



TOOLS

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Computer Workstations



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



- Top of monitor at or just below eye level
- Head and neck balanced and in-line with torso
- Shoulders relaxed
- Elbows close to body and supported
- Lower back supported
- Wrists and hands in-line with forearms
- Adequate room for keyboard and mouse
- Feet flat on the floor

Consider your workstation as you read through each section and see if you can identify areas for improvement in posture, component placement, or work environment. This eTool provides suggestions to minimize or eliminate identified problems, and allows you to create your own "custom-fit" computer workstation.

Use a Checklist!

KNOWLEDGE IS THE KEY! Use the [evaluation checklist](#) to analyze existing workstations. Use the [purchasing guide checklist](#) to evaluate new purchases.

Quick Tips

Look for quick tip boxes to provide basic solutions for common hazards. A more in-depth look at computer workstation hazards and solutions can be found further down the page of each section.

**eTools are web-based products that provide guidance information for developing a comprehensive safety and health program. They include recommendations for good industry practice that often go beyond specific OSHA mandates. As indicated in the disclaimer, eTools do not create new OSHA requirements. Public Test Version for comments through May 2004.*

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Good Working Positions

To understand the best way to set up a computer workstation, it is helpful to understand the concept of neutral body positioning. This is a comfortable working posture in which your joints are naturally aligned. Working with the body in a neutral position reduces stress and strain on the muscles, tendons, and skeletal system and reduces your risk of developing a musculoskeletal disorder (MSD). The following are important considerations when attempting to maintain neutral body postures while working at the computer workstation:



- ✦ **Hands, wrists, and forearms** are straight, in-line and roughly parallel to the floor.
- ✦ **Head** is level, or bent slightly forward, forward facing, and balanced. Generally it is in-line with the **torso**.
- ✦ **Shoulders** are relaxed and **upper arms** hang normally at the side of the body.
- ✦ **Elbows** stay in close to the body and are bent between 90 and 120 degrees.
- ✦ **Feet** are fully supported by floor or footrest.
- ✦ **Back** is fully supported with appropriate lumbar support when sitting vertical or leaning back slightly.
- ✦ **Thighs** and **hips** are supported by a well-padded seat and generally parallel to the floor.
- ✦ **Knees** are about the same height as the hips with the **feet** slightly forward.

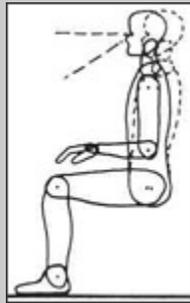
Regardless of how good your working posture is, working in the same posture or sitting still for prolonged periods is not healthy. You should change your working position frequently throughout the day in the following ways:

- ✦ Make small adjustments to your chair or backrest.
- ✦ Stretch your fingers, hands, arms, and torso.
- ✦ Stand up and walk around for a few minutes periodically.

These four **reference postures** are examples of body posture changes that all provide neutral positioning for the body.

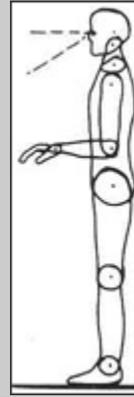
Upright Sitting

Upright sitting posture. The user's torso and neck are approximately vertical and in-line, the thighs are approximately horizontal, and the lower legs are vertical.



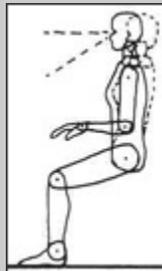
Standing

Standing posture. The user's legs, torso, neck, and head are approximately in-line and vertical. The user may also elevate one foot on a rest while in this posture.



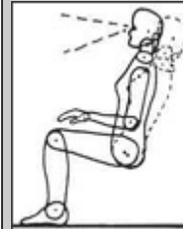
Declined Sitting

Declined sitting posture. The user's thighs are inclined with the buttocks higher than the knee and the angle between the thighs and the torso is greater than 90 degrees. The torso is vertical or slightly reclined and the legs are vertical.



Reclined Sitting

Reclined sitting posture. The user's torso and neck are straight and recline between 105 and 120 degrees from the thighs.



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Selecting and arranging your workstation components

Appropriate placement of the components and accessories for the desktop computer workstation will allow you to work in [neutral body positions](#), help you perform more efficiently, and work more comfortably and safe.

A laptop workstation creates special challenges due to its computer design, size, and the variety of areas in which it is used. While many aspects of this eTool will be applicable to laptops, special considerations may be necessary when working with laptop units.

The following sections explain how to select and arrange specific workstation components.

[Monitors](#)[Keyboards](#)[Pointer/Mouse](#)[Wrist/Palm Supports](#)[Document Holders](#)[Desks](#)[Chairs](#)[Telephones](#)[Good Working Positions](#) | [Workstation Components](#) | [Checklists](#) | [Work Process](#) | [Workstation Environment](#)

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Monitors

Choosing a suitable monitor and placing it in an appropriate position helps reduce exposure to [forceful exertions](#), [awkward postures](#), and [overhead glare](#). This helps prevent possible health effects such as excessive fatigue, eye strain, and neck and back pain.

Consider the following issues to help improve your computer workstation:

- ⌘ [Viewing distance](#)
- ⌘ [Viewing angle \(height and side-to-side\)](#)
- ⌘ [Viewing time](#)
- ⌘ [Viewing clarity](#)

You should choose a monitor and consider its placement in conjunction with other components of the computer workstation, including the [keyboard](#), [desk](#), and [chair](#).



Monitor Quick Tips

- ⌘ Put monitor directly in front of you and at least 20 inches away.
- ⌘ Place monitor so top line of screen is at or below eye level.
- ⌘ Place monitor perpendicular to window.

Viewing Distance



Potential Hazards

- ⌘ Monitors placed too close or too far away may cause you to assume awkward body positions that can lead to eyestrain.
 - ⌘ Viewing distances that are **too long** can cause you to lean forward and strain to see small text. This can fatigue the eyes and place stress on the torso because the backrest is no longer providing support.
 - ⌘ Viewing distances that are **too short** may cause your eyes to work harder to focus (convergence problems) and may require you to sit in awkward postures. For instance, you may tilt your head backward or push your chair away from the screen, causing you to type with outstretched arms.

Possible Solutions

- ⌘ Sit at a comfortable distance from the monitor where you can easily read all text with your head and torso in an upright posture and your back supported by your chair. Generally, the preferred viewing distance is between 20 and 40 inches (50 and 100 cm) from the eye to the front surface of the computer screen (Figure 1). **Note:** text size may need to be increased smaller monitors.
- ⌘ Provide adequate desk space between the user and the monitor ([table depth](#)). If there is not enough desk space, consider doing the following:
 - ⌘ Make more room for the back of the monitor by pulling the desk away from the wall or divider; or
 - ⌘ Provide a flat-panel display, which is not as deep as a conventional monitor and requires less desk space (Figure 2); or
 - ⌘ Move back and install an adjustable [keyboard tray](#) to create a deeper working surface.



Figure 1
Preferred viewing distance is 20 to 40 inches

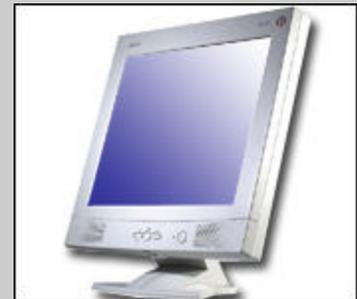


Figure 2
Flat-panel displays take up less room than conventional monitors

Viewing Angle–Height and Side-to-Side



Potential Hazard

- ⌘ Working with your head and neck turned to the side for a prolonged period loads neck muscles unevenly and increases fatigue and pain.

Possible Solutions

- ⌘ Position your computer monitor directly in front of you (Figure 3), so your head, neck and torso face forward when viewing the screen. Monitors should not be farther than 35 degrees to the left or right.
- ⌘ If you work primarily from printed material, place the monitor slightly to the side and keep the printed material directly in front. Keep printed materials and monitors as close as possible to each other.



Figure 3
Place monitors directly in front of the user

Potential Hazard

- ⌘ A display screen that is too high (Figure 4) or low will cause you to work with your head, neck, shoulders, and even your back in awkward postures. When the monitor is too high, for example, you have to work with your head and neck tilted back. Working in these awkward postures for a prolonged period fatigues the muscles that support the head.



Figure 4
Display screen is too high

Possible Solutions

- ⌘ The top of the monitor should be at or slightly below eye level. The center of the computer monitor should normally be located 15 to 20 degrees below horizontal eye level (Figure 5).
- ⌘ The entire visual area of the display screen should be located so the downward viewing angle is never greater than 60 degrees when you are in any of the four reference postures. In the reclining posture the straight forward line of sight will not be parallel with the floor, which may increase the downward viewing angle. Using very large monitors also may increase the angle.
- ⌘ Remove some or all of the equipment (CPU, surge protector, etc.) on which the monitor may be placed. Generally, placing the monitor on top of the CPU will raise it too high for all but the tallest users.
- ⌘ Elevate your line of site by raising your chair. Be sure that you have adequate space for your thighs under the desk and that your feet are supported.



Figure 5
Comfortable viewing angle

Potential Hazard

- ⌘ Bifocal users typically view the monitor through the bottom portion of their lenses. This causes them to tilt the head backward to see a monitor that may otherwise be appropriately placed. As with a monitor that is too high, this can fatigue muscles that support the head.

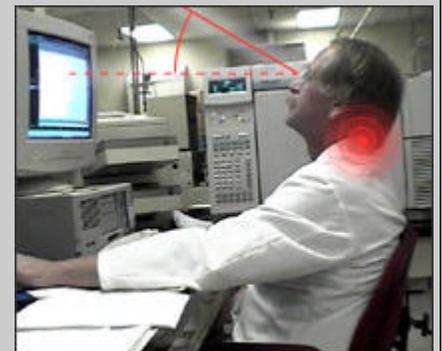


Figure 6
Stresses because of bifocal lenses

Possible Solutions

- ⌘ Lower the monitor (below recommendations for non-bifocal users) so you can maintain appropriate neck postures. You may need to tilt the monitor screen up toward you.
- ⌘ Raise the chair height until you can view the monitor without tilting your head back. You may have to raise the keyboard and use a foot rest.
- ⌘ Use a pair of single-vision lenses with a focal length designed for computer work. This will eliminate the need to look through the bottom portion of the lens.

