

COMPUTER ERGONOMICS

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Ergonomic Guidelines for arranging a Computer Workstation - 10 steps for users

Creating a good ergonomic working arrangement is important to protecting your health. The following 10 steps are a brief summary of those things that most Ergonomists agree are important. If you follow the 10 steps they should help you to improve your working arrangement. You can also use the Computer Workstation Checklist to help to pinpoint any areas of concern and take a look at the 'Computer Workstation Summary Diagram' for specific tips. However, every situation is different, and if you can't seem to get your arrangement to feel right or you are confused about some of the following recommendations you should seek professional advice.

10 steps for a good ergonomic workstation arrangement

Work through the following 10 steps to help you decide on what will be a good ergonomic design for your situation:

1. How will the computer be used?

- who will be using the computer? - If the computer will only be used by one person then the arrangement can be optimized for that person's size and shape, and features such as an adjustable height chair may be unnecessary. If it's going to be used by several people, you will need to create an arrangement that most closely satisfies the needs of the extremes, that is the smallest and tallest, thinnest and broadest persons, as well as those in between these extremes.
- **how long will people be using the computer?** If it's a few minutes a day then ergonomic issues may not be a high priority. If it's more than 1 hour per day it is advisable that you create an ergonomic arrangement. If it's more than 4 hours then you should immediately implement an ergonomic arrangement.

2. What kind of computer will be used?

- **Desktops** - most ergonomic guidelines for computer workstation arrangements assume that you will be using a **desktop system** where the computer screen is separate from the keyboard.
- **Laptop computers** are growing in popularity and are great for short periods of computer work. Guidelines for laptop use are more difficult because laptop design inherently is problematic - when the screen is at a comfortable height and distance the keyboard isn't and vice versa. For sustained use you should consider purchasing either:

- an external monitor
- an external keyboard, preferably with a negative-tilt keyboard tray
- both, and
- a docking station

and then arranging your workspace to create a good workstation layout. See "5 tips for using a Laptop Computer".

3. **What furniture will you use?** Make sure that the computer (monitor, CPU system unit, keyboard, mouse) are placed on a stable working surface (nothing that wobbles) with adequate room for proper arrangement. If this work surface is going to be used for writing on paper as well as computer use a flat surface that is between 28"-30" above the floor (suitable for most adults). You should consider attaching a **keyboard/mouse tray system** to your work surface. Choose a system that is height adjustable, that allows you to tilt the keyboard down away from you slightly for better wrist posture (negative tilt), and that allows you to use the mouse with your upper arms relaxed and as close to the body as possible and with your wrist in a comfortable and neutral position.

Thinking about a **sit-stand workstation**, see below.

Thinking about a **height-adjustable split workstation**, see below.

4. **What chair will be used?** Choose a comfortable chair for the user to sit in. If only one person is using this the chair can even be at a fixed height providing that it is comfortable to sit on and has a good backrest that provides **lumbar support**. If more than one person will be using the computer, consider buying a chair with several ergonomic features. Studies show that the best seated posture is a reclined posture of 100-110 degrees NOT the upright 90 degree posture that is often portrayed. In the recommended posture the chair starts to work for the body and there are significant decreases in postural muscle activity and in intervertebral disc pressure in the lumbar spine. Erect sitting is NOT relaxed, sustainable sitting, reclined sitting is.

5. **What kind of work will the computer be used for?** Try to anticipate what type of software will be used most often.
- **Word processing** - arranging the best keyboard/mouse position is high priority.
 - **Surfing the net, graphic design** - arranging the best mouse position is high priority.
 - **Data entry**- arranging the best numeric keypad/keyboard is a high priority.
 - **Games** - arranging the best keyboard/mouse/game pad is a high priority.
6. **What can you see?** Make sure that any paper documents that you are reading are placed as close to the computer monitor as possible and that these are at a similar angle - use a document holder where possible.

The computer monitor should be placed:

- **directly in front of you and facing you**, not angled to the left or right. This helps to eliminate too much neck twisting. Also, whatever the user is working with, encourage him/her to use the screen scroll bars to ensure that what is being viewed most is in the center of the monitor rather than at the top or bottom of the screen.
- **center the monitor on the user** so that the body and/or neck isn't twisted when looking at the screen. However, if you are working with a large monitor and spend most of your time working with software like MSWord, which defaults to creating left aligned new pages, and you don't want to have to drag these to more central locations, try aligning yourself to a point about 1/3rd of the distance across the monitor from the left side.
- **put the monitor at a comfortable height** that doesn't make the user tilt their head up to see it or bend their neck down to see it. When you are seated comfortably, a user's eyes should be in line with a point on the screen about 2-3" below the top of the monitor casing (not the screen). Sit back in your chair at an angle of around 100-110 degrees (i.e. slight recline) and hold your right arm out horizontally, your middle finger should almost touch the center of the screen. From that starting position you can then make minor changes to screen height and angle to suit. Research shows the center of the monitor should be about 17-18 degrees below horizontal for optimal viewing, and this is where it will be if you follow the simple arm extension/finger pointing tip. You actually see more visual field below the horizon than above this (look down a corridor and you'll see more of the floor than the ceiling), so at this position the user should comfortably be able to see more of the screen. If the monitor is too low, you will crane their neck forwards, if it's too high you'll tilt their head backwards and end up with neck/shoulder pain.
- **bifocals and progressive lens** - even if you wear bifocals or progressive lens, if you sit back in your chair in a reclined posture (with you back at around 110 degrees) that is recommended for good low back health, rather than sitting erect at 90 degrees, and if you slightly tilt the monitor backwards and place this at a comfortable height you should be able to see the screen without tilting your head back or craning your neck forwards. Postural problems with bifocals can occur if you sits erect or even hunched forwards. The problem with low monitors is that they cause neck

flexion and suffer more from glare. Recent studies have shown that the best position for a computer monitor is for the center of the screen to be at around 17.5 degrees below eye level. Try to align your eyes with the top of the viewing area of the screen, and this should put the center about right geometrically.

