the chance of preventing a serious injury.

When an employee reports occasional discomfort due to work activities, it does not necessarily mean that they will eventually develop a WMSD, but it is a sign that problems exist that will need to be addressed. Often, making simple changes to their job, work practices or workstation will reduce the symptoms to a level where injury is no longer a concern; this process will be the focus of the rest of this document.

However, it will not be possible to prevent all WMSD's, and you may even have employees who currently have symptoms of an injury but do not understand the cause or the need to get medical treatment. One step you may want to take to find out who is experiencing symptoms and at what level is to hand out a ***Symptoms Survey***, using the form in **Appendix B**.



APPENDIX B: SYMPTOMS SURVEY

Date

Last Name _____ (optional) First Name _____ (optional)

Work location Job

Shift _____ Supervisor _____ (optional)

Time in 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.

A symptoms survey can help you find out where help is needed most.

More frequent, severe and longer lasting symptoms should be evaluated by a medical professional experienced in diagnosing and treating WMSD's, who will determine whether the symptoms constitute an actual injury, and also if the injury is work-related. More serious cases may be referred to a specialist such as a neurologist or hand specialist. WMSD's often involve time loss and some work restrictions; therefore it is often beneficial to have a contact person within your company who will be responsible for keeping in touch both with the employee and with their health care professional. Management of more serious injuries can involve extensive changes to job duties and workstation equipment, and for this you may need the assistance of an experienced consultant. Labor and Industries can provide you with this assistance; see the **Resources** section in **Appendix C** for the location of the office nearest you.

Proactive approach

You will find that the application of ergonomics principles is most effective when used before problems result in serious injury. The goals of a proactive program should be to prevent as many workers' compensation claims as possible and to reduce the severity of those claims that do occur.

Injuries that are addressed early on through an ergonomics process will often be less severe, have little or no time loss, and will allow the employee to continue on as a productive member of the company. Employers also benefit through reduced workers' compensation costs.

Important Elements of a Proactive Approach

- Comprehensive program with management support
- Employee involvement
- Worksite analysis to identify problems
- Employee awareness training
- Early reporting of symptoms

RETURN-TO-WORK PROGRAMS

Case Study:

Injury claims show need for ergonomics program

The Human Resources Manager at the home office of Fictional Industries noticed a trend in office injury claims - a steady increase in both the number and cost of claims since 1990, when the office had first computerized. A closer look at the claims and at the incidence reports revealed that about 30% of injuries were related to computer use, with several claims for tendinitis and carpal tunnel syndrome. Because many of the injuries resulted in a considerable amount of time loss (one worker was off work for 45 days while recovering from carpal tunnel surgery) they were expensive claims, and accounted for approximately 45% of the company's claim costs. The increase in injury claims had resulted in higher workers' compensation insurance payments, and therefore higher personnel costs. To make matters worse, it was some of their most dedicated and experienced employees who were getting injured.

The manager brought his findings to the company president, and after getting her approval, began a comprehensive ergonomics program which included awareness training for all of the office staff, worksite analysis, and a management commitment to make changes to both jobs and workstations. At first, the rate of injury claims increased slightly, as employees who had been experiencing symptoms for months were encouraged to report them. However, the cost of the claims was much lower, since the early reporting kept time loss to a minimum, and injury claims began a steady decline in the following years. After three years, the number of claims had been reduced by 50% and the costs by 80%, and Fictional Industries received its first workers' compensation premium reduction in seven years. At this point, the manager calculated that the company had saved three dollars for every dollar they had spent on training and workstation improvements, with the savings coming not only from reduced workers' compensation payments, but also from reduced absenteeism, fewer overtime hours, and reduced need to hire temporary workers to replace those out on injury leave.

Note: While this is a fictional company, similar success stories have been reported by several real companies who have implemented ergonomics programs in the office.

Risk factors for WMSD's

Ergonomists have examined a number of jobs where there have been a high incidence of WMSD's, and have found some common elements present in each of these jobs which are associated with these injuries. These elements are called ***risk factors***, because exposure to them increases the chance that a worker will become injured. The following are examples of risk factors that are found in office work, some or all of which may be present at the same time:

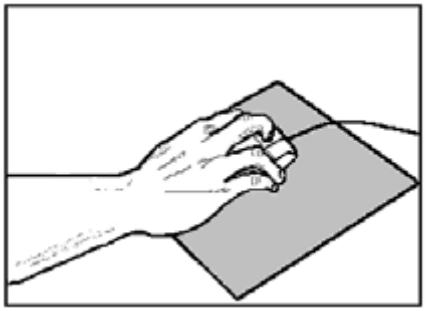
Common Risk Factors

- Repetition
- Static Loading or Sustained Exertions
- Awkward Postures
- Mechanical Contact Stress

FORCE

Repetition

Performing the same or similar motions repeatedly can result in trauma to the joints and surrounding tissues. Without time for rest and recovery, repetition can lead to injury.



Repetitive mouse use has been associated with WMSD's

Examples:

Computer Work

- typing at the keyboard
- moving and clicking the mouse
- looking back and forth between the monitor and source documents

Office Work

- flipping through files and paperwork
- using a calculator
- writing by hand
- stapling and three-hole punching by hand

Static loading or sustained exertions

One of the risk factors that has increased in the computerized office is ***static loading***, where the muscles must hold the body in a single position for a long period of time. This lack of movement reduces circulation and causes muscle tension, which can contribute to or aggravate an injury. ***Sustained exertions*** are a type of static loading where force is applied continuously for long periods of time.

Avoid sitting without back support

Examples:

Computer Work

- holding the hands in place above the keyboard or mouse
- holding down the Shift key
- keeping the head still while reading from the monitor
- sitting still for long periods of time

Office Work

- looking down at documents laying flat on the desk
- sitting upright without back support
- holding the handset while talking on the telephone
- holding boxes in the hands while carrying them long distances

Awkward postures

Postures that bend the joints into positions where they are more likely to become injured are termed awkward postures.

Examples:

Computer Work

- typing with bent wrists
- turning the head to the side to view the monitor
- reaching up and over the keyboard to use the mouse
- leaning over to type in data from papers laying flat on the desktop

Office Work

- slouching or leaning forward in the chair
- cradling the phone between the ear and the shoulder
- elevating the arms when writing on a work surface that is too high
- bending at the waist to load copy machines

Avoid awkward postures such as:

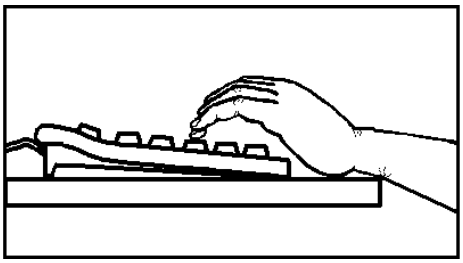
Reaching forward to use the mouse

Hunching one shoulder to cradle the phone

Looking down at papers laying flat on the desk

Mechanical contact stress

A hard or sharp surface or object pressing into the soft tissues -- the tendons, nerves and blood vessels -- can cause damage that over time can result in serious injury. This damage is termed ***mechanical contact stress***.



Sharp edges can damage soft tissues

Examples:

Computer Work

- resting wrists on the desk edge while typing or using the mouse
- leaning the elbows on hard chair armrests or work surfaces
- typing with palms resting on the hard lip of a keyboard tray

Office Work

- using rubber stamps with handles that press into the palm of the hand
- using scissors with hard, metal handles
- sitting in a chair that places pressure on the backs of the thighs

Force

Many office tasks require a moderate amount of force to be applied by very small muscles, which may cause fatigue, swelling, muscle strains and ligament strains.

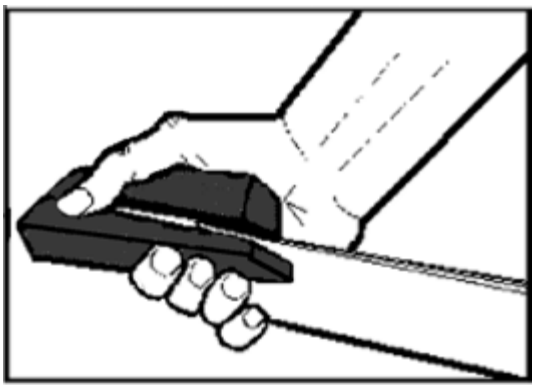
Examples:

Computer Work

- "dragging and dropping" with the mouse
- gripping the sides of the mouse tightly
- "pounding" on the keyboard

Office Work

- grasping thick file folders or manuals
- stapling or stamping by hand
- opening 3-ring binders
- lifting heavy manuals with one hand



Stapling by hand can require high forces

In addition, there is still the occasional need to lift items such as computer equipment and boxes of copy paper or files. Most office workers are not trained in proper lifting techniques. Also, seated work tends to weaken the stomach muscles, which would ordinarily help support the spine when lifting. Both of these factors place office workers at a greater risk for injury, even from the occasional lift.

Additional risk factors

While the risk factors described previously are typically found in the office environment, there are other risk factors that are more common in industrial jobs or work at home which your employees should be aware of. These include:

- ***hand-arm vibration***, such as when holding a power tool
- ***whole body vibration***, such as when driving a car over rough roads
- exposure to ***extreme temperatures***, especially to cold
- wearing ***loose fitting gloves*** when working with tools

These risk factors all reduce sensation in the hands and fingers, and therefore lead to the use of too much force when gripping objects. In addition, vibration, whether to the hands or the whole body, can lead to changes in circulation and the break down of tissues.

Other considerations

For each of the risk factors above, a longer duration of exposure results in a greater potential for injury. Complaints of discomfort and reports of injury are higher for workers who spend six or more hours a day doing repetitive data entry compared to those who only spend an average of two hours per day repetitively keying.

Factors that increase risk of injury:

- Duration of exposure to risk factors
- Combinations of risk factors
- Environmental factors
- Organizational factors

Also, you may have noticed in the risk factor examples that common tasks such as using the mouse and stapling by hand show up more than once. Combinations of risk factors associated with one task further increase the likelihood of WMSD's. For example, repetitive arm motions when using the mouse are much more likely to result in shoulder injury if the mouse is beyond the keyboard, forcing the worker to elevate their arm and work in an awkward posture. Also, repetitive keyboard use has been shown to be more likely to result in a WMSD when more force than is necessary is used on the keys.

Environmental factors (lighting, temperature, noise) and organizational factors (job design, work schedules) can also increase the risk of injury, as well as cause other problems that affect worker performance.

Factors outside of work

The phrase "work-related" in *work-related musculoskeletal disorders* implies that workplace factors may not always be the sole or primary cause of the injury. Other factors which have been associated, in part, with WMSD's include:

- Poor physical condition
- Lack of flexibility
- Recreational activities which involve the risk factors described previously
- Computer use at home
- Predisposing medical conditions (*e.g.* - previous joint injury, some forms of diabetes, pregnancy)

Many predisposing medical conditions increase the risk of WMSD's by causing swelling in the joints, such as with fluid retention during pregnancy. It is important that any such medical conditions be properly diagnosed and treated.

Since this is a workplace guideline, it will focus on those factors at work which are under your control as an employer. However, an important part of any ergonomics program is providing training to your employees, in order to increase their awareness of WMSD's and their causes. This will allow them to apply the principles of ergonomics to those areas under their control, at home and at work.

CASE STUDY:

Risk factors combine to cause injuries

DataHum Inc.'s safety committee had recently begun dealing with ergonomics issues in their offices, and their first step was to review accident and injury data to help them decide which work areas and individual employees needed attention. The committee found that one area, which consisted mostly of data entry personnel and clerks, had an injury rate much higher than other areas in the company, and decided to make this area a priority. The management in the area welcomed the idea of further analysis, because they had been wondering why the data entry people had been getting injured much more often than the clerks, even though they worked side by side at identical computers in workstations with the same furniture and chairs.

The safety committee began by discussing concerns with the employees in the area, and listing the general tasks that they did on a daily basis. In order to get more detail they had the employees keep a log of specific tasks, with entries every 15 minutes, over the period of one work week. They also had the employees complete symptoms surveys, not only to help them prioritize changes, but also to give them a measurement to which they could compare discomfort levels after the changes to see if they were effective. In addition, they observed the employees while working in order to identify risk factors present in each job.

From their analysis, the committee found the following:

- The data entry staff all spent over five hours per day doing repetitive keyboard work, while the clerks averaged less than five hours per day at the keyboard.
- Data entry staff mostly listed "entered data" over and over in their task logs, while the clerks had a greater variety of tasks listed.
- Data entry staff reported higher levels of discomfort on average than the clerks.
- While both groups were observed working in similar awkward postures, the committee found that the data entry staff had much higher levels of repetition and static loading.
- Within the data entry staff, the "high producers" tended to key for longer periods of time without a break, and these employees had the more serious, high cost injuries.

It was obvious to the committee that simply adjusting workstations to fix awkward postures wouldn't prevent the injuries among the data entry staff, since the repetition, static loading, and duration of keyboard work were also important risk factors. Using the results of their analysis, they were able to work with management to begin a more comprehensive effort. In addition to furniture adjustments and training, the biggest step that management and the committee took was to change the duties of the data entry staff to limit repetitive keyboard work to five hours per day. They accomplished this by having them share tasks with the clerks so that keyboard work was more evenly distributed between the two groups.

Six months after the changes were made the committee went back to the area and did another symptoms survey, which showed lower levels of discomfort for all employees, but especially for data entry staff. The management and employees were happy with the way the changes in job duties worked out, and both groups wanted to make it permanent. As a result of their success in this one area, DataHum now has a policy that limits repetitive keying to five hours per day, and they use this as a guideline when creating new positions within the company.

Applying ergonomics to your office environment

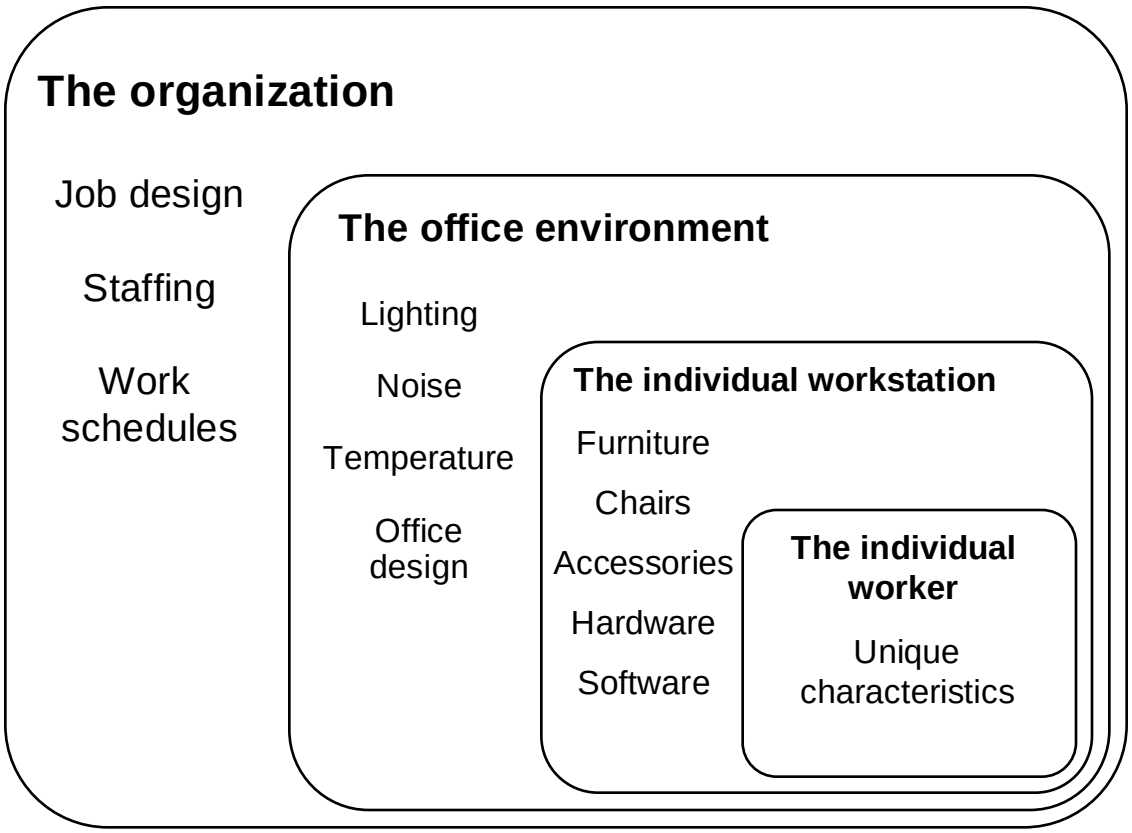
Your first step in implementing ergonomics in the office is to analyze the work being done, whether you are looking at a single workstation or the entire department. A careful analysis will help you to find the true cause of the problem and to apply the appropriate resources. Many times your analysis will reveal that only small changes are necessary, in which case a more involved analysis may not be necessary. Other times, you may find more complex problems that are beyond the scope of this publication, and will require evaluation by an experienced professional. Most of the time, however, you will find that the problems can be resolved with the help of the employees in the area and the resources at hand.