Viewing Time



Potential Hazard

- ⌘ Viewing the monitor for long periods of time can cause eye fatigue and dryness. Users often blink less while viewing the monitor.

Possible Solutions

- ⌘ Rest your eyes periodically by focusing on objects that are farther away (for example, a clock on a wall 20 feet away).
- ⌘ Stop, look away, and blink at regular intervals to moisten the eyes.
- ⌘ Alternate duties with other non-computer tasks such as filing, phone work, or customer interaction to provide periods of rest for the eyes.

Viewing Clarity



Potential Hazard

- ⌘ Monitors that are tilted significantly either toward or away from the operator may distort objects on the screen, making them difficult to read. Also, when the monitor is tilted back, overhead lights may create glare on the screen. This can result in eyestrain and sitting in awkward postures to avoid eye glare.



Figure 8
A monitor support that adjusts the height and angle of the monitor

Possible Solutions

- ⌘ Tilt the monitor so it is perpendicular to your line of sight, usually by tilting the screen no more than 10 to 20 degrees. This is most easily done if the monitor has a riser/swivel stand. A temporary solution involves tilting the monitor back slightly by placing a book under the front edge. **Note:** Tilting the monitor back may create glare on the screen from ceiling lighting and a glare screen may be needed.
- ⌘ Monitor support surfaces should allow the user to modify viewing distances and tilt and rotation angles.

Potential Hazards

- ⌘ Factors that reduce image quality make viewing more difficult and may lead to eye strain. These factors include
 - ⌘ electromagnetic fields caused by other electrical equipment located near computer workstations, which can result in display quality distortions; and
 - ⌘ dust accumulation, which is accelerated by magnetic fields associated with computer monitors and can reduce contrast and degrade viewing conditions.

Possible Solutions

- ⌘ Computer workstations should be isolated from other equipment that may have electrostatic potentials in excess of +/- 500 volts.
- ⌘ Computer monitors should be periodically cleaned and dusted.

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Keyboards

Proper selection and arrangement of the computer keyboard helps reduce exposure to [awkward postures](#), [repetition](#), and [contact stress](#).

Consider the following factors when evaluating your computer workstation.

- ⌘ [Keyboard Placement - Height](#)
- ⌘ [Keyboard Placement - Distance](#)
- ⌘ [Design and Use](#)

You should choose a keyboard and consider its placement in conjunction with other components of the computer workstation, including the [pointer/mouse](#) and [wrist/palm rests](#).



Keyboard Quick Tips

- ⌘ Put the keyboard directly in front of you.
- ⌘ Your shoulders should be relaxed and your elbows close to your body.
- ⌘ Your wrists should be straight and in-line with your forearms.

Keyboard Placement – Height

[TOP](#)

Potential Hazard

- ⌘ Keyboards, [pointing devices](#), or [working surfaces](#) that are too high or too low can lead to awkward wrist, arm, and shoulder postures. For example, when keyboards are too low you may type with your wrists bent up, and when keyboards are too high, you may need to raise your shoulders to elevate your arms. Performing keying tasks in [awkward postures](#) such as these can result in hand, wrist, and shoulder discomfort.

Possible Solutions

- ⌘ Adjust the chair height and work surface height to maintain a [neutral body posture](#). Elbows should be about the same height as

the keyboard and hang comfortably to the side of the body. Shoulders should be relaxed, and wrists should not bend up or down or to either side during keyboard use.

- Remove central pencil drawers from traditional desks if you can't raise your chair high enough because of contact between the drawer and the top of the thighs. The work surface should generally be no more than 2 inches thick.



Figure 1
Keyboard tray

- A keyboard tray (Figure 1) may be needed if the work surface or chair cannot be properly adjusted. The keyboard tray should

- Be adjustable in height and tilt,

- Provide adequate leg and foot clearance, and

- Have adequate space for multiple input devices (for example, a keyboard and [pointer/mouse](#)).

- The keyboard's vertical position should be maintained within the recommended range shown in Figure 2. The tilt of the keyboard may need to be raised or lowered using the keyboard feet to maintain straight, neutral wrist postures while accommodating changes in arm angles.

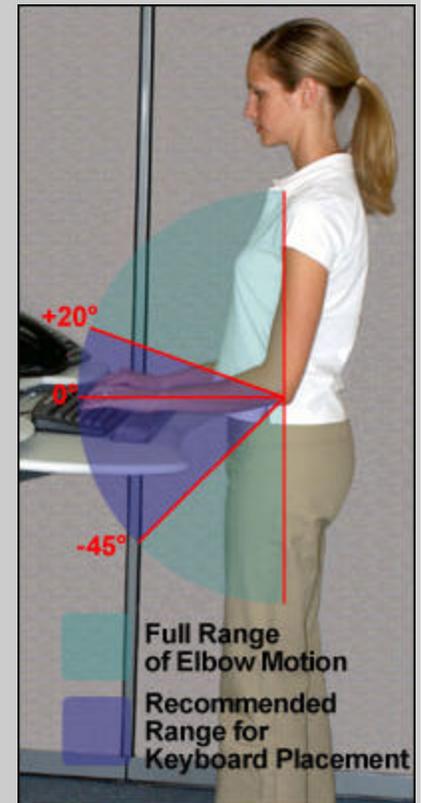


Figure 2
Side view illustration showing the recommended range for keyboard placement

Keyboard Placement – Distance



Potential Hazard

- A keyboard or [pointer/mouse](#) that is too close or too far away may cause you to assume awkward postures such as reaching with the arms, leaning forward with the torso (Figure 3), and extreme elbow angles (Figure 4). These awkward postures may lead to musculoskeletal disorders of the elbows, shoulders, hands, and wrists.



Figure 3
Keyboard that is too far away



Figure 4
Keyboard that is too close

Possible Solutions

- ✎ Place the keyboard directly in front of you at a distance that allows your elbows to stay close to your body with your forearms approximately parallel with the floor.
- ✎ A keyboard tray may be useful if you have limited desk space or if your chair has armrests that interfere with adequate positioning.

Design and Use



Potential Hazard

- ✎ A traditional keyboard may cause you to bend your wrists sideways (Figure 5) to reach all the keys. Keyboard tilt, caused by extending the legs on the back of the keyboard or by a steep design angle, may cause the wrist to bend upward (Figure 6). Smaller keyboards, such as those found on laptops, may also contribute to stressful postures. These awkward wrist postures can create [contact stress](#) to the tendon sheath and tendons that must move within the wrist during repetitive keying.



Figure 5
Side bending of the wrist

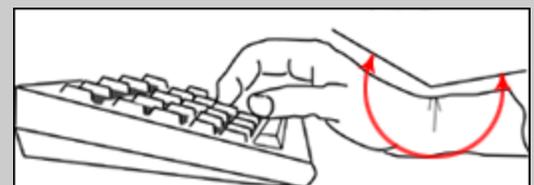


Figure 6
Upward bending of the wrist

Possible Solutions

- ✎ Reduce awkward wrist angles by lowering or raising the keyboard or chair to achieve a neutral wrist posture.
- ✎ Elevate the back or front of keyboards to achieve a neutral wrist posture. For example, if the operator sits lower in relation to the keyboard, slightly elevating the back of the keyboard may help maintain a neutral wrist. Similarly, raising the front of the keyboard may help maintain neutral wrist postures for users who type with the keyboard in a lower position. Do not use keyboard feet if they increase bending of the wrist.

- ⚡ Consider [alternative keyboards](#) (Figures 8 and 9) to promote neutral wrist postures. Alternative keyboards may be provided on a case -by- case basis. Users may need time to become accustomed to these devices. **Note:** alternative keyboards help maintain neutral wrist postures, but available research does not provide conclusive evidence that using these keyboards prevents discomfort and injury.
- ⚡ Keyboards should be of appropriate size and key-spacing to accommodate most users. Generally, the horizontal spacing between the centers of two keys should be 0.71-0.75 inches (18-19 mm) and the vertical spacing should be between 0.71-0.82 inches (18-21 mm) (Figure 7).



Figure 7
Keyboard spacing



Figure 8
Split keyboard design



Figure 9
Tented and raised keyboard design

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Pointer/Mouse

Pointing devices such as a mouse now come in many sizes, shapes, and configurations. In addition to the conventional mouse, there are trackballs, touch pads, finger tip joysticks, and pucks, to name a few. Selection and placement of a pointer/mouse is an important factor in creating a safe computer workstation.

Consider the following factors when evaluating your computer workstation.

- ✎ [Pointer Placement](#)
- ✎ [Pointer Size, Shape, and Settings](#)



Pointer/Mouse Quick Tips

- ✎ Keep the pointer/mouse close to the keyboard.
- ✎ Alternate hands with which you operate the pointer/mouse.
- ✎ Use keyboard short cuts to reduce extended use.

Pointer Placement



Potential Hazard

- ✎ If the pointer/mouse is not near the keyboard (Figure 1) you may be exposed to [awkward postures](#), [contact stress](#), or [forceful](#) hand exertions while using the device. Working in this position (Figure 2) for prolonged periods places stress on the shoulder and arm and increases the likelihood that you will assume awkward wrist and shoulder postures, which may lead to musculoskeletal disorders.



Figure 1
Mouse placement that is too far away because of a small keyboard tray



Figure 2
Mouse placed too far from the user and not in the same plane as the keyboard

Possible Solutions

- ⌘ Position the pointer/mouse to allow you to maintain a straight, neutral wrist posture. This may involve adjustments in your [chair](#), [desk](#), [keyboard tray](#), etc.
- ⌘ If the keyboard tray/surface is not large enough to accommodate both the keyboard and mouse, try one of the following to limit reaching:
 - ⌘ Use a mouse platform positioned over the keyboard. This design allows the mouse to be used above the 10-key pad.
 - ⌘ Install a mouse tray next to the keyboard tray (Figure 4).
- ⌘ Use a keyboard that has a pointing device, such as a touchpad, incorporated into it (Figure 5).
- ⌘ Use a keyboard without a ten-key pad, which leaves more room for the pointer/mouse.
- ⌘ Install keyboard trays that are large enough to hold both the keyboard and mouse.
- ⌘ Use a mouse pad with a [wrist/palm rest](#) to promote neutral wrist posture (Figure 6).
- ⌘ Substitute keystrokes for mousing tasks, such as Ctrl+S to save, and Ctrl+P to print.



