AN INTRODUCTION TO ERGONOMICS

ERGONOMICS

Ergonomics is about matching equipment to the user and the task to the worker. Another term used overseas for ergonomics is human factors.

To apply ergonomics, we need to know about human capabilities and, of equal importance, what the person is trying to achieve.

A person who has expertise in ergonomics is called an Ergonomist.

HUMAN SIZE

A fundamental issue in ergonomics is size. Humans come in a range of sizes. Not only are there those of us who are tall, short, thin or wide, there are those who have small hands, others with a long reach etc.

When choosing equipment, the size range of that part of the person using the product needs to be assessed. For example, for a computer mouse hand size is important while the person's height is not.

REFERENCES

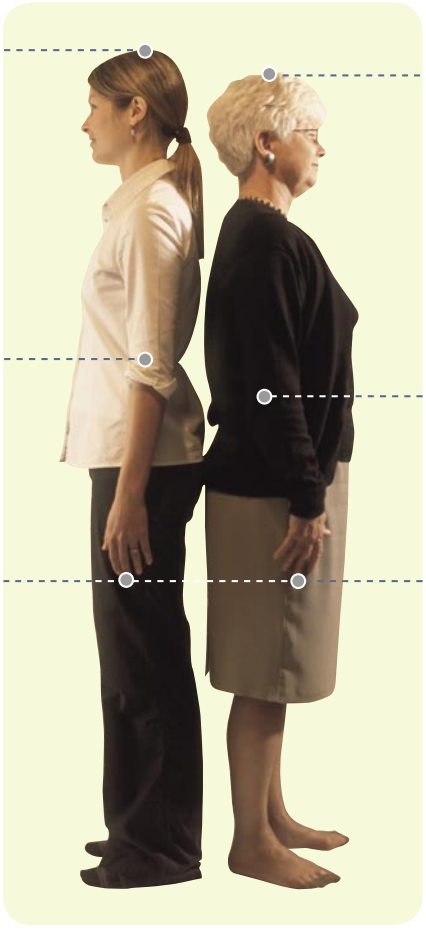
There is lots of information on ergonomics. Research using either 'ergonomics' or 'human factors' as keywords. Alternatively, we recommend;

Ergonomics, Work and Health
by Stephen Pheasant. 1991 Macmillan (an easy to read book written by a well respected English ergonomist)

Ergonomic Principles and Checklists for the Selection of Office Furniture and Equipment
by Ergonomics Unit, Worksafe Australia. 1991 Commonwealth of Australia (developed using Australian data and ergonomics principles)

Some relevant standards are:

- AS/NZS 4442:1997 Office Desks
- AS/NZS 4443:1997 Office Panel Systems - Workstations
- AS 3590.2:1990 Screen-based workstations Part 2: Workstation Furniture
- AS/NZS 4438:1997 Height adjustable swivel chairs
- AS 1680.2.2:1994 Interior Lighting Office and screen-based tasks.



Anthropometry

How do you measure up? Our different body shapes and sizes may require equipment of varying size to suit individual needs.

THE OFFICE ESSENTIALS

WHAT IS ESSENTIAL FOR AN OFFICE WORKER?

Frequent changes in posture including regular breaks from sitting.

OFFICE FURNITURE:

- An adjustable and supportive chair
- Preferably an adjustable desk/ workstation or a fixed height desk/ workstation with the availability of a height adjustable footrest
- Appropriate, well maintained equipment suitable for the tasks undertaken. (This may require expert advice.)
- Sufficient work surface to carry out their tasks
- Sufficient area to both enter and move about their work area easily and allow frequent changes in posture
- Storage for their personal items and work requirements
- An environment that is at a satisfactory temperature for the work, appropriately lit, and has good air quality.

RISKS FOR AN OFFICE WORKER

- POOR POSTURE – hands, arms, neck, shoulders, spine – can lead to back pain, circulation problems and headaches
- DURATION AND VARIETY OF TASKS – occupational overuse syndrome (OOS), musculoskeletal injury (MSD) and psychosocial risks.
- GLARE AND LIGHTING – eye strain and headaches
- WORKING ENVIRONMENT – noise, air quality and temperature.

