

Guidelines for using computers

Preventing and managing discomfort, pain and injury

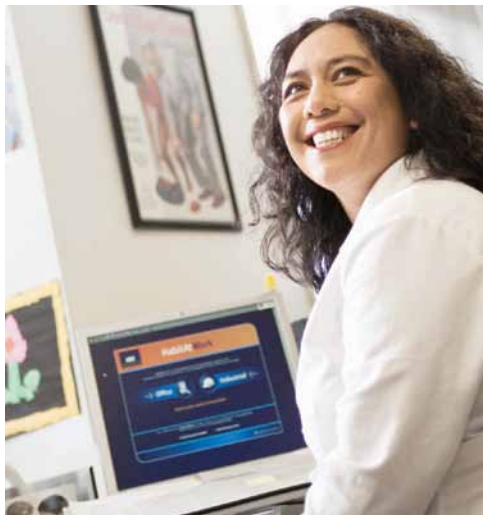


TABLE OF CONTENTS

Introduction.....	4	3.3 Postures and practices.....	36
What the guide covers	4	Reference postures	36
The layout of this guide	4	Standing to work	38
What is a computer workstation?	6	Working practices	39
How do these guidelines relate to the Approved		Regular task breaks	39
Code of Practice for the Use of		Micropauses (brief pauses)	39
Visual Display Units in the Place of Work?	7	Alternative tasks	40
Who should use the guidelines?	7	Keyboard Use	40
1. Identifying and understanding the potential		Mouse Use	41
health issues.....	8	3.4 Furniture and equipment	42
1.1 What are the potential health issues		Assessing the work.....	42
associated with computer use?	8	Assessing the task.....	43
Physical discomfort.....	8	Shared workstations and 'hot desking'	44
Visual discomfort.....	9	Teleworking and working from home.....	45
Stress	11	Planning for new furniture, equipment	
Fatigue	12	and hardware	45
1.2 What are the sources of these health issues?.....	13	Desks	46
Individual factors.....	14	Chairs.....	51
Psychosocial factors.....	15	Foot rests	56
Work organisation	16	Document holders	57
Workplace layout and awkward postures.....	16	Telephone headsets.....	58
Task invariability	17	3.5 The computer hardware.....	59
Loads and forceful movements	17	Screens.....	59
Environment	18	Screen placement	61
1.3 Are computer related health issues solely		Multiple screens	63
related to workplace computer use?	18	Keyboard	64
1.4 Benefits of working safely with computers	18	Mouse and other pointing devices	67
1.5 Management commitment	19	Hand-rests	71
2. Assessing potential hazards	20	Laptops and other portable computer devices....	72
2.1 Hazard identification	20	3.6 Educating computer users	75
Hazard assessment checklist	21	4. Managing health issues	80
2.2 Prioritising hazards.....	21	4.1 Early reporting	80
2.3 Developing a hazard control plan	22	4.2 Referral	81
3. Controlling the hazards	23	4.3 Injury management – 'stay at work' and	
3.1 Work organisation	23	'return to work' programmes	82
Job requirements.....	24	5. Health Monitoring and Programme review.....	83
Supervision.....	24	5.1 What is health monitoring?	83
Workloads	25	5.2 What is reviewing?	83
3.2 The work environment.....	25	5.3 Why monitor or review?	83
Working space	26	5.4 Monitoring the hazards and the health	
Location of workstations.....	26	of employees	83
Lighting.....	27	5.5 Reviewing hazard management	85
Décor	32	Frequently Asked Questions.....	86
Atmospheric conditions	33	Appendices	89
Noise.....	35	Appendix A. Obligations under the Health	
Housekeeping.....	35	and Safety Act 1992	89
		Appendix B. Glossary	92
		Appendix C. Bibliography	96

Introduction

In the past three decades computers have significantly changed the working environment, simplifying and speeding up many tasks across many work areas. However, with these advances have come some potential health issues.