Figure 3
Appropriate mouse placement



Figure 4
Mouse platform



Figure 5
Keyboard with a built-in touchpad

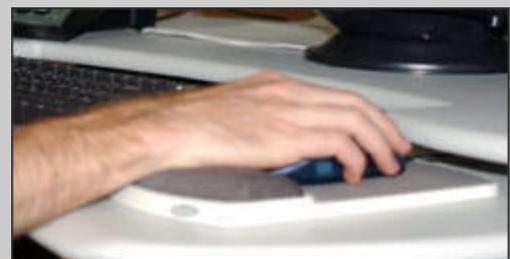


Figure 6
Mouse wrist rest

Potential Hazard

- ⌘ Inappropriate size and shape of pointers can increase stress, cause awkward postures, and lead to overexertion. For example, using a pointing device that is too big or too small may cause you to increase finger force and bend your wrist into awkward positions. Using the left hand to operate a device that is designed for right-hand use can also create force and postures issues and may create contact stress to the soft tissue areas in the palm of the hand. Contact stress can create irritation and inflammation.

Possible Solutions

- ⌘ Select a pointing device designed to fit the hand that will normally operate it. Many devices are available in right hand/left hand models and also come in sizes to fit large and small hands. A device that is designed for either hand use may be desirable, since changing from right- to left-hand operation provides periods of rest for one hand. You should test a device prior to purchase and long term use to ensure proper fit and feel.
- ⌘ Select pointing devices that are appropriately sized and that require minimal force to generate movement. For example, a puck device (Figure 7) must be small enough for single-handed operation (generally, 1.5 to 2.5 inches wide, 2.5 to 4.5 inches long, and 1 to 1.5 inches high).
- ⌘ Reduce the strain on hands by reducing pointing device use. Using keyboard functions, such as page down, may reduce mouse use and provide rest for hand and arm muscles.
- ⌘ Use another type of device that fits the hand better or doesn't require bending the wrist while gripping. A fingertip joystick (Figure 8), touchpad, or trackball (Figure 9) may be less fatiguing for certain tasks. Always try out any new product prior to selection and long term use.



Figure 7
Puck device



Figure 8
Fingertip joystick for a notebook computer

Potential Hazard

- ⌘ When the sensitivity for the input device is not appropriately set, you may

need to use excessive [force](#) and awkward hand postures to control the device. For example, a mouse that is too sensitive may require excessive and prolonged finger force to provide adequate control. A mouse that has insufficient sensitivity may require large deviation of the wrist to move the pointer around the screen. Exerting prolonged force or repeatedly bending the wrist can fatigue the muscles of the hand and arm and increase the risk of musculoskeletal injuries.

Possible Solutions

- ⌘ Sensitivity and speed (how fast the pointer moves on the screen when the pointing device is moved by the hand) should feel comfortable and be adjustable. The pointer should be able to cover the full screen while the wrist is maintained in a straight, neutral posture.
- ⌘ Sensitivity should be set so you can control the pointing device with a light touch. Most current devices have sensitivity settings that can be adjusted through the computer control panel.
- ⌘ Avoid tightly gripping the mouse or pointing device to maintain control.
- ⌘ A trackball's exposed surface area should be at least 100 degrees (Figure 9). It should feel comfortable and rotate in all directions to generate any combination of movement.

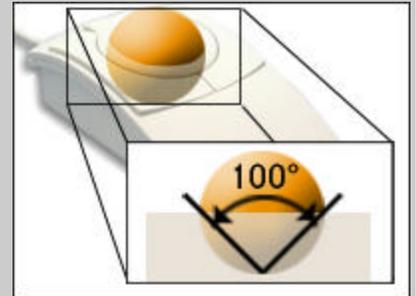


Figure 9
Trackball device

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Wrist/Palm Supports

Proper arrangement of the [keyboard](#) and [mouse](#) help create a comfortable and productive workstation. Wrist or palm rests can also increase your comfort.

Although opinions vary regarding the use of wrist/palm supports, proper use has been shown to reduce muscle activity and to facilitate neutral wrist angles.

☞ [Design and Use](#)



Wrist Rest Quick Tips

- ☞ Use a wrist rest to maintain straight wrist postures and to minimize contact stress during typing and mousing tasks.

Design and Use

[TOP](#)

Potential Hazards

- ☞ Performing keying tasks without a wrist rest may increase the angle to which users' wrists are bent (Figure 1). Increasing the angle of bend increases the contact stress and irritation on tendons and tendon sheathes. This is especially true with high repetition or prolonged keying tasks. Keying without a wrist rest can also increase [contact stress](#) between the users wrist and hard or sharp workstation components.



Figure 1
Bending the wrist upward.

- ☞ Resting the wrist/palm on a support while typing may inhibit motion of the wrist and could increase [awkward wrist posture](#).

Possible Solutions

- ☞ Your hands should move freely

and be elevated above the wrist/palm rest while typing. When resting, the pad should contact the **heel or palm** of your hand, not your **wrist**.

⚡ If used, wrist/palm rests should be part of an ergonomically-coordinated computer workstation.



Figure 2
Wrist/palm rests encourage neutral wrist postures.

⚡ Reduce bending of the wrists by adjusting other workstation components ([chair](#), [desk](#), [keyboard](#)) so the wrist can maintain an in-line, neutral posture.

⚡ Match the wrist support to the width, height, and slope of the front edge of the keyboard (keeping in mind that the goal is to keep wrist postures as straight as possible).

⚡ Provide wrist/palm supports that are fairly soft and rounded to minimize pressure on the wrist. The support should be at least 1.5 inches (3.8 cm) deep.



Figure 3
Diagram of wrist support.

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Document Holders

Document holders keep printed materials needed during computer tasks close to the user and the monitor. Proper positioning of document holders depends on the task performed and the type of document being used. Appropriate placement of the holder may reduce or eliminate risk factors such as awkward head and neck postures, fatigue, headaches, and eye strain.

☞ [Source Document Position](#)

The position of the document holder is also related to the placement of the [monitor](#), [keyboard](#), and a well-adjusted [chair](#).



Document Holder Quick Tips

- ☞ Documents should be at the same height and distance as the monitor.

Source Document Position

TOP

Potential Hazard

- ☞ Documents positioned too far from the monitor may require [awkward](#) head postures or [frequent movements](#) of the head and neck to look from the monitor to a document. Those awkward postures can lead to muscle fatigue and discomfort of the head, neck, and shoulders.

Possible Solutions

- ☞ Document holders should
 - ☞ Allow you to place documents at or about the same height and distance as the monitor screen (Figure 1), and
 - ☞ Be stable when loaded with heavier documents such as a textbook (Figure 2).

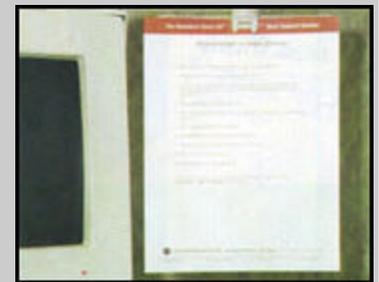


Figure 1
Screen and document holder are close together and same distance from the eye

- ☞ A document holder can be positioned directly beneath the monitor (Figure 2). This provides a sturdy writing surface, if written entries are necessary, and reduces frequent movement of the head, neck, or back.
- ☞ Task lighting on the document should not cause [glare](#) on the monitor.



Figure 2
Example of in-line document holder

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Desks

A well-designed and appropriately -adjusted desk will provide adequate clearance for your legs, allow proper placement of computer components and accessories, and minimize awkward postures and exertions. The installation, setup, and configuration of comfortable and productive workstations involves the following considerations:

- ⌘ [Desk or work surface areas](#)
- ⌘ [Areas under the desk or work surface](#)



Desk Quick Tips

- ⌘ Desk surface should allow you to place the monitor directly in front of you, at least 20 inches away.
- ⌘ Avoid storing items, such as a CPU, under desks.
- ⌘ Desks should be able to accommodate a variety of working postures.

Desk or Work Surface Areas

[TOP](#)

Potential Hazards

- ⌘ Limited space on the work surface may cause users to place components and devices in undesirable positions. This placement may lead to [awkward postures](#) as you reach for a pointer/mouse or look at a monitor that is placed to the side.

Possible Solutions



Figure 1
Poor mouse and keyboard placement because of desktop clutter

- ⌘ Work surface depth should allow you to:
 - ⌘ View the monitor at a distance of **at least** 20 inches (50 cm), and
 - ⌘ Position the monitor to achieve the appropriate viewing angle, which is generally directly in front of you.
- ⌘ The location of frequently-used devices (keyboard, phone, and mouse) should remain within the repetitive access (primary work zone) (Figure 2).

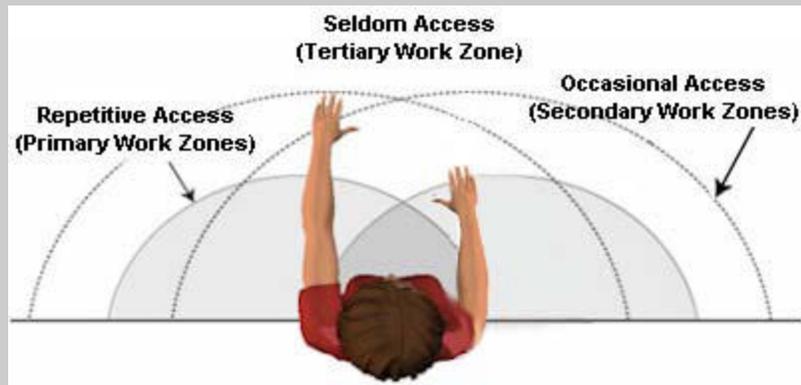


Figure 2
Recommended zones for workplace components

Potential Hazard

- ⌘ Some desks and computer equipment have hard, angled leading edges that come in contact with a user's arm or wrist (Figure 3). This can create contact stress, affecting nerves and blood vessels, possibly causing tingling and sore fingers.

Possible Solutions

To minimize contact stress,

- ⌘ Pad table edges with inexpensive materials such as pipe insulation,
- ⌘ Use a wrist rest, and
- ⌘ Buy furniture with rounded desktop edges.