EMPLOYERS DUTY OF CARE – PREVENTATIVE MAINTENANCE

Employers in Australia have a general duty of care to their employees to provide a safe and healthy work place. In the office work environment the general duty of care includes:

- Appropriate equipment and environment are provided
- Reasonable time is allocated for tasks
- Ensuring employees know how to use and adjust the equipment (including their desks, chairs and computers) e.g. providing instruction and/or training
- Supervision to ensure the equipment is being used properly.
- Ensuring the system of work is appropriate and not detrimental to the employee's health, safety or welfare.

POSTURE & SITTING

GENERAL INFORMATION – SITTING

Generally, people in offices perform tasks requiring fine motor skills using their arms, hands and fingers.

Sitting allows people to stabilise their trunks and heads, while having free movement of the arms and hands for fine work with less effort than standing.

However, the stability that sitting offers also encourages immobility that is not good for muscles. It is important to recognise that sitting should be a dynamic activity (not a static posture).

People sitting should try and change posture frequently — every 10 to 15 minutes. No one should sit in the exactly the same posture for long and at a minimum, should get out of their chair every hour and walk around.

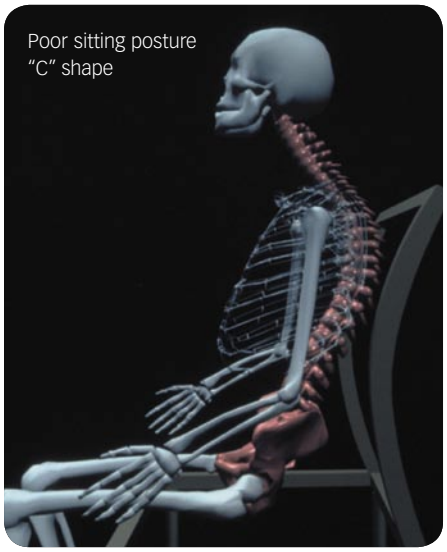
By designing an appropriate work system it is possible to incorporate these changes in posture without loss of productivity.

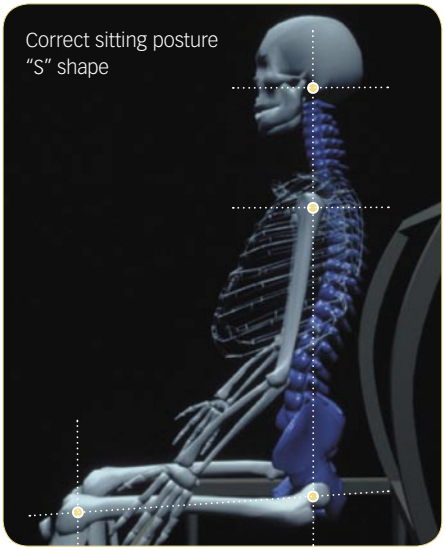
For example, a person who is typing letters, printing, photocopying and filing can organise the tasks such that, instead of typing all the letters in one session then printing and photocopying them as one job, they can intersperse these tasks throughout the day.

Performing different tasks throughout the day will encourage different postures and can help alleviate many of the problems people experience due to sitting for extended periods.

SEATING ESSENTIALS

- To sit for long periods at work people need a padded, well-dimensioned chair that can be adjusted in height with appropriate seat depth. It must have lumbar support in an appropriate spot – a firmly padded part that can fit snuggly in the small of the back.
- A seat pad that allows adjustment into a forward tilt is also highly desirable. Forward tilt increases the angle between the hip and the back and people find it easier to keep the curve in the small of their back. Many people with back pain find this increase in angle beneficial.
- The upper arms should be hanging relaxed beside the body. The shoulders should not be lifted. There should be no pressure points between the person and the chair. The person should have clearance between the seat front and the calves while the lumbar spine is supported by the backrest.
- Remember: changes in posture are important and muscles are designed to move; so getting up and out of the chair at regular intervals is critical.
- Postures recommended when sitting encourage a 'tall' back with natural curves – an 'S'-Shape instead of a slouching 'C'-Shape. By aligning the ears, shoulders and hip vertically, muscles do not need to work as much to maintain a correct posture.





TAKE A SEAT...

OFFICE CHAIRS

Traditionally there has been a distinction made between clerical chairs and Management/ Executive chairs to demonstrate a difference in power. The difference is becoming less valid as the tasks of executives increasingly involve the use of computers.