Getting Started

- Worksite Analysis
- Implementing Solutions
- Training and Education
- Evaluation

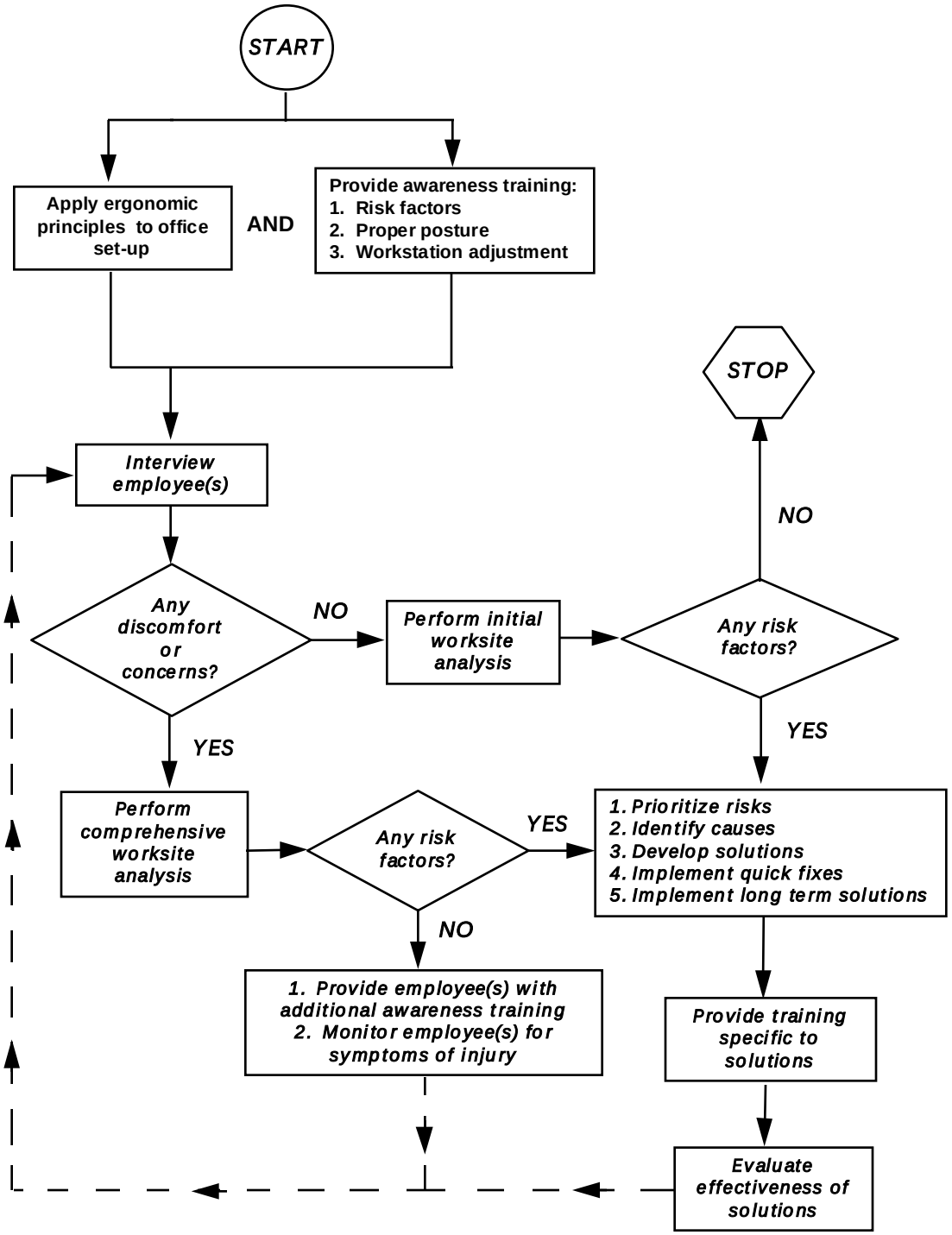
Organization of the office

Ergonomics deals with many issues, starting with a single employee and their workstation, and expanding out to include an entire department or organization. Most of the organizational and environmental factors, as well as the selection of workstation furniture, are under management control. Many of the factors related to the arrangement of the workstation and work habits are under each employee's control. The focus of ergonomics is always on designing for the individual employee, who brings unique characteristics with her or him to the job. Some of these characteristics, such as height and age, cannot be changed, while others, such as training and experience, can be changed.



Ergonomics process flow chart

Begin your ergonomics process with awareness training, and start applying ergonomic principles as early in the process as you can, especially if you are purchasing new equipment or setting up new workstations. Refer to the flow chart to help you decide the level of effort to put into the analysis and development of solutions. If no problems exist, training in the principles of ergonomics is still an appropriate preventive measure.



Worksite analysis

Worksite analysis is the first step in developing solutions to potential causes of WMSD's. Causes of injury can come from any of the different levels in your organization, and you should therefore be as comprehensive as possible when performing the analysis. There are a number of different types of analyses that you can do as part of a worksite analysis, including the following:

Task Analysis looks at what each of your employees does on the job on a daily basis. It differs from a job description which usually contains generic job requirements, because it gathers information about how a specific worker does his or her job. For this reason, you will need to involve the workers in the task analysis, as they are the best sources of information on their daily activities. The application of ergonomic principles to workstation equipment selection, lighting design and other worksite elements depends on the nature of the task being done. Therefore, you will need to do a task analysis before doing any of these other forms of analysis:

> ***Workstation Analysis*** looks at the physical components of the workstation, such as monitor and keyboard location, work surfaces, and chair adjustments. Each of these components is measured relative to the individual worker, and therefore employee participation will be required for this analysis as well.
>
> ***Environmental Analysis*** examines the area surrounding the individual workstations, looking at factors such as lighting and glare, temperature, humidity and noise, all of which affect employee comfort and performance.
>
> ***Organizational Analysis*** deals with issues at the department or company-wide level, such as staffing levels, assignment of responsibilities, work schedules, overtime policies and other aspects of what are typically considered "working conditions." These issues are typically outside the control of individual employees, but they can have the greatest impact on risk factors such as repetition and static loading, as well as the duration of exposure to all risk factors.

Any or all of these analyses may be appropriate, depending on the nature of the problem. Keep in mind, that employees may not be aware of all of the potential problems or risk factors for injury that exist in their area. Therefore, it is always a good idea to perform some analysis beyond the obvious problems or stated concerns.

CASE STUDY:

A thorough analysis results in creative solutions

Mark, a human resources specialist at Northwest Technologies, had attended ergonomics training in order to learn how to do workstation analysis and set up a formal program within his company. When he spoke with managers, supervisors and employees in each area, he heard the same thing from all of them: "We need new chairs." Rather than do just a workstation analysis to determine what types of chairs to recommend, Mark began with a full task analysis for each job class and for each individual employee who was experiencing discomfort. With a better understanding of each job, he was able to identify solutions for risk factors in addition to, and in some cases instead of, the chairs. In some areas, he found that the computer monitors were too low, and employees were leaning forward to look at them. He placed reams of copy paper underneath the monitors, allowing the employees to sit in a more upright posture. He also found that some employees had to lift heavy boxes of files which had been placed in storage, even though they were still frequently used. He concluded that their back discomfort was probably just as much due to the lifting as it was to their chairs. He recommended that more short term file storage be created in each work area to make these files more readily available. Mark found that these solutions were highly effective in reducing injury claims.

Steps in an initial worksite analysis

A good, proactive method that will help you decide on the appropriate types of analysis is an ***initial worksite analysis,*** which involves a brief walk-through and informal interview of employees to see if there are any concerns. At the same time, if you haven't already done so, you can give awareness training to encourage employees to bring up concerns before they become problems.

1. Talk to employees to find out if any of their work tasks involve repetition, static loading, awkward postures or any of the other risk factors, even if they have not experienced discomfort or symptoms of injury during these tasks.

2. Briefly observe employees as they perform these tasks to determine the risk factors and their causes. At the same time, note any obvious workstation, environmental or organizational factors that could create risk factors.

3. Discuss possible quick fixes and longer term solutions with employees when risk factors are present. Make immediate changes to simple workstation problems such as monitor height or mouse location whenever possible.

Steps in a comprehensive worksite analysis

If you have employees who have more serious concerns, discomfort, or actual injuries, you will want to perform a ***comprehensive worksite analysis***. This combines workstation analysis, task analysis and environmental analysis.

1. Interview the employee, letting them know the reason for the analysis and putting them at ease so they'll be able to answer questions openly. Find out what they do, and for how long, if they work on a fixed schedule or have required quotas, and whether or not they've had any problems, discomfort or symptoms of injury.

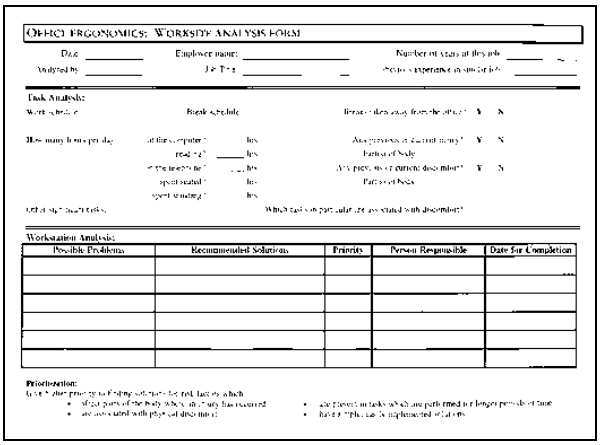
2. Observe them working for a while to get an idea of their work habits. Let them demonstrate their work undisturbed before interrupting with questions. Then, find out why they work the way they do, and if they've ever tried doing things differently. Have them focus on the parts of the job where they've had problems or discomfort, as these will be a priority for developing solutions. Identify risk factors for each task and note how often and for how long each risk factor is present.

3. Analyze the workstation, equipment and environment relative to the different tasks the employee must perform. Remember to focus on fitting the equipment and environment to the employee, rather than expecting them to adapt their posture or behavior.

Using the Analysis and Implementation Guide

At first, performing a worksite analysis may seem beyond your comfort level. As with any new experience, you will need more guidance at first. Appendix A is an Analysis and Implementation Guide that will help you go step-by-step through the analysis and the development of solutions.

The guide asks a series of questions about posture, furniture and equipment, lists some of the risk factors and discomfort that can result, and then lists some potential solutions. There is also a Worksite Analysis Form which covers the basic task analysis questions and has sections for recording your findings from the other forms of analysis as well.


OHIO ERGONOMICS: WORKSITE ANALYSIS FORM

Date _____ Employee name: _____ Number of years at this job _____

Analyzed by _____ Job Title _____ Previous experience in same job _____

Task Analysis:

Work schedule: Break schedule: Breaks taken away from the office? Y N

How many hours per day: at the computer? _____ hrs; reading? _____ hrs; at the keyboard? _____ hrs; speaking? _____ hrs; listening? _____ hrs. Any pressure at current duties? Y N. Factors of Stress

Which tasks do you feel are related to discomfort?

Workstation Analysis:

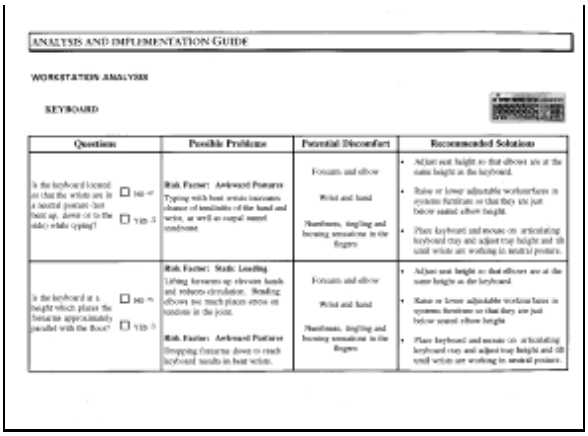
Possible Problems	Recommended Solutions	Priority	Person Responsible	Date for Completion

Prioritization:

Use the following criteria to determine which tasks need fixed first:

- Which parts of the body which are being affected
- Are tasks related with physical discomfort
- Are tasks which are performed for longer periods of time
- Ease of implementation of solutions

The Worksite Analysis Form


ANALYSIS AND IMPLEMENTATION GUIDE

WORKSTATION ANALYSIS

KEYBOARD

Questions	Possible Problems	Potential Discomfort	Recommended Solutions
Is the keyboard located so that the wrists are in a neutral posture (not bent up, down or to the side) while typing? ☐ NO ☐ YES	Risk Factor: Awkward Posture Typing with bent wrists increases chance of tendinitis of the hand and wrist, as well as carpal tunnel syndrome	Forearm and elbow Wrist and hand Numbness, tingling and burning sensations in the fingers	• Adjust seat height so that elbows are at the same height as the keyboard. • Raise or lower adjustable workstations in systems furniture so that they are just below seated elbow height. • Place keyboard and mouse on articulating keyboard tray and adjust tray height and tilt until wrists are working in neutral posture.
Is the keyboard at a height which places the forearms approximately parallel with the floor? ☐ NO ☐ YES	Risk Factor: Static Loading Lifting forearms up elevates hands and reduces circulation. Bending elbows too much places stress on tendons in the joint. Risk Factor: Awkward Posture Dropping forearms down to reach keyboard results in bent wrists.	Forearm and elbow Wrist and hand Numbness, tingling and burning sensations in the fingers	• Adjust seat height so that elbows are at the same height as the keyboard. • Raise or lower adjustable workstations in systems furniture so that they are just below seated elbow height. • Place keyboard and mouse on articulating keyboard tray and adjust tray height and tilt until wrists are working in neutral posture.

The Analysis and Implementation Guide

Until you have had some experience doing worksite analysis, it is a good idea to use the questions as a checklist and to evaluate the entire workstation. If your employees are already experiencing discomfort, you can also start with the Potential Discomfort column and work your way back to determine the cause.

Symptoms surveys

One way that you can get a better understanding of the types of discomfort that your employees may be experiencing is to hand out a symptoms survey, a sample of which is included in Appendix B. This survey can help you to prioritize workstations, work groups, or jobs for further analysis. It is also a good tool to use for periodically monitoring the success of your ergonomics process. Since discomfort is often the first sign of a potential injury, lower scores on the discomfort surveys following implementation of an ergonomics program is a good indication that the program will be successful in preventing injury.

Time required for analysis

With practice, you will find that an initial worksite analysis takes about 15 minutes per workstation, while a comprehensive worksite analysis may take 30 to 45 minutes per workstation. If you have a number of workstations to evaluate, training your employees to do their own initial analysis may prove to be a more efficient and cost effective alternative to doing all of the analyses yourself (see the Training section, page 35).

Using the results of the analysis

The result of the task analysis should be an itemized list of the worker's daily activities, with an indication of how much time is spent at each task. The risk factors associated with each task should also be detailed, as well as their likely causes. The number of risk factors, the amount of discomfort they cause, the amount of time that the worker is exposed to them, and the impact of environmental and organizational factors will all be used to prioritize each of the tasks when developing solutions.

Implementing solutions

Workstation solutions

During the worksite analysis, you may have identified some quick fixes that could be easily implemented and would provide immediate benefits to your employees. Most quick fixes are small changes to the workstation, such as footrests or monitor stands, which help to alleviate problems with awkward and static postures. Some of these small changes can be implemented by employees themselves, and employees may also have suggestions for low cost solutions. You may even notice some "homemade" workstation changes that your employees have made already in an attempt to make their work areas more comfortable or easier to use. Many times these solutions can be used by other employees at their workstations, too.

A simple solution to an awkward posture – bringing the mouse down to the same level as the keyboard

The individual workstation

Setting up an employee's workstation is simply a matter of placing the employee in one of the neutral postures described on the following pages, and then arranging their furniture and equipment to allow them to work in that posture. For example, the monitor should be just below eye level in order to keep the head level, and the keyboard should be close to elbow level, to help keep the wrists straight. If you can't bring the monitor and keyboard down low enough, then raising the chair and providing a footrest might be the solution. The reason for doing a separate analysis for each employee, rather than just setting up all of your workstations according to a few general rules, is that it is impossible to come up with a set of rules that works in every situation. For instance, an employee who wears bifocals may need to position their monitor much lower in order to keep their head level if they read out of the bottom half of their lenses.

If your task analysis reveals that employees work in other places besides their computer workstation, such as a copy room, storage area or mail room, treat these areas as additional workstations. This would mean performing a separate workstation and environmental analysis for each area, using the appropriate section of the Analysis and Implementation Guide. For example, a storage area should be evaluated using the Lifting and Carrying section.

Your employees will be able to participate in solving many of problems with the set up of their workstations once you have trained them on the principles of ergonomics. Feel free to photocopy and distribute pages from the *Ergonomics Tips for Employees* as part of your training efforts.

Ergonomics Tip

Neutral posture at your workstation helps prevent injury

In order to understand the best way to set up a computer workstation, you first need to understand neutral posture. This is a comfortable working posture in which your joints are naturally aligned and your risk of developing a musculoskeletal disorder is reduced.

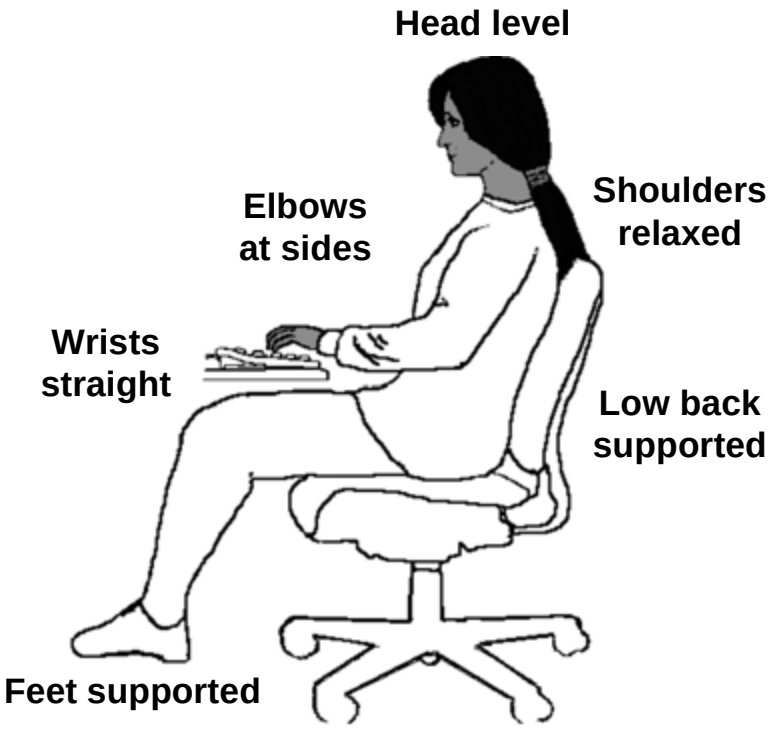
Change postures frequently

Regardless of how good your posture may be, sitting still for long periods of time isn't healthy. You should make small adjustments to your posture about every 15 minutes, by changing the height of your chair slightly, or leaning back a little further into the backrest. Larger changes in posture are also important; stand up and stretch or walk around for one or two minutes every hour.

