

ErgoSystems Presents:

A Practical Approach to Office Ergonomics

**Southwest Health and Human Services
3001 Maple Road
Slayton, MN 56172**

A Practical Approach to Office Ergonomics

Course developed and presented by:

Mark A. Anderson, MA, PT, CPE

Physical Therapist

Certified Professional Ergonomist

ErgoSystems Consulting Group, Inc.

7421 West Shoreline Drive

Waconia, MN 55387

Voice: 952-401-9296

Mark.Anderson@ergosystemsconsulting.com

www.ergosystemsconsulting.com

The information contained in this training workbook has been developed in good faith and is believed to present good ergonomics principles and practices. ErgoSystems Consulting Group, Inc. and all other participating organizations make no representations or warranties as to the completeness or accuracy of the materials thereof. Persons using this information must make their own determination as to its suitability for their purposes. ErgoSystems Consulting Group, Inc. and all other participating organizations are in no way responsible for damages of any nature resulting from the use of this information.

Table of Contents

Instructor's Bio	2
Mark A. Anderson, MA, PT, CPE	2
A Practical Approach to Office Ergonomics.....	3
Welcome!	3
Workshop Logistics	3
Successful Workspace	3
Comfortable?	4
Workshop Objectives.....	4
Workshop Guidelines	4
Office Ergonomics Workstation Assessment Worksheet	4
Printed Worksheet and PDF Fillable Worksheet.....	4
Office Ergonomics Assessment Quick Reference Guide	5
A Word About Pictures	5
Workshop Case Study	5
Introducing Lisa Wang!.....	6
Office Components	9
User – Single/Multi.....	9
Tasks: Single-task or Multi-task	10
Floor space	11
Chair	11
Worksurface	21
Foot support/clearance	27
Keyboards	28
Keyboard Trays.....	33
Mouse	35
Laptop/Desktop.....	39
Monitors	40
Document holder	46
Telephone.....	47
Office equipment storage	48
File cabinet types.....	49
Illumination	50
Recommended Specifications	51
Assessment Follow-up	52
Course Summary.....	52
Selected References.....	53

INSTRUCTOR'S BIO

Mark A. Anderson, MA, PT, CPE



Mark A. Anderson is the president and founder of ErgoSystems Consulting Group, Inc., a Minneapolis, Minnesota based ergonomics consulting group.

Mark Anderson is certified as a Certified Professional Ergonomist by the Board of Certification in Professional Ergonomics (www.bcpe.org). He has consulted and trained in ergonomics for over 25 years.

His background also included licensure as a physical therapist.

Anderson has developed and implemented ergonomics strategies for a wide range of companies and organizations; including Emerson Process Management, Tescom, Tennant Company, General Electric, Alliant Techsystems, Quaker Oats, Pepsi-Cola, General Mills, Bluestem Brands, Fingerhut, Panama Canal Commission, United States Navy and Marine Corps, United States Customs Service, Social Security Administration, USDA Animal and Plant Health Inspection and state and local governments

With an emphasis on a systems approach to ergonomics, Anderson has worked with architectural and engineering design firms to integrate ergonomics principles into the design process.

Adding the elements of ergonomics (*Work Physiology, Engineering Psychology, Epidemiology, Anthropometry and Occupational Biomechanics*) as part of the design equation enhances the effectiveness of the overall process and final outcome.

Anderson has written a number of publications and spoken nationally and internationally on ergonomics. He has been active in the Upper Midwest Chapter of the Human Factors and Ergonomics Society serving as the secretary and past co-program chair.

A PRACTICAL APPROACH TO OFFICE ERGONOMICS

Welcome!

Welcome to *A Practical Approach to Office Ergonomics!*

Office ergonomics, whether in the office workplace and now even more so in the home office environment, is a critical tool to enhance safety and productivity.

A Practical Approach to Office Ergonomics provides a detailed framework to help interested individuals conduct office ergonomics assessments and generate reasonable and feasible recommendations.

Workshop Logistics

- Manual/Handouts
- Workshop schedule
 - Starting/ending times
 - Breaks
- Rest rooms
- Fire exits
- Telephones
- Messages



Successful Workspace

In your mind, what are the words you use to describe the *successful workspace*? The *successful workspace* should be _____.

List as many as you can think of.



1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

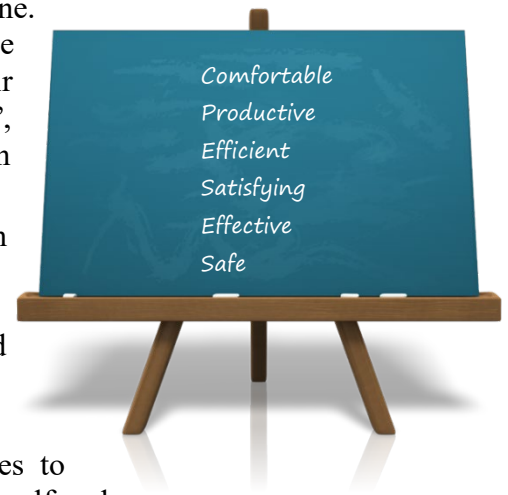
Comfortable?

Was the first word that came to your mind: “*comfortable*”?

If you answered, “comfortable”, you’re not alone. Informal surveys reveal about 9 out of 10 people indicate “comfortable” is what they want in their workplace. Then of course, words like “productive”, “efficient”, “satisfying”, “effective”, “safe” and so on follow along.

We recognize there is a direct relationship between workplace comfort levels and these other descriptors; a workplace that is more comfortable is typically also more productive, functional and safe.

That’s what this training session is all about; how you can use ergonomics principles and techniques to perform office ergonomics assessments to help yourself and your co-workers optimize comfort levels as well as enhance safety, and productivity.



Workshop Objectives

- Discover what Office Ergonomics is all about.
- Learn about the components that make up the successful office and home office workspace.
- Use the ErgoSystems Ergonomics Workstation Assessment Worksheet to analyze and setup the office and home office workplace.
- Acquire confidence in using the assessment system through hands-on practice.

Workshop Guidelines

- Follow along with the demonstrations unless you think they may cause you a problem.
- Do not go against doctor's orders or do anything that you feel you should not.
- If you are uncomfortable sitting during the training, feel free to move about.
- Use your good judgment when trying new techniques or exercises once you complete the training.



Office Ergonomics Workstation Assessment Worksheet

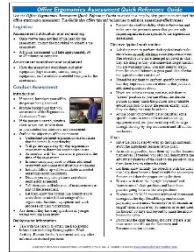
Printed Worksheet and PDF Fillable Worksheet

Let’s introduce the *Office Ergonomics Workstation Assessment Worksheet*. We’ll get into the detail of completing the form a little later.

Two versions are available: one is a printed form completed by filling out the form by hand by checking the pertinent boxes and writing in comments in each section.

The second version has the same information but is a PDF fillable document that contains checkboxes and comment fields for each section. An option to include pictures is also included in this version.

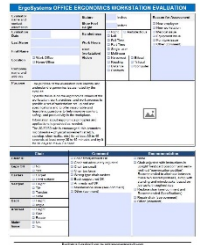
Office Ergonomics Assessment Quick Reference Guide



Refer to the *Office Ergonomics Assessment Quick Reference Guide* to assist you in a step-by-step process to conduct the office ergonomics assessment.

Take the *Guide* with you for the first several assessments you perform to help speed up the process.

The *Guide* also offers tips and techniques to enhance assessment effectiveness.



A Word About Pictures

With some caveats, pertinent pictures of the user in the workstation can be included in the assessment report. The old saying that, “A picture is worth a thousand words!” is an apt expression in this context.

Pictures also become a valuable teaching tool because you can help the individual “see” what the issues are in terms of chair, workstation and equipment set-up.

If you can make changes in the set-up and adjustment of the workspace during the assessment you can show the “before” and “after” pictures with a significant impact on behavior.

ErgoSystems OFFICE ERGONOMICS WORKSTATION ASSESSMENT			
Evaluator name and contact information	Mark Anderson, PT, CPE ErgoSystems 953-451-4268	Station	SD: <input type="checkbox"/> indoor
Evaluation Date	9/25/02	Show Head Height	<input type="checkbox"/> indoor
Last Name	Wang	Handedness	<input type="checkbox"/> Right <input type="checkbox"/> Ambidextrous <input type="checkbox"/> Left
First Name	Lee	Work Hours	<input type="checkbox"/> Full Time <input type="checkbox"/> Part Time
Location	in Work Office <input type="checkbox"/> Home Office	Chair	<input type="checkbox"/> Single-seater <input type="checkbox"/> Multi-seater
Company name and address	KYE Company Street Address City, State Zip Code	Visions	<input type="checkbox"/> No screen <input type="checkbox"/> Without <input type="checkbox"/> Distance <input type="checkbox"/> Computer
Purpose	<p>The purpose of the evaluation is to identify and understand ergonomic issues noted by the evaluator.</p> <p>Specific focus is on the ergonomics aspects of the workstation, with particular emphasis on providing a set of workstation set-up and use recommendations to help improve comfort, safety, and productivity in the workplace.</p> <p>Information about ergonomics principles and applications is provided as needed.</p> <p>The 30/20/10 rule is encouraged: this promotes movement – at least 30 seconds of standing, 20 seconds of short walks, etc. for at least 30 to 45 minutes at least every 90 to 120 minutes and try to do 30 days to make it a habit.</p>		
Chair ID	Swing	Chair	<input type="checkbox"/> Chair not adjustable <input type="checkbox"/> Chair too small <input type="checkbox"/> Chair too large <input type="checkbox"/> Back support not OK <input type="checkbox"/> Wrong type chair centers <input type="checkbox"/> Armrests not OK <input type="checkbox"/> Maintenance issue (see comment) <input type="checkbox"/> Other (comment)
Legs OK	<input type="checkbox"/> No <input type="checkbox"/> Yes	Comment	<input type="checkbox"/> None <input type="checkbox"/> Chair adjusted with instructions in upright “keyboard position” and semi-reclined “communication position”
Casters	<input type="checkbox"/> Casters <input type="checkbox"/> Casters not OK	Recommendations	Recommendations to alter chair settings: these two seated positions, along with standing chair (see comment), based on job tasks throughout day. (Recommended Specifications) <input type="checkbox"/> Repair chair (see comment) <input type="checkbox"/> Other (comment)
Seatpan	<input type="checkbox"/> Height <input type="checkbox"/> Tension <input type="checkbox"/> Roll <input type="checkbox"/> Other	Armrest	We discussed a set-up protocol where you sit at the start of the day, set the chair seatpan height appropriately (feet on the floor with even weight on the hips and legs) based on their shoe heel height. Then you will fine tune the workstation height for both seated and standing.
Back	<input type="checkbox"/> Height <input type="checkbox"/> Tension <input type="checkbox"/> Roll <input type="checkbox"/> Other	Issue	<input type="checkbox"/> None <input type="checkbox"/> Yes



The pictures can also help a manager or supervisor who will read the report better understand the issues and subsequent recommendations.

However, and this is a BIG HOWEVER; typically, you must get approval for the pictures from the appropriate individuals, including the person being assessed, supervisors, managers, etc. In a few cases a written release may be needed.

And in some cases, due to the proprietary nature of the workspace, pictures may not be allowed at all.

Workshop Case Study

No doubt about it, the very best way to learn how to perform an effective and efficient office ergonomics assessment is to have hands-on practice. We'll go through a case study assessment in a step-by-fashion in the workshop.

Once you have completed the training, we are going to ask you to perform a real live assessment. A good way to start is to use the “buddy” approach; do the assessment with another person.

Then, we'll get back together as a group so you can share your assessment with the group, bring any questions you have and get constructive feedback from the instructor and workshop attendees.

Also, there are two other example assessments available for you to review.

Introducing Lisa Wang!

Our case study person is Lisa Wang. She works for XYZ Company in Human Resources.

She recently moved into her current office and would like to ensure appropriate ergonomics set-up and use of her workstation.

Refer to the *Office Ergonomics Assessment Quick Reference Guide* for step-by-step instructions.



Logistics

Assessment notification and scheduling

- Once you've been notified of the need for the assessment, contact the individual to schedule the assessment.
- A typical assessment will take approximately 30 to 45 minutes to complete.

Assessment worksheet and equipment

- Have the assessment worksheets and other equipment (tape measure, camera, sample equipment, etc.) available as needed with you for the assessment.

Conduct Assessment

Introduction

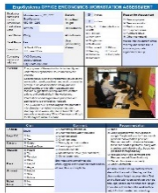
- If needed, introduce yourself to the person being assessed.
- Provide background that you are member of the Ergonomics Assessment Team.
- If the person is seated, obtain a chair so you can sit with the person as you conduct the interview and assessment.

Outline assessment objectives:

- Understand pertinent ergonomics related issues that the person is experiencing.
- Go through a step-by-step ergonomics assessment to determine ergonomics issues.
- As feasible, let them know you will work with them to "fix" whatever is possible at the time of the assessment.
- In some cases, you may need to obtain additional assist with equipment modifications or changes.
- Indicate follow-up will be available as needed regarding recommendations.
- Discuss you may take pictures and obtain permission as needed.
- Tell them you will take a set of measurements as part of the assessment.
- Let them know the bottom line objective is to assist them to take full advantage of the ergonomics furniture, equipment and work processes in their workstation.
- Ask them if they have any questions as you get started with the assessment.

Background information

- Talk with the person to complete the Background Information section. Refer to the Worksheet and either complete it by filling out the form by hand by checking the pertinent boxes and writing in comments in each section or using the PDF fillable document that contains checkboxes and comment fields for each section.
- Respect the confidentiality of the information and make sure the person is aware that you are only requesting information specific to the ergonomics assessment.
- Here is Ms. Wang's background information.



ErgoSystems OFFICE ERGONOMICS WORKSTATION ASSESSMENT				
Evaluator name and contact information	Mark Anderson, PT, CPE ErgoSystems 952-401-9296	Stature	59 inches	Reason for Assessment
		Shoe Heel Height	1 inches	
Evaluation Date	9/25/20	Handedness	<input checked="" type="checkbox"/> Right <input type="checkbox"/> Left	<input type="checkbox"/> New employee <input checked="" type="checkbox"/> New workstation <input type="checkbox"/> Medical issue <input type="checkbox"/> Equipment issue <input type="checkbox"/> Furniture issue <input checked="" type="checkbox"/> Other (comment)
Last Name	Wang	Work Hours	<input checked="" type="checkbox"/> Full Time <input type="checkbox"/> Part Time	Moved into the current office recently and would like to ensure appropriate ergonomics set-up.
First Name	Lee	User (workstation)	<input checked="" type="checkbox"/> Single-user <input type="checkbox"/> Multi-user	
Location	<input checked="" type="checkbox"/> Work Office <input type="checkbox"/> Home Office	Vision	<input type="checkbox"/> No correct <input type="checkbox"/> Reading <input checked="" type="checkbox"/> Distance <input type="checkbox"/> Contacts	
Company name and address	XYZ Company Street Address City, State Zip Code		<input type="checkbox"/> Bifocal <input type="checkbox"/> Trifocal <input type="checkbox"/> Computer	
Purpose	<p>The purpose of the evaluation is to identify and understand ergonomics issues noted by the evaluatee.</p> <p>Specific focus is on the ergonomics issues of the workstation, work practices, and work process to provide a set of workstation set-up and use specifications and to offer reasonable and feasible suggestions to help improve comfort, safety, and productivity in the workplace.</p> <p>Information about ergonomics principles and applications is provided as needed.</p> <p>The 30/30/30 rule is encouraged; this promotes microbreaks – physical movement (stretch, standup, short walks, etc.) for at least 30 to 45 seconds at least every 30 to 45 minutes and try it for 30 days to make it a habit.</p>			









Observe typical work routine

- Ask the person to perform their typical work tasks. Have them actually perform some purposeful work. The objective is to have them get involved in what they are doing so they will somewhat forget the fact you are watching them. You may need to watch them for a few minutes to get a good idea of what the typical routine consists of.
- If need be, ask them to perform specific activities they expressed concern about or that you have additional questions about.
- At this point you probably have identified some specific issues in terms of workstation set up, equipment used, etc. your next step will be to go through the step-by-step assessment and fill out the worksheet.