The adjustments considered essential by ergonomists on an office chair are:

- Height
- Backrest angle and seat depth
- Lumbar support height
- Adjustable armrests - desirable
- Forward tilt - desirable.

ARMRESTS

Armrests on chairs are generally not recommended for people doing a large quantity of typing. The armrests generally restrict how far the chair can move in under the desk and may be too high for some users. However, armrests can help less mobile people push themselves out of the seat. Also, armrests can be used to change posture for managerial, professional and executive staff that spend less time on keying tasks but long periods sitting.

CASTORS

Castors on chairs on hard surfaces are unsafe. The chair can move too freely. Glides or rubber tyred 'brake' castors are recommended on hard surfaces. This reduces the risk of a person sitting and inadvertantly falling when the chair rolled away.

THE RELATIONSHIP BETWEEN SEAT, FLOOR AND DESK

The relationship between the three surfaces: work surface, seat pan and floor, is important.

To accommodate a range of people doing a range of tasks, the seat pan (as well as one of the other two surfaces) has to be adjustable in height.

Adjustable height work surfaces are preferred. Footrests act as a false floor.

If the desk surface is fixed in height then it needs to be high enough for long lower legs.

The chair then needs to be able to be adjusted sufficiently high for a small person to sit with their arms appropriately positioned.

Footrests will need to be provided to any person who cannot place their feet on the floor when the chair is adjusted for the task - generally shorter people.

HOW TO WORK ERGONOMICALLY

1. Use a good chair with a dynamic chair back and sit back in this.
2. Keep arms and elbows relaxed close to body.
3. Sit tall with ears, shoulders and hips in a vertical line.
4. Ensure that the top of the monitor casing is 5-8 cm above eye level.
5. Sit at arms length from the monitor.
6. Make sure there is no glare on the screen, use an optical glass anti-glare filter where needed.
7. Centre the monitor and keyboard in front of you.
8. Keep the wrists flat and straight in relation to forearms to use keyboard/mouse/input device.

9. Use a negative tilt keyboard tray with an upper mouse platform or downward tiltable platform adjacent to keyboard.
10. Use a document holder, preferably in-line with the computer screen.
11. Use a stable work surface and stable (no bounce) keyboard tray.
12. Place feet on floor or a stable footrest.
13. Take frequent short breaks (microbreaks).

Information compiled by the DEA651 class of 2000 - Bethany Johnson; Emily Kuperstein; Mari Mitchell; Heidi Tinnes; with Garrick Goh (TA) and Professor Alan Hedge

Information sourced from the Cornell University Ergonomics Web – Reproduced with permission

HOW TO CHOOSE AN ERGONOMIC CHAIR

To help you to choose an ergonomic chair, check whether it meets the following criteria:*

DOES THE SEAT PAN FEEL COMFORTABLE AND FIT YOUR SHAPE?

When you sit in the chair the seat pan should be at least 2cm wider than your hips and thighs on either side. The seat pan should not be too long for your legs otherwise it will either catch you behind the knees or it will prevent you from leaning fully back against the lumbar support. Most ergonomic chairs have a seat pan with a waterfall front that prevents the seat from catching you behind the knees. The seat pan should also be contoured to allow even weight distribution and it should be comfortable to sit on.

IS THE SEAT CHAIR HEIGHT ADJUSTABLE?

The chair should be pneumatically adjustable so that you can adjust seat pan height while you are sitting on the chair. Some chairs have a mechanical height adjustment (spinning) mechanism that is also acceptable.

IS THE RANGE OF HEIGHT ADJUSTMENT OF THE CHAIR SUFFICIENT TO MEET THE NEEDS OF ALL USERS?

You should be able to adjust the height of the seat pan so that the front of your knees is level or slightly below level and your feet are firmly on the ground. In most cases there should be no need for you to use a footrest. The mechanism to adjust seat height should be easy to reach and operate when seated.

DOES THE CHAIR HAVE A COMFORTABLE LUMBAR (LOWER BACK) BACK REST?

Many chairs have cushioned lumbar supports that can be adjusted up and down and forwards and backwards to best fit your shape. If the chair will be used by multiple users then this level of adjustment may be required. If the chair has a fixed height lumbar support and it feels comfortable when you sit back against this, and you will be the primary user of the chair then a fixed lumbar support may be acceptable.

