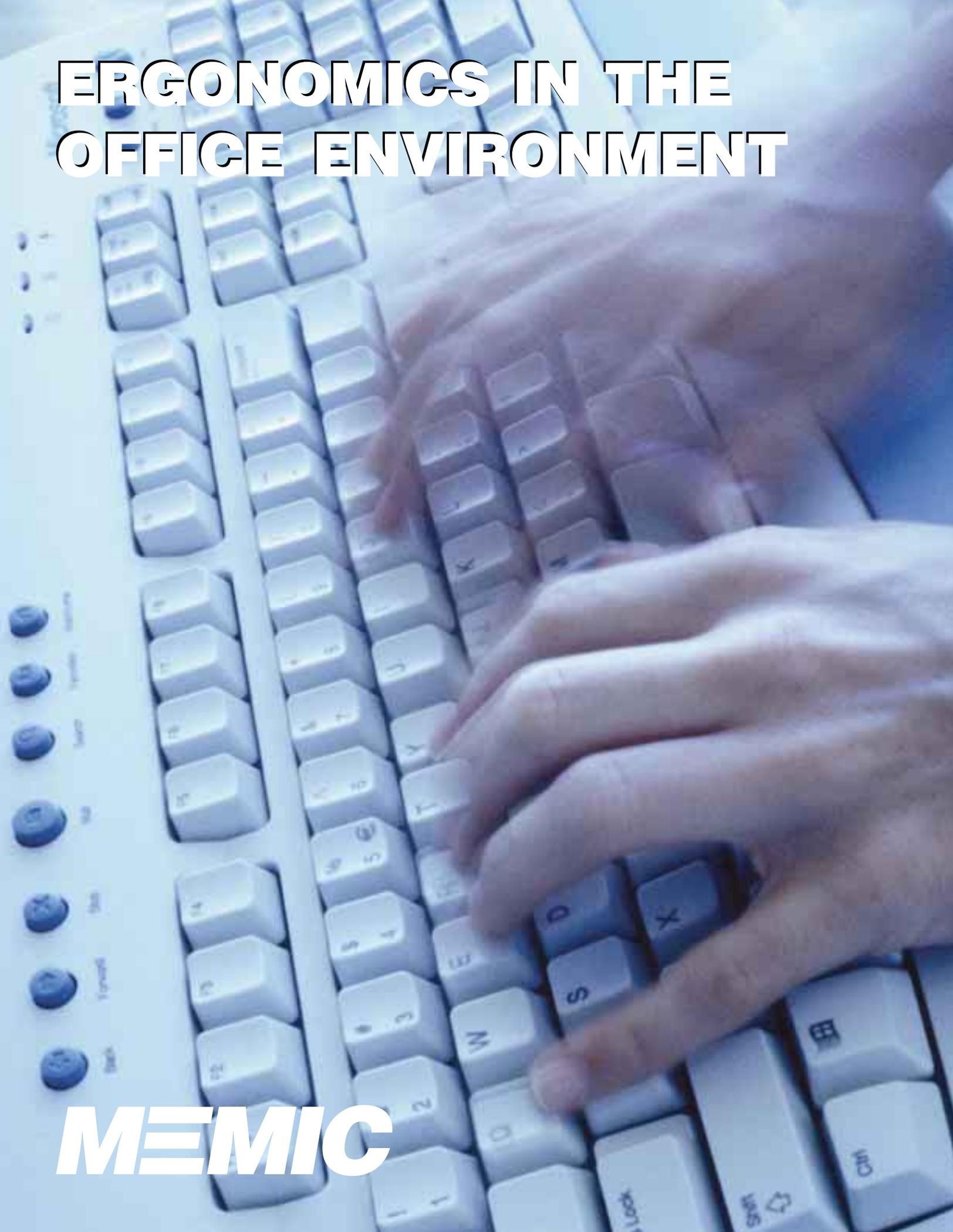


ERGONOMICS IN THE OFFICE ENVIRONMENT



MEMIC

ERGONOMICS IN THE OFFICE:
A GUIDE TO PROPER
WORKSTATION DESIGN

BY

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WORKSTATION SETUP

The objective of good workstation design is to allow the worker to adopt the comfortable dynamic sitting posture that will minimize fatigue and discomfort. *Dynamic sitting posture* is the organization of the work area, tasks, and equipment to facilitate and/or encourage postural changes throughout the work shift. No single posture can remain comfortable if maintained for a long period. In fact, studies have shown that we can only sit for one hour before the onset of muscle fatigue. Each arrangement may be unique to the individual worker based on his or her tasks, how the work is organized, the worker's size, and working preferences.