- **viewing distance** - the monitor should be at a comfortable horizontal distance for viewing, which usually is around an arms length (sit back in your chair and raise your arm and your fingers should touch the screen). At this distance you should be able to see the viewing area of the monitor without making head movements. If text looks too small then either use a larger font or magnify the screen image in the software rather than sitting closer to the monitor.
- **screen quality** - use a good quality computer screen. Make sure that the text characters on your screen look sharp, and that they are a comfortable size (you can change the screen resolution to find a comfortable and clear character size). If you can see the screen flickering out of the corner of your eye you should try increasing the refresh rate of your monitor (with a PC you can change monitor resolution and refresh rates using the Monitor control panel in your Settings folder, with a Mac you can use the Monitor control panel). You can also consider using a good quality glass anti-glare filter or an LCD display (like a laptop screen).
- **eye checkup** - there are natural changes in vision that occur in most people during their early 0's. It's a good idea to periodically have your eyes checked by a qualified professional.
- If any screen adjustments feel uncomfortable then change them until the arrangement feels more comfortable or seek further professional help.

7. **Posture, posture posture!** Good posture is the basis of good workstation ergonomics. Good posture is the best way to avoid a computer-related injury. **To ensure good user posture:**

- **Watch the user's posture!**
 - Make sure that the user can reach the keyboard keys with their wrists as flat as possible (not bent up or down) and straight (not bent left or right).
 - Make sure that the user's elbow angle (the angle between the inner surface of the upper arm and the forearm) is at or greater than 90 degrees to avoid nerve compression at the elbow.
 - Make sure that the upper arm and elbow are as close to the body and as relaxed as possible for mouse use - avoid overreaching. Also make sure that the wrist is as straight as possible when the mouse is being used.
 - Make sure the user sits back in the chair and has good back support. Also check that the feet can be placed flat on the floor or on a footrest.
 - Make sure the head and neck are as straight as possible .
 - Make sure the posture feels relaxed for the user.

8. **Keep it close!**

- Make sure that those things the user uses most frequently are placed closest to the user so that they can be conveniently and comfortably reached.
- Make sure that the user is centered on the alphanumeric keyboard. Most modern keyboards are asymmetrical in design (the alphanumeric keyboard is to the left and a numeric keypad to the right). If the outer edges of the keyboard are used as landmarks for centering the keyboard and monitor, the users hands will be deviated because the alphanumeric keys will be to the left of the user's midline. Move the keyboard so that the center of the alphanumeric keys (the B key, is centered on the mid-line of the user).
- make sure that the phone is also close to you if you frequently use it.

9. **A good workstation ergonomic arrangement** will allow any computer user to work in a neutral, relaxed, ideal typing posture that will minimize the risk of developing any injury. An ideal keyboard arrangement is to place this on a height adjustable negative-tilt tray. An ideal mouse arrangement is for this to be on a flat surface that's 1-2" above the keyboard and moveable over the numeric keypad. If you want a surface at the level of the keyboard base then make sure that this can also be angled downwards slightly to help to keep your hands in wrist neutral while you are mousing, and keep your elbow is as close to the body as possible while you work. Check out the 10 tips for using a computer mouse.

10. **Where will the computer be used?** Think about the following environmental conditions where the computer will be used:

- **Lighting** - make sure that the lighting isn't too bright. You shouldn't see any bright light glare on the computer screen. If you do, move the screen, lower the light level, use a good quality, glass anti-glare screen. Also make sure that the computer monitor screen isn't backed to a bright window or facing a bright window so that there's the screen looks washed out (use a shade or drapes to control window brightness).
- **Ventilation** - make sure that you use your computer somewhere that has adequate fresh-air ventilation and that has adequate heating or cooling so that you feel comfortable when you're working.
- **Noise** - noise can cause stress and that tenses your muscles which can increase injury risks. Try to choose a quiet place for your workstation, and use low volume music, preferably light classical, to mask the hum of any fans or other sound sources.