Practice neutral posture while seated

The following are the important components of neutral posture while seated:

1. Keep your head level or tilted slightly downward. Place your work in front of you so that you are looking straight ahead.
2. Sit with your shoulders relaxed, not elevated, hunched or rotated forward.
3. Keep your elbows close to your sides and bent at about a 90° angle, not extended out in front of your body.
4. Use the chair's backrest to support your lower back, or lumbar curve.
5. Sit with your entire upper body upright or leaning slightly back.
6. Keep your wrists straight while you work, not bent up, down or to the side.
7. Sit with your knees at the same level or slightly below the level of your hips. There should be no pressure points along the backs of your thighs or at the backs of your knees.



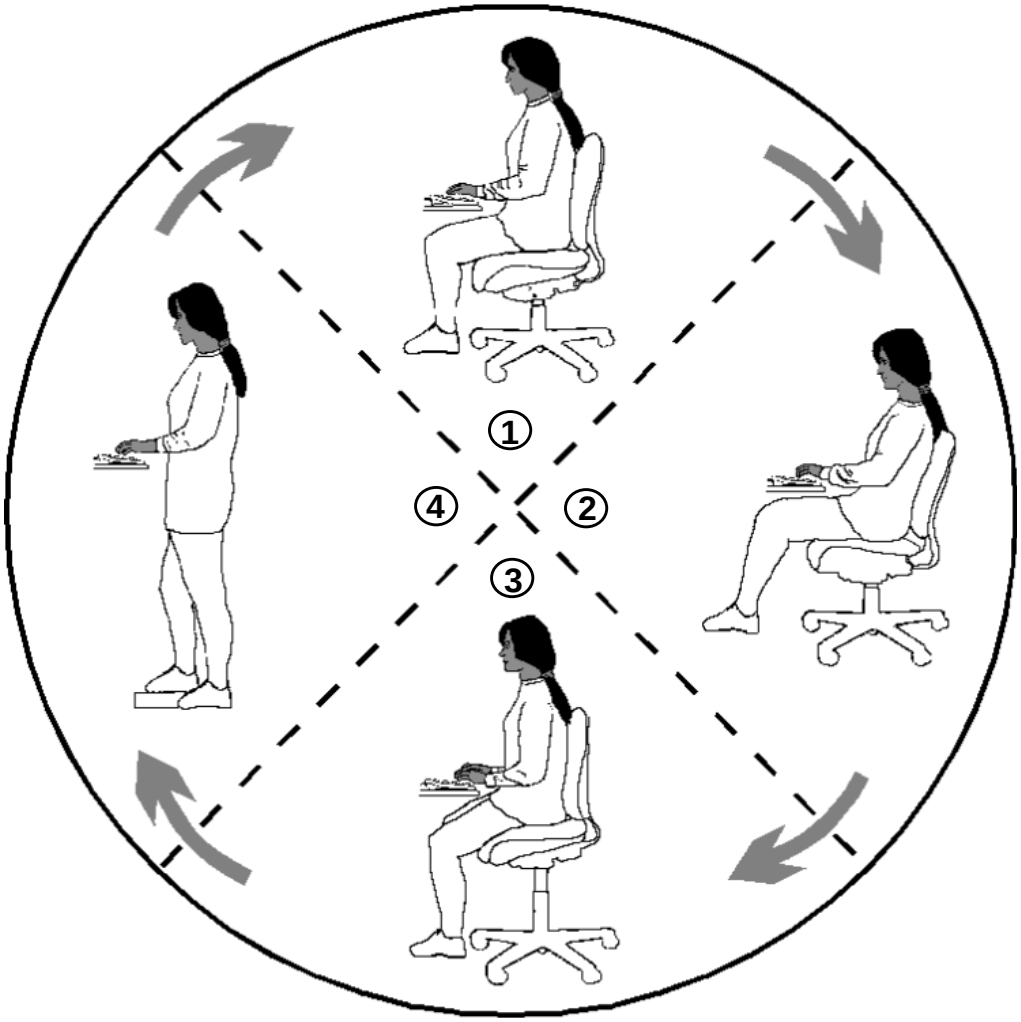
8. Place your feet slightly out in front of your knees and make sure they are comfortably supported, either by the floor or by a footrest.

Pay attention to overall posture

Although the components of neutral posture are listed individually above, it is really the posture of your body as a whole that is important. Having just one part of your body out of neutral can affect the rest of your posture. Try sitting with your feet hooked under your chair. You will notice that this tends to pull you forward in your seat, away from your chair's backrest. Now place your feet out in front of you and you will notice that it is much easier to lean back into the chair. Similarly, if you place your monitor too low on your desk, this will also tend to make you lean forward to view it. Practice adjusting your workstation to achieve a neutral posture for your whole body. It may help to have a co-worker take a look at you while you work and give you feedback on your posture.

There is no single "correct" posture

There are many variations of neutral posture, and depending on what tasks you have to perform and the furniture in your workstation, you may find one of these alternatives to be more comfortable for you. These variations are also useful when changing postures throughout the day.



① **"90-degree" posture:** Sit upright with your elbows, hips and knees bent at right angles and your feet flat on the floor or on a footrest. This position is biomechanically correct, but it can fatigue your back muscles over time. Fatigue can lead to slouching, even on a chair with lumbar support.

② **Reclining posture:** Lean back 10° - 20° into the chair's backrest and put your feet out in front of you to open up the angle at your hips and knees. This helps relax your back muscles and promotes blood circulation. Leaning back too far can result in an awkward neck posture when trying to keep your head upright, however.

③ **Forward tilt posture:** Raise the height of your chair's seat a few inches and tilt the front of it downward about 8°. This will open up your hip angle and allow you to support some of your weight using your legs rather than having it all rest on your hips and the backs of your thighs. You may not find this posture comfortable if you have knee or foot problems, or if you feel like you are sliding off the front of the seat. A contoured chair seat can help to hold you in place.

④ **Standing posture:** Standing provides the biggest change in posture, and is a good alternative to prolonged sitting, which can aggravate low back injuries. It can be fatiguing, however, so have a counter height chair available at standing workstations, or use a height adjustable sit/stand workstation. Also, prop one foot up on a low footrest occasionally to help shift your weight.

Adjustable task chairs

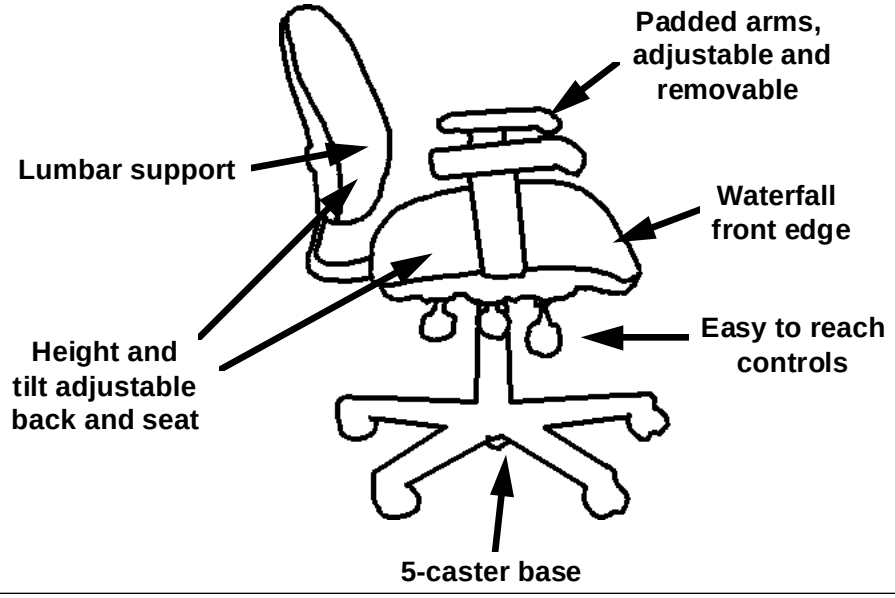
It is obvious from the discussion of neutral postures and the need for frequent changes in posture that it will be important to provide employees with an adjustable chair that fits them well.

Adjustable task chairs vs. standard office chairs:

Adjustable task chairs are recommended for workers who spend a considerable amount of time seated, especially if they work at a computer or other job which does not allow for a lot of movement. The adjustments and features on a task chair are intended to provide support and allow workers to vary their posture throughout the day. These features also make them good chairs to provide to workers who have an injury or who do not fit well into standard chairs.

Standard office chairs will typically lack many of the adjustment features of a task chair, although they should have the following: an adjustment for seat height, good lumbar support, a waterfall front edge, a five star pedestal, casters and a swivel base. A standard chair is acceptable for office jobs that have a variety of tasks and frequent opportunities to stand and move around. However, care should be taken to ensure that a standard chair fits the worker well and is comfortable.

Minimum features of an adjustable task chair



Improving existing chairs

Purchasing adjustable task chairs can be a considerable capital investment, although one which should result in a good return. During the time it takes to budget for the purchase of new chairs, there are steps that you can take to make the chairs you currently have better fit your employees:

1. Make sure that all employees are trained on proper adjustment of their chairs.
2. Have employees report any chair parts that are malfunctioning, especially if they prevent proper adjustment or easy movement of the chair.
3. Provide lumbar cushions for chairs that do not have adequate lumbar support built into their backrest, or for chairs with seats that are too deep for the employees using them.
4. Remove armrests which prevent employees from pulling close enough to their work, interfere with their movement in some way, or create awkward postures such as hunched shoulders.
5. Pad armrests that are hard or which have square edges.

Benefits of adjustable furniture

In addition to chairs, there are a number of other pieces of furniture and equipment with adjustability built in, including keyboard platforms, monitor arms, and entire work surfaces that raise and lower with a hand crank or motor. Because the furniture will fit a variety of sizes of people, the extra expense is easily justified for workstations that have multiple users, or in areas where turnover rates are high. Adjustable furniture also allows individual workers to vary their posture throughout the day to reduce static loading. Some workstations even have enough adjustability to move from a seated to a standing height position, allowing large changes in posture. Keep in mind that these benefits will not come from the furniture alone; you must train employees on how to make the adjustments and the importance of movement and proper posture in order for the furniture to be effective.

Office design

The design or layout of the office and its furnishings and equipment should also be analyzed to determine if they present risk factors that may contribute to WMSD's. For example, when arranging office shelving, place those items used most frequently nearest the work area to reduce the amount of frequent, awkward, overhead reaching. Likewise, consider purchasing equipment that will automate some repetitive office tasks, such as letter folding or date stamping. The cost of automation may be offset by a lower risk of WMSD's. Input from your workers prior to making office changes or equipment purchases will often result in a more efficient work environment while also reducing the employer's risk.

CASE STUDY:

Employee suggestions improve office layout and productivity

Electronic Sales Company has a large customer service department. Frequently, in order to answer a customer's questions about a particular product, the customer service representatives must refer to a variety of large 3-ring binders that each representative maintains in their office. To make finding the correct binder easier they are arranged alphabetically by product type. Recently, several of the representatives have complained of neck and shoulder discomfort. Upon investigation, the customer service manager found that the discomfort seemed to be most severe when the representatives had to retrieve binders that were a long reach from their workstation. He conducted interviews with each of the representatives to solicit their ideas on improving the layout of their office, with the goal of reducing long, overhead reaches. Several suggestions were received and implemented. They included: developing a computerized database of the most frequently accessed information as an alternative to the binders, moving the remaining binders as close as possible and positioning them at desk height, and limiting the size of the binders used to two inches capacity. A follow-up symptoms survey after three months showed a significantly lowered incidence of discomfort as well as severity of discomfort. Because the information was easier to retrieve, response time to customers also was improved.

Office floor plans

The layout of furniture in the office can be just as important as the type of furniture. Consider the following when redesigning an office:

Space allocation

When you add a standard computer with a keyboard, mouse and a monitor to a cubicle and account for room in front of it for an operator to sit, it takes up an additional 12 square feet of floor space. However, most offices are still the same size they were before the introduction of the desktop computer, and some companies have even begun reducing office size to save on facilities costs. This often leads to overcrowding, poor layout, awkward postures, and inefficiencies. Allocating additional space to employees with computers provides more room for an ergonomic set up. Also, allocate additional square footage as necessary for the following:

- Printers and other large pieces of equipment
- Telephones
- Storage such as bookcases and file cabinets
- Space to work with documents, especially large binders, folders or technical drawings
- Adequate room for visitors
- Sufficient space for changes in posture, stretching
- An unobstructed path at least 28" wide for safe exit in case of emergency

(For ADA [Americans with Disabilities Act] purposes, a width of 36" is required for wheelchair users, according to 28-CFR-Part 36)

Work flow

The layout of furniture and the organization of an individual workstation can make a big difference in the way work gets done; poor layout can be a barrier to physical movement and communication, while a well-planned layout can enhance teamwork and efficiency.

Keep the following in mind when designing workstations:

- Right-handed workers usually find it easier to move between the computer and desk work if the writing surface is to the right of the computer, while left-handed workers are the opposite.
- Right-handed people may need to answer the phone with their left hand if they need to take notes with their right, while left-handers are the opposite; locate phone lines accordingly.
- Phone lines, power cords and computer cables should be long enough to allow some flexibility in the placement of equipment.
- Smaller cubicles and offices will require more in the way of organization aids such as file holders, shelves, telephone stands, etc., to maximize use of space.

The following apply to the design of the floor plan as a whole:

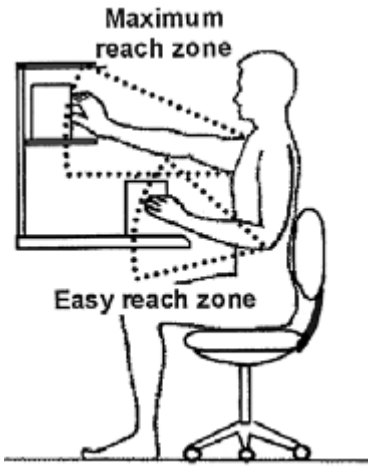
- Place co-workers who interact frequently close together; pass-throughs and half-height cubicle panels will aid communication.
- Provide a central location for common use items such as printers and copiers and make sure they are accessible by a main aisle; avoid locating equipment that can only be accessed by walking into or through someone's office, as this can be distracting.

Your employees will want to have some control over the way in which their work areas are arranged, and will probably be able to make many of the necessary changes themselves. You can help them to make good decisions by providing them with the "Organizing Your Work Area" handout from the *Ergonomics Tips for Employees* section.

Ergonomics Tip

Organizing your work area

The way you organize your work affects your body's position and the amount of reaching that you have to do. Long reaches to pick up heavy objects or items that you use frequently can contribute to discomfort and injury. This is because reaching puts your body in an awkward position and stretches your muscles beyond their normal limits, making them vulnerable to pulls and strains.



An important concept to think about is how far you can reach without straining your body (***reach zones***). You can determine your ***easy reach zone*** by moving just your hands and forearms with your elbows at your sides and your shoulders relaxed. For most people, this is an area about 16" to 18" in front of their body. The other zone you need to consider is your ***maximum reach zone***, which is how far you can reach just by moving your arm at the shoulder, without leaning forward. For most people this is an area about 26" to 34" in front of their body.

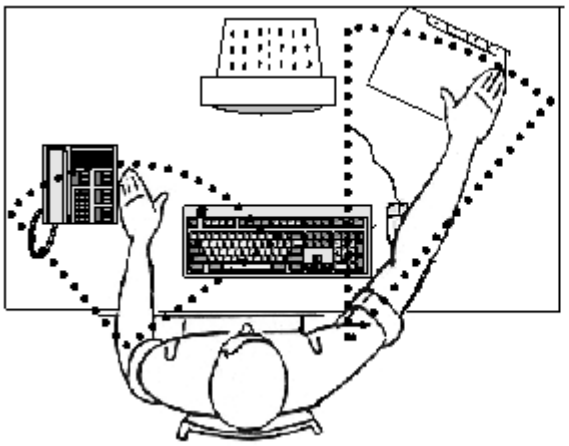
Keep these items in your easy reach zone:

- Frequently used items
- Items that require finger dexterity to use (keyboard, mouse, telephone)
- Items that require hand force to use (stapler, 3-hole punch, staple remover)
- Heavy objects (large binders, manuals, telephone books)

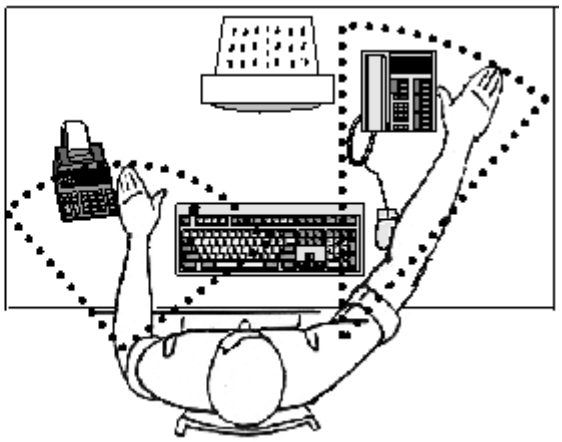
Try to keep items that you use less frequently within your maximum reach zone.
Stand up to reach items that are above your shoulder height or beyond your maximum reach zone.

Customizing your work area

Depending on what your job requires, you might have a different layout than your co-workers. For example, a receptionist might need to have the telephone within easy reach, while an accountant might need to have the calculator closer than the telephone.



Receptionist's Work Area



Accountant's Work Area

You are the best judge of how to arrange your work area, since you know what you use the most often. If you take the time to bring everything into its appropriate reach zone, you'll not only be more comfortable as you work, but also more efficient.