IS THE CHAIR BACK REST LARGE ENOUGH TO PROVIDE GOOD BACK SUPPORT?

Many chairs have back supports that are large enough to provide mid-back and upper-back support, in addition to good lumbar support.

WHEN YOU SIT BACK AGAINST THE LUMBAR SUPPORT IS THERE AMPLE SPACE FOR HIP ROOM?

Insufficient hip room can make you sit too far forwards on the seat pan so that you will not have enough thigh support.

DOES THE SEAT PAN STILL FEEL COMFORTABLE AFTER YOU'VE BEEN SITTING IN IT FOR 60 - 120 MINUTES?

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

DOES THE CHAIR BACKREST RECLINE AND SUPPORT YOUR BACK IN DIFFERENT POSITIONS?

Movement of the back while you are sitting helps to maintain a healthy spine. Look for chairs that allow you to easily recline, that provide you with good back support in different recline postures, and that have a back that tracks where your back is. Locking the chair backrest in one position generally isn't recommended or beneficial to users.

DOES THE CHAIR HAVE A 5 STAR PEDESTAL BASE?

If chair mobility is important to help you to do your work then the chair should have at least a 5 star pedestal base with castors that glide freely over the floor surface. You may also want to choose a chair that swivels easily.

DO YOU NEED ARMRESTS ON YOUR CHAIR?

If so, are the armrests broad, contoured, cushioned and comfortable? While sitting can you easily adjust the height of the armrests and can you move the armrests closer together or further apart? Can you easily move the arms out of the way?

DO YOU NEED A FOOTREST?

In the majority of situations you should not need a foot support to be able to sit comfortably. If you do need a foot support, choose a free-standing floor-mounted support that allows you to rest your feet out in front of you in a comfortable manner.

WHAT CHAIR COVERING IS BEST?

Chairs can be covered in a variety of upholstery materials. Vinyl and vinyl-like coverings are easy to clean and spill resistant, but they don't breath and if the chair begins to heat up under the thighs uncomfortable amounts of moisture can accumulate. Cloth upholstery is the most common covering, but this is less resistant to spills and more difficult to clean. A cloth covered seat pan can also become warm and moisture laden, and cloth covered foam seat pans can be a significant source of dust mite allergen. When selecting your chair covering think about cleaning and maintenance issues and plan appropriately.

DO YOU NEED AN ADJUSTABLE TILT SEAT PAN ?

In most situations this is not an essential feature. In some situations it can be helpful to change the tilt of the seat pan to help to maintain a balanced seated posture.

*You can also complete the **Ergonomic Seating Evaluation Form**, which can be downloaded from our website).

THE WORK AREA & EQUIPMENT

WORK SURFACES (DESKS)

A work surface can be a desk or part of a workstation. Australian Standard AS/NZS 4442:1997 states the minimum requirements for a work surface as:

- 800 mm deep (14-15" CRT monitors)*
- 1200 mm wide for a single task (e.g. keyboard work only)
- 1600 mm wide for mixed tasks (e.g. clerical and keyboard work)
- Work surface height is preferably adjustable:
  - Adjustable including range from 610 to 760 mm
  - Fixed, 700-720 mm preferred but can be as low as 680 mm.
- Legroom width should be a minimum of 650 mm (preferably 800 mm to allow chair to swing both ways)
- Knee space just under the work surface should be a minimum of 450 mm deep over the whole legroom width
- Legspace at 120 mm above the floor should be a minimum of 600 mm deep over the whole legroom width.

The minimum depth specified allows monitors to be placed a comfortable distance from the eyes and allows flexibility in the positioning of the keyboard and mouse. Australian Standard AS/NZS 4442:1997 was written in an era where monitors were typically 14"or 15". Bigger monitors often are deeper and a deeper desk should be used (as stated in the standard).

*The use of flat screens may allow flexibility in the depth of work surfaces.

An ideal workstation

An adjustable work surface is preferred. Alternatively, a height adjustable footrest will need to be provided for any person who cannot place their feet on the floor when the chair is adjusted for the task. Generally, only tall workers will not need a footrest

The work surface should be thin, light in colour and have a matt finish.