Below are several general recommendations for safe computer use:

1. **Take a break!** All Ergonomists agree that it's a good idea to take frequent, brief rest breaks: Practice the following:
 - **Eye breaks** - looking at a computer screen for a while causes some changes in how the eyes work, causes you to blink less often, and exposes more of the eye surface to the air. Every 15 minutes you should briefly look away from the screen for a minute or two to a more distant scene, preferably something more than 20 feet away. This lets the muscles inside the eye relax. Also, blink your eyes rapidly for a few seconds. This refreshes the tear film and clears dust from the eye surface.
 - **Micro-breaks** - most typing is done in bursts rather than continuously. Between these bursts of activity you should rest your hands in a relaxed, flat, straight posture. During a micro-break (< 2minutes) you can briefly stretch, stand up, move around, or do a different work task e.g. make a phone call). A micro-break isn't necessarily a break from work, but it's a break from the use of a particular set of muscles that's doing most of the work (e.g. the finger flexors if you're doing a lot of typing).
 - **Rest breaks** - every 30 to 60 minutes you should take a brief rest break. During this break stand up, move around and do something else. Go and get a drink of water, soda, tea, coffee or whatever. This allows you to rest and exercise different muscles and you'll feel less tired.
 - **Exercise breaks** - there are many stretching and gentle exercises that you can do to help relieve muscle fatigue. You should do these every 1-2 hours.
 - **Ergonomic software** - working at a computer can be hypnotic, and often you don't realize how long you've been working and how much you've been typing and mousing. You can get excellent ergonomic software that you can install on your computer (free download available at <http://www.magnitude.com>). The best software will run in the background and it will monitor how much you've been using the computer. It will prompt you to take a rest break at appropriate intervals, and it will suggest simple exercises.
2. **What about ergonomic gizmos?** These days just about everything is labeled as being "ergonomically designed" and much of the time this isn't true and these so-called ergonomic products can make things worse. If you're thinking about buying an "ergonomic product" as yourself the following 4 questions:
 - Does the product design and the manufacturer's claims make sense?
 - What research evidence can the manufacturer provide to support their claims? Be suspicious of products that haven't been studied by researchers.
 - Does it feel comfortable to use the product for a long period? Some ergonomic products may feel strange or

slightly uncomfortable at first because they often produce a change in your posture that's beneficial in the long-term. Think of some products as being like new shoes that initially may feel strange but then feel comfortable after being used for a while. If a product continues to feel uncomfortable after a reasonable trial period (say at least a week) time then stop using it.

- What do ergonomics experts say about the product? If they don't recommend it don't use it.

There are many computer-related "ergonomic" products, the most common ones being:

- **"ergonomic" keyboards** - most of these are keyboards where the alphanumeric keys are split at an angle. For a non-touch typist this design can be a disaster! The split design only addresses issues of hand ulnar deviation, and research studies show that vertical hand posture (wrist extension) is more important. There is no consistent research evidence that most of the split-keyboard designs currently available really produce any substantial postural benefits. For most people a regular keyboard design works just fine if it's put in the proper neutral position.
- **"ergonomic" mouses** (yes it's 'mouses' not 'mice') - many of these mouse designs or alternative input device designs can work well to improve your hand/wrist posture. However, it's important to check that you can use these with your upper arm relaxed and as close to your body as possible. Overreaching to an "ergonomic mouse" defeats any benefits of this design. Check out the 10 tips for using a computer mouse.
- **Wrist rests** - these were very popular a few years ago, but research studies haven't demonstrated any substantial benefits for wrist rests. In fact, a wrist rest can actually increase pressure inside the carpal tunnel by compressing the undersurface of the wrist (take a look at your wrist and you'll probably see blood vessels that shouldn't be compressed!). Studies by Dr. David Rempel at the University of Berkeley, California, show that pressure applied to the underside of the carpal tunnel is transferred into the tunnel itself via the transverse carpal ligament and that intracarpal pressure doubles with a wrist rest compared with floating the hands over a keyboard. If you choose to use a wrist rest, using one with a broad, flat, firm surface design works best, and rest the heel of your palm on this NOT your wrist. Try not to rest while you're actually typing, but rest in between bursts of typing movements. Avoid soft and squishy wrist rests because these will contour to your wrist, restrict the freedom of movement of your hands, and encourage more lateral deviation during typing. Look at the surface of a typical wrist rest that's been used and you'll see that it gets eroded away, which means that the user has been sliding their wrists over the surface which also compresses the blood vessels

often visible at the wrist. Remember, your hands should be able to glide above the surface of a wrist rest during typing, don't lock them in place on the rest while you type.

- **Support braces/gloves** - There is no consistent research evidence that wearing wrist supports during computer use actually helps reduce the risk of injury. If you do like wearing a wrist support make sure that it keeps your hand flat and straight, not bent upwards. There is some evidence that wearing wrist supports at night in bed can help relieve symptoms for those with carpal tunnel syndrome.
- **Sit-stand Workstations** - the use of a height adjustable worksurface for sitting and standing work is becoming fashionable. However, there is scant evidence that sit-stand furniture has cost effective benefits. The evidence suggests that there may be a reduction in back discomfort, but the research for this has not used adequate comparison groups (e.g. testing people who stand for the same time at the same frequency without doing keyboard/mouse work). There is no evidence that sit-stand improves wrist posture when keying or mousing. Logically, the real benefit of sit-stand is just that, changing between sitting and standing. But standing in a static posture is even more tiring than sitting in a static posture, so movement is important. We recommend that the most cost effective way to obtain the benefits from sitting and standing is for people to sit in a neutral work posture and then intermittently to stand and move around doing other things, like filing papers, making phone calls, getting coffee, making photocopies etc.) rather than trying to keyboard or use a mouse while standing.
- **Height adjustable, split worksurfaces** - with respect to wrist posture, the issues are the same for height adjustable, split worksurfaces and sit-stand worksurfaces:
 - If the surface is too low the hand will be in greater extension
 - If the surface is too high the elbow will be in sustained flexion
 - If it's a flat surface then it's just the same argument as is used above for a negative-slope keyboard tray arrangement.