Typical pictures taken

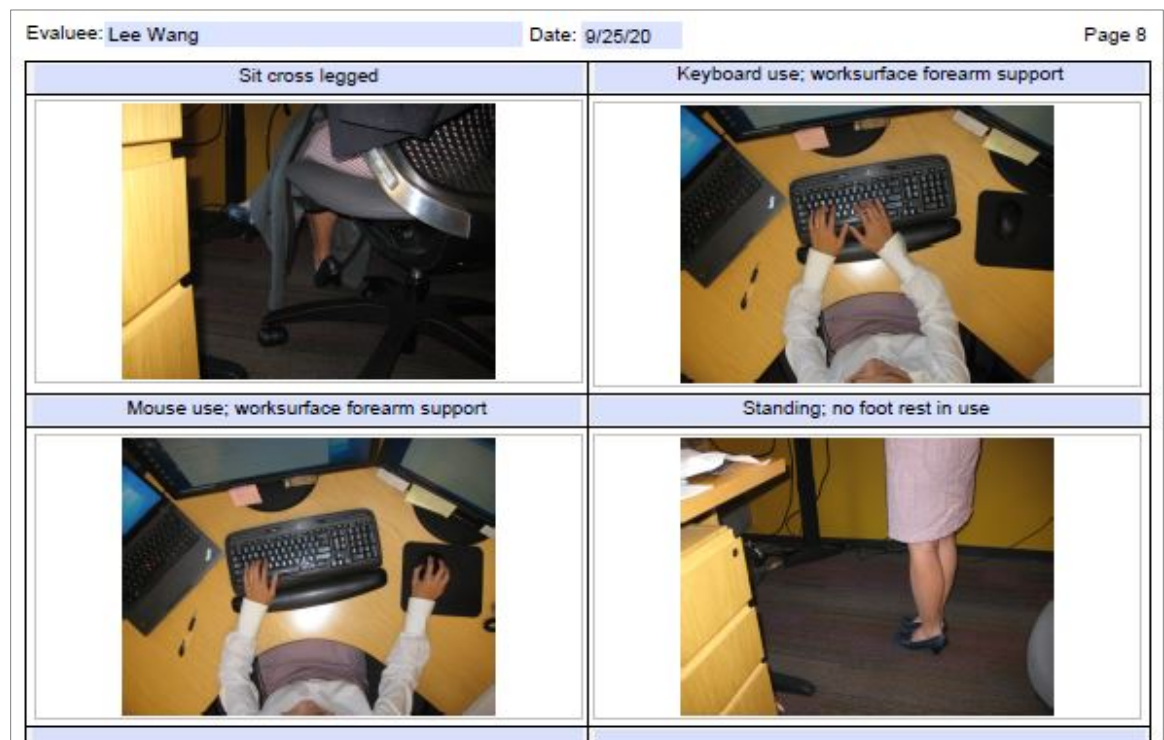
- If you are using a camera, you may ask them to "freeze" position so you can obtain the desired picture. In many cases, the pictures are a valuable educational tool to show the person exactly what they are doing that may be at issue. Generally, you will take a series of pictures to document the workstation.
- Let's look at the pictures for Lisa Wang's assessment.

Evaluatee: Lee Wang
Date: 9/25/20
Page 7

Illustrative Pictures	
Overview of workstation - seated	Overview of workstation - standing
	
View underneath desk	View from behind looking at monitors
	
Overhead view of keyboard in use	Overhead view of mouse in use
	
Side view of chair - upright position	Side view of chair - semi-reclined position
	

Other pictures taken

For Ms. Wang's assessment other pertinent pictures were also taken to document other specific issues and modifications recommended.



Office Components

Earlier we alluded to the components that make up the typical office, let's spend a minute and outline them in some detail.

They include:

- User – Single/Multi
- Tasks – Single/Multi
- Floor space
- Chair
- Worksurface
- Floor surface
- Computer
- Telephone
- Office equipment
- Storage
- Conference tables/chairs
- Light
- Noise
- Temperature

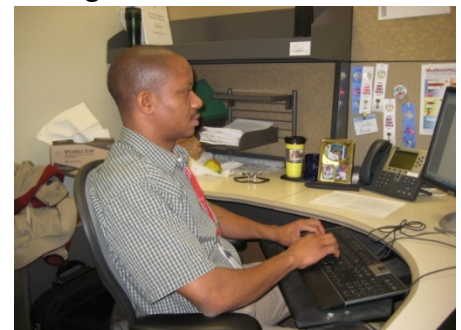
User – Single/Multi

In terms of the user of the workstation it is critical to be aware if a single person will primarily use the workstation or if two or more individuals will share it on a regular basis. We also need to determine how often the changeover occurs.

We need to determine if the workstation is a **single-user** or **multi-user** workstation.

Single-user

By definition, a single-user workstation is designated for use by one individual only. For the single-user workstation we are less influenced by the need for adjustability of the workstation itself.



For example, once we determine the proper height of the worksurface it can be fixed at this height with little or no need for adjustability. An exception to this is a height adjustable sit/stand workstation.

For instance, a fixed height or adjustable/fixed worksurface (i.e. worksurface can be height adjusted but once adjusted is not readily changed; e.g. wall panel mounted worksurfaces) makes for a viable workstation

Multi-user

On the other hand, multi-user workstations (e.g. reception counters) by definition, will require a significantly greater degree of adjustability.

To make the workstation effective, it is critical that the changeover from one user to the next be accomplished quickly and easily.

An adjustable/adjustable worksurface is desired. In this case, either through a spring balanced manual system or a powered system, the height of the worksurface can be readjusted within seconds.



Tasks: Single-task or Multi-task

Specific tasks performed in the office workstation will help to determine the office workstation configuration and setup. Typically, we categorize job demands as *single-task* or *multi-task*.

Single-task

An office workstation designated as single-task is defined as one where the majority of the work time is spent accomplishing a specific, focused task.

For example, a customer service representative may spend a majority of the day on the computer and telephone performing computer lookup activities. Physically the job demands are concentrated in a single area.

The efficient set up of the single-task workstation is critical because the user tends to maintain a sustained position to perform their activities. Another example of a single-task workstation includes data entry.



Multi-task

In the workstation designated as multi-task, a number of different tasks need to be accomplished. For example, the user may spend some of the day at the computer, talking on the telephone, reading and writing, attending meetings and so on.

Physically, the job demands may be spread across several areas if the workspace is available to accomplish this.



However, in many situations the space is not available, and the user tries to multitask in a confined workstation. The efficient set up of the multi-task workstation either provides for separate workstations for separate tasks or makes it extremely easy for the user in the same workstation area to shift from one task to the next.

Other examples of multi-task workstations include supervisory positions, technicians, etc.



Work activity (percentage breakdown)

Part of the assessment includes identifying a rough breakdown of specific tasks (computer, telephone, read, write, meetings and misc.) performed to accomplish the overall job demands. Ask the user to roughly estimate the percentage of the task based on an average week or month, recognizing that variations occur from day-to-day. This information helps determine how best to focus the assessment efforts. A 90% rating for computer activity is much different than a 10% rating.

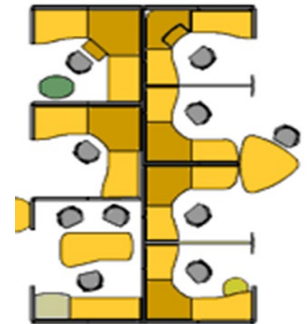
Floor space

In the ideal world, the dimensions of the office workstation are determined exclusively by the job tasks.

For example, in some very focused single-task workstations 36 square feet may be sufficient. In other cases, a multitask workstation may require 120 square feet or even more to effectively accomplish the job tasks.

However, as we all recognize we do not live in the ideal world. Floor space may be determined by a host of factors not relative to job task.

This does not negate the need to perform an effective job analysis to make recommendations but does cause us in many cases to be quite creative!



Chair

No doubt the chair is a critical component in the office workstation. To make the point, just tell the person their chair has been removed from their workstation to “promote more standing” and you will have a mutiny on your hands.

Interestingly enough, anecdotally this has actually been done in some conference rooms where typically relatively short (5 to 20 minutes) meetings occur; the result has been shorter, more effective meetings.

Objectives of chair

What does the chair accomplish for the user?

- Support body and limbs to provide relief from weight bearing.
- Provide a stable base or platform for the body and limbs.
- Position the user at the correct height and reach relationship to the worksurface and tasks at hand.
- Allow for easy change in position/movement of the user.

Types of seating systems

A number of seating systems are available in the office workplace and include office task chairs, stools, lean platforms and other miscellaneous seating.



Without question, the traditional office task chair is the most commonly used seating system in the office workstation.

Chair criteria

In the office environment, the type, use and efficiency of the chair are critical elements. The acceptable chair criteria are determined by the type of job activities performed, the size and shape of the user and the duration of time spent in the chair. These criteria are typically considered necessary for an adequate office task chair (Note: First we will discuss the chair's feature and then we will go through chair feature adjustment based on the user's specific needs.)

Legs

Minimum 5-point support system for the chair legs is the industry standard.

This is specifically intended to reduce the likelihood of inadvertently tipping over the chair. The older style 4-point leg systems seen primarily in "secretary" chairs are a thing of the past.



Casters

Different types of chair casters are necessary based on the floor surface.

Most office workstations will have a carpeted floor and should have "carpet caster" to match. This will typically be a fairly wide, hard plastic shell caster that rolls smoothly on the softer floor surface.

On the other hand, for a hard surface such as tile or concrete, etc. the caster type should be a softer, often rubberized material that allows for increased friction between the caster and floor.

Imagine a "carpet caster", hard plastic shell on a hard surface floor. What do you get? The user goes for a ride! Reports have noted users have fallen out of their chairs because the chair slipped away from them.



The only exception noted may be in a control room where the user wants to quickly “scoot” along the control room workstation for access.

Next imagine a “hard surface caster”, softer rubberized on a softer floor surface. Now what do you get? Too much friction between the caster and floor and excessive and awkward force to roll the chair.

Remember the “rule of opposites”. Hard caster on a soft floor and soft caster on a hard floor.

Floor surface

The floor surface of the workstation is important to consider in terms of providing ease of rolling the chair on the floor surface, a nonskid surface to prevent slips and falls and a non-glare surface to reduce overall glare in the workstation.

Seatpan

Height, tilt and tension adjustability need to be suited for the individual user's body segment length and size.

- If the height of the seatpan is not fixed, the type of mechanism to raise or lower the seatpan could be spin up/down but in a modern chair will be a gas pneumatic cylinder.
- A seatpan slide is also a recommended feature. This allows for the apparent depth of the seatpan to be changed to fit the user.
- The seat pan height and angle establish the relationship between the user, work surface and the floor
- The seat pan tension allows you to adjust the seat so that you are stable in your chair. The seat pan tension provides a balance between adequate support and movement in the chair.



Back support

Adjustable back support height and angle needs to be suited for the individual user's body segment length and size.

The back support angle and height influence the angle between the upper and lower body as well as the relationship to the worksurface.

The back support angle allows the user to adjust the lumbar support built into the back support so that it can comfortably support the upper body weight.



Cushion

Suitable cushion - in terms of foam density, wearability and breathability, type of material (fabric or rubberized) - for the seatpan and back support should be in the chair. A number of chairs have introduced web or mesh fabrics in place of the traditional cushion.

Armrests

Armrests may be used to support the weight of the arms and upper body. If used, the armrests need to be adjustable in height, lateral position and axial rotation. (Non-adjustable armrests on office task chairs are essentially non-functional.)

The armrest adjustments allow you to position the armrests where they will provide adequate support for your arms and shoulders in neutral postures. Appropriate upper extremity support through the forearms supported on the armrests will “unload” the neck, shoulders and back to reduce axial weight bearing.



Adjustment levers/knobs/controls

Adjustment levers/knobs/controls for the chair should generally be within easy reach of the user when seated in the chair. The levers should be easy to manipulate and not be so complicated that they discourage use.

Cervical support

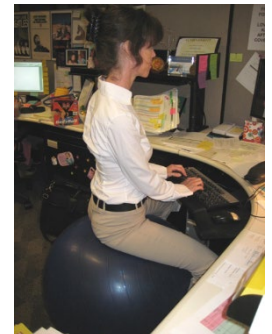
Additional modifications are possible for chairs. In some situations, the user may require cervical and head support in addition to mid and low back support.



Exercise ball chairs

Therapeutically, exercise balls have been used in clinical settings as treatment modalities to improve spinal stability. Over the past several years, the use of exercise balls in the workplace in place of or in addition to task chairs has been noted.

At this point, primarily only anecdotal evidence exists to support the full-time use of them. Most ergonomists continue to advocate for properly sized and properly adjusted office task chairs rather than the use of ball chairs.



Micro-breaks

Frequent and regular body movement is one of the basic ergonomics principles, the 30/30/30 Rule of Physical Movement (physically active micro-breaks 30 seconds in length taken about every 30 minutes and practiced for the next 30 days to make it a habit) is supported by research to reduce tissue compression and joint stiffness, enhance circulation and improve overall comfort levels.

When the 30/30/30 concept is described to people, to a person they will agree it makes all the sense in the world. Like many things in life the idea is marvelous but the actual implementation leaves something to be desired.

Encourage the person to figure out reminders that will work for them; post-it notes, the buddy approach, drink a lot of water, set reminders on their calendar.

Have them try out various strategies to see what works for them.

Art of sitting

The body is not designed to sit - particularly for long periods of time. Studies have determined that even when seated in well-supported postures, individuals want to move to gain relief within a few minutes. Let's cover the art of sitting.

Three-point contact

Trunk

Imagine sitting on a bleacher without any back support. Very uncomfortable and promotes a slumped posture, rounded out low back.