EQUIPMENT PLACEMENT

When laying out the workspace the time spent performing different tasks is important. For example, if a person spends much of their time making phone calls then the telephone keypad should be in the most convenient location. If a CAD operator spends most of the time using the mouse/pointing device then the mouse/pointing device should be in the most convenient location rather than the keyboard.

The most convenient location for the placement of equipment is the area that the hands can reach with the upper arms hanging down freely beside the body - the **'Optimum Reach Zone'**. Position frequently used items in this zone. The **'Maximum Reach Zone'** is the area that the seated person can reach by extending the arms. This zone is used for items intermittently placed or retrieved e.g. the telephone for those who receive and make calls intermittently throughout the day. The **'Outer Reach Zone'** is the area that can be reached by bending forward or raising the chair. This area is only suitable for occasional reaches e.g. storage of reference books.

People should be encouraged to adjust the work surface layout as they change tasks. For example, while doing keyboard work the keyboard should be placed in the Optimum Reach Zone but it can be stored in the Maximum or Outer Reach Zone while reading or writing.

Work should be designed to provide variety throughout the day. People should stay seated for no longer than one hour at a time.

ANGLE BOARDS

Angle boards are placed on desks to allow the angle of the work surface to be adjusted. They allow the neck to be in a more upright posture while reading and writing for prolong periods. These boards perform a similar function to a draftsperson's drawing board. As these boards can take up a large amount of desk space they are generally only recommended for people who spend long periods of time reading and/or writing.


Adjustable tilt boards enable reading and writing whilst 'sitting tall'.

THE WORK AREA & EQUIPMENT

WRIST RESTS

The use of wrist rests can reduce the muscle activity in the forearm and shoulder muscles, which can reduce muscle stress. They can also restrict the movement of the wrist and arms, which is not beneficial. Many users are finding that support of the wrists and hands is very helpful in reducing pain and find their muscles feel less tired. Wrist rests are primarily for periods of rest between bouts of typing.

DOCUMENT HOLDERS

Document holders are used to hold copy material and position it for the task. The copy should be at a distance from the eyes so the material can be comfortably read. Holders reduce the amount of neck bending and twisting caused by prolonged viewing of documents placed on the desk beside the keyboard. The best location for the holder depends on the nature of document, the weight of the document, the typist's skill, whether the original document needs to be annotated as information is entered, etc.

FOOTREST

- preferred height adjustable range of 50-185 mm at the front edge
- slope range of 0 to 15 degrees at least
- preferred dimensions 350 mm deep by 450 mm wide

Footrests act as a false floor and need to be stable and able to support both feet set comfortably at hip width apart.

LAPTOPS

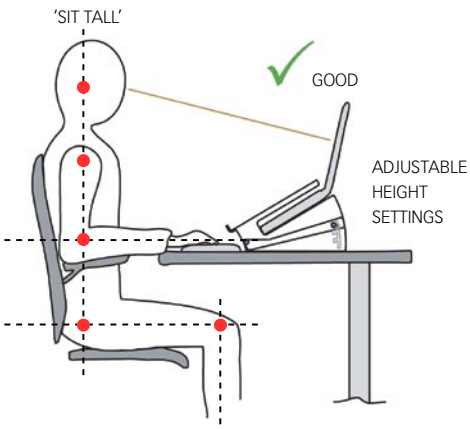
Laptops are becoming increasingly common in the office. They are often a great convenience. However, the proximity of the integrated keyboard and screen is not good for regular use. If a laptop is to be used for prolonged periods it is recommended that, as a minimum, a laptop station, or external monitor, keyboard and mouse are used. Additionally, an external pointing device should be used during extended periods of use. Having either an external monitor or laptop station with external keyboard and mouse in the most common locations of use, allows an important degree of freedom in setting one's posture that is not possible with just the laptop. Having an external keyboard and mouse at both the office and home does not present a huge cost.

