

## Step 1. The Work Area

---



Your work area should be large enough for you and the equipment and materials that make up your workstation.

You should:

- Have enough space to perform all your required tasks.
- Place the items you use most often directly in front of you.
- Use a headset for lengthy telephone work.

Your work area should be located in a comfortable work environment:

- Avoid overcrowding.
- Do not direct the warm air flow from the central processing unit (CPU) and disk drives toward you.
- Use anti-static floor mats or other static grounding in low humidity workplaces.

## Step 2. The Desk

---



Your connection to your work is through your hands. Place equipment on and around your desk so that when you perform routine tasks:

- Your shoulders are relaxed.
- Your upper arms are close to your body.
- The angle between your upper arm and forearm is in the range of 75° to 135°.
- Your wrists are bent no more than 5° right or left and no more than 10° up and down.

### **Adjustable Desk**

Ideally, your desk should have an adjustable surface large enough to accommodate a monitor and a separate, adjustable keyboard tray. Adjustable desktops and keyboard trays allow for different operators and a variety of tasks to be performed.

### **Fixed-Height Desk**

- A fixed-height desk can make using the computer uncomfortable. A desk that is too low causes curvature of the lumbar spine, increasing the load. A desk that is too high causes abduction of the arms and forward flexion or elevation of the shoulder and neck muscles (a 15° bend at the neck is acceptable).
- If a fixed-height desk is used, add a keyboard tray that adjusts vertically to provide added adjustability. The minimum adjustment range for this tray should be 22" to 28" (56 to 71 cm) from the floor.
- Adjust your chair to a comfortable position, adjust the keyboard tray to allow you to type with the angle between your upper arm and forearm in the range of 75° to 135°, and your wrists bent no more than 5° right or left and no more than 10° up and down. Then adjust the monitor support surface to allow you to gaze slightly down to view the center of the screen.

### **Desk Design**

- Select a desk that is stable.
- Desktops should have a matte finish to minimize glare and reflection.
- Avoid sharp edges—rounded or sloping edges are preferable.
- Avoid glass tops—sharp edges compress the arm during writing tasks. Also, glass tops present a glare problem.
- From your desk's edge, the minimum under-desk clearance depth should be 15" (38 cm) (optimally, 17" (43 cm)) for your knees and a 23 1/2" (60 cm) for your feet. The minimum under-desk clearance width should be 20" (51 cm).
- The desktop should be large enough for work objects (at least 27 1/2" (70 cm) wide), and should prevent the sliding of these objects.
- The desk surface should be deep enough to provide at least 16" (41 cm) between your eyes and the monitor screen. If necessary, move the desk away from the wall to provide enough space between your eyes and the monitor screen.
- Under desk obstructions should be removed to provide sufficient leg room.
- Taller workers or workers with a history of back pain may be more comfortable with a height-adjustable desk, a sit/stand desk, or a standing workstation. The minimum adjustment range for a keyboard tray on a standing workstation should be 34 1/2" to 47 1/4" (88 to 120 cm) from the floor.
- If your desk is too low, raise your desk by placing stable wood or concrete blocks under the desk legs or use a desk leg stand. If your desk is too thick for you to place your legs under the desk, remove a middle drawer or add a keyboard tray.

### Step 3. The Chair—Controls and Seat

---



Most chairs are designed for people weighing no more than 275 pounds. If you weigh more than 275 pounds, you will need a chair designed to support your additional weight.

#### Controls

- Your chair should be easily adjustable and require the use of only one hand.
- The controls should be easily reached and adjusted from the standard seated work position.
- The controls should provide immediate feedback.
- The operation of the controls should be logical and consistent.

#### Seat Height

- Adjust the seat height of your chair so your feet are flat on the floor and your lower back is supported, then adjust your desk.

- If your desk is not adjustable, adjust your chair to allow you to reach your work comfortably. Since you are adjusting to your desk, your feet may not touch the floor. You can support your feet by adding a footrest.
- Ideally, you should adjust your seat height until the crease behind your knees is slightly above the seat. Raise your desk if it is too low. The minimum adjustment range for seat height should be 16" to 20½" (41 to 52 cm).

### **Seat Pan Length**

- The seat pan length should be 15" to 17" (38 to 43 cm). With your back against the backrest, the front edge of the seat pan should not touch the crease of your knee.
- A seat pan that is too short may not give adequate support under your thighs. This may force you to shift your weight to other body tissues, which leads to whole body discomfort during long periods of sitting.
- If the seat pan is longer than your buttock-knee length, the front edge of the seat contacting the back of your legs can cause discomfort, and force you to sit forward in the seat, completely out of contact with the backrest. On some chairs, the backrest moves forward over the seat pan, allowing you to adjust the seat pan length.