Workers should also be provided with education and training related to workstation design and layout, so that they may optimize the adjustment and arrangement of their workstations.

Height adjustability of chairs and tables may be necessary for various types of tasks. In terms of user comfort, adjustability of furniture and video display terminals (VDTs) is particularly important when it involves users who perform prolonged seated tasks and workstations that must accommodate multiple users.

Within the workstation, some general considerations are important:

- ✓ Frequency of use
- ✓ Importance
- ✓ Sequence of use
- ✓ Reach requirements
- ✓ Movement
- ✓ Communication

Frequency of use: The frequency with which a piece of equipment is used should be considered when arranging its location in the workplace. For example, if the computer is not used frequently, it may be located on a swivel arm that can be pushed out of the way to free up desk space for the high-frequency tasks. Likewise, if the telephone or a calculator is frequently used, it should be located on the dominant side and within close reach.

Importance: Items that are critical to the job tasks should be located where they can be accessed quickly and readily and without an extended reach.

Sequence of use: Common sequence patterns should be identified so the items or equipment can be grouped and located in their order of use. For example, if a worker must reach for a form, place it in the printer, use the computer to input information, and then take the form from the printer, these items should be placed in a logical sequence. Functionally related items should be placed together; for example, paper near printers, telephone directories near the telephone, and so on.

Reach requirements: Material and equipment should be placed within a comfortable reach of a worker sitting in the dynamic sitting posture. Frequency, importance, and sequence of use should be considered.

Movement: Sufficient space should be maintained around equipment and furniture to allow freedom of movement for the worker to adjust posture, stand and stretch, reach into storage areas such as drawers, and so forth.

Communication: The need for communication and for privacy should be considered in the layout and arrangement of the work area. The types of tasks, individual worker preferences, and confidentiality needs should be taken into consideration.

Seating is an integral part of the workstation and can have the largest impact on overall user comfort. A well-designed chair will positively affect posture, circulation, and the amount of strain placed on the spine.

The chair should provide adjustability for height considerations and the seat pan should provide angle adjustments to encourage a seated posture that supports the body weight and assures lumbar-region contact with the seat back.



The height of a seat should allow the user to place feet firmly on a supported surface, providing adequate lower leg support. It should be noted that the preferred support surface is the floor, but a foot support, or footrest, may be necessary if the seat height is adjusted to compensate for a fixed work-surface height.



The angle between the seat back and seat pan should allow the user to assume a working posture with a torso-to-thigh angle of at least 100 degrees but not less than 90 degrees.



The seat pan should provide sufficient cushioning to minimize mechanical compression and to augment blood flow through the lower extremities. It should have a front-edge relief design, or “waterfall” contour, just behind the user’s knees and underside of the thighs. The purpose of the “waterfall” design is to avoid mechanical compression that can compromise blood flow.



If the chair is equipped with armrests, they should not interfere with the user’s ability to maintain an acceptable work posture. Armrests should be adjustable to accommodate a wide population of users.

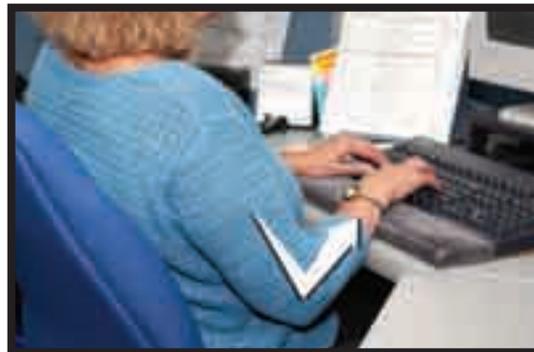
Users should also be trained in the features of the chair and in recommended postures for seated work. Chairs need to be periodically inspected for safety and functional condition.

Keyboards, in combination with the work surface and chair, should permit users to adopt and maintain acceptable arm positions.