Figure 3
Contact stress from the table edge

Areas Under the Desk or Work Surface



Potential Hazard

- ⌘ Inadequate clearance under the work surface may result in discomfort and performance inefficiencies, such as the following:
 - ⌘ Shoulder, back, and neck pain due to users sitting too far away from computer components, causing them to reach to perform computer

tasks; and

- ⌘ Generalized fatigue, circulation restrictions, and [contact stress](#) due to constriction of movement and inability to frequently change postures.

Possible Solutions

- ⌘ Provide, to the extent possible, adequate clearance space for users to frequently change working postures ([see recommended dimensions](#)). This space should remain free of items such as files, CPUs, books, and storage (Figure 4).

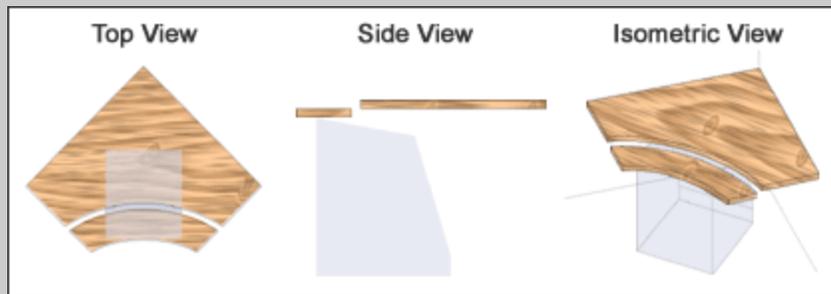


Figure 4
Diagram of clearance area under a work surface

- ⌘ Be sure clearance spaces under all working surfaces accommodates at least two of the three seated [reference working postures](#), one of which must be the upright seated posture.

Potential Hazard

- ⌘ Desk surfaces that are too high or too low may lead to awkward postures, such as extended arms to reach the keyboard, and raised shoulders.

Possible Solutions

- ⌘ Raise work surfaces by inserting stable risers such as boards or concrete blocks under the desk legs if necessary.
- ⌘ Remove center drawers of conventional desks to create additional thigh clearance if necessary.
- ⌘ Lower work surfaces by cutting off desk legs if necessary. If the work surface cannot be lowered, raise the [chair](#) to accommodate the user. If needed, provide a footrest to support the user's feet (Figure 5).



Figure 5
Footrest

- ⌘ Provide height-adjustable desks. Desk should generally be between 20-28 inches (50-72 cm) high.

Work Space

The clearance space under the work surface should provide adequate room for the users legs when in the upright seated posture and at least one other of the seated reference postures. This can be accomplished by using Method 1 or Method 2.

Method 1 - Upright and Reclined Seated Postures

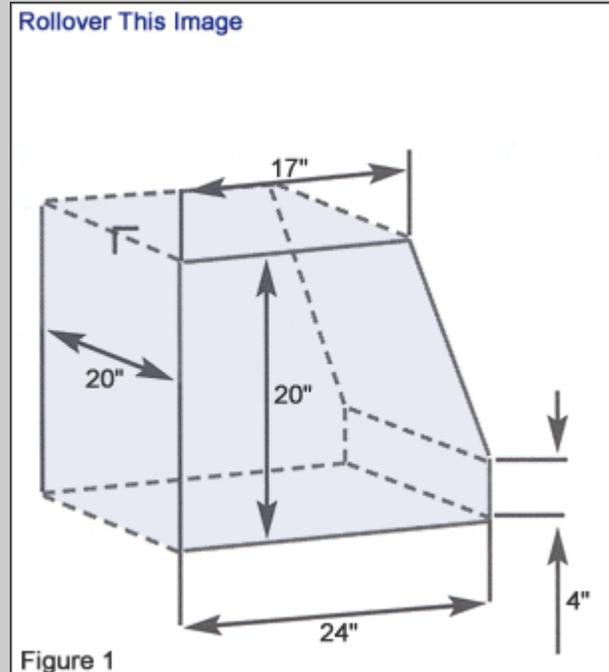
The following dimensions represent clearances that accommodate the majority of users (5th percentile female to 95th percentile male) when in a seated posture where the top of the legs are about parallel with the floor.

Minimum dimensions (Figure 1)

- 20 inches (52 cm) wide.
- 17 inches (44 cm) deep at knee level.
- 24 inches (60 cm) deep at foot level.
- 4 inches (10 cm) high at the foot.

Variable dimensions ("rollover" the image)

- Height is adjustable between 20 and 27 inches (50 and 69 cm) near the user. (Figs. 1 and 2)



Figures 1 & 2
Minimum Clearance Areas

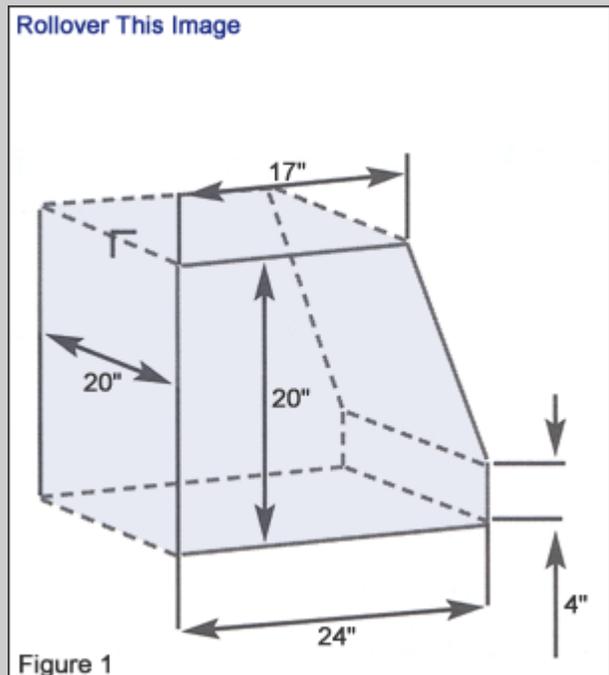
Method 2 - Upright, Reclined, and Declined Seated Postures

The following dimensions accommodate the largest operator clearance spaces (5th percentile female to 95th percentile male). Thus, specifications conforming with Method 2 will meet Method 1 requirements. This method also includes postures where the knee is slightly lower than the buttocks (declined-seated).

Minimum dimensions (see above)

Variable dimensions ("rollover" the images)

- Adjustable between 20 and 28 inches (50 and 72 cm) high at the hip. (Figs. 1 and 3)
- Adjustable between 20 and 25 inches (50 and 64 cm) high near the user's knee. (Figs. 1 and 3)



Figures 1 & 3
Minimum Clearance Areas

Computer Workstations

[eTool Home](#)[Good Working Positions](#)[Workstation Components](#)[Checklist](#)[Work Process](#)[Workstation Environment](#)

Chairs

A chair that is well-designed and appropriately adjusted is an essential element of a safe and productive computer workstation. A good chair provides necessary support to the back, legs, buttocks, and arms, while reducing exposures to awkward postures, contact stress, and forceful exertions.

Increased adjustability ensures a better fit for the user, provides adequate support in a variety of [sitting postures](#), and allows variability of sitting positions throughout the workday. This is particularly important if the chair has multiple users.

To ensure that the chair will provide adequate support, it is important that you try out different chairs before purchasing one.

The following parts of the chair are important elements to consider in creating a safe and productive workstation:

- ⌘ [Backrest](#)
- ⌘ [Seat](#)
- ⌘ [Armrest](#)
- ⌘ [Base](#)



Chair Quick Tips

- ⌘ The backrest should conform to the natural curvature of your spine, and provide adequate lumbar support.
- ⌘ The seat should be comfortable and allow your feet to rest flat on the floor or footrest.
- ⌘ Armrests, if provided, should be soft, allow your shoulders to relax and your elbows to stay close to your body.
- ⌘ The chair should have a five-leg base with casters that allow easy movement along the floor.

You should adjust your chair along with appropriately placing your [monitor](#), [keyboard](#), and [desk](#).

Backrests



Potential Hazard

- ⌘ Poor back support and inappropriate postures may result from inadequate backrest size, material, positioning, or use. Working in these postures may lead to back pain and fatigue. For example, a chair without a suitable or adjustable backrest will not provide adequate lumbar support or help maintain the natural S-shape curvature of the spine.

Possible Solutions

- ⌘ If your current chair does not have a lumbar support, use a rolled up towel or a removable back support cushion to temporarily provide support and maintain the natural curve of the spine.
- ⌘ Use a chair with a backrest that is easily adjustable and able to support the back in a variety of [seated postures](#). A backrest should have the following:
 - ⌘ A lumbar support that is height adjustable so it can be appropriately placed to fit the lower back. The outward curve of the backrest should fit into the small of the back.
 - ⌘ An adjustment that allows the user to recline at least 15 degrees from the vertical. The backrest should lock in place or be tension adjustable to provide adequate resistance to lower back movement.
 - ⌘ A device enabling it to move forward and backward. This will allow shorter users to sit with their backs against the backrest without the front edge of the seat pan contacting their knees. Taller users will be able to sit with their backs against the backrest while still having their buttocks and thighs fully supported. **Note:** some chair designs provide this adjustability by adjusting the position of the seat pan.



Figure 1
Adjustable chair and backrest

Seat

TOP

Potential Hazard

- ⌘ Using a chair with a seat that is too high may force you to work with your feet unsupported or encourage you to move forward in the chair to a point where your back is unsupported making it more difficult to maintain the S-shape of the spine (Figure 2). These awkward postures can lead to fatigue, restricted circulation, swelling, numbness, and pain.

Possible Solutions

- ⌘ If the seat cannot be lowered (for example, it would make the keyboard or monitor too high), use a footrest to provide stable support for the feet (Figure 3).
- ⌘ Provide a chair with a seat pan that is adjustable and large enough to provide



Figure 2
Natural S-curve of the spine

support in a variety of [seated postures](#). It is recommended that the seat should be

- ⌘ Height adjustable, especially when shared by a number of users. The chair height is appropriate when the entire sole of the foot can rest on the floor with the back of the knee slightly higher than the seat of the chair (Figure 4).
- ⌘ Padded and have a rounded, "waterfall" edge (Figure 5).
- ⌘ Wide enough to accommodate the majority of hip sizes. Chairs with oversize seat pans should be provided for larger users.



Figure 3
Footrest



Figure 4
Knee slightly higher than the seat
of the chair

Potential Hazard

- ⌘ An inappropriately sized seat pan can be uncomfortable, provide inadequate support to the legs, and restrict movement. One that is too short can place excess pressure on the buttocks of taller users, one that is too long can place excess pressure on the knee area of shorter users and minimize back support. One that is too small can restrict movement and provide inadequate support. Prolonged use can restrict blood flow to the legs and create irritation and pain.