Low and mid-back support from the chair is needed to maintain a neutral spine.

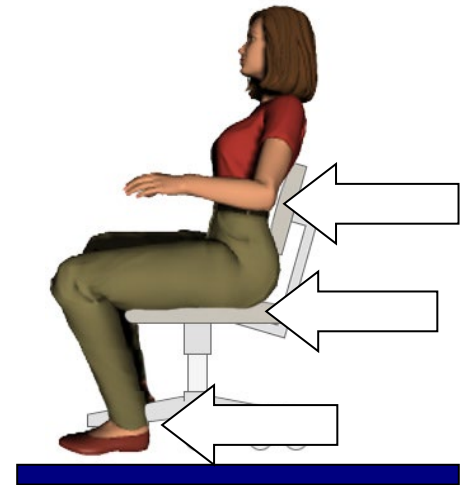
Thighs/Hips/Buttocks

Of course, without a seatpan it wouldn't be a chair! However, appropriate size and cushioning of the seatpan is necessary for comfortable use.

Feet

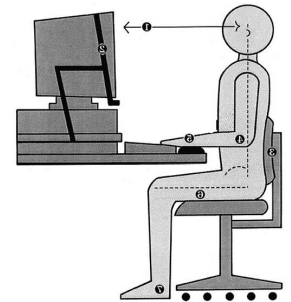
Imagine sitting on a high stool with no support for the feet. Very uncomfortable and promotes a slumped posture.

Foot support is needed to allow for appropriate seated posture.



90/90 seated posture?

You probably have seen illustrations of an office workstation where the person is seated at the chair with their hips and knees at 90 degrees. In all practicality very few people actually sit this way. A much more commonly accepted seated posture is 105 to 110 degrees at the hips and knees. Let's look at how people sit.



Sitting styles

Sitting styles can be quite varied from person to person. The particular sitting style observed needs to be assessed to determine why it is being used.

It may be a habit that has been developed over time; it may be in response to a poor workstation setup or a combination of both.

What drives the problem is the frequency and duration of the seated position. If the individual only occasionally sits in an undesirable position it may not be a concern; however, if that is their habitual manner of sitting it could lead to problems.

Let's look at some potentially problematic sitting styles.

Percher

Perchers tend to sit on the front lip of the chair and seldom sit all the way back to gain low back support.

Also, perchers have been observed to be up and down from the chair frequently and as a result tend not to take the time to position themselves all the way back in the chair even if they do have long enough femurs. Anecdotally many perchers tend to exhibit quite good erect posture when seated.

Potential reasons for perching may be related to the user's stature. Shorter individuals will correspondingly have shorter femurs; they have learned if they try to sit all the way back in the chair, the seatpan is too deep and they end up with contact stress behind the knee. Manufacturers produce petite versions of chair that are appropriately sized for people of shorter stature.



Sloucher

Slouchers tend to slump in the chair. The result may be a decrease in the lumbar lordosis, and some are even observed to demonstrate a lumbar kyphosis (reversal of the typical inward lumbar lordosis). The slouching will sometimes become more pronounced with extended seated durations.

Studies have shown a kyphotic lumbar curve increases inter-vertebral disc pressure compared to the maintenance of the lumbar lordosis. When seated the desired S-curve of the spine slumps into a C-curve.

Chair designers have recognized this factor and work to design chairs that can support the user's lumbo-sacral spine in the neutral inward curve configuration.

With this style of seated posture, instruction in chair set-up along with an emphasis on getting out the chair more frequently is beneficial.



Sit Cross Legged

People that tend to sit cross legged are observed quite commonly. These individuals have found they achieve greater support and stability in the chair if they cross one leg over the other.

You can demonstrate this for yourself by trying this little experiment. As best you can sit all the way back in the chair with both feet directly on the floor. Next allow your legs to slide forward on the seatpan and determine how easy it is to slump in the chair. Pretty easy, isn't it.

Now sit all the way back in the chair but this time cross one leg over the other. Try the forward slide maneuver again. What did you find out? That one foot on the floor



tends to allow you to “lock” yourself in the chair and helps you to push your lower back against the back support?

If this is a habitual way of sitting it may cause issues with asymmetrical seated posture not to mention the potential lower extremity blood circulation issue. Individuals have reported the leg “goes to sleep” and they have difficulty in standing up.

Many times, the relationship between the fit and adjustment of the chair to the person is inappropriate. Also, the worksurface may tend to be set at a higher level than recommended because otherwise the person can’t get the crossed leg under the worksurface.

Ensuring the appropriate size chair, instruction in proper chair set-up and matching the worksurface height to proper seatpan height can remedy this seated posture.

Sit on Leg

At one time or another we probably have all sat on one leg tucked under us. Next time you are at restaurant do a little “chair study”.

Restaurants tend to have not the most comfortable chairs in the world; they don’t want you to sit there forever. They want to move patrons through.

For some individuals sitting on one leg improves stability in the chair and can seem to make an uncomfortable chair a little more comfortable.

In the workplace it is common to see shorter individuals sit on a leg because they have learned this technique positions them at higher position in relation to the worksurface.

Imagine a fixed worksurface height at 29” (industry standard) with an individual who needs a worksurface height of 27” based on their anthropometry. Sitting on one leg seems to make them “taller”.

The appropriate height worksurface that allows the user to position the seatpan at a height that promotes the feet on the floor or providing a footrest for foot and lower extremity support for a worksurface that is on the high side can be the solution.

Functional seated positions

A common question is, “What is the best sitting posture?”, does it make sense that the best answer is, “The next one!”?

A general guideline in the “art of sitting” is to provide for different acceptable seated postures that a person can rotate throughout the day on a regular basis.

Tying the functional seated position to the task at hand is a viable method for people to remember to make the change in posture throughout the day.

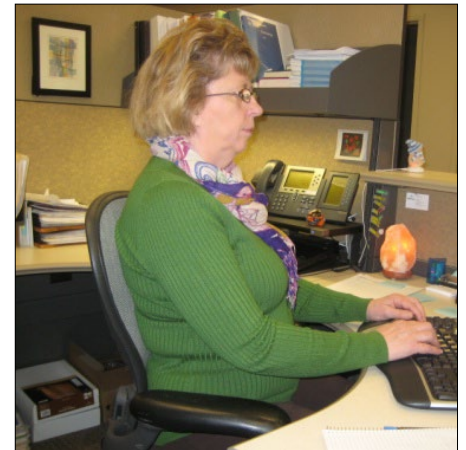


Upright Keyboard Position

When the person is performing primarily hand centric activities such as keyboard and mouse use along with handwriting the “upright keyboard position” is recommended. The chair is adjusted with the back support fairly upright and the seatpan about horizontal allowing for an easy reach to the worksurface.

Chair armrests if used, can be positioned to allow for forearm support to unload the neck, shoulders and back. Just make sure the armrests don’t limit close access the worksurface.

For those individuals who use the “forearm worksurface support keyboard technique” (more about this technique in the Keyboard Section) the armrests need to be adjusted low enough to go underneath the worksurface.



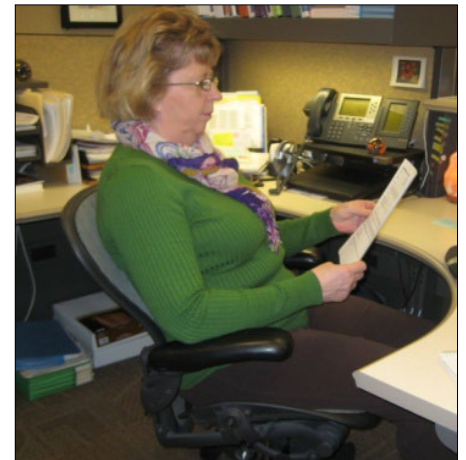
Semi-reclined Conversation Position

For tasks that are not hand centric, such as reading, having a conversation with someone in the office or on the telephone the “semi-reclined conversation position” is recommended.

The chair is adjusted to provide for semi-reclined position by tilting the seatpan back about 5 to 15° and reclining the back support as well if possible.

Armrests are brought into play to support the forearms to unload the neck, shoulders and back.

Some individuals tend to rock their feet off the floor in this position and benefit from a footrest for foot support.



Axial loading of the spine is reduced and with the pivot action between the skull and first vertebrae the head remains balanced over the shoulders.

Standing

We recognize standing is not a seated posture, but it makes the point that an individual needs to get out of the chair and either stand or walk around the workplace on a regular basis. Promote the 30/30 Rule!

With the advent of sit/stand workstations this concept is getting easier to accomplish.

We will discuss the details of using sit/stand workstations in the Worksurface Section.



Adjustment anxiety

Chairs can be pretty expensive. They can have all kinds of bells and whistles. So, let's see what this baby will do! It seems that the answer is nothing until we do something to the chair.

Sometimes we overemphasize what a chair can do and forget to emphasize what it is we need to do to make it work. The truth is that a chair is only as good as what we choose to do with it.

Some people have never adjusted their chair. They just sit down and go to work. The bottom line is people need to be able to adjust their chair to fit them properly as well as throughout the day to provide the body with a break.



Chair solutions

Manual

Look for the chair manual for specific information about the chair or to talk to someone who handles chairs in the work area. Most chair manufacturers have how-to-adjust videos on their websites.

Hands-on approach

Better yet, just start playing with the adjustments. Most people learn best by the “hands-on” approach. Practice relates to increased comfort level and efficiency of adjustment. Have the person practice going between the recommended seated postures so they can quickly make the change. Promote their commitment for the next two to four weeks to make the change a habit so they will integrate this behavior into their day-to-day routines.

Going through the Chair Section of the assessment will take some time. You may end up with 30 to 40% of the assessment dedicated to the chair set-up and use.

Case Study: Chair

Refer to the *Office Ergonomics Assessment Quick Reference Guide* for step-by-step instructions

- Have the person go step-by-step through the adjustment features and learn about the chair.
- As much as possible, have them try out the features themselves. If needed, you also can demonstrate the adjustment features of the chair to the person to help them learn how to adjust the chair.

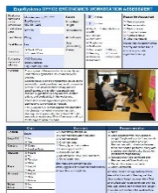
Chair adjustment tips and techniques

Here is a series of chair adjustment steps along with tips and techniques:

- Let them know initially the objective with the chair is to help them become familiar with the adjustment features and then the proper set-up.
- Adjust the **pan seat height** to get feet on the floor with even pressure on hips and thighs.



- If the feet do not touch the floor adjust the seat pan height to get the feet on the floor with even pressure on hips and thighs – if still not possible to get the seatpan low enough, a footrest will be needed. Another option is to replace the chair with one that will go low enough.
- If needed, add a seat cushion to elevate the user to a more appropriate height – although many times this means the chair does not fit right and a replacement chair may need to be considered.
- Adjust the **seat pan/back support tension** to hold body in a solid upright neutral position.
- Adjust the **height and angle of the back support** to fill in the low back curve.
 - Add a back cushion to provide better support for spine – although many times this means the chair does not fit right and a replacement chair may need to be considered.
 - If the back of knees run into the front of the chair see if a back cushion to move the body forward on the chair and still have adequate back support, will work. Firmly fix the cushion to the chair, one way to do this is with Velcro tape. *Although many times this means the chair does not fit right and a replacement chair may need to be considered.*
- **Adjust armrests** if they are adjustable, see if they can be adjusted to provide neutral support for the arms based on particular job tasks.
 - Build up the armrests by putting pads on them if more height is needed.
- For the case where hips and thighs don't fit on the seat - the seat pan is too short or too narrow or is too large; see if you can find a chair that better fits.
- If you identify maintenance problems with the chair, make sure you contact the appropriate people to get them taken care of.
- Discuss with them the "upright keyboard" and "conversation" chair positions and have them practice going between the two positions.
- Remember, no matter how perfectly the chair is adjusted it still comes down to physical movement on a regular basis helps keep the body healthy and safe.
 - Discuss the 30/30/30 concept of physical movement throughout the day. Recall this promotes short physically active micro-breaks (30 to 60 seconds in length) taken about every 30 minutes or so and used for the next 30 days and beyond to make the micro- breaks the habit.



Fill out the **Chair Section** of the **Office Ergonomics Workstation Assessment Worksheet**.

- If possible, try to identify the make and model of the chair. Look for identifying tags on the bottom of the seatpan. In some cases, you may not be able to determine the identity and indicate "Not Determined".
- Document the features of chair in terms of number of **Legs**, type of **Casters** and **Seatpan/Back/Armrest** adjustment. Identify any **Maintenance Issues**.
- Next indicate if **Issues** exist (YES or NO).
- Under the **Comment** and **Recommendation** sections check the appropriate box and add any pertinent comments. A one-to-one correlation should exist

between the Comment and the Recommendation. For example, if you comment the chair is not properly adjusted the recommendation should provide a solution.

NOTE: As you go through the assessment and work on completing the form you will sometimes find you can't complete the current section until you get to another section.

Don't worry about this; it demonstrates the inter-relationships among the sections. Once you have gone through the assessment take another swing through the form and complete it.

Here is the completed chair section for our case study.

Chair		Comment	Recommendation
Chair ID	Squig	<div><input type="checkbox"/> Chair fit/adjustment OK</div> <div><input checked="" type="checkbox"/> Chair not adequately adjusted</div> <div><input type="checkbox"/> Chair too small</div> <div><input type="checkbox"/> Chair too large</div> <div><input type="checkbox"/> Wrong type chair casters</div> <div><input type="checkbox"/> Back support not OK</div> <div><input type="checkbox"/> Armrests not OK</div> <div><input type="checkbox"/> Maintenance issue (see comment)</div> <div><input type="checkbox"/> Other (comment)</div> <p>She notes she sometimes sits cross-legged in the chair for short periods of time; this is acceptable.</p>	<div><input type="checkbox"/> None</div> <div><input checked="" type="checkbox"/> Chair adjusted with instructions in upright "keyboard position" and semi-reclined "conversation position". Recommended to alternate between these two seated postures, along with standing and microbreaks, based on job tasks throughout day.</div> <div><input type="checkbox"/> Replace chair (see comment and Recommended Specifications)</div> <div><input type="checkbox"/> Repair chair (see comment)</div> <div><input type="checkbox"/> Other (comment)</div> <p>We discussed a set-up protocol where she will at the start of the day, set the chair seatpan height appropriately (feet on the floor with even weight on the hips and legs) based on her shoe heel height. Then she will fine tune the worksurface height for both seated and standing</p>
Legs OK	<div><input type="checkbox"/> No</div> <div><input checked="" type="checkbox"/> Yes</div>		
Casters	<div><input checked="" type="checkbox"/> Carpet</div> <div><input type="checkbox"/> Hard surface</div>		
Seatpan	<div><input checked="" type="checkbox"/> Height</div> <div><input checked="" type="checkbox"/> Tilt</div> <div><input checked="" type="checkbox"/> Tension</div> <div><input checked="" type="checkbox"/> Slide</div>		
Back	<div><input type="checkbox"/> Height</div> <div><input type="checkbox"/> Angle</div>		
Armrest	<div><input type="checkbox"/> Height</div> <div><input type="checkbox"/> Side</div> <div><input type="checkbox"/> Rotate</div>		
Maint Issue	<div><input checked="" type="checkbox"/> No</div> <div><input type="checkbox"/> Yes</div>		

Worksurface

Whether a desk or table or some type of platform, the worksurface is an essential component in the workstation.