You can't set a flat worksurface at an appropriate height for the 5 main tasks of office work - keyboarding, mousing, writing, viewing documents and viewing the screen- these all require different heights for an optimal arrangement. A negative-slope keyboard tray system serves as the height and angle adjustment mechanism for the keyboard, and the mouse platform serves as the height and angle adjustment for the mouse when attached to a worksurface that is set for writing height. Monitor height is best adjusted by a separate monitor pedestal rather than trying to move a whole worksurface. There are a number of new split worksurface designs that may work quite well to achieve optimal monitor positioning.

Performance Oriented Ergonomic Checklist For Computer (VDT) Workstations

(adapted from ErgoWeb, 1996, by the Cornell University Human Factors Group, Dept. Design & Environmental Analysis, 1996)

Introduction

Among Ergonomists there is general agreement with regard to proper computer workstation set-up, and the optimal body postures assumed by people performing tasks at the workstations. Unfortunately, quick and easy solutions to ergonomic problems, such as wrist rests, seldom help and sometimes they actually make matters worse. Likewise, recommending specific dimensions for workstations without knowledge of the anthropometrics of each user, the dimensions of equipment, and the nature of the work to be done can result in sub-optimal workstation arrangements.

This performance oriented checklist is designed to help you to evaluate what is needed for a good ergonomic workstation arrangement. Specific dimensional constraints intentionally are omitted and replaced by a principles oriented approach for this checklist. A checklist is a guide to good decision making, not an end point in itself. No checklist alone is able to capture the interactions and complexities of all possible combinations of people, task, equipment, and work environment. However, use of this checklist, along with an understanding of the principles of Ergonomics, will allow you to identify workstations which need redesign work, and it will give you guidance on the goals of any workstation redesign that is required.

At a minimum, while using this checklist, remember that designing for ergonomics requires understanding and consideration of

- the physical and psychological attributes of the person or population of people that will perform the job
- the design and arrangement of the workstation furniture, computer hardware, computer software, and other workstation accessories
- the tasks required to perform the job
- the work environment, including such things as noise and temperature, but also management and organizational methods and constraints

The interaction between these general topics is critical, and will define the postures, forces, and repetitions assumed by the person(s). Remember, all parts of the body are linked together, and consequently a modification in one area may have significant effects in another, no single change can be performed without considering the effects on other areas. For example, lowering seat height so that someone may comfortably rest his/her feet on the floor may force a stressful upper body posture if the monitor position and

table or keyboard height are not adjusted in concert (this is often a good reason to provide a footrest). When using this checklist,

- ask not whether the person can merely achieve these general goals, but whether the design of the workstation, task, and environment interfere with, obstruct, or outright inhibit a person from achieving them.
- remember that it is worded for use when reviewing one person and that person's VDT workstation, tasks, and working environment. If more than one person must use the same workstation, the checklist should be applied to each individual, and an easily adjustable workstation becomes even more important.
- remember that there is no "perfect posture for all time" and that a dynamic posture (frequent changes in posture) is a good way to reduce stress and redistribute pressure related to long duration static postures. However, work can be sustained for longer times without causing harm if the person is working in a neutral posture.
- remember that the checklist is not all inclusive, and may not cover all of the topics important to your specific situation.
- remember that a good ergonomics approach will improve comfort, productivity and quality, as well as health and safety.

"NO" responses indicate conditions that may be associated with higher risk of illness/injury and steps should be taken to address the source of the problem. "YES" responses to questions indicate acceptable ergonomic design conditions.

Performance Oriented Ergonomic Checklist

1. POSTURE

Lower Extremities

- Is the person able to rest the feet comfortably?
- Is the person able to sit with the knees in a comfortable position?
- Is the person free of uncomfortable pressure points, obstructions, or other interferences in the lower extremities?

Upper Extremities

- Is the person able to work with the head in a vertical orientation, such that the neck is not stressed by holding the head off balance from the neck and shoulders?
- Is the person able to work with the head facing forward of the plane of the upper body the majority of the time, such that repetitive or long duration head rotation is minimized?
- Is the person able to reach to objects on the workstation without extended reaching, especially where the reaching is held for long durations, is repetitive, or requires trunk/torso deviations?

Is the person able to work with comfortable arm positions, or approximately:

- neutral shoulder positions (upper arms tucked close to the body and hanging relaxed, not abducted out to the side, extended forwards or backwards, raised up, or hunched)?
- comfortable elbow positions that do not force shoulder or elbow positions from approximately neutral?
- neutral wrist positions (hands in a straight line with the lower arms, hands not flexed down towards the palm not extended up, nor bent towards the little finger, nor bent towards the thumb)?