These guidelines describe how managers, health and safety representatives, occupational health and safety personnel, human resource personnel and computer users can work together to achieve a healthy and productive workplace environment. The guidance reflects current knowledge and best practice for the use of computers so you can achieve maximum efficiency, safety and health in your workplace.

WHAT THE GUIDELINES COVER

From these guidelines you will learn about how to create healthy and productive computer work environments. You will find advice on organising work, providing an appropriate work environment and furniture, and setting up a computer workstation, including the importance of selecting suitable computer hardware and software.

The guidelines also outline the different computer-related health issues and the steps you can take to identify and address hazards in order to prevent these health issues occurring. In the event that a computer user develops a health problem, we have also provided guidance on what your legal obligations are.

Although you may not have any health issues from computer work in your workplace, it is important that you regularly monitor the health of computer users and review your management of computer hazards. These guidelines outline steps for monitoring health, managing hazards and training.

At the end of the guidelines you will find a set of frequently asked questions and a glossary of terms used throughout the document.

THE LAYOUT OF THESE GUIDELINES

These guidelines present a hazard management process that will help you to identify hazards associated with computer use, assess their significance and present controls to eliminate, isolate and/or minimise them. This process will take you through five key steps:

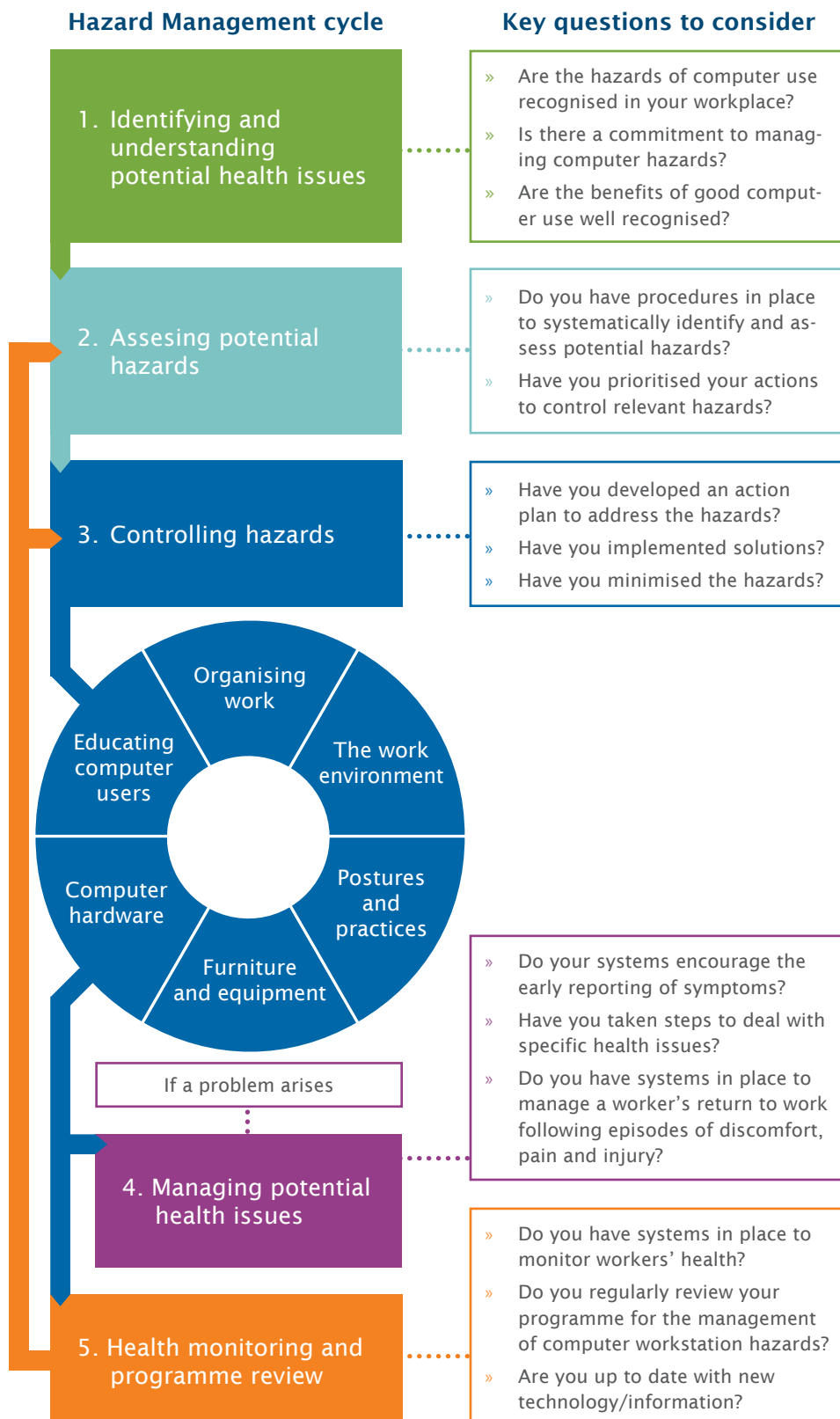
1. Identifying and understanding potential health issues;
2. Assessing potential hazards;
3. Controlling hazards;
4. Managing potential health issues;
5. Health monitoring and programme review.