Worksurface objectives

The objectives of the worksurface include:

- Provide functional workspace (depth, width)
- Support and position equipment
- Provide access to work materials
- Achieve the desired relationship match between the user and the work

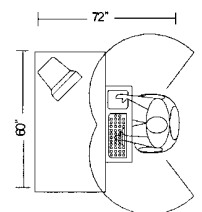
Types of workstation layouts

Three types of workstation layouts are typically recognized.

Straight line (desk/table)

The **straight in-line** configuration is suited for single task activities with minimal reach requirements for other office equipment and materials.

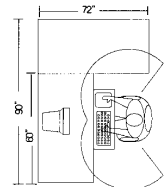
A common example of the straight-line configuration is a stand-alone desk.



L-shape (two work surfaces), U-shape (three worksurfaces)

The **L-shape or U-shape** configuration is suited for single to multitask activities that require two or more separate workspaces.

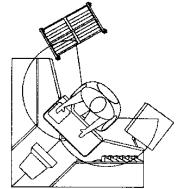
For example, one workspace may be used as the computer workstation and another as a writing or collating workstation.



Corner/Cockpit (middle with two side pieces)

The **corner/cockpit** configuration is well suited for multitask activities in the same workspace with significant requirements to frequently reach other office equipment and materials.

Modular furniture systems are often configured in corner set-ups.



Worksurface height adjustability

Height adjustability of the worksurface is a critical component. In general terms, three different types of worksurface adjustability are recognized:

Fixed

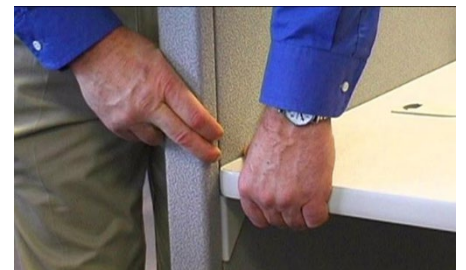
An example is the traditional desk at a fixed worksurface height of 29 inches. There are literally millions of these types of worksurface in workstations. In this case *Fixed* means that they are not designed to be changed in height.



Note: It is possible to raise a fixed height worksurface on supports but typically very difficult to lower it. (Although we have been known to actually shorten legs on traditional desks!)

Fixed/Adjustable

An example of a *Fixed/Adjustable* work-surface is a wall panel mounted system where the worksurface is hanging on the wall panel or a worksurface on legs where the height can be adjusted by loosening screws and sliding sleeves up or down in the legs.



These worksurfaces are termed *Fixed/ Adjustable* because they can be adjusted within a given range but once adjusted, they are fixed in that position and not readily moved.

Adjustable/Adjustable

Adjustable/adjustable indicates that the user – as needed throughout the day - can readily and easily adjust the worksurface height.

Examples of these worksurfaces are sit/stand workstations. Sit/stand worksurfaces have become much common in the past 5 years. For many companies this is becoming the standard workstation configuration. We'll discuss details of sit/stand workstations a little later.



Other Considerations

Sharp edges

It is a problem if sharp edges in contact with the wrists and forearms.

Make sure that you are at the proper work height in relation to the worksurface edge. Simply getting at the proper work height may change the contact point of your desk and distribute the pressure more evenly.

Another option is to pad the sharp edge. This may be as home grown as a small washcloth or dishtowel folded up or a commercially available edge added to the worksurface edge itself.

Not enough layout space

Occasionally, or possibly quite frequently, there is not enough space on the worksurface to lay out materials. Now, one option is to get a bigger desk, and a bigger office.

Assuming that this is probably not a realistic option, we may need to be a bit more creative.

- Try a little house cleaning and see if this frees up more available space on the desk.
- Look around to see if there are other worksurfaces available for use, for example a file cabinet at a standing height to review documents or perform other work. If there is available space, see if any more worksurface can be added to the workstation. This can be a small worktable.
- If it doesn't need to be readily available, relocate some of the equipment on the desk to see if it provides more space.
- Make use of any pullout drawers already in the desk.
- A computer monitor stand can be added to provide more clearance on the desk.



Work organization

Organize work in a way that allows work goals to be achieved as efficiently as possible. This considers all aspects that make up the workstation including your chair, desk, computer, telephone and other materials used through the day. This also includes the organization and structure of tasks and activities performed throughout the workday.

Worksurface height solutions

Wrong desk height

What are some options if the issue is the wrong desk height in relation to the user's position at the desk?

NOTE: We haven't discussed yet how to determine what is the wrong worksurface height in relation to the user's position at the worksurface. To answer this question, we need to talk about how the keyboard is used. Yes, the keyboard.

Hang onto this thought we will address it in the Keyboard Section. But for now, let's look at some potential worksurface height solutions.

Adjustable height

If work height is adjustable, adjust it. For example, modular work surfaces that can be adjusted on the wall panels or a sit/stand desk that can be adjusted.

Adding a height adjustable keyboard tray mounted underneath the work surface is an option. We'll get into the pros and cons of keyboard trays in the Keyboard Tray Section.

Fixed height

For a fixed height desk, one option is to raise the height of the work surface by putting it up on desk risers. This can be commercially available risers or even just blocks. Just make sure that the desk or work surface is solidly placed on the blocks and won't fall off. It may be advisable to get maintenance or someone else to help do it safely.

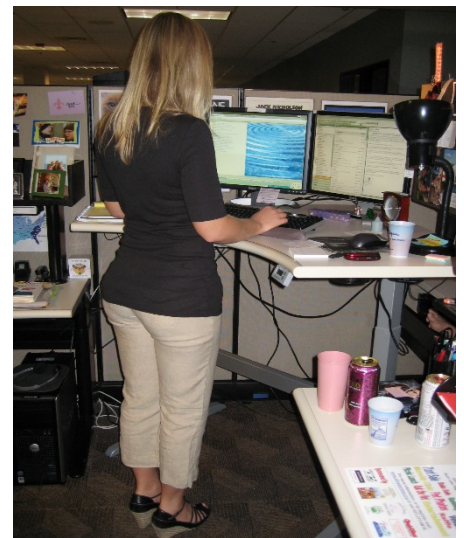
Another option is to adjust chair height. Once again, make sure the feet are supported either on the floor or with a footrest.



Sit/Stand Workstations

Sit/stand workstations are becoming more and more prevalent in offices these days. Office jobs are very sedentary in nature with resulting negative impact on general health and wellness.

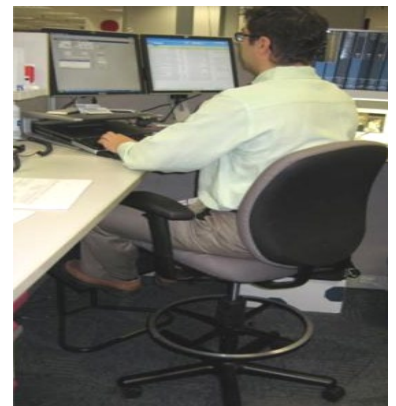
Several options exist for creating sit/stand workstation that range all the way from makeshift ones created by putting boxes on the desk to full-fledged powered sit/stand workstations and other options in between. The same setup principles for office ergonomics in general remain in effect: neutral body position and support, reach zones, control exposure to sustained positions by promoting movement throughout the day and so on. Here are some ways to create a viable sit/stand workstation.



Fixed worksurface at standing height

The correct height of the worksurface when the user is standing at it is determined.

A stool and footrest are provided to allow for an elevated seated position.



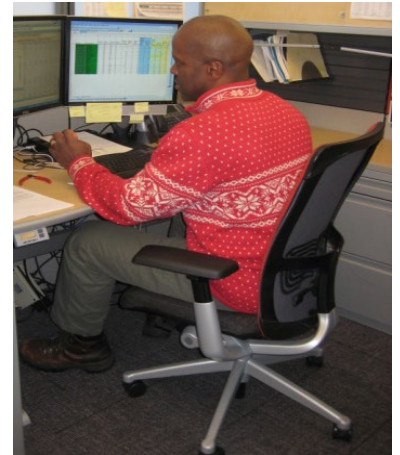
Portable system placed on desk

Portable desktop systems are now available to be placed on the worksurface. The system can be height adjusted to alternate between a seated and standing position.



Sit/Stand workstation

The entire workstation is height adjustable allowing for seated and standing height work positions.



Tips for Sit/Stand Worksurfaces

Here are some tips to obtain the most benefits from sit-stand workstation.

- Employ the adjustment strategies to make sure seated and standing worksurface heights are correct.
- Utilize footwear that has significant cushioning and support. If they are good walking shoes, they also will be good standing shoes.
- Use a footrest that will allow one foot up on the rest and then alternate with the other foot. This promotes varied standing postures and intermittently redistributes weight-bearing stresses.
- Shift weight forward to the balls of the feet and backwards to the heels when standing on both feet or alternately when standing with one foot in front of the other.
- Perform “heel lifts” frequently. This will improve lower extremity circulation.

Remember to provide a break-in period if new to sit/stand workstations. Start with a specific schedule for the first week; for example, 10-15-minutes of standing followed by a 30-second walk, then 45-minutes seated work followed by a 30-second walk and repeat. And then modify the time periods based on the response.

Remember the mantra . . . **“Don’t wait until it’s too late!”**

Move on a regular basis.

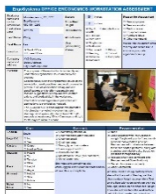
Conference rooms

What about conference rooms? We need to take into account not only the information that is being delivered but is our audience capable of receiving and using the information in an effective way? One issue of meetings in conference rooms is the lack of physical movement: Long meetings without adequate movement can lead to fatigue, discomfort and a non-productive meeting. Ineffective workstation setup (often just a conference table with poor chairs) is an issue with meetings.

For example, meetings held at a standard conference table could make you perform your work outside of the neutral postures. It is tough to be in one position for long periods of time. Look for as many opportunities as possible to move as part of your meeting.

You probably have heard that people think better on their feet. It has to do with improving oxygen flow. If your company wants people to think better during a meeting, consider doing a bit of standing mixed in with sitting.

If you get uncomfortable in long meetings bring in a small footrest or back cushion if you can't adjust the chair or worksurface.



Case Study: Worksurface:

- Complete the **Worksurface Section** of the **Office Ergonomics Workstation Assessment Worksheet**.
- Document the **Worksurface Configuration** (Straight/Corner/L-shape/U-shape) and **Type** (Fixed or Adjustable).
- Measure the current worksurface **Height** in the sit and/or stand set-ups.
- Next indicate if **Issues** exist (YES or NO).
- Under the **Comment** and **Recommendation** sections check the appropriate box and add any pertinent comments. A one-to-one correlation should exist between the Comment and the Recommendation. For example, if you comment the worksurface is too low the recommendation should provide a solution.

Worksurface		Comment	Recommendation
Config	<input type="checkbox"/> Straight <input checked="" type="checkbox"/> Corner <input type="checkbox"/> L-shape <input type="checkbox"/> U-shape	<input type="checkbox"/> Worksurface is appropriate <input type="checkbox"/> Worksurface is too low <input type="checkbox"/> Worksurface is too high <input type="checkbox"/> Would like to discuss options for a sit/stand workstation	<input type="checkbox"/> None <input type="checkbox"/> Lower worksurface to <input type="text"/> inches <input type="checkbox"/> Raise worksurface to <input type="text"/> inches <input type="checkbox"/> Good candidate for a sit/stand workstation (see comment).
Type	<input type="checkbox"/> Fixed Height <input checked="" type="checkbox"/> Adjust Height	<input checked="" type="checkbox"/> Sit/stand worksurface not adequately adjusted <input type="checkbox"/> Worksurface does not have enough work area	<input checked="" type="checkbox"/> Discussed protocol to maximize benefit of sit/stand workstation. Start with about 20 to 30 minutes of seated position, have a short walk (30 to 60 seconds) followed by 20 to 30 minutes of standing. Rotate through regimen for first few days and then modify times based on response. Goal is to, "Not wait until it is too late to move!"
Sit/Stand – current height (inches)	<input type="checkbox"/> Stand: 27 <input type="text"/> inches) <input type="checkbox"/> Sit: 38 <input type="text"/> inches)	<input type="checkbox"/> Other (comment)	<input type="checkbox"/> Reorganize to provide additional worksurface area <input type="checkbox"/> Other (comment)

Foot support/clearance

Foot support

In the ideal world the best foot support when seated in the chair is the floor. However, based on work at a fixed height worksurface where the chair needs to be adjusted upwardly or work at a standing height workbench where a stool is used, a foot support will be needed.

It is never acceptable to have dangling feet; circulation into the lower extremities is negatively impacted.



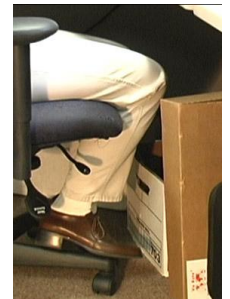
The footrest should be a stable platform at least 18 inches wide and at a height that provides foot support, so the thighs and lower legs are comfortably positioned.

Clearance

A common issue is not enough access or clearance under the worksurface. For example, file drawers that are in the way or boxes piled under the desk.

Survey the work area and determine what is blocking access. For example, it may be a pencil drawer that needs to be removed to make that space accessible for the legs.

Determine what is really needed in the immediate work area. Move what is not needed to some other storage position or get rid of it. Use vertical files or other stands to get materials off the worksurface. Use a secondary shelf or other platform on the worksurface to free up primary worksurface.



Case Study: Foot Support/Clearance

Let's examine the **Foot Support/Clearance** Section of the **Office Ergonomics Workstation Evaluation Worksheet**.

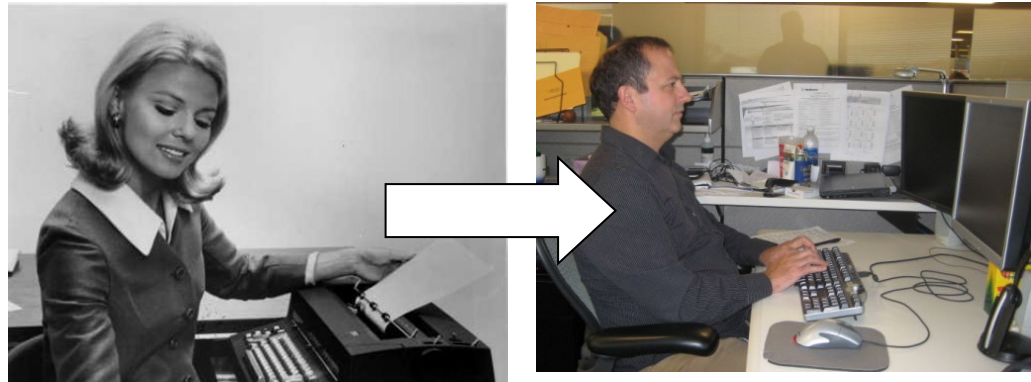
Document if the **Feet** are dangling or supported, any **Clearance** issue and if there is a **Footrest** or not. Next indicate if **Issues** exist (YES or NO).