Lifting, carrying and storage

While frequent, heavy lifting isn't typically a requirement of most office jobs, some lifting is inevitable no matter where you work. The way that materials are stored and moved around the office can create risk factors for injury. It can be as simple as an employee picking up a box of copy paper, or as complex as all the tasks a mail room employee must perform to deliver the mail, including lifting, carrying, pushing, pulling and sorting.

Common WMSD's from lifting and carrying include injuries to the low back, upper back and shoulders. Injuries also can occur to the abdomen, hips, knees and ankles. Unlike computer-related injuries, which are a recent and rapidly growing phenomenon, injuries from lifting and carrying have always been a part of office work. For this reason, lifting injuries don't always receive the same amount of attention as WMSD's from computer work. However, since these injuries are one-third of all of the injury claims in the office each year, you should include lifting and other materials handling tasks in your worksite analysis. Evaluate lifting and carrying tasks by analyzing the tasks themselves, looking at the location where items are stored and where they are used, and observing your employees' work practices when they lift.

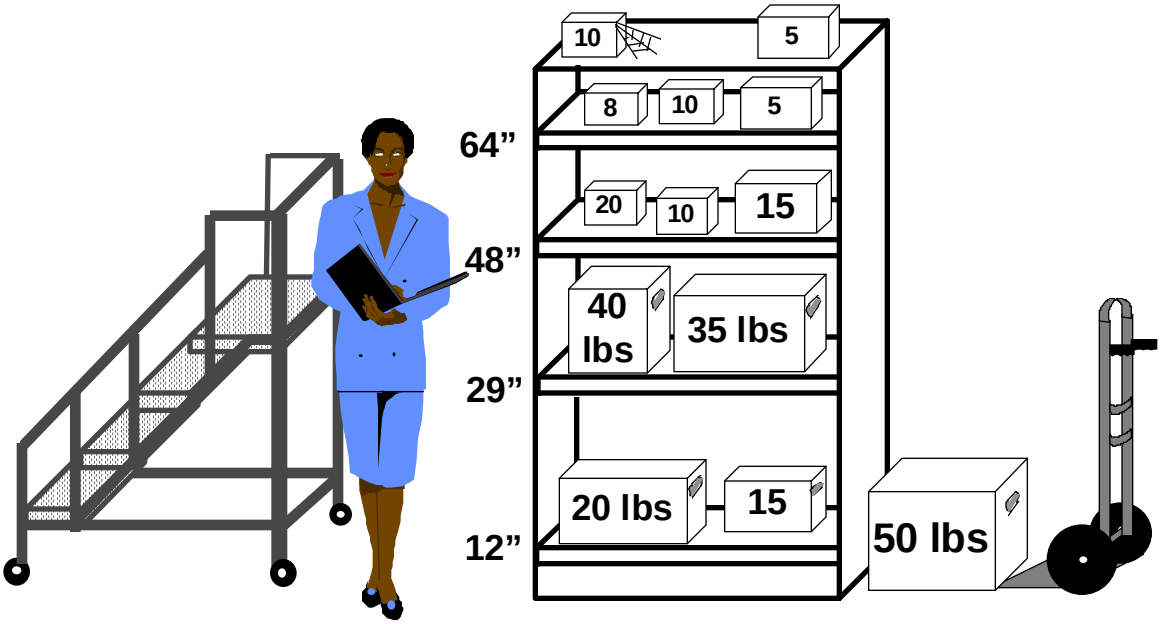
Typical weights of items in the office:

Computer manuals, set	**6½ lbs.**
2" 3-ring binder, full	**4 lbs.**
File folder, overstuffed	**4 lbs.**
Copy paper, single ream	**5½ lbs.**
Copy paper, whole box	**42 lbs.**
Computer monitor, 15"	**41 lbs.**
Laser printer	**55 lbs.**
Laptop computer, in case	**15½ lbs.**
Side chair	**28½ lbs.**
Recycling barrel, ½ full	**37 lbs.**

Proper storage and movement of supplies

In areas where lifting tasks are infrequent, it may not be practical for you to try to observe all of the possible lifting tasks during your analysis. An alternative method is to look at the area where items are stored, find out how, where, and how often they will be used, and what means are available to transport the items (e.g. wheeled carts vs. carrying by hand). Use the following guidelines during your analysis:

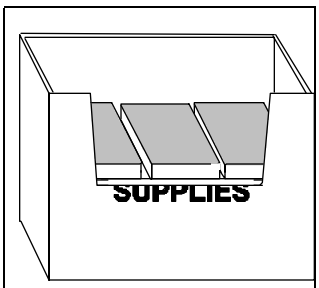
- Store heavy and frequently used items just below waist height (~29"). A cart with a platform at this height will allow items to be slid over and transported, rather than lifted and carried.
- Store lighter, but still frequently used items, between shoulder and knee height, and lightweight and rarely used items above shoulder height. Avoid storing items overhead. If you must store at this height, use a stable step stool or platform ladder instead of reaching.
- The heaviest items are more easily handled if they are stored on the floor and moved with a hand truck or lifted with the assistance of a co-worker.
- Avoid storing items behind other items, so that they do not have to be lifted up and over each other.
- Avoid making shelves too deep. Around 20" is a good depth unless larger objects are stored.
- Place labels on items listing their weight.
- Whenever possible, break down heavier loads into smaller parts before lifting, carrying or storing them. Have an open worksurface available to place boxes on when breaking them down.
- To reduce carrying, store items close to where they will be used.
- Keep aisleways clear and wide enough for any mechanical lifting aids or platform ladders in use.



Boxes and containers

The design of boxes and storage containers can make a difference in how they are lifted and moved. Purchase or modify boxes so that they:

- are small in order to keep their weight down when fully loaded, and to allow employees to lift them close to their bodies.
- have handles that allow employees to grip them with their whole hand rather than their fingertips.
- have cut-outs in the sides so that contents can be accessed without having to reach up and over the side.



Cut-out in box for easier access

Working with files:

- Place frequently used files in middle drawers.
- Avoid overloading upper drawers to prevent tipping.
- Keep frequently used files in file stands or portable filing carts for easier access.
- Break large files down into smaller ones to make them easier to handle.
- Keep file drawers loosely filled, so that files will be easier to remove and replace.

For more help with analyzing and improving tasks which involve lifting and carrying, use the Analysis and Implementation Guide in Appendix A.

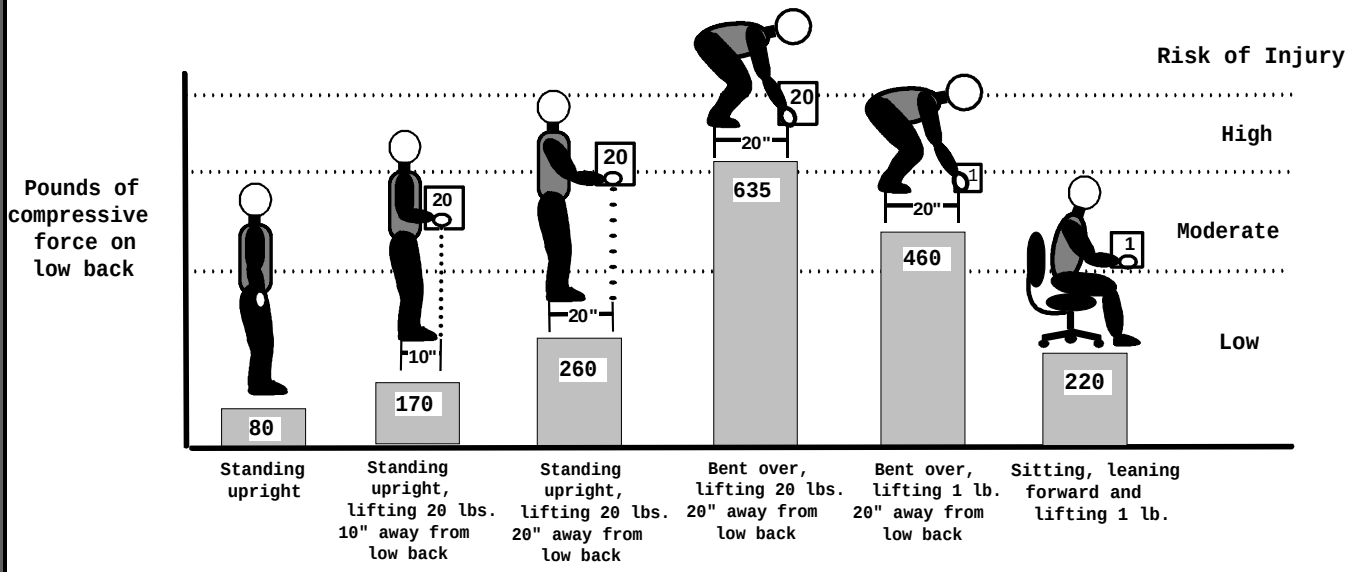
Safe lifting training

If you notice that employees tend to use poor posture when lifting, you will need to address this with training. See *Ergonomics Tips for Employees* for a one-page handout you can copy.

Ergonomics Tip

Your lifting posture affects your risk of injury

The weight of the objects you lift is an important factor in determining your risk of injury, and you will want to be especially careful when lifting heavy items such as storage boxes full of files and cases of copy paper. However, weight is not the only thing that determines your risk of injury. The figure below shows the effect that posture can have when combined with lifting different size loads:



Force estimates based on the Michigan 2-D Static Strength Model

Remember the following when lifting:

1. **Keep the load close:** Holding a 20 pound object with your hands 20 inches from the body creates more compressive force on your low back than holding it 10 inches away. This is because the muscles in your back have to work harder to counterbalance the weight when it is further from the body. **As the compressive force on your low back increases, so does the risk of muscle strains, ligament sprains and damage to disks in the spine.**

2. **Avoid lifting from the floor:** Lifting from the floor can greatly increase your risk of injury for two reasons. Firstly, it is difficult to bring objects close to your body when picking them up from the floor, especially large objects where your knees can get in the way. Secondly, your low back must now support the weight of your upper body as you lean forward, in addition to supporting the weight of the item you are lifting. Lifting the same 20 pounds from the floor more than doubles the amount of force on your low back when compared with lifting it from waist height. Even a one pound object lifted from the floor increases your risk of injury if you use a bent over posture.

3. **Plan ahead:** Decide how you will lift, carry, and place the item before you pick it up. Test the weight of the load by moving or tipping it before you pick it up. Figure out if you can break the load down by placing the contents of a large container into a number of smaller ones before moving them.

4. **Get help when you need it:** Don't try to lift heavy or awkward loads on your own. Even though the muscles in your upper body may be strong enough to handle the load, the muscles, ligaments and disks in your low back may not be because of the additional forces they have to withstand. Get help from a co-worker, and whenever possible, use a cart, hand truck or other mechanical device to move the load for you.

Preventing visual discomfort

About half of all computer users experience symptoms of visual discomfort such as dry, tired eyes or difficulty focusing. In fact, visual discomfort, or eye strain, is much more common than WMSD's. Research to date has not found any permanent effects on vision from computer use. However, eye strain can result in reduced performance and increased errors, and workers will often adopt awkward postures in an attempt to avoid glare or other causes of visual discomfort.

CASE STUDY:

The effects of glare

It is April and Kathy, the office manager for Swayword Enterprises, a P.R. firm of sixty employees, has noticed a greater number of staff coming to her with headaches, fatigue and sore necks. Curious, she notices that most of the people who have these symptoms are from the same general location in the building.

When she goes to the location it becomes clearer to her why she is seeing people from this area. She is at the south side of the building and there are many windows, but no drapes or blinds. All of the people who have cubicles against the windows, as well as many others who are at some distance from them, have considerable glare on their screens from the sun shining into the room. In all, twenty people are affected. Kathy notices that many of the affected employees have their computer monitor screens either facing the windows or with a window directly behind the screen, and both of these situations seem to be causing considerable problems with glare. In talking with these employees, she finds that they too have some discomfort. Also, they relate that the glare slows them down, because they have gotten into the habit of printing out their work to check for errors, since they find it easier to proofread from hard copy than from their computer displays.

She visits other floors on the south side of the building, and finds that the businesses there have installed blinds on their windows and their employees either have moved their monitors so that the screens are perpendicular to the windows, or have installed glare screens when this was not possible. Kathy decides to discuss this with the affected employees in her own company to see if it would be possible for them to reposition their own monitors to help reduce glare. In addition, she decides to contact the president of Swayword and gain her support to install either blinds or mylar film to cover the windows and reduce overall glare.

As a result of her analysis, she was able to provide the company president with the following information:

- One third of Swayword employees were affected
- Absenteeism due to headaches and eyestrain was costly to this one area
- The glare could be resulting in errors and affecting productivity.

The president gives Kathy the go ahead to make the changes she requested. At the same time, she contacts the building owners, and finds that window coverings were part of her lease agreement, and all she has to do is request them. Installation of blinds and a glare reducing film costs the business nothing, while repositioning of workstations involves only a small cost of hiring a facilities contractor to move the cubicles. Following the change, Kathy notices an immediate decline in employee symptoms.

Some of the causes of visual discomfort, such as lighting and glare, are dealt with later in the Environment section. Many of the other causes are subject to individual differences in vision, work habits, job tasks and workstation set-up. One of the simplest strategies that you can use to address problems affecting your employees' vision is to provide them with the information they need to decide what works best for them, and then respond to any remaining concerns they may have. See the two page handout in *Ergonomics Tips for Employees* for more information.

Avoiding eye strain at the computer

If you experience symptoms of visual discomfort, or eye strain, at the computer you are not alone; it's the most common complaint among computer users. The following will help you understand the causes of discomfort and what you can do about it:

Symptoms of eye strain

- dry or itchy eyes
- tired eyes
- sore eyes
- blurred or double vision
- headaches

Lack of blinking

A common complaint among computer users, especially those who wear contacts, are dry or itchy eyes. This is mainly due to the fact that we tend to blink only one-fifth as much when looking at a computer monitor when compared with reading from paper. Combined with the low humidity levels found in many offices, this results in a drying and irritation of the eyes. If you experience dry eyes, try lowering your monitor so that you are looking slightly down (see the **Monitor height** section below) in order to promote blinking. Make sure that exhaust fans from equipment and from the building's ventilation system aren't blowing directly on you. If dryness and irritation persist, see your eye care specialist.

Close work

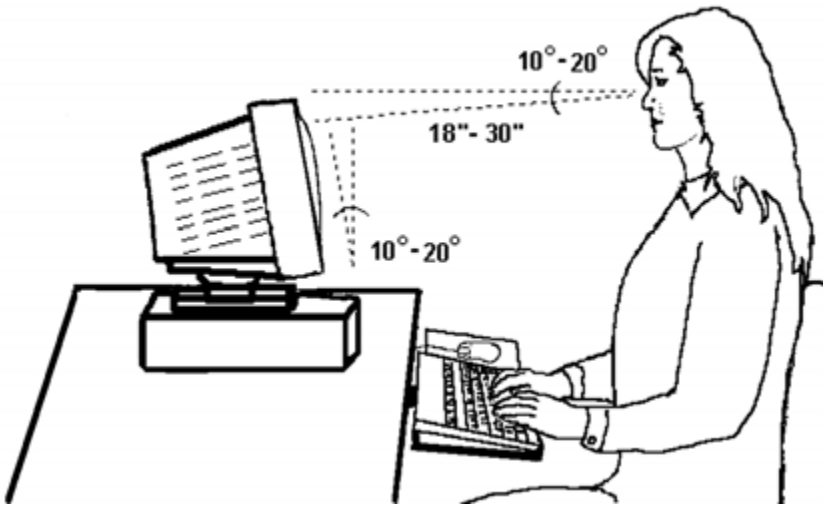
Your eyes are adapted for distance vision; they are most relaxed when you are "staring off into space". However, most of the work that you do in the office, whether it's reading from papers or the computer monitor, is done relatively close to your eyes, and this can cause eye strain. This is because small muscles within your eyes have to work to turn your eyes inward and change the shape of the lenses to focus for near vision. When these muscles fatigue you can experience symptoms of tired, sore eyes the same way that your back muscles will feel tired and sore if you sit for too long in the same position.

Visual angle

When you look down, your eyes have a natural tendency to turn inwards and focus for near vision, since objects that are lower in your field of vision tend to be closer to you. The opposite is true of looking straight ahead or upwards - your eyes tend to turn outwards and focus at a distance, and you will have to work harder to focus on close objects with your head in this position. This is why, when reading from a book or a newspaper, we tend to hold it below eye level. If you read from a monitor or document that is located at eye level or higher, it can contribute to eye strain.

Monitor location

While having your monitor too close or too high can increase your chances of having eye strain, having it too low or too far away can result in awkward postures as you lean forward to view it.



Proper monitor height and distance to prevent eye strain.

ace the monitor at least 18" from your eyes, but close enough so that you can easily read the text without squinting or leaning forward. Adjust the height of the monitor so that the top of the screen is about 10 to 20 degrees below your horizontal line of sight, and tilt it up about 10 to 20 degrees so that the screen remains perpendicular to your gaze. If you wear bifocals, trifocals or progressive lenses you may have to locate the monitor even lower to keep your head level.

Monitor height

If you have normal vision, or wear a single lens prescription, set the height of your monitor so that the top of the screen is just below eye level, and then tilt the screen up slightly towards you. This will allow you to work with your head level, but with a downward visual angle. If you wear bifocals, trifocals or progressive lenses, locate your monitor so that you can view it with your head level when reading through the lenses that give you the best focus at that distance.

Monitor distance

The viewing distance at which our eyes relax varies from person to person, and so there is no one correct distance. For most people, a distance somewhere between 18" and 30" is comfortable. If you're sitting closer than 18", you may not have the proper vision correction that you need (see the **Corrective Lenses** section below). In general, the further away you can place the monitor the better; you may even be able to place it beyond the 30" distance as long as you can comfortably read the text without leaning forward.