Each step is detailed in separate chapters of these guidelines. An overview of the hazard management process is shown in Figure 1.

Other resources that should be used to supplement these guidelines can be found on ACC's website and elsewhere. For example, HabitAtWork for offices provides examples of preventative approaches, such as stretches and exercise, aimed at reducing the risk of computer-related health issues (www.habitatwork.co.nz).

Additional information and resources are presented alongside the main body of the text. These identify supplementary sources of information and references in support of specific recommendations, such as dimensional requirements.

FIGURE 1. GUIDE TO THE MANAGEMENT OF COMPUTER USE



WHAT IS A COMPUTER WORKSTATION?

We define 'a computer' as the combination of computer hardware, display screen, keyboard and/or mouse or other input device. The computer workstation typically encompasses the computer and the workstation furniture, such as the desk, chair, footrest, any equipment used (e.g. telephone, document holder and printer) and the environment (e.g. lighting, ventilation and noise).

We have developed these guidelines mainly from the experiences of office-based computer users, but many recommendations will apply to a wide range of environments in which computers are used. For example, computer users in factory or warehouse settings, control centres and educational environments, and those who work from home or are on the move and use different workplaces should all adopt these recommendations.

FIGURE 2. DIFFERENT COMPUTER WORKSTATIONS



HOW DO THESE GUIDELINES RELATE TO THE APPROVED CODE OF PRACTICE FOR THE USE OF VISUAL DISPLAY UNITS IN THE PLACE OF WORK?

It is intended that these guidelines will replace the Approved Code of Practice for the Use of Visual Display Units in the Place of Work, published by the Department of Labour in 1995.

The guidelines have been developed in response to changing technology and new ways of managing the hazards of computer use. As a guide to 'best practice', they reflect the current state of knowledge, particularly with respect to the early identification and management of discomfort, pain and injury.

You can use these guidelines in any situation in the workplace or at home where a person uses a computer for normal work. They explain how you can meet your obligations under the Health and Safety in Employment Act 1992 to provide a safe place of work.

You may choose to meet only some of the recommendations in these guidelines, or use other means to provide for the health and safety of computer users. This level of flexibility is necessary because it may be difficult or inappropriate for you to meet a specific requirement in your particular work setting. However, if you are not following this guidance, you should ensure that you have identified all of the relevant hazards and are adequately controlling them to provide a level of health and safety at least equivalent to what would be achieved by these guidelines.

You can also refer to Appendix A for more detailed information on how the Health and Safety in Employment Act 1992 applies to the use of computers.

WHO SHOULD USE THE GUIDELINES?

Anyone who uses a computer, or works with people who do, will find these guidelines helpful. These recommendations will help computer users to stay comfortable and productive.