Under the **Comment** and **Recommendation** sections check the appropriate box and add any pertinent comments.

Foot/leg support/clearance		Comment	Recommendation
Feet	<input checked="" type="checkbox"/> Dangling <input type="checkbox"/> Supported	<input type="checkbox"/> Foot support appropriate <input type="checkbox"/> Feet dangling – not supported	<input type="checkbox"/> None <input checked="" type="checkbox"/> Add footrest to provide for foot support when seated (see comment)
Footrest	<input checked="" type="checkbox"/> No <input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No footrest for alternative foot position for seated worksurface <input checked="" type="checkbox"/> No footrest for alternative foot position for sit/stand worksurface	<input checked="" type="checkbox"/> Add footrest to provide for alternative foot placement when making use of recommended sit/stand workstation. Allows for one foot up on footrest and then other foot up to provide for variation in standing position (see comment).
Clearance OK	<input type="checkbox"/> No <input checked="" type="checkbox"/> Yes	<input type="checkbox"/> Inadequate foot/knee clearance <input type="checkbox"/> Other (comment)	<input type="checkbox"/> Remove foot/knee obstruction <input checked="" type="checkbox"/> Other (comment) When she is at the fixed height desk (30") she will raise her chair seatpan height and use the footrest

Computer equipment

The next step is to properly position the computer equipment (keyboard, mouse, monitors, desktop or laptop computer, hard copy holder, and so on).



To put this into perspective, let's take a brief look at the differences between modern keyboards and old-style typewriters. In the "olden days" you had to actually insert paper, hit the shift bar and physically stop what you were doing to correct mistakes.

Not only that, but you also couldn't go too fast or the keys would stick together. In essence, the task had built in breaks that kept it from becoming too much of a problem. Now it is possible with a modern keyboard to come in at 7 in the morning, start keying as fast as you can, never take a break, and keep this up until 5 o'clock without a break.

Because we have lost a lot of the natural breaks and position changes that were associated with the old style typewriter, we have to actively make good choices during our day.

Keyboards

Keyboard types

Keyboards come in a variety of configurations. While intuition may indicate that keyboard configuration influences hand/arm position and consequently physical stressors, studies have indicated that proper position of the keyboard in relation to the user (height and reach) has been shown to be more important than the actual configuration. Having said that, personal preference and specific issues also can drive the type of keyboard used.

Standard/Straight line

A vast majority of the billions of keyboards presently in use are of the standard/straight-line configuration. Most users will do well if properly positioned.



Curved/Ergonomic

Curved or so-called ergonomic keyboards are angled up and out to allow for more neutral hand and wrist positions. For individuals with specific upper extremity issues they can be helpful. Proficient keyboard use is a motor skill acquired through practice.



If a person switches from a standard to a curved keyboard, there will be a transition period to become familiar with the new configuration.

Articulated

Articulated keyboards have a “joint” that allows the two halves of the keyboard to be customized configured all the way from straight and flat to quite angled. For individuals with upper extremity issues they can be quite helpful.



Other keyboard considerations

Other keyboard configurations are available that may be worthwhile to consider on a case by case basis. Examples include some of the Kinesis keyboards.

Keyboards are also available that have the 10-key pad on the left side rather than the right side of the keyboard. Separate 10-key pads are available.



Mini keyboards are available that do not have a 10-key pad integral to the keyboard.

Keyboard wrist rests

A wrist rest can be a good addition to a keyboard. Remember that it is called a wrist ‘rest’ not wrist ‘anchor’. In other words, it should provide some weight-bearing supports for the arms to provide an opportunity for rest. The wrists should NOT be anchored to the rest when keying; the objective is to move the hands and fingers side to side.

Keyboard Shortcuts

In the Mouse Section we discuss the best use of a mouse is to “use it as little as possible”. To achieve this, learning and utilizing “Keyboard Shortcuts” as much as possible is recommended.

Keyboard shortcut use will minimize stress to the wrist and hand related to mouse use. Reference the Help Menu of the commonly used software to identify keyboard shortcuts.

Common Keyboard Shortcuts					
[CTRL] – A	Select “all” on a page	[CTRL] – S	Saves current file	[ALT] – F4	Close current program
[CTRL] – B	Apply “bold” to selection	[CTRL] – U	Apply “underlining” to selection	[ALT] – Tab	Toggles user through all open programs
[CTRL] – C	Copy the selection	[CTRL] – V	Paste contents of clipboard	[Home]	Move to beginning of current line
[CTRL] – F	Find particular text on a page	[CTRL] – W	Same as File > Close	[End]	Move to end of current line
[CTRL] – I	Apply “italics” to selection	[CTRL] – X	Cut the selection	[CTRL] – Home	Return to “Home” position (upper left) of window
[CTRL] – O	Same as File > Open	[CTRL] – Y	Redo last action	[CTRL] – End	Move to “End” position (lower right) of window
[CTRL] – P	Print	[CTRL] – Z	Undo last action	[Tab]	Tab forward through fields
[CTRL] – R	Refresh current page			[SHIFT] – Tab	Move backward when tabbing through fields

Seated keyboard/worksurface height relationship

Recalling that ergonomics is all about finding the right relationship between the user and the workstation; what is the correct seated worksurface height for

keyboard use? To answer this question, we mentioned in the Worksurface Section we needed to talk about keyboard technique.

Individuals primarily tend to use keyboards in one of two techniques; “piano player” or “forearm supporter”.

Piano Player

Piano player keyboard users position the keyboard close to the edge of the worksurface. They relax their elbows at their sides, bent to about 90 to 100° and float their hands over the keys as they type.



Forearm Supporter

Forearm supporters position the keyboard farther forward on the worksurface and rest their forearms on the worksurface.



Strategy to determine worksurface height

Either keyboard technique is acceptable, but a crucial difference is that the worksurface heights are different for the two styles! Typically, the “forearm support” keyboard technique worksurface height will be higher (1 to 2”) than the “piano player” technique.

Here is a strategy to determine the correct seated worksurface height for either a fixed height worksurface or an adjustable height worksurface.

NOTE: When employing these strategies, have the person wear whatever footwear they typically wear at the workstation. Shoe heel height is a factor that will influence the set-up and measurements.

Fixed worksurface height

For a fixed worksurface height, use the chair seatpan height adjustment to position the hands at the appropriate position based on whether the technique is the “piano player” or “forearm supporter”.

Evaluate foot placement to determine if a footrest will be required to provide suitable foot support. In a few cases, with taller individuals it may be necessary to determine if the worksurface can be raised (refer to the Worksurface Section for more details).

Adjustable worksurface height

For an adjustable worksurface height first adjust the chair’s seatpan height so the hips are slightly higher or equal to the knees and the feet supported on the floor.

Next, if you are a “piano player” keyboard user, position your hands where they would be when using the keyboard and then adjust the worksurface height to match your hand position. Type a bit and fine tune the worksurface height as needed making sure the wrists are in a neutral (straight) position.

If you are a “forearm supporter” keyboard user, position your hands and forearms where they would be when using the keyboard and adjust the worksurface height to match this position. Type a bit and fine tune the worksurface height as needed.

Fixed/Adjustable worksurface height

One last scenario is for the fixed/adjustable worksurface; this are generally the modular wall mounted worksurfaces. Recall these are height adjustable, however once the height is set you don’t change it on a frequent basis.

So, the worksurface is adjustable but how do you figure the correct height?

Access to adjustable sit/stand workstation

If you have access to an adjustable sit/stand workstation available, make use of it following the adjustable worksurface height strategy. Once you have the worksurface height dialed in, take a measurement from the floor to the top of the worksurface, this is the recommended height for the modular wall mounted worksurface.

Generally, these can be adjusted in one inch increments; if the measurement is halfway between, the rule of thumb is go the ½ inch higher rather than the ½ inch lower. This strategy tends to promote better seated posture.

No access to adjustable sit/stand workstation

If you don’t have access to an adjustable sit/stand workstation follow this strategy. First adjust the chair’s seatpan height so the hips are slightly higher or equal to the knees and the feet supported on the floor. Locate a specific point on the chair and take a vertical measurement from that point to the floor.

Next have the person adjust the chair seatpan height to place their hands on the keyboard using their identified keyboard technique, “piano player” or “forearm supporter”. Using the same point on the chair take a second measurement to the

floor. The difference between the two measurements is how much the current worksurface height needs to be changed.

So, let's say the initial worksurface height was 29". The chair seatpan height was raised to obtain to recommended placement. The difference in the two measurements was 2". This tells us the current worksurface should be lowered by 2" to 27".

So, there you have it; the correct worksurface height when seated.

Standing keyboard/worksurface height relationship

To determine the correct standing worksurface height you basically use the same strategy as for the seated position but from the standing position.

- Stand comfortably tall; not forced erect tall but not slumped either.
- For the piano player style position the hands as if using the keyboard and then adjust the worksurface height to match.
- For the forearm supporter style position the hands and forearms appropriately and adjust the worksurface height.

Poor Technique

If you observe really poor keyboard technique; very slow and the most commonly used keys are backspace and delete, a recommendation is for the user to invest time in one of the computer training programs that teach improved technique. A keying speed increase from 20 words per minute to even just 40 words per minute can be a huge productivity boost.



Take a break

One of the biggest problems with the modern computer is that it does not cue us to take a break. There are a number of human movements, such as reaching our arms over head, arching the back or rotating the neck, that are normal human movements, but are not a normal part of the day. The computer workstation is notorious for discouraging much movement. For that reason, people need to recognize the need for adding stretching to the day.

Case Study: Keyboard

Let's examine the **Keyboard Section** of the **Office Ergonomics Workstation Evaluation Worksheet**.

Document the **Type** of keyboard used (Straight/Curved/Articulated/Other), keyboard **Technique** (Piano Player or Forearm Supporter), if **Keyboard Shortcuts** are used and any **Maintenance** issues (sticky keys). Next indicate if **Issues** exist (YES or NO).

Under the **Comment** and **Recommendation** sections check the appropriate box and add any pertinent comments. A one-to-one correlation should exist between the Comment and the Recommendation. If you comment the keyboard location does not allow neutral hand/arm position, the recommendation should present a solution.



Keyboard		Comment	Recommendation
Type	<input checked="" type="checkbox"/> Straight <input type="checkbox"/> Curved <input type="checkbox"/> Articulated <input type="checkbox"/> Other	<input type="checkbox"/> Keyboard type and location appropriate <input type="checkbox"/> Keyboard type does not allow neutral arm/hand position	<input type="checkbox"/> None <input checked="" type="checkbox"/> Adjusted keyboard position and provided user instruction <input type="checkbox"/> Replace keyboard (see comment)
Location	<input checked="" type="checkbox"/> Worksurface <input type="checkbox"/> Tray	<input checked="" type="checkbox"/> Keyboard location does not allow neutral arm/hand position	<input type="checkbox"/> Add gel keyboard wrist rest (see comment)
Technique	<input type="checkbox"/> Piano Player <input checked="" type="checkbox"/> Forearm Supporter	<input type="checkbox"/> No wrist rest in use for support <input checked="" type="checkbox"/> Other (comment)	<input checked="" type="checkbox"/> Other (comment)
Wrist Rest	<input type="checkbox"/> No <input checked="" type="checkbox"/> Yes	Tends to position the keyboard at the edge of the worksurface; results in inadequate support for upper extremities.	Keyboard positioned on worksurface to allow for forearm support on the worksurface.
Maint	<input checked="" type="checkbox"/> No <input type="checkbox"/> Yes		

Keyboard Trays

Response to desktop personal computers

Keyboard trays to initially position just the keyboard and then to also include the mouse once mouse use became more ubiquitous, were a response to the addition of personal computers to the office desk environment.

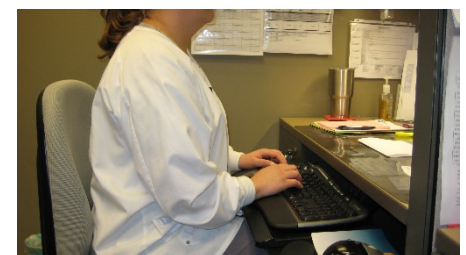
Offices had fixed height desks at 29"; when a keyboard was placed on the desk surface it took up needed desk space and also for many users, positioned the keyboard at too high of a level to provide for comfortable keyboard use. This was not a problem with typewriters because had their own home on the typewriter desk return which was set at 26" and often positioned at right angles to the desk proper.

Keyboard trays fulfilled an important role in the transition to desktop personal computers; millions of trays were retrofitted to desks. Typically, they were attached to a sliding platform mounted to the undersurface of the desk. They become more sophisticated in design to allow tray height and angle adjustment to better meet the user's postural requirements.

Keyboard trays have a downside; they will push the user about 10 to 12" away from the worksurface and can result in reach issues to materials on the desk, particularly for shorter arm individuals. The mechanism mounted under the desk can be a knee banger. Some trays lack height and angle adjustment features,

Some trays do not have enough room on the tray for both the keyboard and mouse; the mouse gets positioned outside the recommended reach zone.

Some trays have a separate mouse tray next to the keyboard tray that may position the mouse a lower level to the keyboard again resulting in out of neutral hand and wrist position.



Current keyboard tray use

With the advent of modular furniture that allows for fixed/adjustable worksurfaces and in the last several years of user-controlled, powered sit/stand worksurfaces, the need for keyboard trays is on the downward trend. Do they still have a role in the modern office environment? Depending on the circumstances the answer is a qualified, “Yes”.

Imagine a scenario where a fixed height stand-alone desk is still used; a keyboard tray may be the right answer to provide for appropriate keyboard and mouse access.

Another example is where the user needs a very precise placement of the tray in terms of height and angle.

Keyboard tray criteria

Based on the assessment the recommendation may be to remove a tray and provide an alternative suitable placement of the keyboard and mouse. If it is determined the tray is needed, make sure it is properly positioned and meets the following criteria:

- Tray size accommodates both the keyboard and mouse
- Mouse position is at the same level as the keyboard
- Tray is height and angle adjustable
- Knee clearance is adequate



Case Study: Keyboard Tray

Let's examine the **Keyboard Tray Section** of the **Office Ergonomics Workstation Evaluation Worksheet**.

Document if a **Tray** is in use. If in use is it **Height** and **Angle** adjustable and is the **Size** appropriate for both the keyboard and mouse.

Next indicate if **Issues** exist (YES or NO).

Under the **Comment** and **Recommendation** sections check the appropriate box and add any pertinent comments. A one-to-one correlation should exist between the Comment and the Recommendation. For example, if you comment the “keyboard tray limits reach access” the recommendation should present a solution.