Possible Solutions

- ⌘ Seat pan should be "depth" adjustable to adequately support taller users while allowing shorter users to sit with their back fully supported. The seat pan should provide support for most of the thigh without contact between the back of the user's knee and the front edge of the seat pan.
- ⌘ Provide a footrest, which may elevate the knee slightly to relieve pressure on the back of the leg.
- ⌘ Provide a chair that is sized to fit small or large users. **Note:** this is especially important if the chair is to be shared by several users.

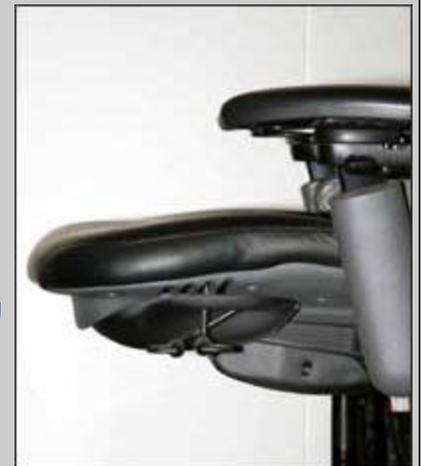


Figure 5
Seat pan with a rounded,
"waterfall" edge

Note: using an armrest is up to you and the system integrators. Consider factors such as the amount of time during the workday that the user performs computer work, whether the user is experiencing or has experienced a musculoskeletal disorder (MSD) or [symptoms](#), and user preference.

Potential Hazards

⚠ Armrests that are not adjustable, or those that have not been properly adjusted, may expose you to [awkward postures](#) or fail to provide adequate support. For example armrests that are



Relaxed

Armrest
too High

Armrest too
High & Wide

Figure 6

Shoulders in various positions

- ⚠ **Too low** may cause you to lean over to the side to rest one forearm. This can result in uneven and awkward postures, fatiguing the neck, shoulders, and back.
- ⚠ **Too high** may cause you to maintain raised shoulders (Figure 6), which can result in muscle tension and fatigue in the neck and shoulders.
- ⚠ **Too wide** (Figure 6) cause you to reach with the elbow and bend forward for support. Reaching pulls the arm from the body and can result in muscle fatigue in the shoulders and neck.
- ⚠ **Too close** can restrict movement in and out of the chair.
- ⚠ **Too large** or inappropriately placed may interfere with the positioning of the chair. If the chair cannot be placed close enough to the keyboard, you may need to reach and lean forward in your chair. This can fatigue and strain the lower back, arm, and shoulder.
- ⚠ Armrests that are made of hard materials or that have sharp corners can irritate the nerves and blood vessels located in the forearm. This irritation can create pain or tingling in the fingers, hand, and arm.

Possible Solutions

- ⚠ If your armrests cannot be properly adjusted, or if they interfere with your workstation, remove them, or stop using them.
- ⚠ Position adjustable armrests so they support your lower arm and allow your upper arm to remain close to the torso. Properly adjusted armrests will be
 - ⚠ Wide enough to allow easy entrance and exit from the chair,
 - ⚠ Close enough to provide support for your lower arms while keeping your upper arms close to the body,
 - ⚠ Low enough so your shoulders are relaxed during use (Figure 6) (Adjust your armrests so they just make contact with your lower arms



Figure 7
Office chair with adjustable
armrests

when positioned comfortably at your sides.), and

- ⌘ High enough to provide support for your lower arms when positioned comfortably at your sides. You may be able to add padding to the top of your armrests if they are too low and not adjustable.
- ⌘ Armrests should be large enough to support most of your lower arm but small enough so they do not interfere with chair positioning.
- ⌘ Armrests should be made of a soft material and have rounded edges.

Chair Base

[TOP](#)

Potential Hazard

- ⌘ Chairs with four or fewer legs may provide inadequate support and are prone to tipping.
- ⌘ Inappropriate choice of casters, or a chair without casters, can make positioning the chair in relation to the desk difficult. This increases reaching and bending to access computer components, which can lead to muscle strain, and fatigue.



Figure 8
Chair caster

Possible Solutions

- ⌘ Chairs should have a strong, five-legged base.
- ⌘ Ensure that chairs have casters that are appropriate for the type of flooring at the workstation.



Figure 9
Chair with five-leg base

Computer Workstations



- eTool Home
- Good Working Positions
- Workstation Components
- Checklist
- Work Process
- Workstation Environment

Telephones

Many office tasks today are centered around telephones and computers as key workstation components. For example, employees making reservations may take information from customers and transfer it into the computer. They may also receive information from the computer and relay it to customers by telephone.

Telephones add to the convenience of a workstation; however, telephones have cords that can get tangled up, and can cause the user to assume awkward postures. Consider the following to help prevent musculoskeletal disorders.

☞ [Placement and Use](#)



Telephone Quick Tips

- ☞ Use a speaker phone or head set for long conversations.
- ☞ Keep it close enough to avoid repeated reaching.

Placement and Use eTools

Potential Hazard

- ☞ Placing the telephone too far away can cause you to repeatedly reach, resulting in strain on the shoulder, arm, and neck.

Possible Solutions

- ☞ Place the telephone in the [primary or secondary work zone](#), depending on usage patterns. This will minimize repeated reaching, reducing the possibility of injury.
- ☞ Keep the telephone cord out of working areas so it does not create a tripping hazard.

Potential Hazard

- ☞ Prolonged conversations with the phone pinched between your shoulder and head (Figure 1) may cause stress and neck pain.

Possible Solution:

- ☞ Use a "hands-free" head set (Figure 2) if you plan to spend a lot of time on the phone. Speaker phone options may also be appropriate, provided the volume of this feature does not annoy your co-workers.



Figure 1
Awkward posture during telephone use



Figure 2
Conventional headset

Computer Workstations



- eTool Home
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Checklist

[View/Print the Evaluation Checklist PDF](#)

This checklist can help you create a safe and comfortable computer workstation. You can also use it in conjunction with the [purchasing guide checklist](#). A "no" response indicates that a problem may exist. Refer to the appropriate section of the eTool for assistance and ideas about how to analyze and control the problem.

WORKING POSTURES—The workstation is designed or arranged for doing computer tasks so it allows your	Y	N
1. Head and neck to be upright, or in-line with the torso (not bent down/back). If "no" refer to Monitors , Chairs and Work Surfaces .	<input type="checkbox"/>	<input type="checkbox"/>
2. Head, neck, and trunk to face forward (not twisted). If "no" refer to Monitors or Chairs .	<input type="checkbox"/>	<input type="checkbox"/>
3. Trunk to be perpendicular to floor (may lean back into backrest but not forward). If "no" refer to Chairs or Monitors .	<input type="checkbox"/>	<input type="checkbox"/>
4. Shoulders and upper arms to be in-line with the torso, generally about perpendicular to the floor and relaxed (not elevated or stretched forward). If "no" refer to Chairs .	<input type="checkbox"/>	<input type="checkbox"/>
5. Upper arms and elbows to be close to the body (not extended outward). If "no" refer to Chairs , Work Surfaces , Keyboards , and Pointers .	<input type="checkbox"/>	<input type="checkbox"/>
6. Forearms, wrists, and hands to be straight and in-line (forearm at about 90 degrees to the upper arm). If "no" refer to Chairs , Keyboards , Pointers .	<input type="checkbox"/>	<input type="checkbox"/>
7. Wrists and hands to be straight (not bent up/down or sideways toward the little finger). If "no" refer to Keyboards , or Pointers .	<input type="checkbox"/>	<input type="checkbox"/>
8. Thighs to be parallel to the floor and the lower legs to be perpendicular to floor (thighs may be slightly elevated above knees). If "no" refer to Chairs or Work Surfaces .	<input type="checkbox"/>	<input type="checkbox"/>
9. Feet rest flat on the floor or are supported by a stable footrest. If "no" refer to Chairs , Work Surfaces .	<input type="checkbox"/>	<input type="checkbox"/>
SEATING—Consider these points when evaluating the chair:	Y	N
10. Backrest provides support for your lower back (lumbar area).	<input type="checkbox"/>	<input type="checkbox"/>
11. Seat width and depth accommodate the specific user (seat pan not too big/small).	<input type="checkbox"/>	<input type="checkbox"/>

12. Seat front does not press against the back of your knees and lower legs (seat pan not too long).		
13. Seat has cushioning and is rounded with a "waterfall" front (no sharp edge).		
14. Armrests , if used, support both forearms while you perform computer tasks and they do not interfere with movement.		
"No" answers to any of these questions should prompt a review of Chairs .		
KEYBOARD/INPUT DEVICE —Consider these points when evaluating the keyboard or pointing device. The keyboard/input device is designed or arranged for doing computer tasks so the	Y	N
15. Keyboard/input device platform(s) is stable and large enough to hold a keyboard and an input device.		
16. Input device (mouse or trackball) is located right next to your keyboard so it can be operated without reaching.		
17. Input device is easy to activate and the shape/size fits your hand (not too big/small).		
18. Wrists and hands do not rest on sharp or hard edges.		
"No" answers to any of these questions should prompt a review of Keyboards , Pointers , or Wrist Rests .		
MONITOR —Consider these points when evaluating the monitor. The monitor is designed or arranged for computer tasks so the	Y	N
19. Top of the screen is at or below eye level so you can read it without bending your head or neck down/back.		
20. User with bifocals/trifocals can read the screen without bending the head or neck backward.		
21. Monitor distance allows you to read the screen without leaning your head, neck or trunk forward/backward.		
22. Monitor position is directly in front of you so you don't have to twist your head or neck.		
23. Glare (for example, from windows, lights) is not reflected on your screen which can cause you to assume an awkward posture to clearly see information on your screen.		
"No" answers to any of these questions should prompt a review of Monitors or Lighting/Glare .		
WORK AREA —Consider these points when evaluating the desk and workstation. The work area is designed or arranged for doing computer tasks so the	Y	N
24. Thighs have sufficient clearance space between the top of the thighs and your computer table/keyboard platform (thighs are not trapped).		
25. Legs and feet have sufficient clearance space under the work surface so you are able to get close enough to the keyboard/input device.		
ACCESSORIES —Check to see if the	Y	N
26. Document holder , if provided, is stable and large enough to hold documents.		
27. Document holder , if provided, is placed at about the same height and distance as the monitor screen so there is little head movement, or need to re-focus, when you look from the document to the screen.		
28. Wrist/palm rest , if provided, is padded and free of sharp or square edges that push on your wrists.		
29. Wrist/palm rest , if provided, allows you to keep your forearms, wrists,		

and hands straight and in-line when using the keyboard/input device.		
30. Telephone can be used with your head upright (not bent) and your shoulders relaxed (not elevated) if you do computer tasks at the same time.		
"No" answers to any of these questions should prompt a review of Work Surfaces , Document Holders , Wrist Rests or Telephones .		
GENERAL	Y	N
31. Workstation and equipment have sufficient adjustability so you are in a safe working posture and can make occasional changes in posture while performing computer tasks.		
32. Computer workstation, components and accessories are maintained in serviceable condition and function properly.		
33. Computer tasks are organized in a way that allows you to vary tasks with other work activities, or to take micro-breaks or recovery pauses while at the computer workstation.		
"No" answers to any of these questions should prompt a review of Chairs , Work Surfaces , or Work Processes .		