Large monitors

If you work with a monitor which is 17" or larger, you may need to have it a few inches farther away from you than you would a smaller monitor. This is because the size of the screen would otherwise require you to tilt your head either too far up or down in order to view the very top and bottom of the display. To avoid awkward postures such as these, increase the size of the text or image you work with in order to take full advantage of the larger screen, and move the monitor as far back as you safely can.

Document location

If your source documents are at different distances from you eyes compared to your monitor, then you will have to be continually refocusing your eyes as you look from one to another. Like your monitor, place your documents just below eye level and angle them up slightly towards you. Ideally, they should be the same distance from your eyes as the monitor so that you don't have to refocus; if the text on the document is small, you will need to bring it closer. You may also have one eye that is dominant over the other. Try placing documents on either side of the monitor until you find a location that is comfortable for you.

Corrective lenses

If you still have problems with eye strain after trying the fixes described above, you may be one of the many people who require vision correction such as eyeglasses or contacts for close work. Even if you already wear corrective lenses, the prescription may not be appropriate for computer work, especially if it is outdated. In addition, if you wear bifocal or trifocal lenses, you may experience neck discomfort if you tilt your head up or down in an awkward posture when viewing the monitor or documents. This can happen if the reading lens isn't in a good location for the type of work you do. If this is the case, raise or lower your monitor until you can work with your head in a level position.

If any of the above are true, you should visit your eye care specialist to see about a new prescription. Once you have your workstation set up properly and your monitor located according to the directions above, you should write down the distance to the monitor and any other reading that you do, as well as a general description of your daily tasks, and bring this information with you when you see your eye care specialist.

Environmental analysis

The environment surrounding an employee's workstation can be just as important as the workstation itself in determining their comfort and performance. The ideal office environment is well lit, without being overly bright or harsh, has a comfortable temperature and humidity level, is quiet enough to allow concentration, and is not overcrowded or hectic.

Below are some general guidelines to consider when analyzing the environment in your office. For more assistance in developing solutions, refer to the Analysis and Implementation Guide.

Lighting

Office lighting can have a considerable effect on both comfort and performance. Harsh, excessively bright fluorescent lighting can cause eye strain, especially when it creates glare on computer monitors. Too little lighting can also result in eye strain when working with paper documents, as well as a "gloomy" atmosphere in which to work.

Windows can cause lighting and glare problems as well, although most employees prefer to have natural light and a view, given the choice. Direct sunlight can create light levels many times brighter than what is needed for office work, however.

Benefits of improved lighting

- Reduced glare
- Increased productivity
- Improved work quality
- Energy savings

Appropriate light levels

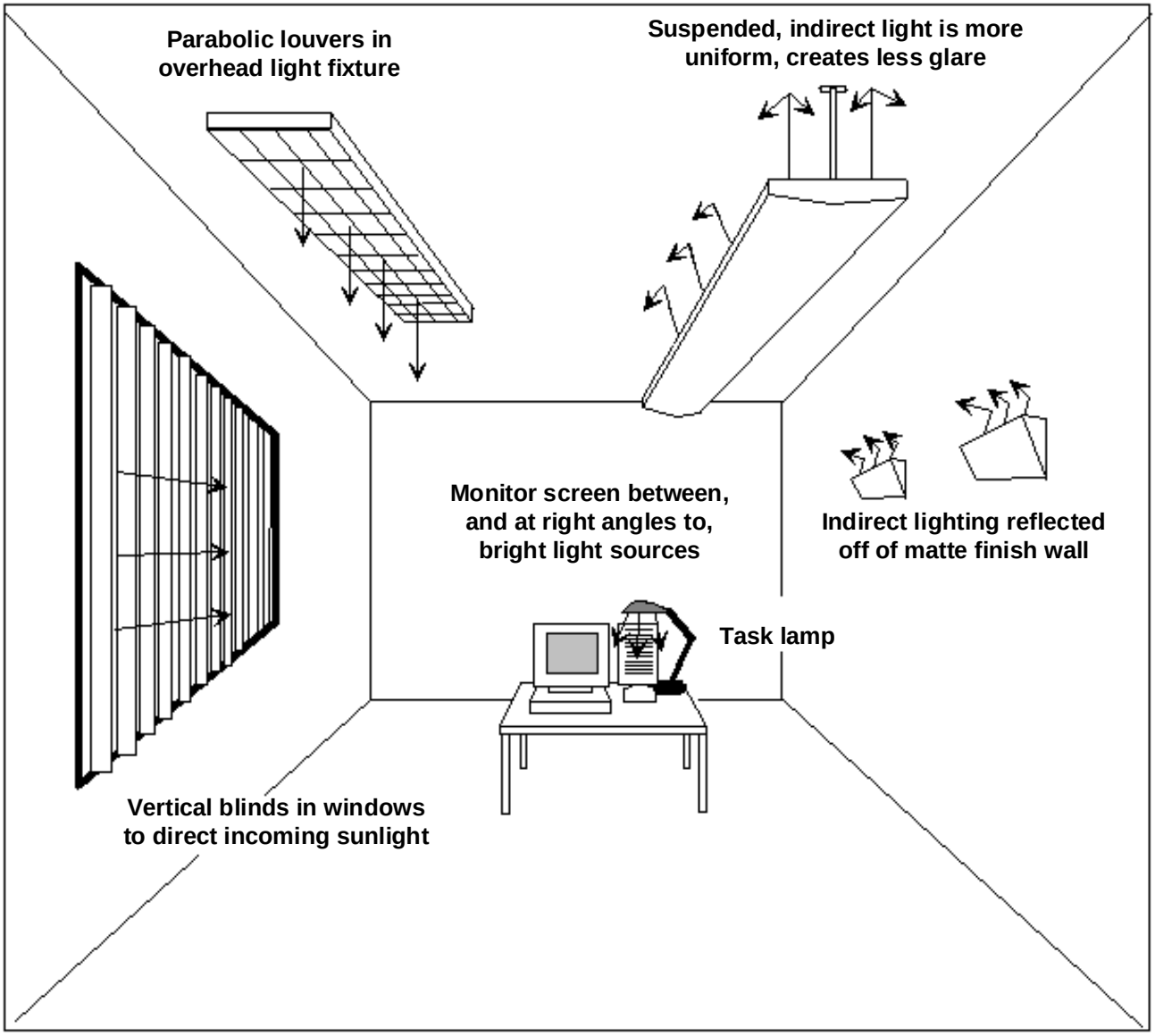
Light levels for computer use should be lower than those for reading from paper documents. The difference is due to the fact that computer monitors give off their own light, while paper depends on reflected light to be legible. In order to prevent eye strain at the computer, it is important that the surrounding, or ambient, light levels are similar to the amount of light emitted by the monitor screen. A window or other bright light source in the field of vision behind or to the side of the monitor can be just as annoying as glare reflecting off of the monitor itself.

Testing light levels

While you could measure light levels in your office using a photographer's light meter, a simpler method is to survey employees in the area as to whether the lighting is too bright, too dim, or just right. A quick test to see if overhead lights are too bright is to shade your eyes by placing your hand above them, as if searching for something at a distance. If you can feel your eyes relax, then the lighting is too bright or too harsh.

Optimizing light levels

There are considerable differences in individual preferences for light levels. These differences can make consensus difficult when trying to set a single light level. Lighting to a uniformly low level and then providing task lighting to employees who need more light can help to resolve this issue.



Preventing glare

Light can shine directly into the eyes, such as sunlight through a window, or be reflected off surfaces such as the monitor screen or the desk top. The glare that direct or reflected light causes can result in eye strain and poor performance. Our eyes are especially sensitive to glare from light sources in our peripheral vision. For this reason, it is important to evaluate all light sources from the worker's perspective. Glare is best prevented at the source, and so many of the steps which reduce light levels will also help to reduce glare. For information on reducing glare on the monitor screen itself, see the Environment section of the Analysis and Implementation Guide.

Lighting common use areas

The need to control the amount of available light is not limited to an individual workstation. Common use areas, such as copy rooms and areas where there are file cabinets, may require more available light. In general, any time when someone has to read small print, visually inspect something, or search for something, higher light levels are appropriate.

Temperature and humidity

As with lighting, the temperature and humidity levels in the office affect not only comfort, but also productivity. Most office work is done while seated, and the low level of physical activity means that employees will typically prefer a slightly higher temperature than if they were active. However, offices can get too warm when the number of people and amount of heat producing equipment overwhelms the ventilation system. Problems can also be caused by installing cubicle or hard-wall offices where they cut off the normal flow of air through the building. Uncomfortably high temperatures can cause fatigue, which can then lead to awkward postures such as slouching or slumping in the chair.

Problems with low temperatures are typically localized, such as when an individual employee's office has been placed directly under a cooling vent. The cool air blowing directly down can cause cold feet and hands, as well as increased muscle tension and increased risk for tendinitis.

Humidity levels are also important to comfort and health. Too low a level of humidity results in dry skin, especially when handling paper, and can increase the amount of force used as sensation through the fingertips is reduced. Too much humidity can lead to a "stuffy" feeling and can make the temperature seem higher than it actually is. It can also have an effect on actual or perceived indoor air quality.

Noise

Noise in the office almost never reaches a level where it is harmful to our hearing, but it can be a distraction that is detrimental to performance and productivity. Studies have shown that noise is most disruptive when workers are performing tasks that are mentally demanding, require attention to detail, or rely on spoken communication. Conversation can be especially distracting, since it is harder to filter out than random noise.

While you can have a consultant come in to take measurements with a sound level meter, a simpler method is to use your own judgment regarding noise levels. Also, ask employees if they have any concerns about noise, or if it interferes with communication or creates a distraction.

There are a few simple steps that you can take when a noise problem arises:

- Reduce or eliminate noise at the source whenever possible.
- Maintain equipment to prevent noisy malfunctions.
- Isolate or enclose equipment that generates noise even when it's in good repair.
- Have conference rooms available for meetings and conversations.

Organizational analysis

Introduction

Organizational analysis includes both business-wide and department-wide issues that are beyond the control of a single employee. The analysis looks at job design factors such as scheduling, overtime, shift work, rotation, staffing levels, incentive work, machine-paced jobs, and break schedules.

Job design

How your employees' jobs are designed can influence the risk factors associated with work-related musculo-skeletal disorders (WMSD's). Good job design is especially important in reducing duration of exposure to risk factors and reducing the overall repetitiveness of a job.

When analyzing how your business's or department's work is performed, you should look at any factors that influence how frequently your employees are performing repetitive tasks and for what duration. Machine-paced jobs or incentive work both have the potential for increasing repetitions and the risk of WMSD's. If the work pace is out of the control of your employees, pauses to rest over-stressed muscle groups may not be possible. While the pace of incentive work is under your employees' control, their desire for financial gain may cause them to work through pain, to skip breaks, and to work faster, all of which create more repetitions. This may result in a greater number of WMSD's and/or more serious WMSD's.

Job design factors associated with an increase in WMSD symptoms:

- Overtime
- Incentive pay
- Lack of control over work pace
- Deadlines
- Electronic monitoring
- Close supervision
- Conflicting responsibilities
- Boring, mundane work
- No authority to make decisions
- Social isolation
- Lack of support from supervisor

While it seems obvious that factors such as overtime and deadlines can result in an increase in WMSD's through a longer duration of exposure to risk factors or a tendency to work through breaks, it is less obvious why factors such as social isolation and a lack of participation in decision making are associated with higher injury incidence. These job and organizational design factors, sometimes referred to as ***psychosocial factors***, may increase risk for injury by increasing stress levels. High workplace stress can cause physiological changes to body systems that lead to musculoskeletal changes such as increased muscle tension. A relaxed working atmosphere, on the other hand, may increase productivity and reduce the risk of WMSD's.

The body's response to stress:

- Increased muscle tension
- Increased blood pressure
- Increased heart rate
- Eye strain due to changes in vision
- Reduced resistance to illness

Improving the design of office jobs

Employee participation, which has been mentioned repeatedly in this booklet, is especially important when it comes to job design. Allowing employees to provide input into the structure and content of their own jobs is one of your best opportunities to have a positive effect on injury prevention and productivity, without the capital expense of buying new furniture or equipment. Your employees may have a number of ideas on ways that they can share tasks, rotate between jobs, increase variety and improve efficiency.

Job rotation

Periodic (every 2 hrs.) job rotation to tasks with lower repetition, or to tasks where different muscle groups are used, may not only provide your employees with variety and increased job satisfaction but also may decrease their risk of WMSD's. For example, rotating someone from a data entry task, which involves repetitive keyboard use, to an information retrieval task, which allows more time for thinking and interacting with co-workers, gives them a chance to recover from repetitive finger movements. Avoid rotating employees from a task which seems different on the surface, but which actually contains similar motions. For example, you wouldn't want to rotate an employee from typing at a keyboard to sorting, folding, and mailing letters, as each task involves repetitive finger movements. A well designed rotation scheme can be especially helpful in reducing the risk of injury when your employees are working overtime at repetitive tasks.

CASE STUDY:

Job redesign reduces repetitiveness while improving productivity

The claims processing manager at Ideal Insurance, a small locally owned company, was concerned about all the turnover that her department was experiencing. There were five employees in this department and each one had an assigned task. One answered the phone and coded the incoming claims; another called claimants with questions; another keyed in information; another reviewed and handled problems; and another authorized checks and filed the paperwork.

When the manager discussed the problem of turnover with the employees, she received some valuable feedback. She learned that three of the employees felt bored with their jobs and resented having to wait until others completed their steps before they could do their work. Often, since the processors had to complete a claim within a week of receiving it, they had to really rush on certain days to complete the work. The employee who keyed information all day had sore hands and wrists, and the employee who had previously worked in that position had quit with similar symptoms. In addition, the employee who had to call claimants was always stressed because often she heard all the complaints about the company.

So, together the manager and the employees agreed to reorganize the jobs. Over a three month period, they cross-trained each other so that each of them could complete all five steps for their claimants. There were two tasks that they shared: answering the phone and reviewing each others claims for accuracy before authorizing a check. One employee had to take a typing course since she did not have adequate keying skills to handle the job. All the employees were provided with a one hour course based on a video on office ergonomics so that they could learn health and comfort strategies. The claims manager worked closely with the group to make sure they learned the necessary skills.

Even though the first six months were a challenge, all of the employees were much happier with their jobs. When the manager met with them to evaluate the progress of the change, they reported that they felt less stressed because they could work at their own pace and did not have to wait for others to complete their task; and they enjoyed being able to talk on the phone, even though it meant dealing with difficult customers at times.

After a year, all the employees were still there and, very importantly for the company, the five employees were now processing 40% more claims and had reduced the claims processing time from a week to three days. The employees were really taking pride in being able to take care of "their clients." The manager and the claims processors received an award at the annual meeting for "most improved" department.

Job enlargement

Job enlargement is similar to job rotation; it is a way for you to add meaningful variety to your employees' jobs, reducing their risk of injury while potentially improving their morale. You can enlarge jobs by giving your employees more control over some of the issues that effect them but are typically handled now by management or their supervisor. Employees gain responsibility and ownership in their jobs while reducing monotony and repetition.

Staffing and scheduling

In some cases adding temporary staff rather than requiring employees to work overtime at a repetitive task may have long-term financial advantages due to reduced injury costs. Likewise, if you adjust your scheduling to spread out highly repetitive tasks over a longer time, rather than letting a job wait until it requires lengthy repetitive work, you may lessen the risk of WMSD's.

Rest breaks

Breaks at mid-morning, lunch and mid-afternoon have long been a part of work schedules and are an important part of allowing employees time to recover from the demands, both mental and physical, of their jobs. You should encourage your employees to take these breaks away from their computers and use the opportunity to walk around and give their hands and eyes a rest.

Recovery pauses

Recent studies have shown that shorter (one to three minutes), more frequent (every 30-60 minutes) breaks, when given in addition to the usual breaks, may help to reduce discomfort while improving productivity. These short breaks, called micro-breaks or recovery pauses, work best if taken before discomfort and fatigue set in. Recovery times will be faster and employees will be less tired at the end of the day. It is important that you merely recommend more frequent breaks to your employees rather than trying to enforce a set schedule, however. Experience has shown that employees will rush to get work done before a scheduled break, and this actually increases their level of stress. Instead, it is best to design these breaks so that they occur naturally in the job, educate your employees on the importance of recovery time and then allow them the latitude to take breaks as they see fit.

Stretch and exercise breaks

Computer work, and seated work in general, can cause a number of problems because of the lack of whole body movement combined with awkward postures and repetitive motions of the joints in the upper body. Blood flow to the extremities is reduced, while muscles become either stretched out and weakened or shortened and tight. Stretch and exercise programs can be useful in increasing movement and circulation while addressing muscle imbalances that can occur, but it is important that they be well designed.

Problems that have been found with some exercise programs include: exercises that involve the same motions as computer work, and therefore add to the repetitive strain; exercises that could aggravate a pre-existing injury; exercises that are unsafe, such as seated exercises that could cause the chair to tip over; and exercises that place employees in embarrassing positions or are not practical while professionally dressed. There are a number of commercially available stretch and exercise programs designed for office workers; evaluate each one carefully before deciding if any are appropriate for your employees.

Also, it is best to allow your employees to decide if they want to participate in an exercise program or not, especially if they have pre-existing injuries which are best managed through exercises prescribed by a health care professional. Finally, keep in mind that an exercise program alone won't alleviate all of the problems that hours of awkward postures and repetition can cause; it should be just one component of your overall program.

Training and education

The need for training

Experience has shown that buying new furniture alone does not reduce discomfort or risk of injury. Very often, employees will not adjust new furniture properly, partly because they have not been taught proper posture, and partly because they may not know how the adjustment mechanisms operate. They may not even know that their furniture is adjustable, and they'll leave it in the same position in which it was given to them. Employees may also feel that good posture, rest breaks, and good work habits are not that important, so they need to be educated on the possible consequences of not changing their workstations or their work methods.

Reducing your work load

By training employees and supervisors to handle most ergonomics issues, you will reduce the amount of time that you will have to spend doing analysis and coming up with solutions. The goal of a good training program is to help employees take responsibility for their own well-being, and to give them the necessary tools to address concerns on their own, as well as an understanding of what to do if they have a problem that they can't solve alone.