In the workplace, a collaborative approach between computer users and managers is encouraged to achieve the most effective use of computers in the workplace.

It is intended that these guidelines will replace the Approved Code of Practice for the Use of Visual Display Units in the Place of Work (1995).

1

Identifying and understanding the problem

1.1

WHAT ARE THE POTENTIAL HEALTH PROBLEMS ASSOCIATED WITH COMPUTER USE?

Four potential health issues are associated with computer work.

- » Physical discomfort, pain or injury;
- » Visual discomfort;
- » Stress;
- » Fatigue.

While we discuss these problems separately below, they often influence each other.

PHYSICAL DISCOMFORT

A range of physical conditions may develop or be made worse by working with computers. By 'physical conditions' we mean problems that may affect muscles, connective tissues, tendons, ligaments, joints, bony structures, the blood supply, nerves and the skin.

The symptoms associated with these conditions are sometimes given a medical diagnosis such as 'epicondylitis' or 'carpal tunnel syndrome', or a general umbrella label such as 'gradual process injury' (the currently accepted umbrella term for these types of injury). The terms 'occupational overuse syndrome' (OOS) or repetitive strain injury' (RSI) have also been used, amongst others. Within the literature, there are a number of umbrella terms that have been used to describe these symptoms.

Many people experience upper limb, neck or back discomfort and pain, whether or not they work with computers. However, the onset of symptoms and the movements or body postures adopted while working at computers are often related. Symptoms may include:

- » Pain;
- » Fatigue;
- » Muscle discomfort;
- » Stiffness;
- » Burning sensations;
- » Weakness;
- » Numbness;
- » Tingling.

ACC provides accident cover for personal injury caused by work-related gradual process disease or infection. Eligibility for cover is defined in Section 30 of the Accident Compensation Act 2001.

Sometimes computer users find that these sorts of symptoms worsen during the day or week and, at least initially, improve at weekends and holidays. It is important to act as soon as symptoms present. Small changes made at the first indications of discomfort usually produce the best outcomes and prevent more significant problems developing.

VISUAL DISCOMFORT

Eye discomfort is a common health problem experienced by computer users. Eyesight naturally deteriorates with age. However, several long-term scientific studies comparing computer users and non-computer users have shown that these changes are not necessarily increased through computer use. Often, people are unaware of existing visual problems that only become apparent when they begin using computers, because the demands placed on the visual system by computer work can be very high.

Vision problems are generally only temporary and decline after stopping computer work at the end of the day. However, some computer users may experience continued visual impairment even after work.

Some individuals who experience symptoms of visual discomfort have been found to have uncorrected vision problems. They usually get rapid relief when they are provided with glasses or contact lenses that are suitable for computer screen use (lighting and glare problems should also be considered).

It may be appropriate for computer users to have eye examinations prior to or soon after beginning computer work and periodically thereafter. People with no need for glasses for either distance or near tasks may need specially prescribed glasses for using computers.

The symptoms of visual discomfort vary and include:

- » Sore eyes;
- » Red eyes;
- » Watery eyes;
- » Dry eyes;
- » Eyes feeling 'heavy' or 'gritty';
- » Blurring of vision;
- » Headaches.

Studies have shown that eye-related symptoms are one of the most frequently occurring health issues amongst users of computers. Blehm et al. (2005)

It is not a legal requirement for an employer to pay for an eye examination. However, where an employee is required to spend a significant time at computers and monitors it makes for good staff relations, as well as safety and health, to provide for regular eye and vision assessments for employees.

A commitment to meet some or all of the costs of a comprehensive eye examination and lenses can be included in employment agreements where it is appropriate. Regular assessments may result in productivity being increased and/or incidents of eye strain being reduced.