Checklist Purchasing Guide

[View/Print the Purchasing Guide Checklist PDF](#)

Monitors	<input checked="" type="checkbox"/>
1. Make sure the screen is large enough for adequate visibility. Usually a 15 to 20-inch monitor is sufficient. Smaller units will make it difficult to read characters and larger units may require excessive space.	
2. The angle and tilt should be easily adjustable.	
3. Flat panel displays take less room on the desk and may be more suitable for locations with limited space.	
Keyboards	<input checked="" type="checkbox"/>
1. Split keyboard designs will allow you to maintain neutral wrist postures.	
2. Keyboards with adjustable feet will accommodate a wider range of keyboard positions and angles. Adjustable feet on the front as well as the back will further aid adjustments. Increased adjustability will facilitate neutral wrist postures.	
3. The cord that plugs into the CPU should be long enough to allow the user to place the keyboard and the CPU in a variety of positions. At least six feet of cord length is desirable.	
4. Consider a keyboard without a 10-key keypad if the task does not require one. If the task does require one occasionally, a keyboard with a separate 10-key keypad may be appropriate. Keyboards without keypads allow the user to place the mouse closer to the keyboard.	
5. Consider the shape and size of the keyboard if a keyboard tray is used. The keyboard should fit comfortably on the tray.	

6. Consider keyboards without built-in wrist rest, because separate wrist rests are usually better.	<input type="checkbox"/>
7. Keyboards should be detached from the display screen if they are used for a long duration keying task. Laptop keyboards are generally not suitable for prolonged typing tasks.	<input type="checkbox"/>
Keyboard Trays	<input checked="" type="checkbox"/>
1. Keyboard trays should be wide enough and deep enough to accommodate the keyboard and any peripheral devices, such as a mouse.	<input type="checkbox"/>
2. If a keyboard tray is used, the minimum vertical adjustment range (for a sitting position) should be 22 inches to 28 inches from the floor.	<input type="checkbox"/>
3. Keyboard trays should have adjustment mechanisms that lock into position without turning knobs. These are frequently over tightened, which can lead to stripped threads, or they may be difficult for some users to loosen.	<input type="checkbox"/>
Desks and Work Surfaces	<input checked="" type="checkbox"/>
1. The desk area should be deep enough to accommodate a monitor placed at least 20 inches away from your eyes.	<input type="checkbox"/>
2. Ideally, your desk should have a work surface large enough to accommodate a monitor and a keyboard. Usually about 30 inches is deep enough to accommodate these items.	<input type="checkbox"/>
3. Desk height should be adjustable between 20 inches and 28 inches for seated tasks. The desk surface should be at about elbow height when the user is seated with feet flat on the floor. Adjustability between seated and standing heights is desirable.	<input type="checkbox"/>
4. You should have sufficient space to place the items you use most often, such as keyboard, mouse, and monitor directly in front of you.	<input type="checkbox"/>
5. There should be sufficient space underneath for your legs while sitting in a variety of positions. The minimum under-desk clearance depth should be 15 inches for your knees and 24 inches for your feet. Clearance width should be at least 20 inches.	<input type="checkbox"/>
6. Purchasing a fixed-height desk may require the use of a keyboard tray to provide adequate height adjustment to fit a variety of users.	<input type="checkbox"/>
7. Desktops should have a matte finish to minimize glare. Avoid glass tops.	<input type="checkbox"/>
8. Avoid sharp leading edges where your arms come in contact with work surfaces. Rounded or sloping surfaces are preferable.	<input type="checkbox"/>
9. The leading edge of the work surface should be wide enough to accommodate the arms of your chair, usually about 24 inches to 27 inches. Spaces narrower than this will interfere with armrests and restrict your movement. This is especially important in four-corner work units.	<input type="checkbox"/>
Chairs	<input checked="" type="checkbox"/>
1. The chair should be easily adjustable.	<input type="checkbox"/>
2. The chair should have a sturdy five-legged base with good chair casters that roll easily over the floor or carpet.	<input type="checkbox"/>
3. The chair should swivel 360 degrees so it is easier to access items around your workstation without twisting.	<input type="checkbox"/>
4. Minimum range for seat height should be about 16 inches.	<input type="checkbox"/>
5. Seat pan length should be 15 inches to 17 inches.	<input type="checkbox"/>
6. Seat pan width should be at least as wide as the user's thighs. A minimum width of about 18 inches is recommended.	<input type="checkbox"/>

7. Chair edges should be padded and contoured for support.	<input type="checkbox"/>
8. Seat pan tilt should have a minimum adjustable range of about 5 degrees forward and backward.	<input type="checkbox"/>
9. Avoid severely contoured seats as these limit seated postures and are uncomfortable for many users.	<input type="checkbox"/>
10. Front edge of the seat pan should be rounded in a waterfall fashion.	<input type="checkbox"/>
11. Material for the seat pan and back should be firm, breathable, and resilient.	<input type="checkbox"/>
12. The seat pan depth should be adjustable. Some chairs have seat pans that slide forward and backward and have a fixed back. On others the seat pan position is fixed and the backrest moves horizontally forward and backward so the effective depth of the seat pan can be adjusted. Beware of chairs where the back only tilts forward and backward. These do not provide adequate adjustment for a wide range of users.	<input type="checkbox"/>
13. The backrest should be at least 15 inches high and 12 inches wide and should provide lumbar support that matches the curve of your lower back.	<input type="checkbox"/>
14. The backrest should widen at its base and curve in from the sides to conform to your body and minimize interference with your arms.	<input type="checkbox"/>
15. The backrest should allow you to recline at least 15 degrees and should lock into place for firm support.	<input type="checkbox"/>
16. The backrest should extend high enough to support your upper trunk and neck/shoulder area. If the backrest reclines more than about 30 degrees from vertical, a headrest should be provided.	<input type="checkbox"/>
17. Armrests should be removable and the distance between them should be adjustable. They should be at least 16 inches apart.	<input type="checkbox"/>
18. Armrest height should be adjustable between 7 inches and 10.5 inches from the seat pan. Fixed height armrests are not desirable, especially for chairs that have more than one user.	<input type="checkbox"/>
19. Armrests should be large enough (in length and width) to support your forearm without interfering with the work surface.	<input type="checkbox"/>
20. Armrests should be padded and soft.	<input type="checkbox"/>
21. Most chairs are designed for weights under 275 pounds. If the user weighs more than 275 pounds, the chair must be designed to support the extra weight.	<input type="checkbox"/>
Document Holders	<input checked="" type="checkbox"/>
1. The document holder needs to be stable but easy to adjust for height, position, distance, and viewing angle.	<input type="checkbox"/>
2. If the monitor screen is your primary focus, purchase a document holder that will sit next to the monitor at the same height and distance.	<input type="checkbox"/>
3. If the task requires frequent access to the document (such as writing on the document) a holder that sits between the keyboard and monitor may be more appropriate.	<input type="checkbox"/>
Wrist Rests	<input checked="" type="checkbox"/>
1. Wrist rest should match the front edge of the keyboard in width, height, slope, and contour.	<input type="checkbox"/>
2. Pad should be soft but firm. Gel type materials are recommended.	<input type="checkbox"/>
3. Wrist rest should be at least 1.5 inches deep (depth away from the keyboard) to minimize contact pressure on the wrists and forearm.	<input type="checkbox"/>
Mouse/Pointing Devices	<input type="checkbox"/>

	<input checked="" type="checkbox"/>
1. Choose a mouse/pointer based on the requirements of your task and your physical limitations. There really is no difference, other than preference, among a mouse, trackball, or other device.	<input type="checkbox"/>
2. A mouse should match the contour of your hand and have sufficient cord length to allow its placement next to the keyboard.	<input type="checkbox"/>
3. If you choose a trackball, avoid ones that require the thumb to roll the ball-they may cause discomfort and possible injury to the area around your thumb.	<input type="checkbox"/>
4. A smaller mouse may be more appropriate especially if you have small hands. Caution should be taken if a mouse is used by more than one person.	<input type="checkbox"/>
5. A mouse that has sensitivity adjustments and can be used with either hand is desirable.	<input type="checkbox"/>
Telephones	<input checked="" type="checkbox"/>
1. If task requirements mandate extended periods of use or other manual tasks such as typing while using the phone, use a telephone with a "hands-free" headset.	<input type="checkbox"/>
2. The telephone should have a speaker feature for "hands-free" usage.	<input type="checkbox"/>
3. "Hands-free" headsets should have volume adjustments and volume limits.	<input type="checkbox"/>
Desk Lighting	<input checked="" type="checkbox"/>
1. Good desk lighting depends on the task you're performing. Use bright lights with a large lighted area when working with printed materials. Limit and focus light for computer tasks.	<input type="checkbox"/>
2. The location and angle of the light sources, as well as their intensity levels, should be fully adjustable.	<input type="checkbox"/>
3. The light should have a hood or filter to direct or diffuse the light.	<input type="checkbox"/>
4. The base should be large enough to allow a range of positions or extensions.	<input type="checkbox"/>

Computer Workstations

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Work Process and Recognition

Even when the design of the workstations is correct and environmental factors are at their best, users can face risks from task organization which can intensify the impact of other risk factors, such as [repetition](#). Additionally, failing to recognize early [warning signs](#) could allow small problems to develop into serious injuries. Addressing task organization factors and medical awareness can help minimize the risk of developing musculoskeletal disorders (MSDs) and stop the progression to injury.