### **Seat Pan Width**

The seat pan should be wide enough to allow you to shift in your seat (at least as wide as your thighs), a minimum of 18¼" (46.5 cm) wide at its back edge, and padded and contoured for support. A wider chair seat, or one with armrests that can be removed or moved further apart, should be used for larger workers.

### **Seat Pan Slope**

The seat pan should have an adjustable range that allows 5° of tilt both forward and backward. If you lean forward for a significant part of the day, a forward tilting seat pan is important. The seat pan should lock in each position.

### **Seat Pan Padding**

- The seat pan cushion should be firm, and the contour should allow your lower back to come in contact with the backrest. Avoid severely contoured seats.
- The front edge of the seat pan should be softly padded, with the front edge rounded in a waterfall fashion.
- The entire seat covering should be made of a porous, breathable, and resilient material.
- Hard, unpadded, and flat seat pans are uncomfortable for periods over 1 hour.
- Soft, deeply padded seat pans cause you to sink too far into the seat. Over long periods of time, this causes tension in the hip muscles.
- Slippery material on the seat may cause you to slide away from the backrest, thus providing little back support.

## Step 4. The Chair—Backrest, Armrests, and Base

---



### **Backrest**

The support surface of your backrest should be a minimum of 15" (38 cm) high and 12" (30.5 cm) wide, and should contour to the curve of your lower back. The backrest should also:

- Be large enough to support your entire back, but should not interfere with the use of your arms.
- Widen from top to bottom, and be concave from side to side to conform to your body and support you in the chair.
- Have a forward and backward tilt, reclining a minimum of 15° and locking into place to provide support if you choose to sit back in a relaxed position.
- Extend high enough to provide support to your upper trunk, head, and neck when you lean back.

- Contain a spring-loaded pivoting mechanism, which allows it to follow your natural body movements while maintaining constant body support.

The chair back should have a lumbar (low back) support that conforms to your lumbar curve. If the lumbar support is permanently attached to the seat back, there should be a vertical seat back adjustment to allow you to position the middle of the lumbar support a minimum of 6" to 10" (15 to 25.5 cm) above the seat pan. You can create a lumbar support by shaping a towel or pillow to conform to your lumbar curve or you can purchase a lumbar support. The lumbar support should be at least 12" (30.5 cm) wide.

### **Armrests**

- Armrests should be removable and the distance between the armrests should be adjustable.
- The armrests should be a minimum of 16" (41 cm) apart. Adjust the armrests so that they are close enough to your sides that you can lean on them without straining, but far enough apart to allow room for your thighs.
- Armrests should also adjust vertically so you can match their height to the height of your elbow at rest. Adjust the vertical height of the armrests to allow you to easily keep your shoulders relaxed, and your upper arms close to your abdomen (the armrests should be about elbow height). Fixed armrest heights should be between 7" to 10½" (18 to 27 cm) above the compressed seat height. Adjustable armrest heights should include at least a portion of the 7" to 10½" (18 to 27 cm) range.
- Rearrange the workstation components so the armrest height (after following the guidelines above) and the desk or keyboard tray height are the same. The armrests should also be:
  - Long enough to support your forearm (e.g., from the elbow to the base of the hand).
  - Wide enough to support your forearm. Avoid narrow armrests (they may dig into your arm).
  - Padded and soft. Avoid hard, stiff armrests.
  - Low and short enough to fit under the work surface or removable. You must be able to reach the work surface and still be able to use the chair's backrest for support.
- If you have large thighs, you may be more comfortable without armrests.

### **Base**

- The chair should have a solid base supported by five legs to prevent tipping.
- The legs should have casters that roll easily over the floor or carpet—different types of casters are available to fit each type of floor covering.
- Locking casters can add stability and prevent unintentional movement of the chair.
- The chair should swivel 360° so it is easier to sit down, stand up, and move within your workstation.

## Step 5. The Footrest

---



You need a footrest if your feet do not rest flat on the floor after your chair has been properly adjusted.

Your footrest should be:

- Adjustable in height and inclination.
- Designed so it does not restrict leg movement.
- Easy to remove.
- As wide as your hips.
- Large enough to support the soles of both of your feet.
- Covered with a nonskid material to reduce slippage.

Several footrest models can move while your feet are resting. The slope responds to the movement of your ankle and alters slightly in height as your foot moves. This allows some leg and foot movement that may help counteract the effects of sitting.