Keyboard Tray		Comment	Recommendation
Tray in Use	<input checked="" type="checkbox"/> No <input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No keyboard tray, one needed <input type="checkbox"/> Keyboard tray appropriate	<input checked="" type="checkbox"/> None <input type="checkbox"/> Adjusted keyboard tray position and provided user instruction
Height Adjust	<input checked="" type="checkbox"/> NA <input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> Keyboard tray limits reach access to worksurface <input type="checkbox"/> Tray type does not allow neutral arm/hand position	<input type="checkbox"/> Remove keyboard tray (see comment) <input type="checkbox"/> Modify mouse tray to support mouse at same level as keyboard (see comment)
Angle Adjust	<input checked="" type="checkbox"/> NA <input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> Tray location does not allow neutral hand/arm position <input type="checkbox"/> Tray mouse platform does not position mouse at same height as keyboard	<input type="checkbox"/> Add keyboard/mouse tray (see comment) <input type="checkbox"/> Other (comment)
Size Fits	<input checked="" type="checkbox"/> NA <input type="checkbox"/> Keyboard only <input type="checkbox"/> Keyboard and mouse	<input type="checkbox"/> Other (comment)	

Mouse

No . . . not that kind of mouse!

The type of mouse we are talking about is one of a number of different types of pointing devices used to navigate through software programs.

In all practicality, the best way to use a mouse is to use it as little as possible. In other words, make full use of keyboard shortcuts as possible for navigation purposes.

Emphasis on keyboard use rather than the mouse limits the amount of time spent reaching to the mouse and also has a positive impact on productivity.



Mouse technique

Placement

In terms of placement, position the mouse in the same plane as the keyboard. Identify the particular mouse technique, this will be the same as for keyboard use:

- Free float piano playing style or
- Use of the worksurface for forearm support

Based on the technique, adjust the mouse position to get the correct height, reach and angle of the mouse to work in neutral.

Right or left hand use

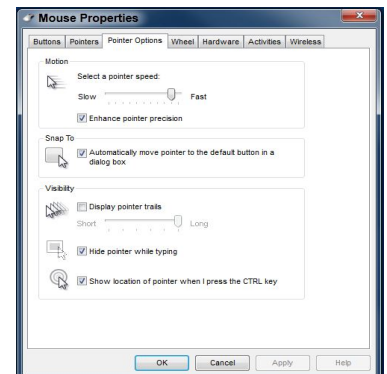
Some individuals may benefit from switching the hand used for mouse manipulation. If a right handed person is experiencing hand, wrist or forearm issues a switch to left hand mouse use will give the right side a break. To be successful this will take a motivated individual and some practice time. Refer to the Mouse Set-up Section for information regarding making changes to the mouse properties.

Mouse set-up

Mouse properties are typically user controllable. Depending on the mouse in use and the computer operating system, access the Mouse Properties dialog box to go through the mouse set-up.

Recommended properties to customize include:

- Button Configuration – Switch primary and secondary buttons
 - The primary button – often described as the left click button it is generally activated by the index finger. It is possible to swap which button on the mouse is the primary button. For instance, if mouse placement is switched from right hand use to left hand use, by swapping the primary button with the secondary button (right click) the index finger on the left continues to be used to click the primary button. This can make for an easier transition.

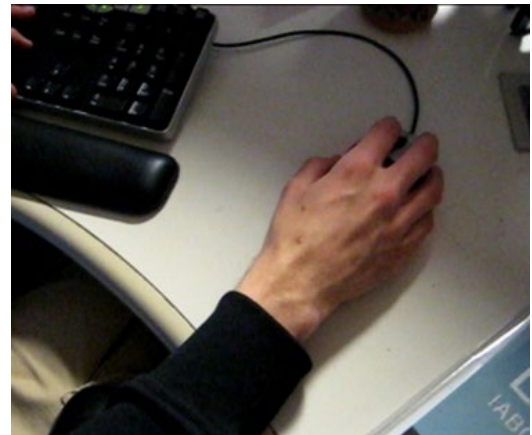


- Pointer Options
 - In Pointer Options the pointer or cursor speed can be slowed or speeded up. Typically, the goal is to set the Motion to as Fast as possible but still being able to stop the cursor where desired.
 - Snap To automatically moves the pointer to the default button in the dialog box. This reduces movement of the mouse itself.
 - Show location of the pointer when the CONTROL (CTRL) key is pressed. Very handy to locate the pointer particularly on multi-monitor set-ups.
- Wheel Vertical Scrolling
 - Controls the sensitivity of the scroll wheel by controlling how many lines of text are scrolled with one notch of the wheel. The default is set at 3 lines per notch. So, to go through 30 lines of text the wheel needs to be moved 10 notches. To decrease the finger movement on the scroll wheel, increase the default; setting of 10 lines means only 3 notches are needed. If the number is set too high, you will overshoot where you want to stop.

Mouse wrist rests

While wrist rests for keyboard use (if used correctly) are often a good idea, in most cases use of wrist rest for mouse use is not. The wrist rest tends to “anchor” the wrist with excessive deviation of the hand side-to-side.

Generally recommended use of the mouse is to allow straight in access allowing the forearm, wrist and hand moving as unit to manipulate the mouse. Think of the mouse as an extension of the arm NOT just an extension of the wrist.



Variety of pointing devices

There is no doubt the traditional mouse is by far the most commonly used pointing device. When properly positioned and setup it works well. However, there are a wide variety of pointing devices available with different shapes and styles that include touchpads, rollerballs, joysticks, pens and so on. Multiple buttons can be programmed to minimize keying. There are some even specifically designed for lefties. Workers should try different models and choose one that suits their needs.

The type of pointing device that works the best is based on the setup of the workstation, the job task and the personal preference of the user. With many mouse designs available here are general suggestions for selection:

Size - The mouse should fit into the hand and the fingers should be able to curl around it comfortably.

Shape - Find a mouse that reduces the need to place the heel of the hand on the desk. Some are larger, especially at the rear, and can support the entire hand.

Buttons - The location of the buttons is important. They should not be cramped nor too spread out. The pressure needed to click the buttons should not be so great that it tires the fingers, but neither should it be so sensitive that it is too easy to activate the buttons.

Scroll wheel – The scroll wheel allows for easy scrolling within a document.




Don't squeeze the mouse. Hold it loosely in the hand and relax the grip. A tight grip will not help to position the cursor any more accurately or quickly.





Program the mouse to manipulate the speed at which the cursor moves or the sensitivity of the buttons.

Wireless - Some pointing devices are wireless; this increases the flexibility of where it can be positioned.

Mouse Pros and Cons

Quite a number of types of pointing devices are available. Refer to the table below for pros and cons for each type of pointing device.

Pointing Device	Pros	Cons
Shell Mouse 	Relatively easy to learn how to use. Installed base is huge with most computer users first exposed to this traditional mouse. Universal shape used with either hand, some are right or left hand specific. Inexpensive.	Promotes “skating” of the mouse with subsequent out of neutral hand/wrist/arm/shoulder positions. Hand size is important to consider matching the correct size shell with hand size. Often poorly positioned in relation to user and keyboard.
Vertical 	Designed to place the hand in neutral position during use. Advantageous for some individuals with hand, wrist and forearm issues. Variety of shell sizes available for different size hands. Right and left hand configurations available.	If frequent reach to the keyboard is part of the job task may result in excessive hand/arm movement. Learning curve may be quite steep for some users. Minimum of one week trial basis to determine benefit is recommended. Typically, more expensive than a traditional mouse.
Roller Mouse 	Places the mouse directly in front of the user; eliminates side reach to traditional mouse. Incorporates a roller bar manipulated with fingers/thumbs. Advantageous for some individuals with hand, wrist and forearm issues. NOTE: keyboard not included.	Learning curve may be quite steep for some users. Minimum of one week trial basis to determine benefit is recommended. Typically, much more expensive than a traditional mouse. Must be able to fit in front of keyboard (will not work with curved keyboard).

Rollerball/Trackball 	<p>Can provide a stable platform for the hand that eliminates 'skating' of the traditional mouse.</p> <p>May be very effective in controlling wrist and elbow problems.</p> <p>Available in a variety of configurations with ball controlled by either the thumb or fingers or in some cases either.</p>	<p>Learning curve is quite steep. Some users never accept it.</p> <p>Hand size is important to consider matching the correct size shell with hand size.</p> <p>Concentrates stress into the fingers or thumb.</p> <p>Currently less popular.</p>
Touch Pad 	<p>Provides an alternative to the traditional and roller ball styles.</p> <p>Same as is typically used in laptops.</p> <p>Can be positioned independent of the keyboard.</p>	<p>Learning curve may be quite steep for some users.</p> <p>Typically, more expensive than a traditional mouse.</p>
Pen/Tablet 	<p>Often used by graphics designers who require the ability to 'draw' on the tablet.</p>	<p>Can be cumbersome for some users.</p> <p>More expensive than a traditional mouse.</p>
Joystick 	<p>Designed to place the hand in neutral position during use.</p> <p>Specific more to use in control room or equipment control environment.</p>	<p>Limited general use.</p> <p>If frequent reach to the keyboard is part of the job task may result in excessive hand/arm movement.</p>



Case Study: Mouse

Let's examine the **Mouse Section** of the **Office Ergonomics Workstation Evaluation Worksheet**.

Document the **Type** of mouse used (Shell/Rollerball/Vertical/Joystick/Touchpad/Other), **Location** (Worksurface/Tray), **Scroll Wheel** used (YES or NO) and **Set-up OK** (YES or NO).

Next indicate if **Issues** exist (YES or NO).

Under the **Comment** and **Recommendation** sections check the appropriate box and add any pertinent comments. A one-to-one correlation should exist between the Comment and the Recommendation. For example, if you comment the mouse location does not allow neutral hand/arm position, the recommendation should present a solution.

Mouse		Comment	Recommendation
Type	<input checked="" type="checkbox"/> Shell <input type="checkbox"/> Rollerball <input type="checkbox"/> Vertical <input type="checkbox"/> Touchpad <input type="checkbox"/> Other	<input type="checkbox"/> Mouse type and location appropriate <input type="checkbox"/> Mouse type does not allow neutral arm/hand position <input checked="" type="checkbox"/> Mouse location does not allow neutral arm/hand position <input type="checkbox"/> Mouse wrist rest in the way <input checked="" type="checkbox"/> Other (comment)	<input type="checkbox"/> None <input checked="" type="checkbox"/> Adjusted mouse position and provided user instruction <input type="checkbox"/> Replace mouse (see comment) <input type="checkbox"/> Remove mouse wrist rest <input checked="" type="checkbox"/> Other (comment)
Location	<input checked="" type="checkbox"/> Work surface <input type="checkbox"/> Tray	Tends to position the mouse at the edge of the worksurface; results in inadequate support for upper extremities.	Mouse positioned on worksurface to allow for forearm support on the worksurface.
Hand	<input checked="" type="checkbox"/> Right <input type="checkbox"/> Left		
Set-up OK	<input type="checkbox"/> No <input checked="" type="checkbox"/> Yes		

Laptop/Desktop

Placement

Slide 123

In many workplaces the laptop with a docking station has replaced stand-alone desktops as the primary computer system.

In some laptop situations, the monitor may be placed on top of the laptop docking station stand. This may position the monitor at too high a level. Refer to the Monitor Section for specific monitor placement information.

Other considerations include access to the laptop or desktop in terms of the on-off switch and access to the disk drives or ports. In that case, position the system on the worksurface or maybe on the floor on a computer stand with easy reach. On the other hand, if it really doesn't make much difference then position it so it is out of the way.

Remember that the laptops and desktop generate heat. Make sure ventilation around the computer isn't blocked – this could result in overheating problems.



Laptops and ergonomics

Design of laptops violates a basic ergonomic requirement for a computer, namely that the keyboard and screen are separated. The reason is simple - with a fixed design, if the keyboard is in an optimal position for the user, the screen isn't and if the screen is in optimal position the keyboard isn't.

This means that you need to pay special attention to how the laptop is used.



Laptop User Type

Determine the extent of laptops use; an **occasional user** who works on the laptop for short periods of time or a **full-time user** with the laptop as the main computer? Occasional users will have less risk of problems than full-time users. All users should pay some attention to how they use their laptop, but full-time users may have more problems.

Occasional Users

Because large muscles control the neck/head position and a pivot joint exists between the skull and first vertebrae, typically it is better sacrificing neck posture rather than wrist posture. For occasional use:

- Position the laptop in the lap or table for the most neutral wrist posture that can be achieved. This may involve adjusting chair seatpan height and ensuring appropriate foot support either on the floor or footrest.
- Angle the laptop screen so it can be seen with the least amount of neck deviation.

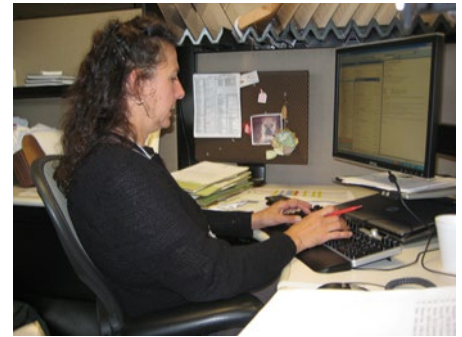
Full-time Users

If the laptop is the main computer, a docking station is strongly recommended to allow for a separate keyboard and mouse and also for separate monitor or monitors.

If a stand-alone monitor is not used the laptop monitor can be placed on a platform to position it at appropriate height and distance to the use.

Laptop transport

If the laptop is frequently transported, the weight of the system particularly if a separate keyboard and mouse are also transported. A wheeled bag or backpack is a viable option for transport.



Case Study: Laptop/Desktop

Let's examine the **Laptop/Desktop Section** of the **Office Ergonomics Workstation Evaluation Worksheet**.

Document the **Type** of system used (Desktop/Laptop), **Location** (Worksurface/Floor) and **In the Way** (YES or NO). Next indicate if **Issues** exist (YES or NO).

Under the **Comment** and **Recommendation** sections check the appropriate box and add any pertinent comments. A one-to-one correlation should exist between the Comment and the Recommendation. For example, if you comment the laptop is in the way the recommendation should present a solution.

Computer		Comment	Recommendation
Type	<input type="checkbox"/> Desktop <input checked="" type="checkbox"/> Laptop	<input checked="" type="checkbox"/> Computer type and location are appropriate <input type="checkbox"/> Computer in the way <input type="checkbox"/> Other (comment)	<input checked="" type="checkbox"/> None <input type="checkbox"/> Reposition computer out of way <input type="checkbox"/> Other (comment)
Location	<input checked="" type="checkbox"/> Work surface <input type="checkbox"/> Floor		

Monitors

Things have changed dramatically from the days when we used to spend our day reading/writing reports on paper.

Now, for most of us, everything we need access to can be viewed through the monitor or more and more so two or even more monitors on our desks.

While this has made our lives a bit easier, the demands of looking at monitors all day long can create some problems if not used appropriately.

Ever watch people when they are sitting looking at their monitors? It's almost like the monitor is a vacuum cleaner; they turn it on and it sucks their head right in!