Encouraging employee involvement

Your employees will be much more receptive to changes in the workplace if they have been involved in the planning process, and training provides a good opportunity to ask for their input. If you keep training classes interactive, you may find that you have as much to learn from your employees as they do from you.

Creating a supportive environment

In addition to giving information to employees, training is also an excellent opportunity to open up lines of communication and to let employees know that you are concerned about their well being. Encouraging employees to come forward with their problems, and to report symptoms of injury early on, can help to create a supportive environment for change. Supervisors and managers should receive training similar to employees, so that they can help maintain this support for the ergonomics process.

Who to train	What to train them on	When to train
• **Management**	• Benefits of ergonomics • Program elements	• Beginning of program • Periodic progress reports
• **Supervisors** • **Safety Committee Members** • **Ergonomics Coordinators**	• Workstation evaluation • Basic problem solving • Handling reports of discomfort or injury • Purchasing requirements	• Beginning of program • Periodic refresher and advanced courses
• **Office Employees**	• Types of WMSD's and their symptoms • Importance of early reporting • Risk factors for WMSD's • Workstation adjustment • Proper posture, work habits and exercises	• Beginning of program • New employee orientation • Periodic refresher course
• **Purchasing** • **Facilities**	• Ergonomic design features of office furniture • Proper workstation set-up	• Beginning of program • When changing furniture or facilities
• **Medical Providers**	• Job tasks and physical demands • Available light duty work	• Beginning of program

Training techniques & tips

Keep presentations simple and to the point

Make sure that the training is directed towards the audience to which you are presenting. Management and employees will need different information; employees typically will be interested in how ergonomics applies to their particular job, while management is usually concerned with the program as a whole. Ergonomics coordinators and safety committee members will need more in-depth knowledge about ergonomics, while employees may only be interested in practical information on solving problems on their own.

Encourage class participation

Employee participation is one of the most important elements of an ergonomics program, and this should be reflected in the training class as well. Participation helps employees to take an active role in their own learning, and this makes it more likely that they will pay attention, learn something that they find personally useful, and then actually put into place what they have learned when they return to their jobs.

Give opportunities for problem solving

Ergonomics is more like on-the-job training than classroom training. It is something that you will want employees to use while working, so they will need some hands-on practice during training. It helps to take pictures or videos of workers within your own company, and to have the class find risk factors and suggest solutions. You can also take the class out to a workstation and have them analyze it and the employee.

Get the class to focus on implementing what they have learned

Before the class leaves, have them fill out an action plan detailing what changes they will make to their own workstations or work habits when they return. This will help them to focus on transferring what they have learned to their work environment, and it will also give you something that you can use to do a follow-up evaluation of the training. Encourage employees to team up and evaluate each other's workstations; often it helps to have an outside observer evaluate posture.

Evaluating training

Training can be expensive, both in the time it takes to develop a good program, and the time that employees spend away from work while learning. However, it can also be a very cost effective addition to work place changes that help prevent injury. Therefore, it's important that the value of training be demonstrated through evaluation. Evaluation will also give you information that you can use to improve your training methods or course content.

Since training is such an important part of an ergonomics program, you will want to do more than just pass out rating sheets for the evaluation. The true test of training is whether employees use what they learn on the job, so you should follow-up a few weeks after training by observing employees while they work and seeing what changes they've made to their workstations and work habits.

CASE STUDY:

Training is an important part of a well-balanced program

Desktop Publishing, Inc. had been in business for a few years when one of their employees filed a claim for carpal tunnel syndrome in both wrists, for which she was going to need surgery. This came as a surprise to her co-workers and supervisor, since she hadn't complained of any discomfort prior to filing the claim. Management decided to be proactive, and sent out a discomfort survey to the other employees. They got another surprise when they found that over half of their employees were experiencing frequent symptoms of discomfort, and a few of them rated their discomfort at fairly high levels. Some employees said that they regularly went to a chiropractor or massage therapist for treatment when the discomfort got bad enough, but that they assumed that their soreness was "just part of the job".

At first, the management couldn't understand why their employees had been having these problems. When they had first set up the business they had bought adjustable chairs, keyboard trays with wrist rests, and document holders. They had even had the lighting in their office building redone to prevent glare. An initial worksite analysis revealed that many of the employees with the worst symptoms had never adjusted their chairs or keyboard trays to fit them, did not take breaks, and did not understand how any of this could be related to their discomfort.

The decision was made to provide training to all of the employees, and this included showing a video on WMSD symptoms and risk factors, hands-on demonstrations by facilities personnel on the adjustment of chairs and keyboard trays, and a two-way discussion of work schedules and rest breaks. The employees gave the training high ratings on a survey at the end of the class, but more importantly, a follow-up worksite analysis showed that just about all of them had made the proper adjustments to their furniture and were now taking regular breaks. In addition, a symptoms survey given out two months after training showed that the employees who had previously reported the most symptoms had now reduced their discomfort levels considerably. Currently, the company's policy is to have the training as part of new employee orientation and to have periodic refresher training with all of their employees.

Evaluation

Purpose of evaluation

Ergonomics shouldn't be approached as just a program; it is an on-going process, and as such it needs to be monitored and occasionally corrected. Making a formal evaluation plan part of your ergonomics process will help you to find hidden problems, and it will also help demonstrate the effectiveness of ergonomics in reducing injury claims and costs.

Evaluation during phased-in implementation

As you begin to make major changes to the workplace, you should evaluate each one before continuing to the next. The most important part of evaluating at this stage is to get feedback from employees. Do they like the changes? Are any new problems being caused by the new procedures or equipment? Do they need more training? The information that you gather by evaluating during implementation can help you to correct problems quickly and to prevent future problems before a lot of time and effort are expended.

Evaluation following implementation

Once all phases of your ergonomics program are in place, you will want to do a more formal evaluation. During the evaluation, you can use the same checklists, discomfort surveys and employee interview techniques that you used during the analysis. This will allow you to do a direct before-and-after comparison so that you'll know your ergonomics program has really made a difference.

You should also plan to do periodic follow-up evaluations to ensure that the program continues to be effective. Some companies experience a recurrence of WMSD's once the novelty of the ergonomics program has worn off and employees and supervisors return to "business as usual." Periodic evaluations help to keep the focus on ergonomics as a process and ensure that the initial efforts are maintained.

You will also need to do further ergonomic analysis when planning changes to equipment, the office environment, or personnel. Making the ergonomics process part of your change management process can help to prevent injuries that might occur due to new risk factors that are introduced into the work environment.

Dealing with difficult problems

Occasionally you will come across an ergonomics issue that does not seem to be covered by the examples in this publication or by the Analysis and Implementation Guide, and that cannot be solved with the same methods that were successful with the majority of issues you've faced. Some problems do not have readily obvious causes and solutions, even to experienced ergonomists, and these often require an almost trial and error approach. If you've done a thorough worksite analysis, you can at least make an educated guess and narrow your focus to a few potential causes and solutions. The important thing is not to give up on the process because it does not work the first time. Returning employees to work and keeping them productive should be your priority.

Persistence and creativity are our best allies in resolving difficult issues. However, problems may arise that are outside your abilities; in these cases, consult with an experienced professional ergonomist.

Emerging technology in the office

Computer technology is developing rapidly, and you can expect to see many changes in the way in which we interact with computers in the next few years. Often, it is necessary to wait a few years for the technology to reach a level where it fulfills its promise of making our lives easier and also becomes affordable to small businesses. One example of technology that is now at this level is the use of page scanners and optical character recognition (OCR) to convert typewritten papers to electronic documents. Improvements in scanner resolutions and OCR software have now made this process very accurate and much more efficient than retyping the pages by hand. The following are descriptions of other emerging technologies that have the potential of becoming usable and affordable in the next five to ten years:

Alternative forms of input

Keyboards, mice, trackballs and other commonly available input devices all require repetitive motions of the hands and fingers and, regardless of how "ergonomic" their design is, are therefore a potential source of WMSD's. One alternative form of input that requires almost no hand motion is the use of speech recognition, where the user simply dictates directly to the computer. At the time that this is being written, the technology is not quite ready for general use, since it has many drawbacks, including: the amount of training time required, the fact that it is typically slower than touch typing, concerns about strain on the vocal cords, and the increase in office noise levels that would occur if everyone talked to their computer. However, for specific functions, such as filling out forms with a limited number of options, legal and medical dictation, or for use by workers who have limited use of their hands, it has been somewhat successful. Simpler programs are available which replace the mouse functions with voice commands, and these have fewer drawbacks. In addition to voice input, work is currently being done on technology that would allow your computer to recognize hand gestures, facial expressions, or even track eye movements. These alternatives are currently being used for special application or as assistive technology for the disabled, but they could also be used individually or in combination to allow us to interact more naturally with our computers.

Display technology

Computer monitors have been getting larger, and while this allows for larger font sizes and graphics to be displayed, it also requires more desktop space. This makes it difficult to place the monitors directly in front of the users and at the correct visual distance; often this results in awkward postures and eye strain. New forms of display technology have resulted in flat panel displays, which have the potential to overcome these drawbacks. Currently, models are available which offer a 21" display that is only 3" thick, with resolution comparable to an SVGA monitor, and which claim to be viewable from a very wide angle. While still out of reach of most small businesses, prices should come down and performance improve as more manufacturers develop these products.

Software packages and data exchange

Many applications these days are designed to work with other applications and allow information exchange. For example, data can be brought directly from a database into a spreadsheet program, and vice versa, without the need to re-enter the numbers. Software has the potential to greatly reduce repetition if well designed.

Networking and the Internet

As computer processing power becomes less expensive, it will become easier for small businesses to run their computers through a common server, allowing employees to share data with each other or download information from the Internet. A lot of redundant data entry can be eliminated in this way; in addition, networks open up another line of communication that can help reduce the negative effects of social isolation.

Technical information

Worksite issues

If you have the resources to take the following measurements they can be useful in ensuring that your workplace meets commonly accepted guidelines:

Lighting Levels[1]

Computer use only	300-500 lux (28-50 foot-candles)
Computers and paper documents	500-750 lux (with supplemental task lighting)
Paper only (including document storage areas)	750-1,000 lux (100 foot-candles)

Temperature[2]

Summer months	73-79 ^{o}
Winter months	68-75°

Humidity Levels[2] 30-60% relative humidity

Noise Levels[3]

Open office plan (e.g. - cubicles)	35-40 dBA average, 60 dBA maximum
Private offices	30-35 dBA average, 55 dBA maximum

Storage[4]

Shelf depth	20" (can be deeper to safely hold larger items)
Shelf height for heaviest items	29" measured from floor
Lowest shelf for frequently used items	22" measured from floor
Highest shelf for frequently used items	48" measured from floor
Height for labels which must be read	22-52" measured from floor

Workstation Layout[4]

Forward reach for frequent work	not more than 16" measured from edge of worksurface
Forward reach for occasional work	not more than 24" measured from edge of worksurface
Overhead reach to access storage (occasional)	not more than 48" high measured from floor and not more than 12" forward measured from edge of worksurface

[1] The Illuminating Engineering Society of North America (IESNA)
[2] The American Society of Heating, Refrigerating, and Air-conditioning Engineers (ASHRAE)
[3] The Canadian Standards Association (CSA)
[4] Based on measurements of height and reach capabilities (anthropometry) of adult workers

Computer issues

Many companies have their information or computer services people involved in their office ergonomics programs, since they are typically the ones responsible for initial computer set up and are also the first ones to become aware of problems related to computer use. In addition to the general information regarding computer and workstation set up contained in this booklet, they may also want to use this checklist containing more technical information:

Monitor display

Does the display driver installed offer the best resolution with the type of monitor (e.g. VGA, SVGA) used?

Has the refresh rate been optimized using the graphics driver software settings?

(Refresh rate should at a minimum be 60 Hz and is best at 75 Hz.)

Are the brightness and contrast set to avoid screen flicker?

Are color combinations used in displays chosen to maximize contrast and prevent eye strain?

(Black text or graphics on a white background provides the best contrast. Avoid using reds whenever possible, especially on the same screen with blues. Dark green on a white background and light green on a black background are also acceptable combinations.)

Software

Have the appropriate drivers been installed for the pointing devices used?

(Many of the newer pointing devices come with software which allows custom programming of one or more buttons to allow a single click to substitute for double-click or click-and-drag operations, thereby reducing repetitive finger movements.)

Have fully functioning on-line help utilities been installed with all of the programs?

Are end users fully trained on the most efficient way to use the software?

Is it possible to create macros for commonly used functions in order to replace repetitive keystrokes?

Could custom software be created to allow data exchange between existing applications that would eliminate redundant data entry?

Network/Intranet

Are computers interconnected to allow file sharing to eliminate the need to retype existing documents?

Can the intranet be used as a way of keeping employees aware of ergonomics issues, allowing communication of ideas and tips for reducing repetitive work, and passing on useful macros (e.g. - bulletin board, ergonomics "tip of the day", etc.)?

New technology

Can scanning and optical character recognition (OCR) be used to replace data entry from hard copy?

Could voice recognition be used for navigation between and within programs to reduce the use of pointing devices, or as a means of input to reduce keyboard use?

For more discussion of issues related to new technology, see the section entitled "Emerging Technology in the Office."

Appendix A: Analysis and implementation guide

The following guide is included to help you perform a worksite analysis and provide you with some recommended solutions. The Worksite Analysis Form can be used to organize your findings from the analysis; a completed form is included as an example.

The guide is organized in the form of a checklist, with a "No" response indicating a possible problem. A brief explanation of the associated risk factors and the physical discomfort that could result are provided for each question.

Also provided is a list of possible solutions for each problem; these are listed in order from the simplest and least costly to the more complex and expensive to implement. When selecting the appropriate solution, you should consider not only the cost, but also the potential benefit of each option. Depending on the situation, a less expensive solution may not be as effective in preventing injury or may only provide a temporary fix that will need to be corrected again later. However, in some cases an inexpensive solution can be just as effective, and can also free up resources for other needs.

Do not feel limited to the solutions listed in this guide. You may have situations unique to your business which are not covered here, or you may be able to improve upon the recommendations given. Often, discussing the options with affected employees, your safety committee or your ergonomics team can help you brainstorm solutions to more complex problems that are not covered here.

OFFICE ERGONOMICS: WORKSITE ANALYSIS FORM

Date: _____ Employee name: _____ Number of years at this job: _____

Analyzed by: _____ Job Title: _____ Previous experience in similar job: _____

Task Analysis:

Work schedule: Break schedule: Breaks taken away from the office? **Y** **N**

How many hours per day - at the computer?: _____ hrs.

reading?: _____ hrs.

on the telephone?: _____ hrs.

spent seated?: _____ hrs.

spent standing?: _____ hrs.

Any previous or current injury?: **Y** **N**

Part(s) of body:

Any previous or current discomfort?: **Y** **N**

Part(s) of body:

Other significant tasks:

Which tasks in particular are associated with discomfort?:

Workstation Analysis:

Possible Problems	Recommended Solutions	Priority*	Person Responsible	Date for Completion

***Prioritization:**

Give higher priority to finding solutions for risk factors which:

- affect parts of the body where an injury has occurred
- are associated with physical discomfort
- are present in tasks which are performed for longer periods of time
- have simple, easily implemented solutions

OFFICE ERGONOMICS: WORKSITE ANALYSIS FORM

Environmental Analysis:

Possible Problems	Recommended Solutions	Priority	Person Responsible	Date for Completion

Organizational Analysis:

Possible Problems	Recommended Solutions	Priority	Person Responsible	Date for Completion

Notes:

OFFICE ERGONOMICS: WORKSITE ANALYSIS FORM (EXAMPLE)

Date: 8/30/97 Employee name: Carrie Defore Number of years at this job: 6

Analyzed by: C.P. Job Title: Accountant Previous experience in similar job: 3½

Task Analysis:

Work schedule: M-F, 8-5, some overtime Break schedule: 10, noon, 3 Breaks taken away from the office? (Y) N

How many hours per day - at the computer?: 6 hrs.
reading?: ½ hrs.
on the telephone?: ½ hrs.
spent seated?: 8 hrs.
spent standing?: 0 hrs.

Any previous or current injury?: Y (N)
Part(s) of body:
Any previous or current discomfort?: (Y) N
Part(s) of body: Neck and shoulder

Other significant tasks: 10 key, 1 hr. Which tasks in particular are associated with discomfort?: Keyboard use

Workstation Analysis:

Possible Problems	Recommended Solutions	Priority	Person Responsible	Date for Completion
Keyboard too high	Lower work surface	High	Erick, facilities	9/10/97
Copy laid flat on desk	Purchase copy holder	High	Sarah, purchasing	9/10/97

Prioritization:
Give higher priority to finding solutions for risk factors which:

- affect parts of the body where an injury has occurred
- are associated with physical discomfort
- are present in tasks which are performed for longer periods of time
- have simple, easily implemented solutions

Analysis and Implementation Guide

Workstation Analysis

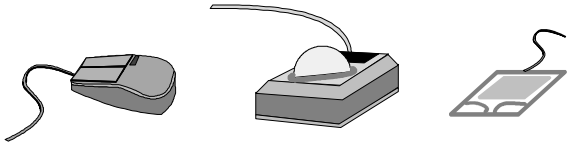
Keyboard

Questions	Possible Problems	Potential Discomfort	Recommended Solutions
Is the keyboard located so that the wrists are in a neutral posture (not bent up, down or to the side) while typing? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Awkward Postures** Typing with bent wrists increases chance of tendinitis of the hand and wrist, as well as carpal tunnel syndrome.	Forearm and elbow Wrist and hand Numbness, tingling and burning sensations in the fingers	• Adjust seat height so that elbows are at the same height as the keyboard. • Raise or lower adjustable worksurfaces in systems furniture so that they are just below seated elbow height. • Place keyboard and mouse on articulating keyboard tray and adjust tray height and tilt until wrists are working in neutral posture.
Is the keyboard at a height which places the forearms approximately parallel with the floor? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Static Loading** Lifting forearms up elevates hands and reduces circulation. Bending elbows too much places stress on tendons in the joint. **Risk Factor: Awkward Postures** Dropping forearms down to reach keyboard results in bent wrists.	Forearm and elbow Wrist and hand Numbness, tingling and burning sensations in the fingers	• Adjust seat height so that elbows are at the same height as the keyboard. • Raise or lower adjustable worksurfaces in systems furniture so that they are just below seated elbow height. • Place keyboard and mouse on articulating keyboard tray and adjust tray height and tilt until wrists are working in neutral posture.