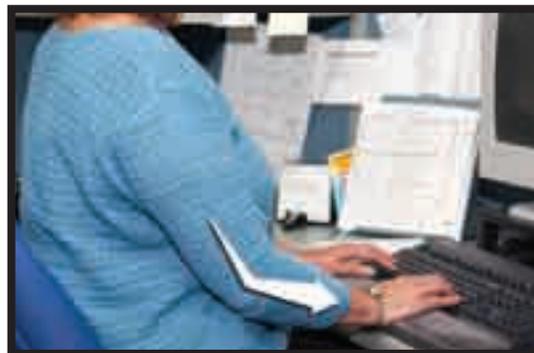
The angle between the upper arm and the forearm should be approximately 90 degrees, with the upper arm hanging comfortably near the side of the torso.



Postures in which the angle between the upper arm and forearm exceed 90 degrees require increased muscle force to support the arm and may result in more rapid fatigue and discomfort.



Postures in which the angle between the upper arm and forearm are far less than 90 degrees often result in awkward wrist postures. Awkward wrist postures increase pressure within the carpal tunnel and compromise blood flow.



The keyboard should be positioned directly in front of the user and in line with the monitor to promote acceptable postures.



Most keyboards and some keyboard trays have angle adjustments. Whether this angle is adjusted or not depends to some extent on how high or low the keyboard is positioned, as well as on worker preferences.



When a standard flat-style keyboard is being used, the user's hands are commonly pronated and positioned in ulnar deviation to operate the keys. Typically, these awkward postures are sustained for prolonged periods and are categorized as static. Awkward static postures lead to increased muscular fatigue and decreased blood flow.



The user should be careful not to increase or decrease keyboard angle to an extent that will place the wrists in an awkward bent posture. Positioning a wristrest device along the front edge of the keyboard also helps the user to avoid wrist extension and/or mechanical compression.



Alternative keyboard designs as shown below can help to promote neutral posture of the hand and wrist.



The keyboard and other input devices such as the mouse can be placed on various work or support surfaces. The objective is to ensure a range of comfortable dynamic sitting postures.

In some cases, specially designed keyboard support surfaces (keyboard trays) may be required for the user to achieve acceptable postures during data input.



When a workstation is shared by multiple users, adjustability in keyboard support and monitor surface height can provide the flexibility to accommodate different body sizes and preferences of workers.

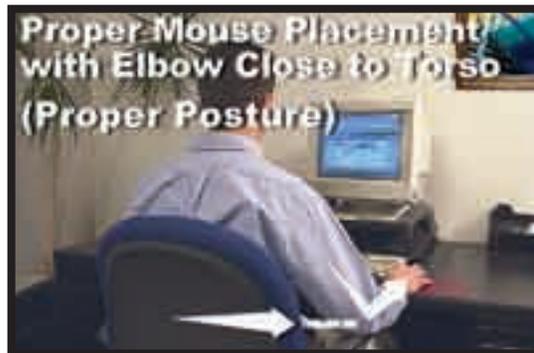


It is important that, regardless of the type of surface chosen for the keyboard, it is stable and secure and can support the weight of the keyboard and other input devices, as well as the arms and hands of the users.

The keyboard tray should allow for horizontal and vertical adjustment as well as tilt or slope adjustment. The keyboard tray must also be wide enough to accommodate a mouse, on either side of the keyboard.

The mouse, or cursor control device, should be situated adjacent to the keyboard and on the same plane as the keyboard.

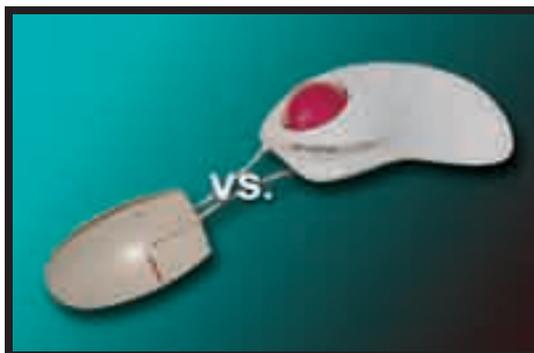
The mouse placement should allow the user to assume a working posture with the elbow near the torso, the upper arm hanging comfortably at the side, the hand positioned at about the same level as the elbow, and the wrist as straight as possible.



When the mouse is on a different horizontal plane, and/or situated away from the keyboard, the arm is naturally held away from the torso. Supporting the arm away from the torso increases the muscular effort and compromises blood flow.



A click-type mouse is preferred over a track-ball device, as a larger muscle group is engaged when a click-type mouse is used.