Force Static Body Posture

- Do the workstation design and job requirements cause non neutral body positions to be held constant for extended periods of time?
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2. WORKSTATION AND ENVIRONMENT DESIGN FEATURES

Seat Surface

- Is the seat surface height adjustable, such that the person is able to set it at an individually comfortable height in relation to the required work activities?
- Is the seat surface of appropriate size, such that it is deep and wide enough to comfortably accommodate the specific person?
- Is the seat slope adjustable, such that the person is able to achieve a comfortable angle, either forward or rearward sloping?
- Is it comfortable and is the front well rounded ("waterfall" front edge), such that the person does not experience excess pressure on the under side of the leg due to the forward edge?
- Overall, is the seat comfortable to the person that is required to use it?

Seat Backrest

- Can the person easily adjust its height to provide mid lumbar support (lower back region)?
- Can the person easily adjust its angle relative to the seat surface?
- Can the person easily adjust it to alter the depth of the seat?
- Overall, is it comfortable to the person that is required to use it?

Worksurface

- With the lower limbs in comfortable positions and feet on the floor, can the person achieve a comfortable worksurface height?
- Is the width of the worksurface appropriate, such that all required task accessories and duties can be located within comfortable reach and viewing distance?
- Is the depth of the worksurface appropriate, such that the computer, and keyboard if necessary, can be placed directly forward of the person with the work orientation parallel to the plane of the upper body?
- Is the area under the desk large enough to accommodate the legs and any accessories, such as footrests and arm rests.

Computer Monitor (VDT)

- Is the person able to easily adjust the height of the monitor?
- Is the person able to easily adjust the fore-aft distance of the monitor?
- Is the person able to easily adjust the tilt (up/down) angle of the monitor?
- Is the person able to easily adjust the yaw angle (left/right rotation) of the monitor?

Keyboard

- Is the keyboard detachable from the VDT/computer monitor?
- Is the person able to easily adjust keyboard height?
- Is keystroke pressure comfortable to the person?
- Has the person correctly adjusted the angle of the keyboard so that their hands/wrists are in a neutral posture when they are typing? Placing the keyboard in a preset angle negative tilt keyboard tray that is height adjustable allows users to access the keyboard in a wrist neutral posture.

Mouse

- Is the shape and button activation comfortable and easy to operate for the person?
- Is the person able to reach and operate the mouse without extended, long duration, or repetitive reaching and with the shoulders, arms and wrists in a neutral posture?
- Is the mouse on a position adjustable platform surface, so that this can be used within the person's immediate reach zone?

Document Holder for Data Entry Tasks

- Is there a special holder or support for the source document?
- Is the person able to easily adjust the document holder height, distance and angle?
- Does the device prevent the document from vibrating?
- Is the device located such that the person is not required to twist the head/neck back and forth between the document and screen extensively or for long durations?

Support for the Hands and Arms

- Are seat or other padded armrests available?
- Are armrests adjustable (height, lateral position)?
- Is a broad, flat keyboard palm support available to support the hands in a [neutral posture](#) in between bursts of typing movements? (Not a wrist rest. Most wrist rests are soft and curved. They can put extra pressure on the carpal tunnel which lies at the wrist increase, and this increases the risk of an ergonomic injury).
- Is the palm supported for mouse use?

Support for the Feet

- Are the feet flat on the floor when the person is sitting comfortably at the workstation?
- Is a footrest available if needed and can the person able to easily adjust its height and its tilt?

Office Lighting

- Are lighting levels in the VDT/computer monitor area comfortable to the person?
- Is the monitor screen placed such that light from windows and overhead lighting do not cause glare? If not, are glare screens or other glare reducing methods used?
- Are diffusers, cube louvers or parabolic louvers used on overhead lights where screen glare from that source is a problem, or is indirect lighting used?
- Are movable task or desk lights available?
- Do work surfaces have a matte finish to reduce light reflection?
- Do windows have curtains, drapes or blinds to block light where glare from that source is a problem?

Temperature

- Is the person comfortable with the ambient temperatures?
- Is the person comfortable with the temperatures of any equipment or surfaces s/he must contact?

Vibration

- Does the person experience any uncomfortable building vibration (e.g. from mechanical systems, outside traffic)?
- Does the person experience any uncomfortable equipment vibration (e.g. from internal fans)?
- Does the person experience any uncomfortable keyboard vibration (e.g. wobble from an unstable keyboard tray)?

Noise

- Are sound levels at comfortable levels, allowing conversation and other communications without significant effort?
- Does the person experience any uncomfortable equipment noise sources (e.g. printer noise)?

Ventilation

- Is air circulation sufficient?
- Is air quality satisfactory?
- Is the air too dry or too humid?

Electrostatic Electricity

- Does the person frequently experience static electricity shocks?

3. THE WORKER

Fatigue Control

- Is the person allowed to take rest pauses or breaks from tasks that require long duration or repetitive postures, forces, keying or mousing activities?
- Is there job rotation or substitution of tasks which require a different type of activity where posture, force, and repetition hazards have not been addressed by design?

Vision

- Does the person wear bifocal glasses, causing him/her to tilt the head to see through the appropriate lens area?
- Are workers with symptoms of eye strain, burning sensation in the eyes, blurred vision, irritated eyes, or headache examined for vision problems?