Keyboard

Questions	Possible Problems	Potential Discomfort	Recommended Solutions
Are the wrists supported by a wrist rest during pauses in typing? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Static Loading** Continuously supporting the weight of the forearms fatigues the muscles of the upper arms. **Risk Factor: Awkward Postures** Forearms tend to drop when fatigued, resulting in bent wrists.	Shoulder and upper arm Wrist and hand Numbness, tingling and burning sensations in the fingers	• Use a wrist rest for support during pauses in typing. • Use armrests on the chair for forearm support during pauses in typing.
Is the wrist rest padded and covered with a soft, non-irritating fabric? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Contact Stress** Hard wrist rests or sharp edges on keyboard trays place pressure directly on the carpal tunnel. Fabrics with rough material build up heat under the palms and restrict movement across the keyboard.	Wrist and hand Numbness, tingling and burning sensations in the fingers	• Replace hard wrist rests or wrist rests with worn fabric with new, padded wrist rests. • Pad sharp edges on keyboard trays with foam (e.g. - pipe insulation) as long as thickness does not affect wrist posture.
Are the upper arms and elbows close to the sides of the body when the hands are on the keyboard? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Static Loading** Lifting elbows up and to the sides or out in front of the body makes the muscles in the upper arms, shoulders and neck work harder.	Neck and shoulder	• Remove any obstacles (desk drawers, boxes, waste baskets) that prevent sitting close to keyboard. • Avoid using chair armrests that are farther apart than shoulder width. • Lower keyboard worksurface to seated elbow level.
Are the shoulders relaxed when the hands are on the keyboard? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Awkward Postures** Hunching shoulders creates tension in the muscles along the sides of the neck.	Neck and shoulder	• Lower or remove armrests that are too high and don't allow the arms to hang down naturally. • Raise chair and provide footrest if feet are not fully supported by the floor. • Lower keyboard worksurface to seated elbow level.

Input Devices (Mouse/Trackball/Touch Pad)



Questions	Possible Problems	Potential Discomfort	Recommended Solutions
Is the input device (mouse / trackball / touch pad) directly to the side of the keyboard? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Awkward Postures** Long reaches to frequently used input devices can cause fatigue in the muscles of the shoulder and neck.	Neck and shoulder Elbow and forearm Hand and wrist Numbness, tingling and burning sensations in the fingers	• Use keyboard shortcuts to reduce the number of reaches to other input devices. • Use input device with the other hand (e.g. - switch to left-handed use if right-handed). • Clear off desk space or relocate computer to provide room for the input device. • Use a keyboard tray that is wide enough to accommodate the input device, or attach adapter to current keyboard tray. • Use a voice navigation program with voice commands in place of input device use.
Is the input device located at the same height as or slightly higher than the keyboard? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Static Loading** Elevating the hand when reaching up to input devices on a high worksurface reduces circulation and places additional stress on the joints of the arm and hand. **Risk Factor: Awkward Postures** Reaching down to use input devices results in a bent wrist.	Neck and shoulder Elbow and forearm Hand and wrist Numbness, tingling and burning sensations in the fingers	If you need to raise the input device: • Place input device on top of book or stack of papers. • Use a platform that places the input device over the keyboard 10-key. If you need to lower the input device: • Use a keyboard tray that is wide enough to accommodate the input device, or attach adapter to current keyboard tray. • Use a platform that places the input device over the keyboard 10-key.

Input Devices (Mouse/Trackball/Touch Pad)

Questions	Possible Problems	Potential Discomfort	Recommended Solutions
Does the mouse/trackball move freely and is it well-maintained? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Repetition** Poorly maintained input devices can cause tracking and input errors which must then be corrected, resulting in unnecessary repetition.	Shoulder Elbow and forearm Hand and wrist Numbness, tingling and burning sensations in the fingers	• Remove and clean mouse ball or trackball. • Check cables to make sure they are fully plugged in.
Is software related to the input device installed, and is the user trained in customizing the software to their own needs? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Repetition** Lack of training and appropriate software can lead to input errors and unnecessary repetition.	Shoulder Elbow and forearm Hand and wrist Numbness, tingling and burning sensations in the fingers	• Install software and customize cursor velocity, acceleration and size. • Assign click and drag or double click functions on programmable input devices.
Is a loose grip used on the mouse or other input device? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Force** Gripping the mouse tightly strains the tendons in the hand and wrist.	Elbow and forearm Hand and wrist Numbness, tingling and burning sensations in the fingers	• Let go of the mouse when not actively using it. • Switch to using keyboard shortcuts instead of pull-down or pop-up menus. • Use a mouse or other input device which is designed to better fit the hand.

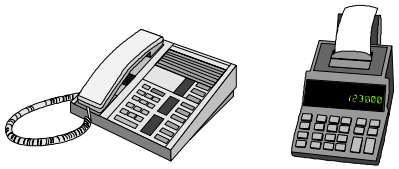
Questions	Possible Problems	Potential Discomfort	Recommended Solutions
Can the monitor screen be viewed without tilting the head up at all or more than slightly down? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Awkward Postures** Looking up at the monitor fatigues the relatively weak neck muscles that lift the head, while looking too far down fatigues the muscles which support the weight of the head against gravity.	Back of neck	If you need to raise the monitor: • Place it on top of the CPU. • Place it on top of reams of paper. • Use a monitor stand or arm. If you need to lower the monitor: • Remove tilt/swivel stand and tilt with a book under the front edge. • Lower monitor work surface. • Cut into work surface and lower portion for monitor.
Can the monitor be viewed by looking straight ahead? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Awkward Postures** Twisting the head while looking at your monitor loads the neck muscles unevenly.	Back and side(s) of neck	• If the monitor is viewed the most, center it directly in front of the QWERTY portion of the keyboard. • If documents are viewed more often, place the monitor just to the side and angled in.
Is the monitor close enough to read from comfortably? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Awkward Postures** Sitting too far from the monitor can result in leaning forward to read small text	Back of neck Lower and upper back	• Sit close enough to monitor to read without leaning forward. • Use a larger font size for text and zoom in on graphics. • Have annual vision exams and make sure any prescription lenses are suited to computer work.

Monitor

Questions	Possible Problems	Potential Discomfort	Recommended Solutions
Is the monitor at least 18" away from the eyes? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Awkward Postures** Sitting further back from the monitor in order to get a comfortable viewing distance can result in reaching forward to use the keyboard.	Shoulder and upper arm	• Move monitor further away on desk surface. • Use a keyboard tray to move the keyboard further back. • Install a corner unit with more room for the monitor.
Does the monitor display: • have good contrast, with crisp, clear text? • have a high enough brightness level? • have bright backgrounds that are free from flicker? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Awkward Postures** such as leaning forward to read blurry text.	Headaches Eye strain Neck and upper back Low back	• Adjust brightness and contrast controls to improve image and reduce flicker. • Display black characters on a white background for improved contrast. • Have a PC technician optimize resolution and refresh rate on the graphics card. • Repair or replace older monitors.

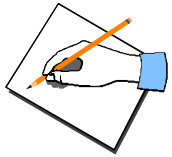
NOTE: If you have problems with glare on the monitor, see the Environment section of the Troubleshooting Guide.

Other Office Equipment



Questions	Possible Problems	Potential Discomfort	Recommended Solutions
Can the telephone be used without having to hold the handset between the ear and shoulder? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Awkward Postures** Tilting the head to one side and hunching one shoulder can strain the muscles in the neck and upper shoulders on that side, while over-stretching the muscles on the other side.	Neck and upper shoulders	• Use a speakerphone in private offices. • Use a headset in cubicles or open office areas.
Can 10-key calculators and other devices with keypads be used in a neutral posture? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Awkward Postures** 10-key use can be just as repetitive as keyboard use, yet often devices like this are placed so that they require long reaches to use.	Shoulder Elbow Hand and wrist	• Make room so that keypad devices can be pulled close. • Use a padded wrist rest for use during pauses in keypad entry. • Place devices on pull out "bread boards" to place them at the appropriate height. • Look for ways to consolidate keypad device functions onto the computer, such as using tape calculator software in place of the 10-key calculator.

Paper Documents

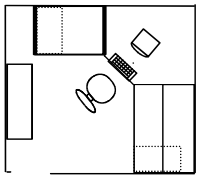


Questions	Possible Problems	Potential Discomfort	Recommended Solutions
Are documents that are referenced while typing at the computer placed on copy holders to the side of or just below the monitor? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Awkward Postures** Documents that are laid flat on the desk surface result in leaning forward and tilting the head downward.	Neck Upper back Low back	• Place documents on copy holders to the side of the monitor and at the same height, or between the monitor and the keyboard. • Make sure copy holders are large enough to handle the size of the documents in use.
Are carbon or carbonless copy forms which must be filled out by hand avoided? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Force** Pressing down to make multiple copies results in relatively high hand forces.	Elbow and forearm Wrist and hand	• Fill out multiple copy forms on the typewriter. • Create electronic forms that can be filled out on the computer and print multiple copies.

Questions	Possible Problems	Potential Discomfort	Recommended Solutions
Does the backrest provide support in the low back? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Awkward Postures** Lack of low back support inhibits normal S-shape of spine while sitting which puts additional stress on the back and can contribute to low back pain.	Back	• Place a rolled up towel or attach a removable back support cushion to existing back support. • Remove or lower arm rests which may prevent sitting back fully due to contact with front of desk or keyboard tray. • Adjust the back rest so the small of the back is in contact with the most outward curved area of the back support. • Replace the seat pan if it's too long and doesn't allow for sitting back fully in chair.
Are feet touching the floor? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Contact Stress** Circulation to the legs and feet is reduced due to contact between the front edge of the chair and the backs of the thighs.	Leg and foot tingling, numbness	• Adjust chair seat height so feet are supported by the floor. • Use a foot rest to support feet.
Is there a comfortable amount of space between the edge of the seat and the back of the knees? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Contact Stress** Circulation to the legs and feet is reduced and pressure is placed on the nerves at the back of the knees and legs.	Leg and foot tingling, numbness	• Adjust the back rest/lumbar support forward to shorten chair seat. • Place a rolled up towel or attach a removable back support cushion to existing back support. • Replace the seat pan if it's too long and doesn't allow for sitting back fully in chair.

Chairs

Questions	Possible Problems	Potential Discomfort	Recommended Solutions
Do armrests support the forearms without resulting in hunched shoulders (armrests too high) or leaning to one side (armrests too low)? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Awkward Postures** Hunching the shoulders can result in muscle tension and fatigue. Leaning to one side results in an uneven posture and muscle imbalance.	Neck and shoulder	If armrests are too low: • Add padding to bring them up to a comfortable level. • Replace with height adjustable armrests. If armrests are too high: • Only use the armrests during short pauses from typing. • Replace with height adjustable armrests.
Are the armrests designed so that they don't bump into worksurfaces or otherwise interfere with movement or sitting close enough to the keyboard? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Awkward Postures** Armrests which limit chair movement must be compensated for by an increase in leaning, twisting and reaching.	Neck and shoulder Upper and lower back	• Remove armrests that interfere with good work postures. • Lower adjustable armrests so that they fit under writing work surfaces. • Replace loop arms with "T" shaped arms that allow the chair to be pulled closer to keyboard worksurfaces.
Are armrests padded and contoured to avoid hard or square edges? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Contact Stress** Hard armrests can place pressure on the elbows, damaging nerves, blood vessels and tendons close to the skin's surface.	Elbow and forearm Numbness, tingling and burning sensations in the fingers	• Add padding to armrests that are low enough to allow this. • Remove armrests where added padding would cause hunched shoulders. • Replace armrests with padded ones at the appropriate height.



Questions	Possible Problems	Potential Discomfort	Recommended Solutions
Are hands/wrists free from contact with the desktop edge? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Contact Stress** Hard or sharp desk edges can place pressure on the carpal tunnel in the palm and tendons in the wrist.	Wrist Hand Numbness, tingling and burning sensations in the fingers	• Move keyboard/input device to the edge of desktop to avoid resting hands/wrists on edge. • Use a wrist rest for support during pauses in typing. • Pad sharp edges on desktop with foam (e.g. - pipe insulation). • Install keyboard tray with wrist rest for support during pauses in typing.
Are desktop accessories (e.g. - telephone, stapler, manuals) within easy reach and arranged according to frequency of use? ☐ NO ⇨ ☐ YES ⇩	**Risk Factors: Repetition** and **Awkward Postures** Repetitive arm motions increase fatigue and risk of injury especially when combined with extended arm reaches.	Neck Shoulder Elbow	• If right-handed arrange accessories (except telephone) to the right of computer. • Locate telephone on the left in order to answer with the left hand and take notes with the right. Just the opposite if left handed. • Determine which accessories are used most frequently and locate them closest to you.
Is there adequate space for proper placement of monitor, keyboard, and input device? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Awkward Postures** Lack of space results in poor placement of equipment, causing twisting and reaching when using it.	Neck and shoulder Back Elbow Wrist and hand	• Install keyboard tray to allow proper placement of keyboard, monitor, and input device. Place CPU on floor in vertical stand to free up space on desktop. • Install free floating monitor stand to bring monitor off the desktop.

Work Space

Questions	Possible Problems	Potential Discomfort	Recommended Solutions
Is there adequate space for knees and legs underneath work surface? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Contact Stress** Bumping into the underside of the desktop or objects underneath can cause bruising and impact trauma to knees or thighs. **Risk Factor: Static Loading** Lack of space under the desktop does not allow changes in posture.	Knee Leg Foot	• Remove materials underneath desk. • Raise desktop surface if taller individual has problems bumping into desktop edges, or lower chair. • Install keyboard tray to increase distance between monitor and desktop and provide more leg room.
Is the reach to overhead storage spaces minimized? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Awkward Postures** Long reaches to items stored overhead can result in over-stretching of the muscles and increased strain.	Shoulder	• Place frequently used items on the desk surface rather than overhead. • Stand and use both hands to lift items from storage. • Lower adjustable height storage units as far as possible without interfering with monitor placement or other work.

Lifting And Carrying

Questions	Possible Problems	Potential Discomfort	Recommended Solutions
Are frequently lifted items located between knee and shoulder height? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Awkward Postures** Especially bending, stooping, kneeling and reaching.	Low back Upper back and shoulder Knees	• Rearrange shelves to maximize storage at a convenient height. • Provide additional open work surfaces at waist height for temporary storage of items.
Can items be brought close to the body before being lifted? ☐ NO ⇨ ☐ YES ⇩	**Risk Factors: Force** combined with **Awkward Postures** Lifting away from the body increases load on the low back and results in reaching and bending.	Low back Upper back and shoulder Knees	• Slide objects close to you before lifting. • Remove obstacles over which you would have to lift. • Use smaller containers which can be brought closer to your body.
Is lifting from the floor avoided as much as possible? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Awkward Postures** Especially bending, stooping, kneeling and reaching.	Low back Upper back and shoulder Knees	• Store frequently used items on shelves. • Use a hand truck to move objects which are stored at floor level. • Unload containers rather than lifting while full.
Are the weights of loads to be lifted minimized? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Force** The weight of the load directly determines the amount of force required to lift, carry, push and/or pull it.	Low back Upper back and shoulder Knees	• Break down large loads into smaller parts before moving. • Use smaller containers for storage.
Are items stored close to where they will be used to reduce carrying distances? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Sustained Exertions** Carrying loads long distances can result in muscle fatigue and strain.	Low back Upper back and shoulder Forearm and hand Knees	• Create storage space to keep supplies near equipment (e.g. - printer stands with shelves for reams of paper). • Use carts and hand trucks to move supplies when storage cannot be created.

Lifting And Carrying

Questions	Possible Problems	Potential Discomfort	Recommended Solutions
Are mechanical assistance devices (carts, hand trucks) available to help eliminate lifting and carrying by hand? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Force** When assistive devices are not readily available, employees may attempt to lift loads beyond their physical capability.	Low back Upper back and shoulder Knees	• Slide items from shelves to the top of a cart at the same level to avoid lifting. • Have a number of carts available to use in place of carrying by hand. • Use a hand truck to move objects which are stored at floor level. • Use rollers for loading and unloading packages in the mail room.
Are co-workers available to help with heavy, awkward or repetitive lifting tasks? ☐ NO ⇨ ☐ YES ⇩	**Risk Factors: Force** and **Repetition** Loads that could easily be handled by a team of workers may be overwhelming for an employee working alone.	Low back Upper back and shoulder Knees	• Encourage teaming up when lifting large containers that cannot be broken down. • Have several employees lift a few boxes each rather than a single employee lifting repetitively.
Are employees trained in proper lifting procedures? ☐ NO ⇨ ☐ YES ⇩	**Risk Factors: Force** and **Awkward Postures** Untrained workers may adopt poor postures or use more force than is necessary when lifting.	Low back Upper back and shoulder Knees	Train employees to: • Lift with the load close. • Minimize twisting by moving their feet. • Push rather than pull loads. • Use mechanical aids properly. • Ask for help if something is too heavy.
Are jobs designed so that lifting is only one of a variety of tasks? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Repetition** Jobs with lifting as the only task may not allow for enough rest and recovery time, resulting in fatigue and an increased risk of injury.	Low back Upper back and shoulder Knees	• Assign lifting tasks to a number of employees who are physically capable. • Redesign lifting jobs to include less physically demanding tasks (e.g. - some desk work). • Use mechanical assistance to reduce or eliminate lifting.