If the mouse is used for long periods of time, the forearm or base of the hand should be supported by a wristrest to minimize static effort of the shoulder muscles. The wristrest can also assist the user in achieving neutral wrist posture and in avoiding mechanical compression at the wrist which can compromise blood flow.



Workers should be encouraged to rest their fingers on the mouse and button, rather than holding them in the air, and not to hold the mouse too tightly. When moving the mouse, workers should be encouraged to keep the wrist straight and in front of the shoulder.

Alternating the mouse from the dominant hand to the nondominant hand on a regular basis provides a rest period for frequently overused muscle groups.



Wristrests, or wrist supports, should be provided to allow the user to rest the palms/wrists on a cushioned area either between keystrokes, during typing, or while operating a mouse.

Wristrests assist the user in achieving neutral wrist postures and in avoiding mechanical compression which results from resting the palms/wrists on a hard surface.

Wristrests that are too firm may improve wrist posture, however, they could compromise blood flow.



Monitors, or VDTs, in combination with their supporting surface should permit users to adopt and maintain acceptable head and neck positions.

For usual office tasks, the viewing distance to the monitor should be no less than 18 inches. For prolonged text-oriented operations, a viewing distance between 18 and 24 inches is suitable for most individuals. Let head and neck postures be your guide. Distances further than 24 inches may require an increase in character size, depending upon the resolution of the monitor and the visual capabilities of the worker.



The top line of text should be between 0 and 15 degrees below the users line of sight while looking forward.

The critical factors for determining the appropriate screen height and distance locations are: the task requirements, the monitor resolution, the normal viewing distance selected by the worker, and the amount of time the worker will spend viewing the monitor.



Improper monitor height and distance can result in workers assuming awkward postures. A monitor that is too low can cause a worker to tilt the head forward, stressing the neck and upper back. A monitor that is too high can cause a worker to tilt the head back, increasing force and strain on the cervical spine.



Workers who wear bifocal eyeglasses should position the monitor as low as possible on the supporting surface. This will eliminate the need to tilt the head back and will remove strain on the cervical spine.



A monitor that is too small can make a worker lean forward to read the text. A monitor that is too large may result in visual discomfort if the monitor cannot be placed far enough away from the worker.

If the worker spends the majority of his or her time viewing the monitor, as opposed to source documents, the monitor should be positioned directly in front of the worker to avoid awkward posture of the head and neck.



Users should adjust the contrast level and brightness, so that the text can be read comfortably. Less stress is placed on the eyes if the screen brightness is adjusted to approximately match other sources of visual information, such as documents.

Monitor location should be carefully selected to prevent reflective glare, which often results in awkward postures and increased stress on the eyes. Usually the least glare on the screen is found when it is close to vertical. Tilting the screen upwards slightly can increase visual comfort, but it can also increase indirect glare from light fixtures.



The screen should also be cleaned regularly to avoid increased stress on the eyes.

Flatscreen monitors are increasingly common. They have the advantage of taking up less desk space and can assist workers in achieving acceptable head and neck postures.

The goal is to optimize the extraction of visual information from the screen while minimizing awkward postures.



Careful consideration should be given to the appropriate choice of a document holder, to ensure that it matches the tasks and activities of the worker.

When the job task is flipping through multiple pages in a large file, a large holder with a lip or edge to support the documents is more appropriate than a document holder that requires each page to be clipped.



If the job task is primarily data entry from a source document, the documents should be placed on the document holder at the appropriate height and distance from the eyes and situated directly in front of the torso in the primary visual field. In these instances, the monitor should be placed slightly off to one side.



If both the monitor and documents are viewed during the task, the documents should be positioned so both can be viewed in the primary visual zone with little or no head movement.



If a document stand is used alongside the monitor, it is a good practice to occasionally move the stand from one side of the monitor to the other. This incorporates the use of different muscle groups and builds in a recovery period for commonly overused muscle groups.



To accommodate variations in the legibility of source documents and the visual requirements of individual users, the document holder should be adjustable both in angle and distance.

Most document holders lack the stability needed when job tasks require the user to write information on a document while supporting it at an angle. In this instance, an angle board or specially designed in-line document holder should be used. This device is placed between the monitor and keyboard and will help decrease forward head/neck postures while at the same time helping to decrease the reaching performed when writing information on the documents.