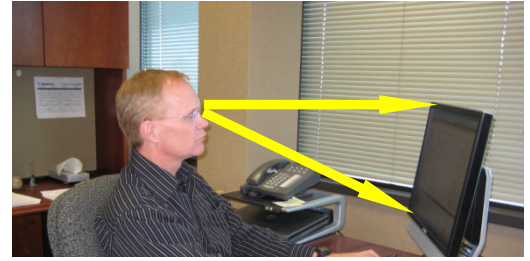
Monitor Placement

Height

A general guideline for monitor screen height is to position it so that the top of the screen is at eye level or slightly lower.

Trying to look at a screen higher than eye-level is uncomfortable because it forces the eyes to open wider than usual causing discomfort as well as a tendency for the eyes to become drier.

Also, with a monitor that's too high, the tendency is to tip the head back putting an additional strain into the neck and shoulders.



Monitor too high

If the monitors are too high, check if the monitor is on an adjustable height stand or monitor arm. If not on an arm, you may try either tipping the monitor forward a bit which in effect lowers the viewing area or raise the chair slightly (as long as this doesn't affect the ability to have adequate foot support.).

Remember, as a final option you may need to consider actually lowering the surface that the monitor is on. This is particularly true as monitors of larger size are more commonly in use. Recall this will influence the relationships you have established between the user and the workstation. For example, you may need to re-examine chair height, keyboard location and so on.

Monitor too low

If the monitor is too low and honestly with the advent of larger monitors this is less of an issue, monitor stands and arms can be employed.

A simple and effective solution for raising the monitor, maybe to place it on an old phone book or other material that places it at the desired height.

Distance

What is an appropriate monitor viewing distance?

Here's a general guideline: get the screen as far away from you as you can and still be able to read it clearly with good posture.

To demonstrate this, focus on a finger at arm's reach, slowly bring your finger toward your nose maintaining focus and notice the increase in stress in eyestrain the closer your finger gets to your eyes. The same thing will be true the closer your monitor gets to your eyes.



Bringing the monitor closer maybe as simple as sliding it closer on the desk. Moving it farther is generally a bit more complicated if simply sliding it farther away isn't an option.

First, figure out why you can't get your monitor farther away. It may be that the worksurface content can be reorganized. If it's not possible to reorganize your worksurface, consider reconfiguring how the monitor is placed on the desk. For

example, you might be able to place the monitor more in a corner of the worksurface to gain greater distance.

Another option you may have is to add a keyboard tray to the existing worksurface; this will let the user sit more comfortably at a greater distance from the monitor. Remember also that a keyboard tray will push the user farther away from the rest of the worksurface and may put some items out of a comfortable reach.

Alignment: side-to-side

Following the ergonomics principle of neutral position, the monitor or monitors should be positioned directly in line with the user to allow neutral head and neck position.

A monitor positioned off to the side results in out of neutral head, neck and spine position.



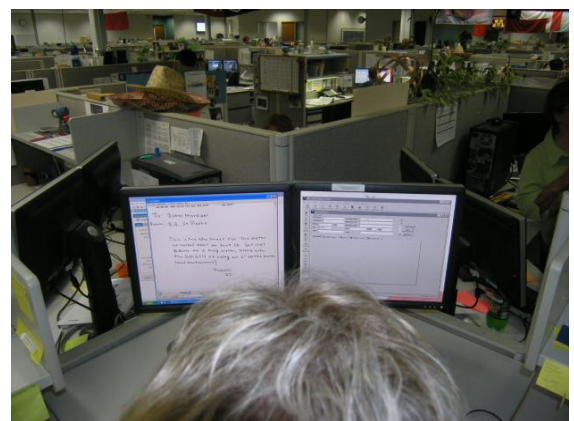
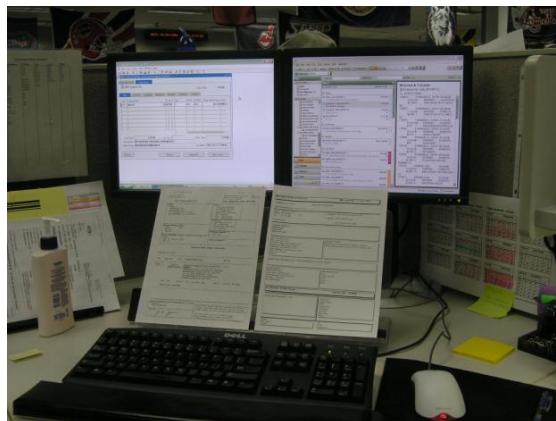
Dual Monitors

More and more use of dual monitors and even three or more, is coming into play. The second monitor provides for open programs to be viewed concurrently and comparison between two documents is much easier.

Typically, the monitors are positioned as Primary/Primary or Primary/Secondary setups. Also maintain a consistent viewing distance to the monitors by positioning the monitors in an angled array as opposed to in a straight-line.

Primary/Primary

In a Primary/Primary setup both monitors are viewed about 50% of the time each. The monitors should be positioned so they are centered on the user.



Primary/Secondary

In the Primary/Secondary setup one monitor is viewed most of the time with the second monitor viewed only occasionally.

The primary monitor should be positioned directly in front of user and the secondary monitor positioned off to the side directly next to the primary monitor.



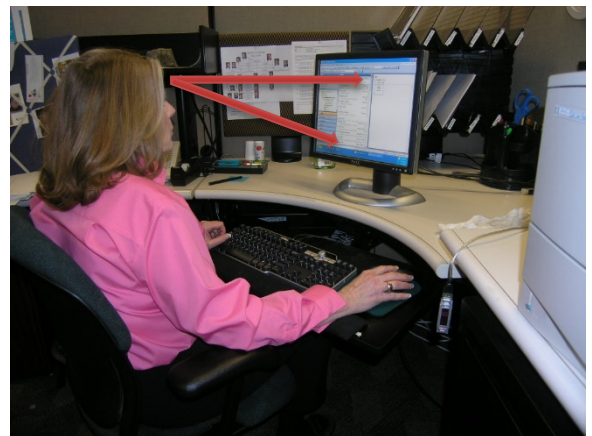
Monitor resolution

No doubt about it, LCD flat panel monitors are the predominant monitor type in use. LCD monitors have what is called Native Resolution. Here is a quick primer on monitor resolution. The LCD screen is made up of tiny cells in a matrix. For instance, if the native resolution is listed as 1680 x 1050, then there are 1680 cells across and 1050 cells down the screen. If the monitor is set to only display at 1680 x 1024, then a large number of the pixels are being 'stretched' over multiple cells, which is what causes the image quality to degrade.

Here is a quick way to check; if the user indicates the monitor is fuzzy but when viewed by someone else it is in focus, the person probably should have their eyes examined. However if both individuals note it is fuzzy, more than likely the issue is with the monitor and a call to IT is in order. Monitor display settings have a number of options to modify display scale and layout, display resolution, display orientation and use of multiple displays.

Functional monitor placement test

- Perform a functional monitor placement test by having the user, once properly seated in the chair, close their eyes and position their head in a balanced neutral position on their neck.
- From this position have them open their eyes. With proper monitor height, they should be able view the top third of the screen without any head movement.
- Next have them view the bottom third of the screen. Look for downward eye movement of up to 30 to 40° and perhaps a small amount of head down tip.
- Make any changes indicated.



Remember that it's all about relationships. Make sure the chair is set at the correct height and the user is in a typical seated posture as a guide to position the height of the monitors.

Glare

Glare on monitors is annoying and can lead to visual strain. First identify the source of the glare; it could be overhead lights or windows.

Control glare by positioning the monitor so that a light source is not behind the user or at an angle that can be reflected by the monitor. Ideally overhead light sources should be perpendicular to the monitor. If an overhead light is a bit behind and can be seen in the monitor, a glare hood on top of the monitor to shield it from the light is an option.

A glare screen added to the monitor will also control glare. In this case you truly get what you pay for. An inexpensive glare screen is generally just wire mesh; it will cut the glare but also will make it harder to read the text on the screen. Look for a good quality optical glass glare screen. Also, privacy screens are available that limit viewing of the screen from the side as well as control glare.

You don't want to have a light source such as window directly behind the monitor. The eyes try to adjust to the level of light coming in, and they have trouble adjusting to the light coming in from outside and the light generated from the monitor. If you can't place the monitor perpendicular to the light source, close the shades when working on the computer.

Check if brightness and contrast can be adjusted and adjust based on the user's perception of the overall quantity and quality of light in the workstation and the need to see what's on the monitor clearly and comfortably.

Clean screens

Dirty monitor screens are a lot like dirty eyeglasses, it isn't until you clean them that you realize they needed to be cleaned.

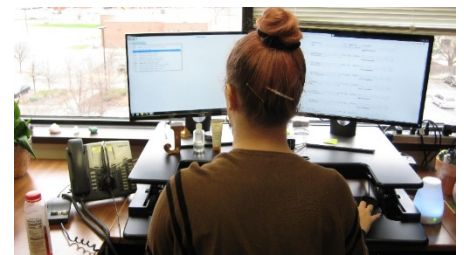
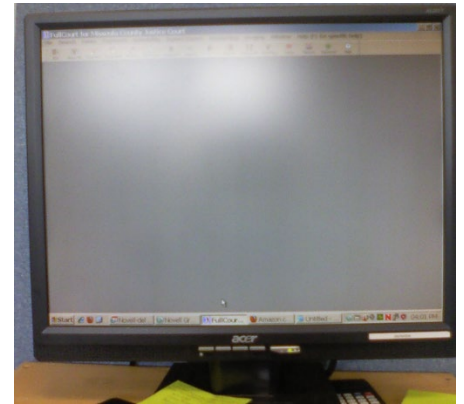
On a regular basis get into the habit of cleaning the monitor screen. There are a variety of sprays/cloths that are commercially available that are made specifically to safely clean the monitor screen.

Eye Examinations

Periodic eye examinations are important for general eye health and to determine if prescriptions for eyeglasses need to be updated.

The examiner should be informed regarding the amount and type of computer work performed.

Take a measurement of the distance from the eyes to the screen and take that into the person performing the examination. This will allow them to have information needed to provide a proper prescription for computer glasses.



Presbyopia

During middle age, usually beginning in the 40's, people experience blurred vision at near points, such as when reading, sewing, or working at the computer. There's no getting around it — this happens to everyone at some point in their life, even if they never had a vision problem before.

Called presbyopia, people find they need to hold books, magazines, newspapers, menus and other reading materials at arm's length in order to focus properly. When they perform near work, they may have headaches or eyestrain, or feel fatigued.

Presbyopia is caused by a slow loss of flexibility within the lens inside the eye.

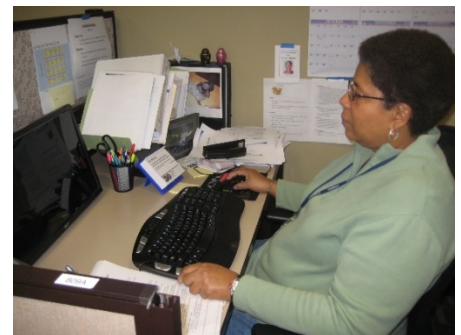
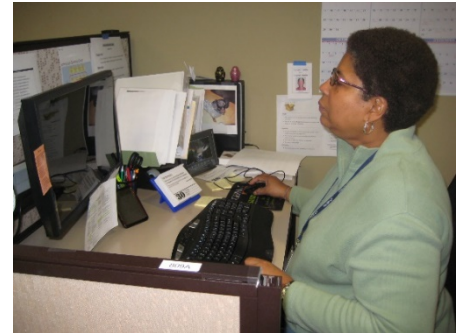
Glasses with bifocal or progressive addition lenses (PALs) are the most common correction for presbyopia. Bifocal means two points of focus: the main part of the spectacle lens contains a prescription for nearsightedness or farsightedness, while the lower portion of the lens holds the stronger near prescription for close work. Progressive addition lenses are similar to bifocal lenses, but they offer a more gradual visual transition between the two prescriptions.

Always be aware that bifocals may result in awkward head and neck position when viewing a computer screen. Options are to reposition the monitor to a lower level, trifocals where the middle of the lens is set for monitor viewing and separate computer glasses used only when at the computer.

Reading glasses are another choice. They may be worn just while doing close work and may even be prescribed to wear over the top of contact lenses (usually worn for distance correction). These glasses may be purchased over-the-counter at a retail store, or higher-quality versions may be prescribed by the eye care practitioner.

There are contact lenses for presbyopes, called multifocal lenses. Multifocal contact lenses in gas permeable or soft lens materials are available.

Another type of contact lens correction for presbyopia is monovision, in which one eye wears a distance prescription, and the other wears a prescription for near vision. The brain learns to favor one eye or the other for different tasks. But while some people are delighted with this solution, others complain of dizziness or nausea, or miss the depth perception they once had.



Case Study: Monitors

Let's examine the **Monitor Section** of the **Office Ergonomics Workstation Evaluation Worksheet**.

Document the **Number** of monitors used (Single/Dual/More), **Adjustable Stand/Arm** (YES or NO) **Resolution OK** (YES or NO) and **Placement OK** (YES or NO). Next indicate if **Issues** exist (YES or NO).

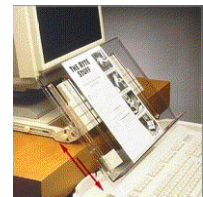
Under the **Comment** and **Recommendation** sections check the appropriate box and add any pertinent comments. A one-to-one correlation should exist between the Comment and the Recommendation. For example, if you comment the monitor is too high the recommendation should present a solution.

Monitor		Comment	Recommendation
Number	<input type="checkbox"/> Single <input type="checkbox"/> Dual <input checked="" type="checkbox"/> More the two	<input type="checkbox"/> Monitor type and location appropriate <input type="checkbox"/> Monitor too low <input type="checkbox"/> Monitor too high <input type="checkbox"/> Monitor too close <input type="checkbox"/> Monitor too far away	<input type="checkbox"/> None <input checked="" type="checkbox"/> Adjusted monitor position and provided user instruction <input type="checkbox"/> Add monitor arm (see comment) <input type="checkbox"/> Add monitor riser see (comment)
Viewing	<input type="checkbox"/> Primary/Primary <input checked="" type="checkbox"/> Primary/Secondary	<input checked="" type="checkbox"/> Monitor side-to-side alignment issue <input type="checkbox"/> Monitor resolution not appropriate. <input type="checkbox"/> Other (comment)	<input type="checkbox"/> Adjusted monitor resolution and provided user instruction <input type="checkbox"/> Other (comment)
Position OK	<input checked="" type="checkbox"/> No <input type="checkbox"/> Yes		
Adjustable Stand	<input type="checkbox"/> No <input checked="" type="checkbox"/> Yes		
Adjustable Arm	<input checked="" type="checkbox"/> No <input type="checkbox"/> Yes		
Resolution OK	<input checked="" type="checkbox"/> No <input type="checkbox"/> Yes		

Document holder

With the evolution to two or more monitors, less hardcopy material is being viewed at the computer, but the entirely paper-free office is still not quite here.