Environmental Analysis

Questions	Possible Problems	Potential Discomfort	Recommended Solutions
Are computer monitors placed at right angles to bright light sources (windows, wall lamps, etc.)? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Awkward Postures** Reflected images on the screen make focusing on the displayed text difficult, often resulting in twisting and leaning when trying to find a glare-free angle to view from	Eye strain Headaches Neck and back	• Turn monitor at right angle to window or bright light source. • Cover window with vertical blinds or shades. • Use anti-glare screen or monitor hood to reduce reflected images.
Are monitors placed between rows of overhead light fixtures to avoid reflections? ☐ NO ⇨ ☐ YES ⇩	**Risk Factor: Awkward Postures** Reflected overhead lights may cause white spots on screen, often resulting in twisting and leaning when trying to find a glare-free angle to view from	Eye strain Headaches Neck and back	• Turn monitors at right angles to the length of the overhead light fixtures. • Install parabolic louvers (egg crates) in overhead light to direct light. • Use anti-glare screen or monitor hood to reduce reflections.
Is the light level behind and to the sides of the monitor similar to the light level emitted from the screen? ☐ NO ⇨ ☐ YES ⇩	Difficulty in adjusting to the differences in light levels can cause eye strain. The eyes are particularly sensitive to glare in the peripheral vision.	Eye strain Headaches Neck and back	• Turn monitor at right angle to window or bright light source. • Cover window with blinds or shades. • Reduce the amount of overhead lighting and use low wattage task lighting.
Are cubicles located so that they are evenly lit by overhead or wall lights? ☐ NO ⇨ ☐ YES ⇩	Low lighting and shadows may make it difficult to see hard copy. This may also lead to increased errors.	Eye strain Headaches	• Use supplemental task lighting in cubicles. • Reorganize cubicles to provide an even distribution of light. • Group computer users that require similar lighting levels in one area. • Reorient work surfaces in cubicle to provide light on needed surfaces. • Add overhead lights to reduce shadows and/or install diffusers to more evenly distribute light (be aware that either of these can increase glare on monitors, however).
Are filing and copier areas well lit? ☐ NO ⇨ ☐ YES ⇩	Low lighting and shadows may make it difficult to see files, which could lead to misfiling.	Eye strain Headaches	• Provide adequate overhead light in filing and copier areas, which may require more light than computer workstations.

Environmental Analysis

Questions	Possible Problems	Potential Discomfort	Recommended Solutions
Is reflected glare from the environment minimized? ☐ NO ⇨ ☐ YES ⇩	Glare reflecting from work surfaces can also shine into workers' eyes and is more difficult to avoid.	Eye strain Headaches Neck and back	• Avoid placing paper and other white objects where they cause reflections on the monitor screen. • Wear dark clothing to avoid seeing your own reflection. • Install parabolic (egg crate) louvers on overhead lights to direct light downward. • Install filters on overhead lights. • Paint walls and select furniture and equipment with a matte finish to reduce reflections. • Switch to indirect lighting (lights that reflect off of walls and the ceiling) and supplement with task lighting.
Are noise levels low enough that workers can work undisturbed by others conversations or equipment (computers, radios, copiers, etc.)? ☐ NO ⇨ ☐ YES ⇩	Noise levels above 85 dBA may cause hearing damage (noise levels this high are typically only found with computers that are located near industrial machinery). High noise levels may be distracting to employees, increasing errors and decreasing productivity. Continuous noise is a source of stress, which results in an increase in muscle tension.	Hearing damage (highly unlikely in most offices) Stress Increased muscle tension Increased general fatigue	• Provide separate enclosed rooms for meetings, private conversations, or break areas. • Repair and maintain equipment to prevent noisy malfunctions • Move noisy machines (copiers, staplers, fax machines, etc.) to separate rooms or floor to ceiling enclosures. • Discourage radio and telephone conversation levels that can be heard outside of the individual's cubicle. Provide separate offices for people who require privacy or who perform noisy tasks. • Use acoustical ceiling tiles and wall panels, carpet floors, and install noise attenuating cubicle panels. • Use electronic noise masking systems in open areas (note: noise masking systems located directly over occupied spaces may be annoying to nearby employees).

Questions	Possible Problems	Potential Discomfort	Recommended Solutions
Are jobs designed so that repetitive tasks are rotated or shared among employees? ☐ NO ⇨ ☐ YES ⇩	**Risk Factors: Repetition** Increased **duration of exposure** to other risk factors.	Overall	• Rotate employees to tasks that use different muscle groups to allow stressed muscles to rest. • Allow job sharing to provide task variety. • Enlarge jobs to include more responsibility with less repetition.
Is the work week 40 hours or less? ☐ NO ⇨ ☐ YES ⇩	**Risk Factors: Repetition** Increased **duration of exposure** to other risk factors.	Overall	• Add temporary or part-time staff when feasible.
Does task scheduling take into account repetitiveness of tasks? ☐ NO ⇨ ☐ YES ⇩	**Risk Factors: Repetition** Increased **duration of exposure** to other risk factors.	Overall	• Schedule employees to tasks that use different muscle groups. • Spread repetitive tasks out over a longer period.
Do staffing levels take repetitiveness into account? ☐ NO ⇨ ☐ YES ⇩	**Risk Factors: Repetition** Increased **duration of exposure** to other risk factors.	Overall	• Adjust temporary or part-time staff to reduce excessive workloads.
Do employees have control over the pace of the task? ☐ NO ⇨ ☐ YES ⇩	**Risk Factors: Repetition** Increased **duration of exposure** to other risk factors. Use of too much **force** when rushing to meet deadlines under stress. Lack of control leads to job dissatisfaction.	Overall	• Request employee input when setting deadlines, quotas, and customer service expectations (e.g. - number of phone calls answered per hour). • Eliminate electronic monitoring of individual output.

Organizational Analysis

Questions	Possible Problems	Potential Discomfort	Recommended Solutions
When task changes are made, are workers asked for their input? ☐ NO ⇨ ☐ YES ⇩	No sense of ownership; job dissatisfaction; less than ideal job design.	Overall	• Request employee input on decisions that affect their work.
Has incentive work been eliminated? ☐ NO ⇨ ☐ YES ⇩	**Risk Factors: Repetition** Increased **duration of exposure** to other risk factors. Lack of recovery time when working through pain, skipping breaks. Use of too much **force** when rushing to increase production under stress.	Overall	• Eliminate incentive work.
Is automation (e.g. - electric staplers, scanning and optical character recognition, electronic forms, collating copiers) used where feasible? ☐ NO ⇨ ☐ YES ⇩	**Risk Factors: Repetition** **Increased duration of exposure** to other risk factors **Force** and **Contact Stress** during certain tasks such as stapling The human cost in terms of inefficiency and increased injury rate may be higher than the machine cost.	Overall	• Look for low cost/short payback automation possibilities, especially for repetitive tasks.
Are rest breaks away from the computer allowed and encouraged? ☐ NO ⇨ ☐ YES	**Risk Factors: Repetition** **Static Loading** **Increased duration of exposure** to other risk factors.	Overall	• Encourage break activities such as walking or talking with co-workers.

Appendix B: Symptoms survey

Date _____ / _____ /_____

Last Name _____ (optional)

First Name _____ (optional)

Work Location _____

Job _____

Shift _____

Supervisor _____ (optional)

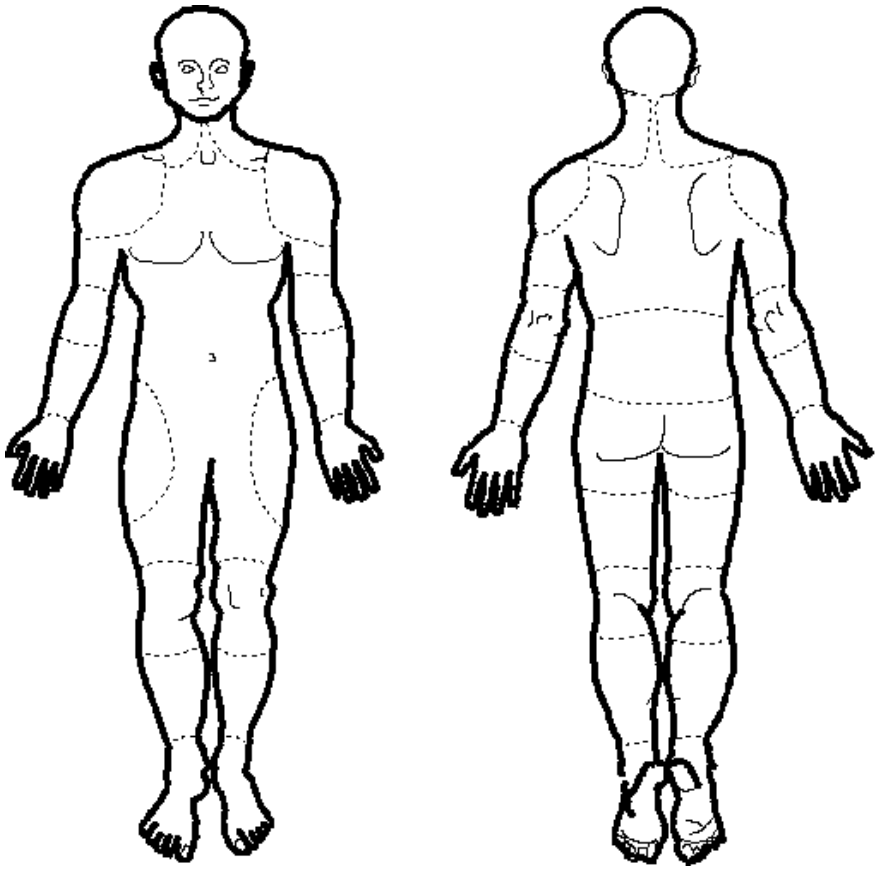
Time on THIS job:

- ❑ 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:



B-2

Symptoms Survey

Name (optional) _____

Please complete a separate page for each area that bothers you.

Check area: ❑ Neck ❑ Shoulder ❑ Elbow/Forearm ❑ Hand/Wrist ❑ Fingers
❑ Upper Back ❑ Low Back ❑ Thigh/Knee ❑ Lower Leg ❑ Ankle/Foot

1. Please put a check by the word(s) that best describe your problem:

_____ 1) Aching/Cramp	_____ 4) Numbness/Tingling	_____ 7) Stiffness
_____ 2) Burning	_____ 5) Pain	_____ 8) Weakness
_____ 3) Loss of Color	_____ 6) Swelling	_____ 9) Other

2. When did you first notice the problem? _____ number of months -or- _____ years ago

3. How long does each episode last? (please check)

_____ 1) Less than 1 hour	_____ 3) 24 hours to 1 week	_____ 5) 1 month to 6 months
_____ 2) 1 hour to 24 hours	_____ 4) 1 week to 1 month	_____ 6) 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: _____

_____

Appendix C: Resources

Department of Labor & Industries

Ergonomics Web Page

Visit L&I's ergonomics page for more information about L&I's educational resources on ergonomics, any regulatory requirements and links to other informative ergonomics sites.
Go to www.LNI.wa.gov/wisha/ergo/.

Consultation Services

While this document is intended to help you develop an ergonomics program on your own, it is possible for situations to arise where you would need more help. If you have technical questions about ergonomics, contact WISHA Services at (360) 902-5450 or by e-mail at **gogr235@lni.wa.gov**.

Workshops

L&I periodically offers a no-fee ergonomics workshop at locations throughout the state. Contact your local L&I office to learn about upcoming sessions or visit the L&I web site at www.LNI.wa.gov/wisha/workshops/wkinfor2.htm

Local L&I offices

Region 1 -	Everett	(425) 290-1300
Region 2 -	Seattle	(206) 281-5400
	Tukwila	(206) 835-1000
Region 3 -	Tacoma	(253) 596-3800
Region 4 -	Tumwater	(360) 902-5799
Region 5 -	Yakima	(509) 454-3700
Region 6 -	Spokane	(509) 324-2600

Video Library

The Department of Labor and Industries operates a video library to help employers and employees learn more about workplace safety and health. The collection includes videos on ergonomics. Setting up an account and borrowing videos is free; the only cost is return shipping by a traceable carrier (e.g., Federal Express, United Parcel Services) or through the U.S. Postal Service's Registered Mail. For more information on setting up an account, call 800-574-9881 or visit www.LNI.wa.gov/wisha/videocat/index.htm.

Publications

The following publications are also available from your local L&I office:

- Fitting the Job to the Worker: An ergonomics program guideline
- Lessons for Lifting and Moving Materials
- Frequently Asked Questions about Portable Total Body Patient/Resident Lifts
- Frequently Asked Questions about Sit-to-Stand Patient/Resident Lifts
- Your Body, Your Job: Preventing Carpal Tunnel Syndrome and Other Upper Extremity Musculoskeletal Disorders
- Work-related Musculoskeletal Disorders of the Neck, Back and Upper Extremity: Washington State Worker's Compensation Claims, 1991-1999
- Back Belt fact sheet
- Quick Tips for Lifting

Private Consultants

If you feel you need additional assistance beyond what was covered in this document and in L&I"s Office Ergonomics workshop, you might consider hiring a private consultant. The Human Factors and Ergonomics Society publishes a directory of consultants in the field; they can be contacted at:

Human Factors and Ergonomics Society
P.O. Box 1369
Santa Monica, CA 90406-1369
TEL: (310) 394-1811
http://hfes.org/

You can also find certified professional ergonomists at the web site for the Board of Certification in Professional Ergonomics (BCPE): http://www.bcpe.org/

Education and Training

In addition to the workshops offered by L&I, a number of consulting companies offer more in-depth training courses in ergonomics. Continuing education courses are also offered by NIOSH Educational Resource Centers; the one in the Northwest is:

Northwest Center for Occupational Health and Safety
Department of Environmental Health
University of Washington
4225 Roosevelt Way NE, Suite 100
Seattle, WA 98105-6099
TEL: (800) 326-7568
http://depts.washington.edu/envhlth/conted/osha/

Additional Reading

For employers:

ANSI/HFS 100-1988: Human Factors Engineering of Visual Display Terminal Workstations
Author: American National Standards Institute/Human Factors Society
Publisher: Human Factors and Ergonomics Society
P.O. Box 1369, Santa Monica, CA 90406-1369
TEL: (310) 394-1811

An Ergonomics Guide to VDT Workstations
Authors: Christin Grant, Ph.D. and Mary Brophy, Ph.D.
Publisher: American Industrial Hygiene Association
2700 Prosperity Ave., Suite 250
Fairfax, VA 22031
TEL: (703) 849-8888

Promoting Health and Productivity in the Computerized Office: Models of Successful Ergonomic Interventions.
Editors: Steven L. Sauter, Marvin J. Dainoff, Michael J. Smith
Publisher: Taylor and Francis, London, 1990
ISBN# 0-85066-756-9

Creating the Ergonomically Sound Workplace
Author: Lee T. Ostrom
Publisher: Jossey-Bass Publishers, 1993
ISBN# 1-55542-621-2

Ergonomics Handbook; Human Factors of Workstations with Visual Displays; Comfort and You; and *The VDT Workstation and Vision*
Author: IBM Corporation
Publisher: IBM Publications
Route 100
Somers, NY 10589

For employees:

Repetitive Strain Injury: A Computer User's Guide
Authors: Dr. Emil Pascarelli and Deborah Quilter
Publisher: John Wiley & Son's, Inc., 1994
ISBN# 0-47159-533-0

The Computer User's Survival Guide: Staying Healthy in a HighTech World
Author: Joan Stigliani
Publisher: O'Reilly & Associates, 1995
ISBN# 1-56592-030-9

Zap! How Your Computer Can Hurt You - And What You Can Do About It
Author: Don Sellers
Publisher: Peachpit Press, Inc., 1994
ISBN# 1-55609-021-0

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Make sure you read this

Ergonomics is a workplace safety and health requirement in Washington State.

Washington State adopted a workplace ergonomics rule (WAC 296-62-051) in May 2000. The rule sets certain requirements that are different than the recommendations in *Office Ergonomics: Practical solutions for a safer workplace.* (The Washington Department of Labor and Industries first published this guidebook in 1997, before any ergonomics requirements were adopted.)

Much of the information in the guidebook remains useful to employers who want to learn about setting up an ergonomics program in the office environment. **However, the guidebook does not tell employers how to comply with Washington State's ergonomics rule.**

Other services and tools from L&I can help employers comply with Washington State's ergonomics rule. **To learn more about the rule and L&I's education and technical assistance services, visit www.LNI.wa.gov/wisha/ergo/ on the web.** If you do not have Internet access, call 1-800-4BE-SAFE (423-7233) to request an ergonomics information packet.

We have clarified information in this guidebook.

This guidebook provides a good introduction to office ergonomics. However, some of the actions suggested in the guidebook are not required by the ergonomics rule or they exceed what is required by the rule. Please note the following:

The guidebook describes risk factors using terms that may be different than the terms used in the rule.

Term in the Guidebook	Term in the Rule
Force	High hand force
Awkward posture	Awkward posture
Repetition	Highly repetitive motion
Mechanical contact stress	Repeated impact
Hand arm vibration	Moderate to high hand arm vibration

Pages 2 & 3. The statistics on these pages are from 1993. More recent statistics show a similar pattern for the types of injuries that occur in the office environment.

Page 12. The flowchart describing a recommended ergonomics process is more encompassing than what Washington State's ergonomics rule requires. Read the rule to determine what steps are required.

Page 26. Visual discomfort is not addressed by Washington State's ergonomics rule.

Page 29. Environmental issues such as lighting, temperature and noise also are not addressed by Washington State's ergonomics rule.

Appendix A. The analysis and implementation guide can be a useful tool for evaluating offices for risk factors. However, its use alone does not necessarily guarantee rule compliance. Refer to the ergonomics rule for applicable analysis criteria.

Thank you for your interest in workplace ergonomics and the safety and health of your employees.