A document stand that is placed between the keyboard and monitor can eliminate neck rotation and allow the worker to view source documents while maintaining an acceptable neck posture. This type of stand can also minimize the effects of repetitive reaching to a document holder when the work involves writing or intensive input from documents. Excessive repetitive reaching can result in shoulder fatigue and discomfort.



The primary objective is, at a minimum, to tilt paperwork up toward the worker to assist them in adopting an acceptable head and neck posture by decreasing viewing distances.

If printers are used frequently by the worker, it may be important to locate them within easy reach. Optimal placement of the printer should be based on an evaluation of usage frequency, importance, and sequence. But above all, the posture of the worker as she or he collects the copies from the printer should be the clinching factor in deciding where to place the printer.

Some high-volume printers have output trays on top of the printers. When these printers are placed on top of the work surfaces, the worker must sometimes make excessive reaches to obtain the output. Noise and distraction from printers should also be considered in their placement.



Sometimes it is preferable to locate such equipment at a distance from a worker, necessitating a walk and physical change of posture to use the equipment. This provides a break from prolonged sitting.



When printers are shared by several workers, the traffic flow to and from the printers may be a source of noise distraction. People will congregate near a printer to wait for documents, and this can lead to congestion and blocked walkways.



A task lamp, or local lighting, is designed to supplement ambient lighting levels, making it all the better to see close work. There are three types of task lighting.

1. Those mounted underneath a shelf or storage area,



2. Those attached to a panel or clamped onto a work surface,

and



3. Those that are stand-alone accessories.

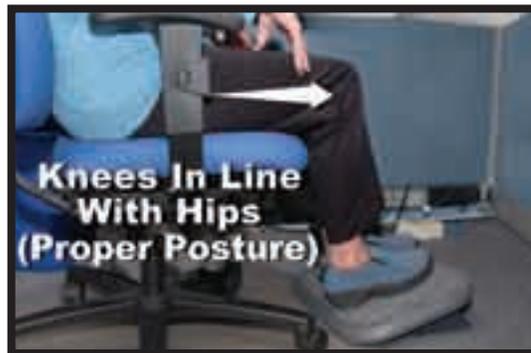


Flexibility should be designed into the task lighting so that it can be placed according to changing task requirements. Some task lamps attached underneath shelving are not movable; be careful that this type does not contribute to glare. A task lamp on an adjustable arm should be positioned so that it does not cause direct glare. Usually it is positioned directly over the source documents and angled away from the worker.

A footrest can provide support when the chair is raised to enable a worker to reach a work surface and the feet are unsupported.



A footrest can also increase comfort by allowing adjustable angles between the legs and feet and by providing a means to create variations in the work postures. Typically, the ankles are most comfortable at an angle close to 90 degrees.



A footrest is necessary in cases where the work chair height is to be set in a position that does not allow the worker's feet to rest flat on the floor. This usually occurs when the work surface height is fixed and the worker adjusts the chair to the work surface to keep his or her arms and shoulders in an acceptable posture.



Sometimes a footrest is also necessary because of advice from a health professional. It should provide firm support to the legs and feet and not be unintentionally movable. The footrest surface should be nonslip and of sufficient size to allow some freedom of movement. When a footrest is provided for comfort and for posture variation, some workers benefit from a rocking footrest, or one that is easily adjustable in angle variation.



Ideally, a user should be able to achieve an acceptable work posture without the use of a footrest by adjusting the height of the chair and work surfaces. Footrests restrict movement somewhat and also make it more difficult for a user to adjust chair features such as seat height. If a worker moves in his or her chair frequently between different work surfaces, he or she may require more than one footrest.

Some workers use the telephone frequently and must, at the same time, access information on a computer screen or write. Location of the telephone is important for high-frequency use. It should be located on the side corresponding to the hand most likely to pick up and hold the receiver, so as to minimize reaching across the body or shifting the telephone between hands. When use is infrequent, the location of the telephone is less important.



Raising the shoulder and bending the neck sideways to cradle the receiver between the head and shoulder contributes to strain in the neck and shoulder muscles, due to the awkward and static muscle contractions. Nerves in the shoulder can also be compressed in this posture.



To prevent this situation, some options are available:

- ✓ Use a headset, enabling the hands to work freely. Headsets are available in a variety of styles, and worker preferences should be considered.



- ✓ Use a speaker telephone, if in a private office or if the noise does not disturb others, and if confidentiality of information is not important.