Psycho-Social Issues

- Does the person have some involvement and control over the work process?
 - Is there good communication between the person and supervisors?
 - Has the person been adequately trained?
 - Is the software "user-friendly"?
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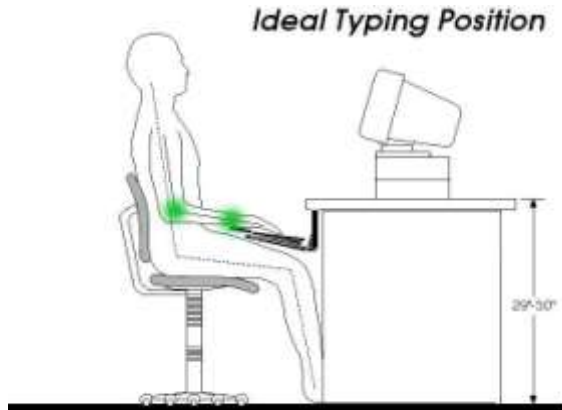
12 tips for an Ergonomic Computer Workstation



1. use a good chair with a dynamic chair back and sit back in this
2. top of monitor casing 2-3" (5-8 cm) above eye level
3. no glare on screen, use an optical glass anti-glare filter where needed
4. sit at arms length from monitor
5. feet on floor or stable footrest
6. use a document holder, preferably in-line with the computer screen
7. wrists flat and straight in relation to forearms to use keyboard/mouse/input device
8. arms and elbows relaxed close to body
9. center monitor and keyboard in front of you
10. use a negative tilt keyboard tray with an upper mouse platform or downward tiltable platform adjacent to keyboard
11. use a stable work surface and stable (no bounce) keyboard tray
12. take frequent short breaks (microbreaks)

Ideal typing posture: Negative slope keyboard support

In the ideal typing posture both static and dynamic muscle loads are minimized. This posture is achieved when the keyboard is below seated elbow height and the keyboard base is gently sloped away from the user so that the key tops are accessible to the hands in a neutral posture. In this position the arms, shoulders, neck and back can relax, especially during brief rest pauses. Also, in this slightly reclined sitting position the low back rests against the lumbar support of the chair, the elbow angle is opened to promote circulation to the lower arm and hand, the abdominal angle, and the popliteal angle (behind the knees) are opened to promote blood circulation. The feet rest firmly upon the floor.



Problem postures

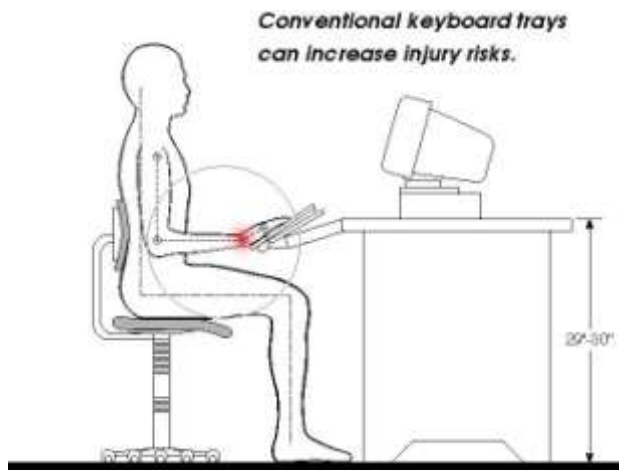
Desk top keyboard

Typing at a keyboard on a desk is a common work posture for many computer users. In this position it is difficult to maintain the wrist is in a neutral posture, because the forearms sag as they tire and this puts the wrists into greater wrist extension. Also, most users have to work with their elbows flexed, which can compress the median and ulnar nerves at the elbow and restrict blood flow to the hands. Working with the forearms sloping up increase muscle loads in the upper arms, shoulders, and neck. Working in this position for more than 3-4 hours invariably leads to muscle fatigue.



Conventional keyboard tray

Typing at a keyboard on a conventional articulating keyboard tray can increase postural problems for users. Working with the keyboard more steeply angled on the tray is a common work posture for many computer users. In this position it is also difficult to maintain the wrist in a neutral posture, because the forearms sag as they tire and this puts the wrists into greater wrist extension. Studies have failed to show that conventional keyboard trays substantially improve wrist posture.



5 Tips for Using a Laptop Computer

1. **Unergonomic Laptops** - the design of laptops violates a basic ergonomic requirement for a computer, namely that the keyboard and screen are separated. In the early days of personal computing desktop devices integrated the screen and keyboard into a single unit, and this resulted in widespread complaints of musculoskeletal discomfort. By the late 1970's a number of ergonomics design guidelines were written and all called for the separation of screen and keyboard. 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 optimal the keyboard isn't. Consequently, laptops are excluded from current ergonomic design requirements because none of the designs satisfy this basic need. This means that you need to pay special attention to how you use your laptop because it can cause you problems.
2. **Laptop User Type** - how to you use your laptop? Are you an **occasional user** who works on your laptop for short periods of time or are you a **full-time user** with the laptop as your 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.
3. **Laptop Posture** - as indicated above, laptops violate basic ergonomic design requirements, so using a laptop is a tradeoff between poor neck/head posture and poor hand/wrist posture.
 - **Occasional Users** - because the neck/head position is determined by the actions of large muscles, you are better off sacrificing neck posture rather than wrist posture. For occasional use:
 - find a chair that is comfortable and that you can sit back in
 - positioning your laptop in your lap for the most neutral wrist posture that you can achieve
 - angling the laptop screen so that you can see this with the least amount of neck deviation
 - **Full-time Users** - if you use your laptop at work as your main computer you should:
 - position this on your desk/worksurface in front of you so that you can see the screen without bending your neck. This may require that you elevate the laptop off the desk surface using a stable support surface, such as a computer monitor pedestal.
 - use a separate keyboard and mouse. You should be able to connect a keyboard and mouse directly to the back of the laptop or to a docking station
 - use the keyboard on a [negative-tilt keyboard tray](#) to ensure a wrist neutral posture
 - use the mouse on an adjustable position mouse platform