If in use, the hard copy should be placed on a document or hard copy holder to position documents on an incline and improve head and neck posture.



This can be placed either directly in front of the user between the monitor and keyboard if enough room is available or can be placed on a stand placed adjacent to the monitor. Both portrait and landscape format orientation document holders are available.

It is not essential the document be the exact same distance as the monitor from the user. In fact, many times if you try to put a holder right next to the monitor you put it out of the desired reach zone.



Case Study: Document Holder

Let's examine the **Document Holder Section** of the **Office Ergonomics Workstation Evaluation Worksheet**.

Document the **if a Holder** is in use (YES or NO), **Format** (Portrait/Landscape) and **Location** (Side/Front). Next indicate if **Issues** exist (YES or NO).

Under the **Comment** and **Recommendation** sections check the appropriate box and add any pertinent comments. A one-to-one correlation should exist between the Comment and the Recommendation. For example, "No document holder in use - awkward head/neck position", the recommendation should present a solution.

Document holder		Comment	Recommendation
Holder	<input type="checkbox"/> No <input checked="" type="checkbox"/> Yes	<input checked="" type="checkbox"/> Document holder OK <input type="checkbox"/> No document holder in use - not needed <input type="checkbox"/> No document holder in use - awkward head/neck position <input type="checkbox"/> Other(comment)	<input checked="" type="checkbox"/> None <input type="checkbox"/> Add landscape holder (see comment) <input type="checkbox"/> Add portrait holder (see comment) <input type="checkbox"/> Other (comment)
Format	<input type="checkbox"/> NA <input checked="" type="checkbox"/> Portrait <input type="checkbox"/> Landscape		
Location	<input type="checkbox"/> NA <input checked="" type="checkbox"/> Side <input type="checkbox"/> Front		

Telephone

Frequency and duration

The telephone is an essential part of our offices. Think for a moment about how much time we spend on the telephone and how important is it for us to have a proper telephone set up? If we make only a few calls a day, it really doesn't have much of an impact.

On the other hand, if we spend hours on the phone every day or if we make frequent short calls here are some things to consider. The position of the head/shoulder/hand can be an issue with telephone use. If a telephone handset is used, how is it held? Between the ear and shoulder forcing out-of-neutral head and neck posture?

Where is the telephone located on the desk? Which side of the desk is it on; right or left? Is the telephone within an acceptable reach zone to access and dial?



Headsets

To improve head/shoulder/hand position, more and more people who use a telephone on a frequent and regular basis are switching to headsets. This frees up both the neck and hands and allows a good neutral position.

Several different types of headsets are available, and you'll want to find one that works the best for the user. Over-the-head and over-the-ear versions are available either in wired or wireless formats.

It does take a little while to get used to headsets, so give it some time.

Think about where to store the headset when not in use. Sometimes a small hook on the wall or on the computer monitor for example, can be a good storage place. This keeps it off the worksurface and also keeps it in ready reach.



Cradle

You could add a phone cradle onto a telephone handset. This does help to put the head and neck in a better position, but it still results in tension in the neck and shoulder to position the telephone handset.

Our recommendation is to not use phone cradles on a regular basis. A headset is a much better solution in most cases.



Speaker phone

An alternative to a handset or a headset is a speaker phone. Private offices are more amenable to speaker phone use.

Sound quality

Poor sound quality and low-volume are problems in the effective use of the telephone. If either the sound quality or volume is identified as an issue, see if there are any adjustments that can be made to improve it. If not, you may want to investigate replacing or exchanging the telephone handset or headset.



Case Study: Telephone

Document the **Type** of telephone used (Handset/Headset/ Speaker) and, **Location on desk** (Left/Right). Next indicate if **Issues** exist (YES or NO).

Under the **Comment** and **Recommendation** sections check the appropriate box and add any pertinent comments. A one-to-one correlation should exist between the Comment and the Recommendation. For example, if you comment the “Telephone located in awkward position”, the recommendation should present a solution.

Telephone		Comment	Recommendation
Type	<input checked="" type="checkbox"/> Handset <input checked="" type="checkbox"/> Headset <input checked="" type="checkbox"/> Speaker <input type="checkbox"/> Mobile	<input checked="" type="checkbox"/> Telephone type and location appropriate <input type="checkbox"/> Telephone located in awkward position <input type="checkbox"/> Awkward head/neck position with handset use <input type="checkbox"/> Other (comment)	<input checked="" type="checkbox"/> None <input type="checkbox"/> Add headset to allow for hands-free operation (see comment) <input type="checkbox"/> Reposition telephone <input type="checkbox"/> Other (comment)
Location	<input type="checkbox"/> Left <input type="checkbox"/> Right		

Office equipment storage

Make use of the principles we have discussed to position office equipment and materials.

It’s amazing how much stuff we can accumulate in our offices; on desktops, in file cabinets, on shelves and in overhead cabinets.

The old adage, “a place for everything and everything in its place” makes good sense.

On a regular basis make sure office equipment and materials can be easily placed and removed from their storage locations in file cabinets, drawers, shelves and cabinets.

Understand and make use of the reach zones: primary, secondary and tertiary.



Storage

Primary- desktop

In primary storage locations like the desktop, place commonly and frequently accessed materials that can be easily and safely reached while seated in the chair.

Documents, pens, paper, staplers, etc. are included in this category.



Secondary - desktop, shelf, file

For materials that are only occasionally accessed be careful they are not located in the “gray” or danger zone on the desktop or shelf or in a file cabinet that can be reached by over-extending from the seated position.

Ensure these items are light weight with a low frequency of access to limit stress and really the best bet is to them move into either the primary location or remove them to the tertiary location.



Tertiary – shelf, file

For materials on shelves and in file cabinets that are accessed only occasionally and maybe quite heavy, locate them so it requires repositioning the chair or actually getting out of chair to reach them.



File cabinet types

If you try to put 50 files in a file cabinet that holds 30, you’re going to have problems trying to get them in and out. This creates a great deal of unnecessary additional work as well as the potential for musculoskeletal disorders. (And not to mention the frustration that goes along with.)

Make good use of the different types available:

- Vertical
- Lateral and
- Rolling



Case Study: Storage

Document if **Desktop/Shelf/File** storage is ok (YES or NO).

Next indicate if **Issues** exist (YES or NO).

Under the **Comment** and **Recommendation** sections check the appropriate box and add any pertinent comments. A one-to-one correlation should exist between the



Comment and the Recommendation. For example, if you comment “Limited desktop storage”, the recommendation should present a solution.

Storage		Comment	Recommendation
Desktop OK	<input type="checkbox"/> No <input checked="" type="checkbox"/> Yes	<input checked="" type="checkbox"/> Adequate desktop and file storage <input type="checkbox"/> Limited desktop storage <input type="checkbox"/> Limited file storage <input type="checkbox"/> Other (comment)	<input checked="" type="checkbox"/> None <input type="checkbox"/> Housecleaning to free up space <input type="checkbox"/> Add additional file storage (see comment) <input type="checkbox"/> Other (comment)
File OK	<input type="checkbox"/> No <input checked="" type="checkbox"/> Yes		

Illumination

Lighting is a big issue. Lighting design within an office setting can get quite complicated and detailed. The recommendation is to work with lighting designers to tackle large jobs.

When you think about light in the office, think about two things: ambient light that allows you to see in the office and task light that is specifically focused on the work itself.



Ambient light

General light in the office may be an issue: either too much or not enough light. If this is identified as an issue, contact the appropriate building facilities staff for assistance.

Task light

Task lights are a great way to add additional light where needed. They come in a variety of configurations and wattage. For example, a desktop lamp to provide additional light on the document holder may be needed. How the light is positioned is important; don't point it directly at the computer screen or into the user's eyes.

For a bulletin board where information is posted; a task light attached to a wall panel or other surface and pointed at the bulletin board can provide proper illumination.



Case Study: Illumination

Document if the **Ambient/Task Light** is ok (YES or NO).

Next indicate if **Issues** exist (YES or NO).

Under the **Comment** and **Recommendation** sections check the appropriate box and add any pertinent comments. A one-to-one correlation should exist between the Comment and the Recommendation. For example, if you comment “Task lighting too low”, the recommendation should present a solution.



Illumination		Comment	Recommendation
Overhead OK	<input type="checkbox"/> No <input checked="" type="checkbox"/> Yes	<input checked="" type="checkbox"/> Ambient and task lighting appropriate <input type="checkbox"/> Ambient light level too high <input type="checkbox"/> Ambient light level too low <input type="checkbox"/> Task lighting too low <input type="checkbox"/> Task lighting too high <input type="checkbox"/> Other (comment)	<input checked="" type="checkbox"/> None <input type="checkbox"/> Increase ambient light level (see comment) <input type="checkbox"/> Decrease ambient light level (see comments) <input type="checkbox"/> Add desktop task light (see comment) <input type="checkbox"/> Remove desktop task light (see comment) <input type="checkbox"/> Other (comment)
Task OK	<input type="checkbox"/> No <input checked="" type="checkbox"/> Yes		



Recommended Specifications

Once the assessment has been completed, generate the Recommended Specifications. Refer to the notes below for details needed to take the measurements.

Recommended Specifications (inches)				Key
Specification	Sit	Stand	Description	
Seatpan height:	18	NA	Seatpan height: distance from floor to seatpan (at side of seatpan) with user in chair.	
Seatpan depth:	18		Seatpan depth: distance from back support to front of seatpan and allows for 1.5 to 2" of space between back of knee and front of seatpan.	
Seatpan width:	18		Seatpan width: outside distance from side-to-side of seatpan; allows for 1.5 to 2" between thigh and edge of seatpan.	
Armrest height:	28		Armrest height: distance from top of armrest to floor.	
Armrest width:	22		Armrest width: distance between armrests measured from outside edge of each armrest.	
Writing / reading desk:	27	38	Worksurface height: (writing/reading desk) distance from floor to top surface of worksurface.	
Keyboard / mouse height:	27	38	Keyboard/mouse height: distance from floor to top surface of platform that keyboard/mouse rest on.	
Monitor height:	44	56	Monitor height: height from floor to top of monitor screen (not top of monitor bezel).	
Monitor distance:	24		Monitor distance: from eye position (bridge of nose between eyes) to screen.	

NOTES

Seatpan height is measured as the distance from the floor to the seatpan (at the side of the seatpan) with the user in the chair. **Seatpan depth** is measured as the distance from the back support to the front of the seatpan and allows for 1.5 to 2" of space between the back of the knee and front of the seatpan.

Seatpan width is measured as the distance side-to-side of the seatpan and allows for 1.5 to 2" of space between the thigh and side of the seatpan.

Armrest height is measured as the distance from the top of the armrest to the floor.

Armrest width is measured as the distance between the outside edges of the armrest.

Worksurface height (writing/reading desk) is measured as the distance from the floor to the top surface of the worksurface.

Keyboard height is the distance from the floor to the top surface of the platform that the keyboard rests on. (It is not to the top of the keyboard.)

Mouse height is the distance from the floor to the top surface of the platform that the mouse rests on. (It is not to the top of the mouse.)

Monitor height is height from the floor to the top of the monitor screen (not the top of the monitor bezel.)

Monitor distance is from the eye position (bridge of the nose between the eyes) to the screen.



Assessment Follow-up

Schedule any follow-up assessments as indicated.

Follow-up	
Date: 10/2/20	Lee Wang has continued to fine tune the worksurface height for seated and standing positions; working well for her. Foot rest has been ordered.
Date:	
Date:	

Workshop Summary

A great number of ergonomics factors enter into the office workplace. Use the principles and ergonomics analysis process to offer solutions that are practical and effective! You can make a major difference for yourself and others you will assist.

Thanks for your time and attention!

SELECTED REFERENCES

Office Ergonomics

Human Factors and Ergonomics Society. (2007). ANSI/HFES 100-2007 Human Factors Engineering of Computer Workstations. Human Factors & Ergonomics Society

Jacko, J.A. (ed) (2012). Human-Computer Interaction Handbook: Fundamentals, Evolving Technologies, and Emerging Applications (3rd Ed.), CRC Press

Kroemer, Anne D., & Kroemer Karl H.E., (2nd ed), (2017), Office Ergonomics: Ease & Efficiency at Work, Taylor & Francis Group

Occupational Safety and Health Administration, (2019) Computer Workstations eTool, <https://www.osha.gov/SLTC/etools/computerworkstations/>

Pronk NP, Katz AS, Lowry M, Payfer JR. Reducing Occupational Sitting Time and Improving Worker Health: The Take-a-Stand Project, 2011. Prev Chronic Dis 2012;9:110323

Rogers, Y., Sharp, H., & Preece, J. (2011). Interaction Design: Beyond Human Computer Interaction (3rd Ed.). Wiley

Shneiderman, B., Plaisant, C., Cohen, M., & Jacobs, S. (2009). Designing the User Interface: Strategies for Effective Human-Computer Interaction (5th Ed.). Prentice Hall

Washington State Department of Labor and Industries, (2019), Office Ergonomics: Practical solutions for a safer workplace, <http://www.lni.wa.gov/IPUB/417-133-000.pdf>

Primary Ergonomics References

Bridger, R. S. (2008). Introduction to Ergonomics (3rd Ed.). CRC Press

Chaffin, D.B., Andersson, G.B.J., & Martin, B.J. (2006). Occupational Biomechanics (4th Ed.). Wiley Interscience

Guastello, S. J. (2006). Human factors engineering and ergonomics: A systems approach. CRC Press

Helander, M. (2005). A Guide to Human Factors and Ergonomics (2nd Ed.). CRC Press

Lehto, M. & Landry, S. J. (2012). Introduction to Human Factors and Ergonomics for Engineers (2nd Ed.). CRC Press

Salvendy, G. (Ed.) (2012). Handbook of Human Factors and Ergonomics (4th Ed.). Wiley

Wickens, C. D., Hollands, J. G., Parasuraman, R., & Banbury, S. (2012). Engineering Psychology and Human Performance (4th Ed.). Pearson

Journals (Selected)

Applied Ergonomics, Elsevier Science Ltd.

Ergonomics, Taylor and Francis.

Human Factors, Human Factors and Ergonomics Society.

(Reference www.ergoweb.com for a list of ergonomics related journals)

Professional Organizations

American Industrial Hygiene Association
2700 Prosperity Avenue, #250
Fairfax, VA 22031
(703) 849-8888

American Society of Safety Engineers
1800 E. Oakton St.
Des Plaines, IL 60018-2187
(847) 699-2929

Human Factors and Ergonomics Society
PO Box 1369
Santa Monica, CA 90406-1369
(310) 394-1811

International Ergonomics Association
Secretary General IEA
Pieter Rookmaaker
SEARBO/Ergonomics
PO Box 2286
3500 GG Utrecht
The Netherlands
+31 30 2399455

National Safety Council
444 North Michigan Avenue
Chicago, IL 60611
(800) 621-7619