- ✓ Hold the telephone receiver in one hand, and when computer work is required, place the receiver down briefly to use both hands.



Telephone cradles that attach to the receiver are not a preferred solution, as using them still requires raising the shoulder and bending the neck, maximizing muscle effort, to hold the receiver in place. A cradle may reduce awkward postures, but does not eliminate them.

A sit/stand workstation arrangement is a good solution for users who may be suffering from low back pain, because standing places less stress on the spine than sitting. However, we can only stand for 30 minutes before the onset of fatigue. Therefore, the ability to switch from sitting to standing when performing job tasks is important.

This can be accomplished by designing the workstation heights for standing, while providing an adjustable high stool for sitting.

There are two important considerations in this workstation design:

- ✓ Provide sufficient leg clearance to allow the stool to be pulled close to the work surface.
- ✓ Provide appropriate support for the feet, so that they can be placed flat and solidly on a foot support, with knee and ankle angles not less than 90 degrees.



Oftentimes, the rung supplied by the high stool results in the knees being considerably bent, which can affect comfort and circulation in the legs. A foot support designed underneath the work surface can, in some cases, provide better posture and support for the lower legs.

The main considerations when choosing work surfaces are the tasks or activities to be performed, the equipment to be accommodated, and, in multiple-user situations, the adjustability needed to meet the range of different workers.

The work surface should provide support for equipment (such as the display and input devices, as well as other equipment and material), and for the hands and arms of the user.



Work surfaces also need to allow adequate clearance for the worker's lower limbs and for postural changes. The height of the work surface should allow comfortable and acceptable postures of the upper arms, forearms, and hands.



Making work surfaces height-adjustable, particularly for keyboards and input devices, will accommodate the widest range of workers.



For seated work, sufficient vertical, horizontal, and lateral clearance is needed between the torso and lower limbs of workers and workstation components such as the underside of the work surface, desk drawers, and table legs.

There should be no sharp edges or corners on work surfaces and their supporting framework that could cause injury or discomfort to workers.

The finish of the work surfaces and all work equipment, including documents, should be a matte finish to minimize reflective glare.



Tasks that involve frequent reaches outside the primary work zone place users at risk of developing shoulder and back injuries. The *primary work zone* is a 12" by 12" square located directly in front of the torso. Items used throughout the work shift (keyboards, input devices, telephone, staplers, calculators, etc.) should be situated in this primary work zone. Items used on a frequent basis should be placed no further than 10"- 16" from the torso. Items used occasionally should be placed no further than 16"-24" inches from the torso. No reaches over 24 inches should be performed from a seated posture.

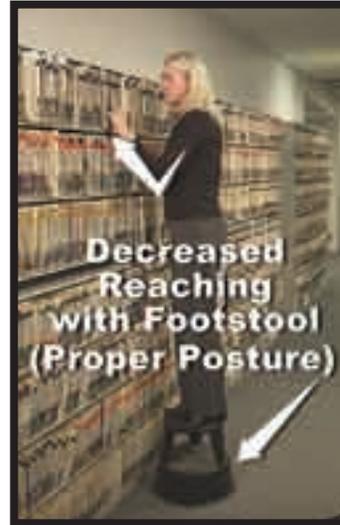
Reaching for items situated on shelving is commonly performed from a seated position. This significantly increases the strain on the shoulder joint and back and should be avoided. Instead workers should be encouraged to perform these tasks while standing to minimize the demands on the body and to break up static sitting postures. Frequently utilized items should not be placed on shelving.



When frequently used items are stored in under-the-station drawers or cabinets, it is common for workers to reach and bend to extract the item while remaining in a seated position. This significantly increases stress placed on the shoulders and back. Situate all items used on a frequent basis within 10"- 16" from the torso.



Reaching into vertical filing cabinets and upper shelving in file libraries can cause workers to reach with the arm above shoulder height and the back in an awkward posture. Portable steps and stools allow the worker to achieve the tasks while maintaining acceptable work postures. These devices must provide stability and be capable of supporting the workers' weight safely.



Ergonomics is the science of designing jobs and work tasks within the capacity and capability of the worker. This booklet outlines how this can be achieved in the office environment by providing the opportunity for employees to work in such a posture that stress to the body is minimized and work efficiency is optimized. Employee education and the implementation of a stretching/strengthening program are also key components that can help keep the workforce safe and injury-free. Work-related injuries and illnesses do not have to occur in the office environment.

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