- follow the [postural guidelines for working at a computer workstation](#)
4. **Laptop dimensions** - many laptops offer large screens (15" plus) and can work as desktop replacements (giving the viewing area of a 17" monitor). However, think about where you will most use your laptop to help you choose the best size. The larger the screen the more difficult it will be to use this in mobile locations (e.g. airplane, car, train). There are a number of smaller notebook and ultraportable laptops on the market. Consider issues of screen size and screen resolution. A small screen (e.g. 12.1") will be useful in mobile settings, but if the resolution is high (e.g. XGA - 1024 x 768) make sure that you can read the screen characters and can easily use the input device to point to areas on the screen. The smaller the laptop, the smaller the keyboard, so make sure that you can comfortably type on a keyboard that may be only 75% the size of a regular keyboard.
 5. **Laptop weight** - if you are a mobile professional who will be frequently transporting your laptop think about the weight of the system. By the word 'system' I mean the weight of the laptop plus the required accessories (e.g. power supply, spare battery, external disk drive, zip drive, CD_RW etc.). Many lightweight portables can become as heavy as regular laptops when you add the weight of all of the components together. If your laptop + components weighs 10lbs or more then you should certainly consider using a carry-on bag that you can pull along. If you want a smaller bag and can comfortably carry your laptop consider a good shoulder bag design (e.g. see "The Perfect Laptop Bag" [article 1](#), [article 2](#)).
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How to choose an ergonomic chair

You should also check whether the chair will meet at least the following criteria:

- **Does the seat pan feel comfortable and fit your shape?**
When you sit in the chair the seat pan should be at least one inch wider than your hips and thighs on either side. The seat pan should not be too long for your legs otherwise it will either catch you behind the knees or it will prevent you from leaning fully back against the lumbar support. Most ergonomic chairs have a seat pan with a waterfall front that prevents the seat from catching you behind the knees. The seat pan should also be contoured to allow even weight distribution and it should be comfortable to sit on.
- **Is the seat chair height adjustable?**
For preference the chair should be pneumatically adjustable so that you can adjust seat pan height while you are sitting on the chair. Some chairs have a mechanical height adjustment (spinning) mechanism that is also acceptable.
- **Is the range of height adjustment of the chair sufficient to meet the needs of all users?**
You should be able to adjust the height of the seat pan so that the front of your knees is level or slightly below level and your feet are firmly on the ground. In most cases there should be no need for you to use a footrest. The mechanism to adjust seat height should be easy to reach and operate when you are seated.
- **Does the chair have a comfortable lumbar (lower back) back rest?**
Many chairs have cushioned lumbar supports that can be adjusted up and down and forwards and backwards to best fit your shape. If the chair will be used by multiple users then this level of adjustment may be required. If the chair has a fixed height lumbar support and it feels comfortable when you sit back against this, and you will be the primary user of the chair then a fixed lumbar support may be acceptable.
- **Is the chair back rest large enough to provide good back support?**
Many chairs have back supports that are large enough to provide mid-back and upper-back support, in addition to good lumbar support.
- **When you sit back against the lumbar support is there ample space for hip room?**
Insufficient hip room can make you sit too far forwards on the seat pan so that you will not have enough thigh support.

- **Does the seat pan still feel comfortable after you've been sitting in it for 60 - 120 minutes?**

If the seat pan is made from low-density foam then continuous use can cause it to become permanently deformed and then it will not provide adequate cushioned support. Insufficient cushioning and inappropriate contouring can cause discomfort, imbalance and hip and back fatigue.

- **Does the chair backrest recline and support your back in different positions?**
Movement of the back while you are sitting helps to maintain a healthy spine. Look for chairs that allow you to easily recline, that provide you with good back support in different recline postures, and that have a back that tracks where your back is. Locking the chair backrest in one position generally isn't recommended or beneficial to users.
- **Does the chair have a 5 pedestal base?**
If chair mobility is important to help you to do your work then the chair should have at least a 5 pedestal base with casters that glide freely over the floor surface. You may also want to choose a chair that swivels easily.
- **Do you need armrests on your chair?**
If so, are the armrests broad, contoured, cushioned and comfortable? While sitting can you easily adjust the height of the armrests and can you move the armrests closer together or further apart? Can you easily move the arms out of the way if you need to do this?