- ⌘ [Prolonged Periods of Activity](#)
- ⌘ [Medical Awareness and Training](#)



Prolonged Periods of Activity

[TOP](#)

Potential Hazard

- ⌘ Computer work, whether it's for a job or for fun, may appear to be a low effort activity when viewed from a total body perspective, but maintaining postures or performing highly repetitive tasks for extended periods can lead to problems in localized areas of the body. For example, using a mouse for a few minutes should not be a problem for most users, but performing this task for several uninterrupted hours can expose the small muscles and tendons of the hand to hundreds or even thousands of activations ([repetitions](#)). There may not be adequate time between activations for rest and recuperation, which can lead to localized fatigue, wear and tear, and injury. Likewise, maintaining static postures, such as viewing the monitor, for a prolonged period of time without taking a break can fatigue the muscles of the neck and shoulder that support the head.

Possible Solutions

- ⌘ Provide variation in tasks and workstations so there is time to recover from the effects of activity. There are several ways to provide recovery time for overused muscles.

- ⌘ Utilize an adjustable workstation so users can easily change their [working postures](#). The use of easily adjustable furniture, for example, allows you to frequently change seated postures, which allows different muscle groups to provide support while others rest.
- ⌘ Ensure that there is enough [work space](#) so you can use each hand alternately to perform mouse tasks. This allows the tendons and muscles of the free hand to rest.
- ⌘ Substitute keystrokes for mousing tasks, such as Ctrl+S to save, Ctrl+P to print. Especially if your job is highly mouse intensive
- ⌘ High repetition tasks or jobs that require long periods of static posture may require several, short rest breaks (**micro breaks or rest pauses**). During these breaks users should be encouraged to stand, stretch, and move around. This provides rest and allows the muscles enough time to recover.
- ⌘ Alternate tasks whenever possible, mixing non-computer-related tasks into the workday. This encourages body movement and the use of different muscle groups.



Medical Awareness and Training



Potential Hazard

- ⌘ Employees who have not been adequately trained to recognize hazards or understand effective work practices designed to reduce these hazards are at a greater risk of harm. Without proper medical awareness, MSD [signs and symptoms](#) may go unnoticed and un-addressed. For example, users who do not understand the risk of bad body postures or techniques do not have the knowledge to actively participate in their own protection. Detection and reporting delays can result in more severe injury.



Possible Solutions

- ⌘ Computer users should take the time to obtain general ergonomics awareness training on the following issues:
 - ⌘ Factors related to specific computer [components](#) that may increase discomfort or risk of injury,
 - ⌘ Being aware of discomfort ([signs and symptoms](#)), and
 - ⌘ How to correctly use and adjust components and [environmental factors](#).

Computer Workstations

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Workstation Environment

Appropriately placing lighting and selecting the right level of illumination can enhance your ability to see monitor images. For example, if lighting is excessive or causes glare on the monitor screen, you may develop eyestrain or headaches, and may have to work in awkward postures to view the screen. Ventilation and humidity levels in office work environments may affect user comfort and productivity.

- ⌘ [Lighting](#)
- ⌘ [Glare](#)
- ⌘ [Ventilation](#)



Environment Quick Tips

- ⌘ Arrange your office to minimize glare from overhead lights, desk lamps, and windows.
- ⌘ Maintain appropriate air circulation.
- ⌘ Avoid sitting directly under air conditioning vents that "dump" air right on top of you.

Lighting

[TOP](#)

Potential Hazard

- ⌘ Bright lights shining on the display screen "wash out" images, making it difficult to clearly see your work. Straining to view objects on the screen can lead to eye fatigue.

Possible Solutions

- ⌘ Place rows of lights parallel to your line of sight (Figure 1).
- ⌘ Provide light diffusers so that desk tasks (writing, reading papers) can be performed while limiting direct brightness on the

computer screen.

- Remove the middle bulbs of 4-bulb fluorescent light fixtures to reduce the brightness of the light to levels more compatible with computer tasks if diffusers or alternative light sources are not available.

Note: a standard fluorescent light fixture on a nine-foot ceiling with four, 40-watt bulbs will produce approximately 50 foot-candles of light at the desktop level.

- Provide supplemental task/desk lighting to adequately illuminate writing and reading tasks while limiting brightness around monitors.
 - Generally, for paper tasks and offices with CRT displays, office lighting should range between 20 to 50 foot-candles. If LCD monitors are in use, higher levels of light are usually needed for the same viewing tasks (up to 73 foot-candles).



Figure 1
Blinds are on the windows and the monitor is placed at an angle (perpendicular)

Potential Hazard

- Bright light sources behind the display screen can create contrast problems, making it difficult to clearly see your work (Figure 2).



Figure 2
Bright light entering from a window

Possible Solutions

- Use blinds or drapes on windows to eliminate bright light. Blinds and furniture placement should be adjusted to allow light into the room, but not directly into your field of view (Figure 1). **Note:** vertical blinds work best for East/West facing windows and horizontal blinds for North/South facing windows.
- Use indirect or shielded lighting where possible and avoid intense or uneven lighting in your field of vision. Ensure that lamps have glare shields or shades to direct light away from your line of sight.
- Reorient the workstation so bright lights from open windows are at right angles with the computer screen (Figure 1).

Potential Hazard

- High contrast between light and dark areas of the computer screen, horizontal work surface, and surrounding areas can cause eye fatigue and headaches.

Possible Solution

- For computer work, use well-distributed diffuse light. The advantage of diffuse lighting is that
 - There are fewer hot spots (or glare surfaces) in the visual field, and
 - The contrasts created by the shape of objects tend to be softer.
- Use light, matte colors and finishes on walls and ceilings to better reflect indirect lighting and reduce dark shadows and contrast.

Potential Hazard

- ✘ Direct light sources (for example, windows, overhead lights) that cause reflected light to show up on the monitor (Figure 3) make images more difficult to see, resulting in eye strain and fatigue.



Figure 3
Glare from overhead light source

Possible Solutions

- ✘ Place the face of the display screen at right angles to windows and light sources. Position task lighting (for example, a desk lamp) so the light does not reflect on the screen (Figure 1).
- ✘ Clean the monitor frequently. A layer of dust can contribute to glare.
- ✘ Use blinds or drapes on windows to help reduce glare (Figure 1). **Note:** vertical blinds work best for East/West facing windows and horizontal blinds for North/South facing windows.
- ✘ Use glare filters that attach directly to the surface of the monitor to reduce glare (Figure 4). Glare filters, when used, should not significantly decrease screen visibility. Install louvers, or "egg crates", in overhead lights to re-direct lighting.
- ✘ Use barriers or light diffusers on fixtures to reduce glare from overhead lighting.

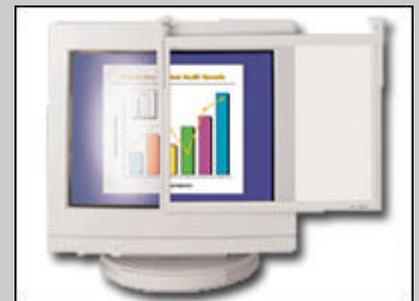


Figure 4
Monitor with a glare screen

Note

Generally, a large number of low powered lamps rather than a small number of high powered lamps will result in less glare.

Potential Hazard

- ✘ Reflected light from polished surfaces, such as a keyboards, may cause annoyance, discomfort, or loss in visual performance and visibility.

Possible Solutions

- ✘ To limit reflection from walls and work surfaces around the screen, paint them with a medium colored, non-reflective paint. Arrange workstations and lighting to avoid reflected glare on the display screen or surrounding surfaces.
- ✘ Tilt down the monitor slightly to prevent it from reflecting overhead light.
- ✘ Set the computer monitor for dark characters on a light background; they are less affected by reflections than are light characters on a dark background.

Potential Hazards

- ⌘ Users may experience discomfort from poorly designed or malfunctioning ventilation systems, for example, air conditioners or heaters that directly "dump" air on users.
- ⌘ Dry air can dry the eyes (especially if the user wears contact lenses).
- ⌘ Poor air circulation can result in stuffy or stagnant conditions.
- ⌘ Temperatures above or below standard comfort levels can affect comfort and productivity.

Possible Solutions

- ⌘ Do not place desks, chairs, and other office furniture directly under air conditioning vents unless the vents are designed to redirect the air flow away from these areas.
- ⌘ Use diffusers or blocks to redirect and mix air flows from ventilation systems (Figure 4).
 - ⌘ Keep air flow rates within three and six inches per second (7.5 and 15 centimeters per second). These air flow rates are barely noticeable or not noticeable at all.
- ⌘ Keep relative humidity of the air between 30% and 60%.
- ⌘ The recommended ambient indoor temperatures range between 68° and 74° F (20° and 23.5° C) during heating season and between 73° and 78° F (23° and 26° C) during the cooling season.

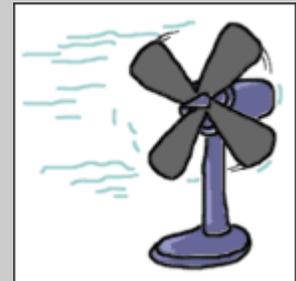


Figure 3
Air circulation



Figure 4
Air ventilation diffuser

Potential Hazard

- ⌘ Exposure to chemicals, volatile organic compounds (VOCs), ozone, and particles from computers and their peripherals (for example, laser printers) may cause discomfort or health problems.

Possible Solutions

- ⌘ Enquire about the potential for a computer or its components to emit pollutants. Those that do should be placed in well-ventilated areas.
- ⌘ Maintain proper ventilation to ensure that there is an adequate supply of fresh air.
- ⌘ Allow new equipment to "air out" in a well-ventilated area prior to installing.



Awkward Postures

Maintaining good postures, such as straight wrists, elbows close to the body and head straight and in-line with the torso is often difficult because of a misalignment between the user and the computer components and accessories.

For Example:

- ✗ A monitor positioned too high can cause you to tilt your head back, which fatigues the neck and shoulder muscles.
- ✗ A keyboard tray that is too small can cause you to move the mouse to a position of the desk that requires you to reach to perform mouse tasks. This pulls the elbow away from the body and can cause you to support your arm in an elevated position for an extended period of time.
- ✗ A keyboard that is too low causes you to bend your wrists at extreme angles, which can cause the finger tendons and tendon sheaths to bend around the bones of the wrist.