The NZ Association of Optometrists can provide further information about visual issues relating to computer use and a computer assessment form – Visual Examination of VDU Operators (2004) www.nzao.co.nz

The New Zealand Association of Optometrists provides a booklet: 'How to Adjust a Microsoft Windows Computer for People with Low Vision'. www.nzao.co.nz

Like other muscles, those in the eyes need periods of relaxation. As computer users tend to work with the screen a fixed distance away, the unvarying demand on the eye muscles can lead to fatigue. If the position of the screen is too high, you are more likely to widen the eye, exposing more of the eye surface and increasing the risk of eye fatigue and dry eyes. A working environment that is too warm or too dry can make these symptoms worse.

Computer users may also experience visual discomfort from:

- » Uncorrected eyesight problems that become apparent with computer use;
- » Visual changes with aging;
- » The wrong glasses or contact lens prescriptions for computer work;
- » Inadequate lighting (too little or too much, or the position and type of lighting);
- » Poor computer workstation set-up;
- » Lifestyle factors, e.g. smoking, lack of sleep.

People suffering from persistent eye trouble need to have their eyesight tested by an optometrist. The optometrist will need to know details about the person's computer tasks, both at home and at work, including the size of screen, the distance from the eyes to the screen and average hours of use per day to ensure that, if required, appropriate glasses/lenses are provided. Optometrists have forms on which you can write this information before visiting one.

Addressing vision problems arising from computer work might include:

- » Adjustments to the work environment, such as lighting or window treatments to reduce glare and minimise variations in light levels;
- » Reducing visual stress from computer work through, for example, the use of rest or alternate task breaks throughout the workday, or frequently looking into the distance to reduce focusing fatigue;
- » Adjustments to the work equipment, such as the location of the screen(s), keyboard, mouse, paperwork and chair;
- » Adjustments to computer software, such as ensuring that the font, font size and screen display settings meet the visual needs of the user;
- » Specific lenses to meet the unique demands of computer work, such as lenses that are focused for the distance of the computer screen, lens designs that incorporate near and intermediate focusing distances, and lens tints or coatings that may help to maximise vision and comfort;
- » A programme of optometric vision therapy. Some computer users may experience problems with eye focusing or eye coordination that cannot be adequately corrected with lenses but may be correctable in other ways.

STRESS

Stressors are events or circumstances that may lead to the perception that physical or psychological demands are about to be exceeded. Stress can occur in a wide range of computer use situations. It can be made worse when the demands and pressures do not match the computer user's knowledge, resources or abilities. Stress may also occur when the computer user feels unable to cope or that they have little control or social support.

Symptoms of stress can include:

- » Increasing distress and irritability;
- » Physical aches and pains;
- » Difficulty relaxing, concentrating or sleeping;
- » Difficulty thinking logically and/or making decisions;
- » Decreased enjoyment of work and/or feeling less commitment to work;
- » Feelings of tiredness, depression or anxiety.

Workplace stressors may be inevitable or avoidable. Inevitable stressors can include:

- » Starting a new job;
- » Learning a new skill;
- » Fluctuations in work flow;
- » Unpredictable emergencies in the workplace.

Avoidable stressors can include:

- » Working for too many hours each week;
- » Working in a situation that is poorly set up for the work being done;
- » No performance feedback or only adverse feedback.

Work stress can affect your business in a number of ways. Stressed computer users are more likely to have health issues, lack motivation and be less productive. External signs to look for include:

- » Increased absenteeism;
- » Increased staff turnover;
- » Impaired performance and productivity;
- » Increased unsafe working practices and incident rates.

Stress is not just restricted to the work environment – pressures at home can be a contributing factor. Therefore, good support both from outside work and in the workplace may strengthen the computer users capacity to deal effectively with work stress. It is important to remember that for most people work is good for health and wellbeing – it contributes to self-esteem, social participation, personal identity and fulfilment.

You can find more information about work stress and how to manage it in the New Zealand Department of Labour publication on stress, ACC's Preventing and Managing Discomfort, Pain and Injury Programme (www.acc.co.nz/dpi), the World Health Organization publication on 'Work Organisation and Stress', the International Labour Organization website on Safe Work: Stress at Work (www.ilo.org/safework/info/lang--en/WCMS_108557) and the European Agency for Safety and Health at Work website on stress (www.osha.europa.eu/en/topics/stress).