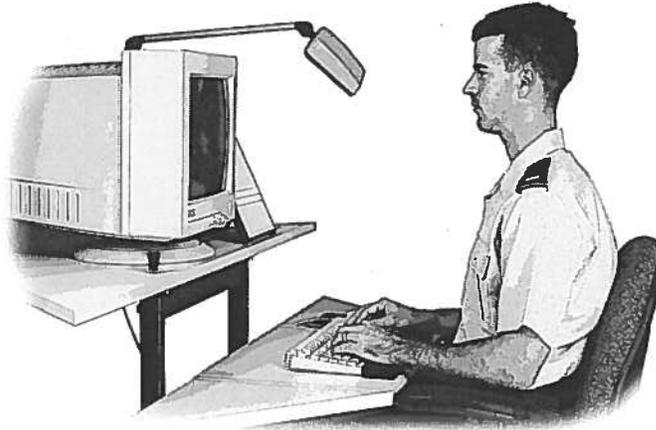
As a quick *temporary* fix for a footrest, use old phone books or binders.

Working in a seated position can cause your lower legs to swell. How much swelling depends on both your activity and personal health.

- Too much pressure on the back of the thighs or knees can affect your nerves and blood circulation.
- The weight of your legs will tend to tilt your pelvis, arching the small of the back.

## Step 6. The Monitor

---



### Monitor Position

- Monitors that swivel horizontally and tilt allow you to adjust for the best viewing angle. Tilt the monitor screen slightly to accommodate your line of sight. Mounting a monitor on an adjustable arm allows movement in all directions and frees up workstation space.
- For comfortable head and neck placement, position your monitor screen to allow you to gaze slightly down to view the center of the screen (do not bend your neck down more than 15°).
- Adjust the height of your monitor to allow you to gaze slightly down to view the center of the screen.
  - If your monitor is too low, place it on a stable box or monitor stand.
  - If your monitor is too high, and adjusting your desk surface and chair (and adding a footrest if necessary) doesn't help, consider replacing it with a smaller monitor.
- If you wear bifocals, you might want your monitor positioned lower.

### **Eye to Screen Distance**

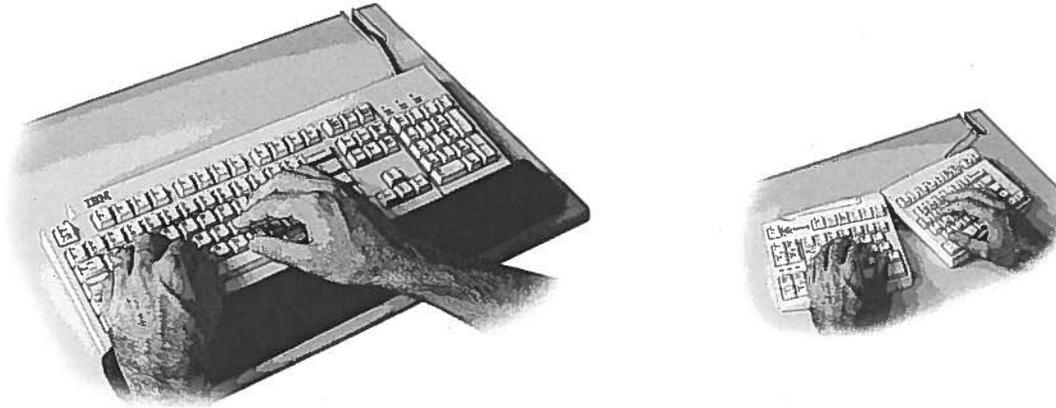
- The user-preferred viewing distances (between your eye and the screen or source document) are normally greater than typical workstations can accommodate—24" to 34" (61 to 86.5 cm)—because desk depth is often too short for deep monitors. Flat display screens or keyboard extensions can allow for proper distance.
- To reduce strain on your muscles, keep your monitor screen at least 16" (41 cm) from your eyes (or farther away than you might hold a book).

### **Character Display**

- The monitor should be large enough to display a sizable amount of information.
- The screen characters should be clear and easy to read with no perceptible flicker or waiver. If characters are difficult to read:
  - Clean/dust the screen.
  - Adjust the magnification or font in the software application.
  - Adjust brightness and contrast.
  - Reduce sources of glare.
- Geometric designs of letters and symbols should not be distorted or appear to melt together.

## Step 7. The Keyboard

---



Choose a keyboard that is detached from the display screen (laptops are not recommended for long-term use) and has:

- Independent angle adjustment and positioning.
- A thin profile to minimize wrist extension.
- A matte-finished surface to reduce reflections and ease eye strain.

All keyboards come with a tilt adjustment toward you. If you feel more comfortable with the keyboard tilting away from you, prop the front end of the keyboard up to create a negative tilt.