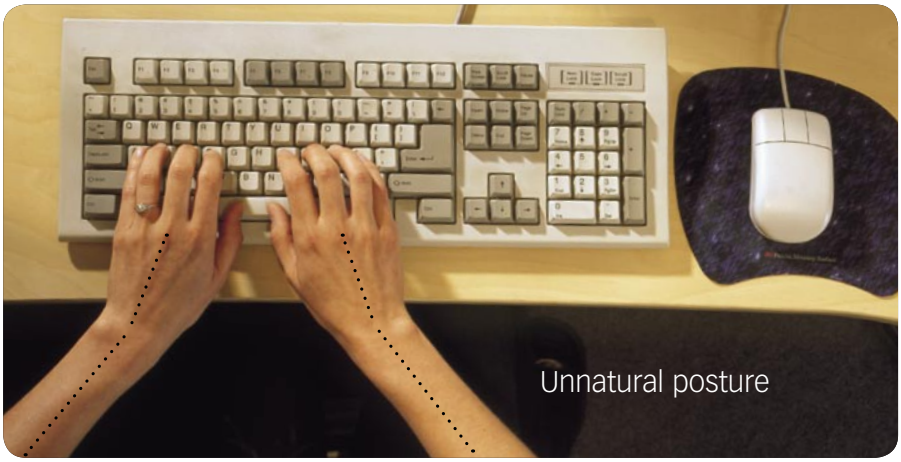
MOUSES/POINTING DEVICES

Computing involves the use of a mouse or pointing device as well as a keyboard. Ideally, the mouse should be straight in front of the hand using it with the upper arm hanging relaxed from the shoulder. This is often in conflict with the position of the keyboard. Using a keyboard without a number pad can be beneficial.

Many people get shoulder, elbow and neck pain from mouse use. It is often found that this is because the arm is being held away from the side of the body for prolonged periods. Try and bring the mouse closer to the body. Other users hold the mouse with their fingers held above the mouse buttons. Again this could lead to pain in the wrist, forearm, neck and/or shoulder. A person should be able to rest their fingers on the buttons without them being inadvertently pressed.
Some users have found using different shaped mouses with different button configurations helps. Trialing different mouse designs is recommended.

Due to differences in tasks and hand size and shape, different mouse designs will suit different people.
It is important that when people use a mouse they do so without high muscle stress – the arm, wrist and fingers should not be in great tension.



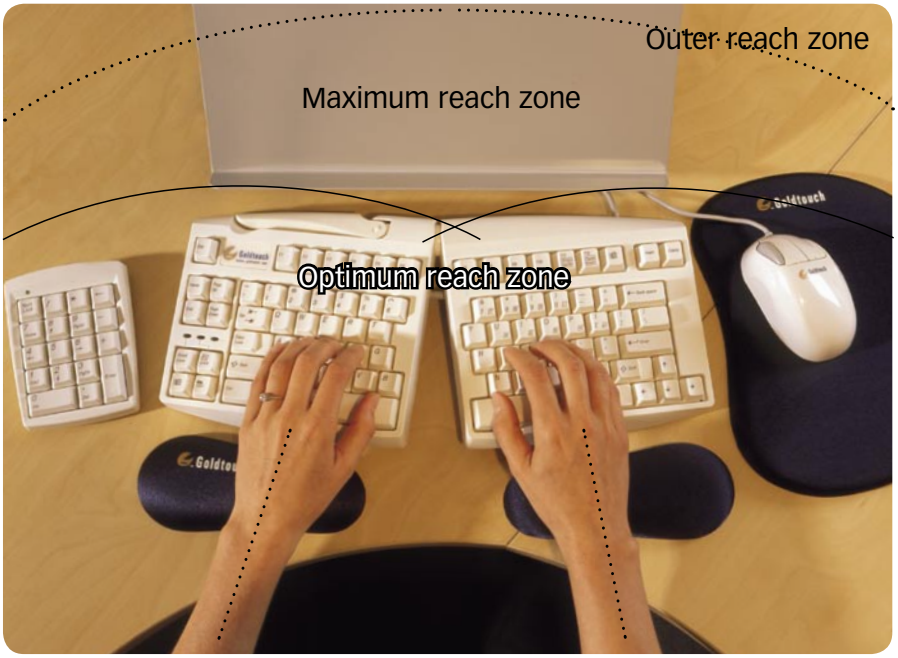


KEYBOARDS

Research suggests that the "ergonomic" keyboards (split keyboards with each hand at a different angle) are more comfortable to use than standard keyboards.

This is because the wrists maintain a natural line rather than angled toward the little finger.

If the number pad is not often used, consider keyboards without a number pad. These allow the mouse to be brought closer to the centre line of the body.