Other considerations:

- **Do you need a footrest?**
In the vast majority of situations you should not need a foot support to be able to sit comfortably on your chair? However, if you do need a foot support then choose a free-standing floor-mounted support that allow you to rest your feet out in front of you in a comfortable manner.
- **What chair covering is best?**
Chairs can be covered in a variety of upholstery materials, each of which has benefits and concerns. Vinyl and vinyl-like coverings are easy to clean and spill resistant, but they don't breath and if the chair begins to heat up under the thighs uncomfortable amounts of moisture can accumulate. Cloth upholstery is the most common covering, but this is less resistant to spills and more difficult to clean. A cloth covered seat pan can also become warm and moisture laden, and cloth covered foam seat pans can be a significant source of dust mite allergen. When selecting your chair covering think about cleaning and maintenance issues and plan appropriately.
- **Do you need an adjustable tilt seat pan ?**
In most situations this is not an essential feature. In some situations it can be helpful to change the tilt of the seat pan to help to maintain a balanced seated posture.

10 Tips for Using a Computer Mouse

The following tips should help you avoid a mouse-related musculoskeletal injury. The same posture principles apply to other input devices (e.g. trackball, touchpad, pen, digitizing puck etc.).

1. **Mouse Grip** - don't throttle your mouse (it's already dead)! Hold the mouse gently to move it over a mousing surface.
2. **Mouse from the Elbow** - don't skate or flick the mouse with your wrist. Make controlled mouse movements using your elbow as the pivot point and keep your wrist straight and neutral.
3. **Optimal Mouse position**- sit back in your chair, relax your arms then lift your mousing hand up, pivoting at the elbow, until your hand is just above elbow level. Your mouse should be positioned somewhere around this point. Don't use a mouse by stretching to the desk or out to the side of a keyboard. With a **flat mouse platform**, position this 1-2" above the keyboard and over the numeric keypad if you are right handed - you can easily move it out of the way if you need to access these keys. With a **downward sloping mouse platform**, position this close to the side of the keyboard so that you can use the mouse in a neutral wrist position. Position adjustable mouse platforms are commercially available (e.g. [Humanscale](#), [Proformix](#), [Flexrest](#), [3M](#) etc.)
4. **Protect your wrist** - if you look at the anatomy of the wrist it is curved away from any contact surface (you can easily see this by resting your hand/arm on a flat surface - you'll see light under the wrist and can probably even pass a thin pen under this). The forearm is shaped liked this for the wrist to remain free of surface pressure contact.
5. **Avoid restricting circulation** - For many people there are exposed blood vessels near the skin at the wrist, which is where the pulse is often taken. Any pressure in this region will disrupt circulation into the hand and this will increase the risks of injury.
6. **Don't use a Wrist Rest** - research has shown that using a wrist rest doubles the pressure inside the carpal tunnel, because the floor of the tunnel is a more flexible ligament that transmits external pressure changes directly into the carpal tunnel (the roof of the tunnel is bone so the pressure doesn't get transmitted on through the hand). Indeed, one test for carpal tunnel syndrome (CTS), known as Tinel's sign, simply involves tapping on the palmar surface of the wrist, which is enough to cause tingling and numbness in someone developing CTS.
7. **Avoid Restricting Arm Movement** - with a softly padded wrist rest, especially one that is rounded, or a soft chair arm rest the forearm becomes "locked" into

- position and this encourages people to make mouse movements by flicking the wrist, which also increases intracarpal pressure.
8. **Keep the Mouse Free Moving** - The base of the palm of the hand is the part of the body designed to support the hand when resting on a surface. For keyboard use a broad palm support is best. However, mouse use is different to keyboard use. With a keyboard the best posture is for users to float their hands over the keyboard when typing and then to rest on the palm support in microbreaks between typing bursts. You can use rest-breaking software (e.g. [Magnitude ErgoManager](#), [Break reminder](#) etc) to help track and advise on your mouse use. With mousing this doesn't happen. A mouse is used by moving it's location over a surface, and resting usually occurs when mouse movements stop but with the mouse still being held in the hand. Mouse movements should be made using the elbow as the pivot point, not the wrist. Anything that impairs free movement of the forearm/hand and mouse will increase injury risks.
 9. **Mouse shape** - choose a mouse design that fits your hand but is as flat as possible to reduce wrist extension. Don't use a curved mouse. Use a symmetrically shaped mouse. Consider a larger mouse, such as the [Whale mouse](#) or the [Perfit mouse](#), that encourage arm rather than wrist movements.
 10. **Load sharing** - if you want to load share between your right and left hands, that is using the mouse for some of the time with each hand. For this you need to choose a mouse platform that can easily be configured to the left or/and right, and a symmetrical shaped mouse that can be used by either hand.

Other input devices - whether you choose a different mouse design, a trackball, a joystick, a pen, a touchpad or some other input device, make sure that your position this comfortably, and that your wrist is in a neutral position when using the device. Personal favorite is the Fingerworks [iGesture Pad](#) (I do work with this company).

Summary recommendations:

- **Best** arrangement for a mouse is a platform over the numeric keypad and just above the keyboard.
- **Good** arrangement is a pad on an angled platform to the side of the keyboard.
- **Poor** arrangement is a flat surface to the side of the keyboard
- **Worst** arrangement is on the desk out to the side of the keyboard.

Other input options that don't cover the numeric keypad

If you need to frequently use the numeric keypad consider the following:

- a platform that incorporates a touchpad into the palmrest (e.g. [Proformix Intellitrax](#))
- an angled mousepad close to the side of the keyboard (e.g. [Humanscale platform](#); [Flexrest platform](#))
- a keyboard that has a touchpad built into the keyboard (e.g. [Crystal vision](#); [Cirque smooth cat](#)).