The height of your keyboard depends on the height of your work surface and chair. To reduce tension in your shoulder muscles, the keyboard should be low enough so your arms are relaxed at your sides. Place your keyboard so the angle between your upper arm and forearm is in the range of 75° to 135°, and your wrists are bent no more than 5° to the right or left and no more than 10° up or down.

- If your keyboard is not adjustable or is too low, use a pad of paper or some books to raise it up as a quick, temporary fix.
- If it is too high, raise your chair or place some padding under your wrists to keep them from drooping. Your hands should be able to move easily and be in a reasonable straight line with your forearms.

Keep your wrists floating while you type, but support your forearms (e.g., on your armrest). Lack of forearm support creates constant shoulder and neck tension and may produce frequent headaches.

### **Wrist and Palm Rests**

A wrist or palm rest should be at least as wide as the usable portions of the keyboard and should match the shape and the height of the keyboard.

- A keyboard fitted with a palm rest supports the heel of your hand and minimizes hand contact with sharp table edges.
- A padded wrist rest provides either a rest for the wrist during breaks from typing, or a reminder to keep your wrist straight or only slightly bent.
- Avoid digging the heels of your palm or wrist into a wrist rest, the sharp edge of the desk or blotter, a watch or a bracelet.
- Use the wrist rest pad to give your wrist a comfortable resting place between typing and to support the weight of your arms.

### **Alternative Keyboards**

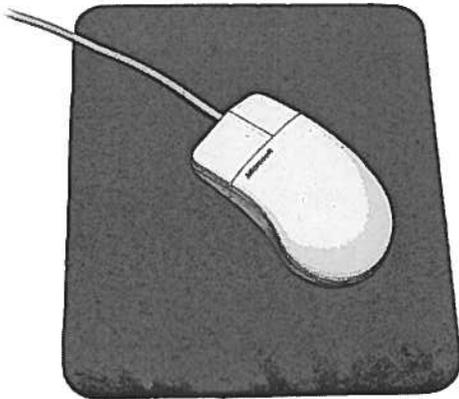
Conventional rectangular keyboards place your hands much closer together than your elbows, causing wrist deviation (turning out of the hands at the wrists). Alternative keyboards reduce ulnar deviation (bending the wrist sideways toward the little finger).

- Some of these keyboards are split horizontally to reduce the wrist deviation.
- Others are split with two halves of the keyboard in a "tower" arrangement to allow wrists to be in a completely neutral posture.
- The vertical split keyboard eliminates the ulnar deviation but may cause some shoulder discomfort. Scooped key arrangements bring the keys slightly closer together requiring less reaching and reducing fatigue.

There is no evidence that the use of these keyboards reduces the frequency or severity of musculoskeletal system disorders.

## Step 8. The Mouse and Trackball

---



Choose your input device—the mouse and trackball are the most popular—based on the requirements of your task and your physical limitations. Place your mouse or trackball in your immediate reach zone for natural comfort and maximum hand-to-eye coordination. Placing your input device too far away, too low, or too much on one side can cause shoulder, wrist, elbow, and forearm discomfort.

### Mouse

The mouse is designed to fit the contours of your hand. A keyboard is used with a mouse, so you should position the mouse as close to your body as the keyboard is, and within easy reach. The mouse and keyboard should be housed together on an adjustable work surface, on a large adjustable tray, or on two adjustable trays. The work surface must be stable; if the mouse is used on a keyboard tray, the tray should not wobble or tip. Also, when a keyboard and mouse are placed on the same tray, an angled tray works best for keyboarding, but a mouse is used most effectively on a flat surface.

Although most mice are designed for use on a work surface, there are some that can be operated in conjunction with a foot clicker. Others are designed for use on a vertical surface—even on your lap.

### Trackball

The trackball—sometimes called an upside-down mouse—is mounted directly onto the keyboard. A mouse uses a rolling ball on its underside, but a trackball has an exposed ball that you manipulate with your fingers. The trackball uses different muscle and tendon groups and can add variety to your input tasks. Avoid trackballs that use the thumb to roll the ball—they may cause discomfort and possible injury to the area around your thumb.

Unlike a mouse, you don't have to use a trackball on a horizontal pad; like a mouse, it is best positioned close to your body and possibly at an angle.

## Step 9. Other Input Devices

---

There are other input devices you may use instead of a mouse or trackball. Choose a device based on the requirements of your task and your physical limitations. Just remember, placing your input device too far away, too low, or too much on one side can cause shoulder, wrist, elbow, and forearm discomfort. Place your device in your immediate reach zone for natural comfort and maximum hand-to-eye coordination.