ADJUSTING THE WORKSPACE

The work surface should be at about elbow height. For keying work this often means the chair needs to be adjusted slightly higher as the height of the middle row of keys is the effective work surface height. For writing tasks people lower their chair slightly to support their lower arms.

WORK SURFACE ADJUSTABLE HEIGHT

Sit on the chair with the seat pad horizontal, or tilted comfortably forwards, and adjust the height until your feet are flat on the floor and there is no pressure under your thighs. Next move to the desk and adjust the work surface height until it is at your elbow height when sitting in the correctly adjusted chair.

WORK SURFACE FIXED HEIGHT

Adjust the height of your chair to suit the work surface. Then, if your feet are not flat on the floor without pressure points under the thighs, you will need a footrest.

POSTURE

Maintain your posture with back tall; hip, elbow and knee angles at 90º or greater. Alter your posture frequently and stand from the chair at least once an hour. Generally, your neck should not twist or bend to the side. Consider using a headset if you use the phone a lot. Your upper arms should be hanging freely beside your body and your shoulders should be relaxed.

COMPUTER MONITORS/ SCREENS

The top of the computer monitor should be placed at or below your eye height. Your natural gaze angle is about 20 degrees below the horizontal. Placing a monitor on the CPU box generally lifts the top of the screen above eye height, which is not recommended. Research has found that people find the position of the screen at about 600-800 mm from the eyes is most comfortable.

Generally, you should look straight onto the monitor; you should not have to twist your neck to view the monitor. Ideally, the monitor should tilt upwards so the monitor is perpendicular to the line of sight. This can sometimes introduce glare. If this is the case, a slight change in the tilt can be tried to see if it removes the glare and does not cause other issues for you. Sometimes moving the monitor along the work surface removes the glare.

EYES

Your eyes should not be neglected. Muscles control the eyes and these muscles need a change in position too! So if you have been looking at a monitor for longer than about 10 minutes you need to swivel on your chair and focus on something straight ahead of you in the distance. This relaxes your eye muscles. The object in the distance can be out the window – what kind of day is it? - or on the other side of the room. Take the opportunity to get up and stretch – this will provide a change in posture.

As computer monitors are generally positioned at a greater distance than for reading paper, standard

The ergonomic positioning of flat panel displays is now easier than ever with a new range of highly adjustable display arms.

"reading" prescription glasses are often inappropriate for computer work. Discuss this with your eye specialist.

FLICKER AND FUZZY IMAGES

Eyes can get tired and sore if they have to deal with glare, flicker or fuzzy monitors.

Computer screens should not flicker and the image should be crisp and clear. Flickering monitors are usually caused when the monitor is not updated at a sufficiently fast refresh rate – a refresh rate of at least 70 Hz and preferably more is recommended. Another cause of flickering screens can be power packs or mains electrical wiring nearby – moving the monitor slightly can dramatically affect this form of flicker. Lettering on the monitor should be sharp. If it is not, some of the reasons could be: the monitor is dirty, the video card may be inappropriate, the phosphor coating on the inside of the screen may be degrading or the monitor may need adjusting - consult a computer technician.

New LCD and other thin-screen all-digital displays have the potential to offer very sharp stable images. They take up less work space and this can be a big advantage when positioning screens and sizing work spaces and floor areas. As well as offering potential power savings and reducing the heat load, new LCD and other thin screen digital displays may reduce air conditioning costs.

LIGHTING

Many offices use general lighting for all areas of the office. This can lead to too much lighting for computer work. CAD operators (computer draughts people) often work in rooms with lower lighting with task lighting provided for specific areas e.g. desk top for documents. Lighting design that allows some flexibility in the lighting level is recommended.

GLARE

Glare can be a major problem in modern office spaces particularly open plan spaces. Glare can result not just in sore eyes and headaches but poor postures. People adopt postures to place themselves between sources of glare and the monitor thus blocking reflections.

Glare is best dealt with by finding its source and controlling it there. Some options for controlling glare are:

- Putting parabolic diffusers on lights
- Drawing blinds over windows at different times of the day
- Repositioning the monitor. Care needs to be taken that other posture problems are not introduced – it may require the work surface to be rearranged
- Using partitions.

To minimise the opportunity for glare to be an issue on monitors, the screen surface would ideally be placed perpendicular to the windows.