Working in awkward postures can irritate or strain the bone-tendon-muscle connections.

- ✗ Muscles can be stretched or compressed causing them to be inefficient and resulting in possible fatigue and overexertion.
- ✗ Non-neutral postures can pull and stretch tendons, blood vessels, and nerves over ligaments or bone where they can become pinched and restricted.
- ✗ Tendons and their sheaths can rub on bone and ligaments, which can lead to irritation and fraying. This can lead to swelling within confined areas such as the carpal tunnel, which then restricts nerves and blood vessels.
- ✗ Tingling and numbness of the fingers and hands as well as pain from tendinitis and tenosynovitis (inflammation of a tendon sheath) can result.

A properly adjusted workstation can help minimize awkward postures. Place the monitor in front of you at a height where you can look straight ahead and not tilt your head forward or backward. Place frequently used items, such as keyboards and pointing devices where you can reach them easily. Adjust and arrange keyboard trays and chairs so you don't have to bend your wrists up, down, or to the side. Adjust your chair so your feet and back are well supported. Proper neutral postures allow you to work with minimal stress on the musculoskeletal system.

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Contact Stress

Contact stress can occur either internally or externally. Internal stress occurs when a tendon, nerve, or blood vessel is stretched or bent around a bone or tendon. External contact stress occurs when part of your body rubs against a component of the workstation,

such as the chair seat pan or edge of the desk. Nerves may be irritated or blood vessels constricted as a result.

- ✎ You can experience contact stress to your forearms when you rest them on the leading edges of work tables or, if the nerves in the forearm are affected, your fingers and hands may tingle and feel numb, similar to the feeling when you hit your "funny bone".
- ✎ You may experience pain and numbness in your legs if blood circulation is cut off by contact with the leading edge of a chair.
- ✎ Your forearms and wrists can be affected if wrist rests have sharp, hard leading edges.
- ✎ Tendons can be damaged when repetitive finger motion tasks are performed with a bent wrist.

To help solve these problems carefully select wrist rests, chairs, and desk surfaces and take frequent rest and stretch breaks to minimize the amount of contact stress that you may experience. Adjust your workstation to maintain neutral wrist postures.

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Force

Force is usually thought of as a strenuous physical exertion, such as when lifting a heavy weight or pushing a heavy load. Computer work seldom requires this type of strenuous exertion, but there are tasks that require concentrated force that can affect smaller, localized muscle groups.

What are some examples?

- ✎ Your finger and forearm muscles may become sore if you use a pointing device at a setting that is so sensitive that it is hard to control. Hand and arm muscles must work continually to keep the device steady.
- ✎ Your shoulder and neck muscles are continually being used to lift the arm away from your body if the mouse is placed too far away.
- ✎ The muscles of the back can become strained if you must tilt your head back to view a monitor that is too high.

Although the muscle is usually the first point of pain when these injuries occur, the tendon, which attaches the muscle to bone, can also be affected. Localized pain, stiffness, and tenderness can signal that the muscle or tendon has been exerted beyond its capacity.

To help avoid these problems, properly arrange computer components on the work surface to maintain neutral postures and provide adjustable furniture to minimize the amount of time spent in one posture.

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General Controls

The arrangement of work components and the purchase of new equipment should

encourage the following body postures:

- ✎ Keep your head and neck vertical and in-line with the spine, not bent or twisted.
- ✎ Keep your torso straight, not twisted, especially when lifting or bending.
- ✎ Generally, whether standing or sitting, keep your torso vertical or within 20 to 30 degrees of vertical.
- ✎ Keep your elbows close to your body by avoiding frequent reaching to your side, in front, or above your head.
- ✎ Keep your forearms approximately parallel to the floor.
- ✎ Maintain a neutral forearm posture whenever possible, by not rotating your forearm repeatedly, especially when your wrist is bent.
- ✎ Keep your wrists straight and in-line with your forearms, not bent up or down or to either side.
- ✎ Keep your thighs approximately parallel to the floor or your hips slightly higher than your knees.
- ✎ Keep your feet firmly on the floor and your legs approximately perpendicular to the floor.
- ✎ Place your keyboard and mouse close together at about the same height to reduce reaching.
- ✎ Use a fully adjustable chair so your body is fully supported and you can change your body postures frequently.
- ✎ Use adjustable height work surfaces so all users can sit with their feet firmly on the floor. If the work surface is not fully adjustable, use an adjustable foot rest.
- ✎ Place all frequently used components such as monitor, keyboard, and mouse in front of you so you don't have to turn your head from side to side.
- ✎ Place your monitor low enough so its top is not above your horizontal line of sight. This will limit the need for you to tilt your head backward to see the screen.
- ✎ If laptops are to be used as primary work computers where intensive keyboard use is necessary, provide auxiliary, full-sized, keyboards and monitors.

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Repetition

Many computer workstation tasks are highly repetitive. You may perform the same motions repeatedly at a fast pace and with little variation. When motions are isolated and repeated frequently for prolonged periods, there may be inadequate time for your muscles and tendons to recover. Combining repetitive tasks with factors such as awkward postures and force may increase the risk of injury.

- ✎ Computers require little task variation. Old typing activities, such as adding paper or

mechanically advancing pages, have been reduced or eliminated. Users can stay in their chairs and type or perform mouse work for an almost unlimited amount of time. Under these conditions, a proficient typist can easily perform more than 18,000 keystrokes per hour. These repetitive motions can lead to tendon and tendon sheath injuries, especially if the wrist is bent during the activity.

- ✦ Similar repetitions occur when using a pointing device such as a mouse. Here, the hazard may be greater because the motions are often concentrated in only a few fingers of one hand.
- ✦ A computer operator may remain in essentially the same posture for an entire shift. This forces a few isolated muscles to repeatedly activate to accomplish a task such as holding the head up or focusing on a computer screen.
- ✦ A poorly designed workstation may cause you to repeatedly reach to use a mouse or answer the phone. This can fatigue the muscles of the shoulder and irritate the tendons.

You can reduce repetition by properly arranging the workstation and its components. For example, a mouse that is placed close to the keyboard should minimize repetitive reaching. However, even the best designed workstation can not eliminate all highly repetitive motions, especially for data input. For this reason, it is extremely important to maintain good posture by providing adequate adjustability at the workstation. You should perform all hand tasks with the wrist in a straight, neutral posture to allow the tendons to slide easily without interference.

The following work process suggestions may also help reduce repetition.

- ✦ Task Rotation or Job Enlargement - If you must perform a variety of tasks, when possible, intersperse them throughout the work day. Minimize long blocks of uninterrupted computer time by doing other non-computer tasks such as photocopying, phone work, cleanup, etc.
- ✦ Micro Breaks or Rest Pauses - Build short micro pauses into computer use sessions. Frequent short breaks are desirable. Every hour, take a five-minute break from computer tasks. Look away, stretch, get up, or walk. These brief pauses provide time for muscles and tendons to recover.

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MSD Signs and Symptoms

It is important to report signs and symptoms as early as possible to prevent serious injury or permanent damage. Users at risk for MSDs associated with computer use may experience some of the following signs or symptoms:

- ✦ Numbness or a burning sensation in the hand
- ✦ Reduced grip strength in the hand
- ✦ Swelling or stiffness in the joints
- ✦ Pain in wrists, forearms, elbows, neck, or back
- ✦ Reduced range of motion in the shoulder, neck, or back
- ✦ Dry, itchy, or sore eyes
- ✦ Blurred or double vision
- ✦ Aching or tingling
- ✦ Cramping
- ✦ Loss of color in affected regions
- ✦ Weakness

Although these symptoms may not necessarily lead to an MSD, if experienced, the user should make an evaluation of their working positions and their workstation layout. The [checklists](#) may be helpful.



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Additional References

The Following references were used for development of the eTool and may provide additional information on the subject. New materials are continually being developed, therefore, this should not be considered as an all-inclusive reference list.

- ✦ [Alternative Keyboards](#). DHHS (NIOSH) Publication No. 97-148 (1997), 471 KB PDF, 17 pages. The purpose of alternative keyboards. What the difference is between alternative and regular keyboards. Information on whether alternative keyboards prevent injuries. What to do if you want to use an alternative keyboard. Ideas for preventing musculoskeletal injuries.
- ✦ [Musculoskeletal Disorders and Workplace Factors](#). DHHS (NIOSH) Publication No. 97-141 (1997), 2.8 MB PDF, 590 pages. This is a critical review of epidemiologic evidence for work-related musculoskeletal disorders of the neck, upper extremity, and low back.
- ✦ [Ergonomics](#), American Federation of Government Employees (AFGE). This site has material on ergonomic hazards and simple steps you can take to avoid injury.
- ✦ [Office Ergonomics](#). Canadian Centre for Occupational Health and Safety. This site covers topics from identifying ergonomic hazards to purchasing and adjusting VDT workstation equipment.
- ✦ [Cornell University Ergonomics](#). Guidelines for arranging safe computer workstations, a checklist for evaluating VDT workstations and several internet links.
- ✦ [Ergonomic tips for the office](#). American Society of Safety Engineers (Sept. 2000). To increase safety in the workplace, ASSE recommends everyone do a workplace safety audit in an effort to reduce accidents and injuries, whether it be in a company office building or a home office.
- ✦ [Ergonomics Program for Employers with VDT Operators](#). California Department of Industrial Relations (March 6, 1998). This site contains a 4-step online ergonomics program for employers with VDT operators includes a downloadable VDT checklist.
- ✦ [Strategic Rests Breaks Reduce VDT Discomforts Without Impairing Productivity](#). (May, 2000). A NIOSH study reporting that short, strategically-spaced rest breaks can reduce eyestrain and musculoskeletal discomfort for VDT operators without decreasing productivity. These findings were published in the May 2000 issue of the scientific journal Ergonomics.
- ✦ [The Keys to Healthy Computing](#). American Federation of State, County and Municipal Employees (AFSCME) Safety and health handbook. The Keys to Healthy Computing includes information on solutions to health problems associated with VDT use.
- ✦ [Office Ergonomic Resources](#). University of Minnesota. This site has information on how to reduce specific ergonomic computer hazards and contains an extensive product database.

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