- **Touch pads** allow you to move the cursor on the computer screen by simply gliding your finger across a small pad. Unlike mouses, trackballs, and other pointing devices, touch pads have no moving parts to clog or break, so they never require disassembly for cleaning.
- **Touch screens** allow you to point directly at an object. They require little or no training, are faster than other pointing devices, and require no extra work surface. However, the disadvantages of touch screens include arm fatigue, smudges, optical interference, and increased glare.
- **Voice input** allows you to "talk" to your computer. Currently, programs can understand and respond to natural speech delivered at rates of up to 160 words per minute.



- **Pen-like devices** enter and manipulate information through contact with the computer screen or a horizontal pad through pressure, light, electromagnetic disruption, or radio frequencies. A pen pad requires about as much room on the work surface as a mouse. If pen technology is used on a horizontal pad, a workstation must provide adequate nonglare lighting for both it and the computer screen.



- A **gesture glove** is worn on your hand and responds to hand and arm motions. A glove is most useful for high-tech applications, such as sophisticated engineering projects, where it might be used to turn the page in a 3-D landscape.
- **Handwriting recognition programs** are available but they are still primitive, with error rates of up to 10%.

## Step 10. The Document Holder

---



If you refer to printed materials often, keep them on a document holder (clip or copy stand) adjacent to the screen.

A document holder should be stable, but you should be able to adjust its height, position, distance, and angle of view.

- **If the monitor screen is your primary focus**, place the document holder either next to your screen at the same height, or between your screen and keyboard. This will allow you to look from the document holder to the screen with little movement of your neck and back and prevent frequent changes of focus. However, if you need to exercise your eyes, place the document holder at a different distance from the monitor.
- **If printed material is your primary focus**, place the document holder directly in front of you and the monitor off to the side.

## Step 11. Lighting

---



The lighting you need in your work area depends on the task you're performing. Bright lights are important when you're working with printed materials. However, bright lights can cause the following problems when you're working on a computer screen:

- Annoying reflections.
- Bright spots in your field of vision.
- Eye strain as you try to focus on the less bright screen.

You must consider both natural and electric lighting and the objects in the space that reflect their light. This is no simple task, because almost all objects in a work area are reflective—the floor, ceiling, walls, partitions, equipment, furniture, and furnishings. Their finishes, such as paint, lacquer, glass, fabric, or carpeting, determine the amount and nature of their reflectivity. Even the clothing you wear may produce unwanted reflections. You should wear medium to dark colored clothing above your waist if reflections from your clothes are a problem.

Because there are so many factors that affect the lighting in your work area, it's important that your workstation lighting is both adjustable and under your control. Whether it's lowering a blind or turning off a bright overhead light, you must be able to adjust the lighting for the task at hand.

If you use a task light, it should:

- Be directed at your work, not diffused.
- Not focus on a small area.
- Not be in your line of sight.

## Step 12. Glare

---

Glare is a difficult lighting problem to eliminate. *Direct glare* occurs when a light source (the sun, overhead lights, etc.) enters the eye directly. *Reflective glare* occurs when a light source bounces off a surface (walls, the monitor, etc.) then enters the eye. Both can cause discomfort and interfere with a visual task. Even a low level of glare can cause enough eyestrain to impair your performance, but you *can* control glare:

- Turn off some lights. If you are viewing the monitor screen by itself, you can reduce glare (and you will not strain your eyes) by turning off all other lights and reading by the light emitting from the screen
- Make sure your workstation has matte or nonglare surfaces.
- Install blinds on windows near your computer.
- Install grid or parabolic diffusers on overhead lights to soften the light.
- Adjust brightness and contrast on your display screen.
- Cover the screen with glare filters.
- Tilt your monitor.
- Rearrange the workstation so you are at a reasonable distance from the window and not directly below overhead lights.
- Wear medium to dark clothing.

### Hood and Filters

- Hoods offer a simple and inexpensive solution to screen glare. Although available from manufacturers, they can be easily constructed out of cardboard and tape—black cardboard with a matte finish is best.
- Glare filters are made of either a hard glass or plastic or a loosely woven mesh. Most filters increase your screen's contrast by reducing the reflected glare more than the emitted light.
  - Hard filters reduce glare through anti-reflective coatings and tint or polarization application. Because the attachment of a hard filter often leaves a gap between the filter and screen, they can trap dust, and some create more reflection problems than they solve. Generally, the closer they are mounted to the screen, the better.
  - Mesh filters are particularly effective when there is a bright light reflecting directly off the screen. Unfortunately, they also partially obscure the screen image.