Stress and fatigue are covered by the Health and Safety in Employment Act 1992 as potential work hazards and sources of harm. The best way to prevent stress and fatigue in the workplace is to promote healthy work through good management and good work organisation. Healthy work is more fulfilling for employees and more productive for organisations than badly designed work.

FATIGUE

Fatigue is the temporary inability or decrease in ability to respond to a situation because of previous over-activity. This over-activity may be physical, mental or emotional in nature.

Physical fatigue

Physical fatigue is probably the most familiar and, in terms of physically demanding jobs, tends to be naturally self-limiting. However, in sedentary computer use the physical fatigue of smaller postural and arm muscles may not be recognised until the onset of discomfort or pain.

Common approaches for preventing physical fatigue and discomfort when using computers include micropauses, regular breaks, stretching and task variety as discussed in other sections of this document.

Mental fatigue

Mental fatigue may also occur after long periods of computer use without the user being aware of their developing symptoms. To combat mental fatigue, preventative strategies should be targeted at managing tasks during the day to allow mental resources to be allocated and used effectively:

Task duration

Match the task duration to the intensity of attention required. For example, if a computer user is writing a report and:

- » There is no deadline pressure;
- » All necessary resources are at hand;
- » The author is very familiar with the material,

... this task could probably go on all day without additional breaks.

However, if a computer user:

- » Is developing a response to an unfamiliar question;
- » Is under the pressure of a deadline;
- » Does not have resources immediately to hand,

... this task may require careful pacing. Time should be spent on planning and extra breaks taken.

Interruptions

Give thought to how computer users can put down and pick up tasks during scheduled and unscheduled breaks.

Deadlines

Computer users will not be able to meet constant, urgent, recurring deadlines for a long time unless effective management strategies are used:

- » Break large tasks into smaller ones;
- » Give computer users the ability to feed back on their progress and negotiate deadlines when required;
- » Provide some relief from the continued pressures of work.

Intense tasks

Writing tasks involving complex matters that require reference to a variety of materials (such as data, legislation, company policies, product specifications, export rules) can be very tiring.

This sort of work usually requires several hours of intense attention without interruption. When it ceases, a longer break should be taken.

Note that visual and ocular fatigue may accompany mental fatigue if intense inspection of the screen contents is required for long periods.

Emotional fatigue

Emotional fatigue may result from the need to complete tasks where mental fatigue is involved and is coupled with the uncertainty of emotional responses.

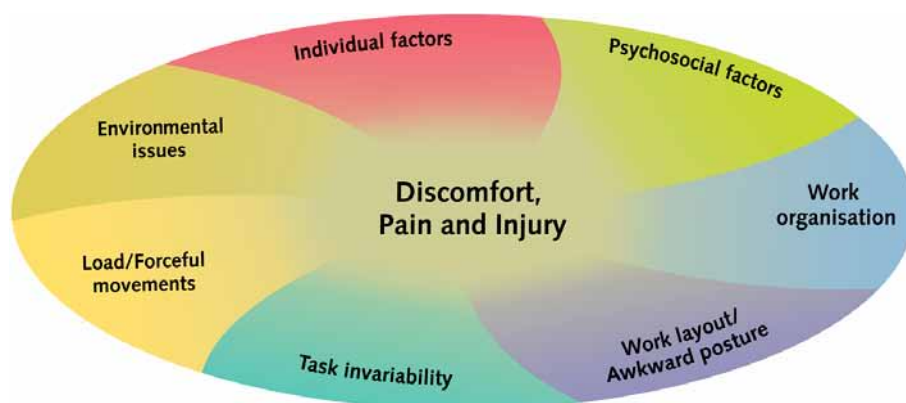
Working as normal when a restructuring programme is taking place and your job is perceived as under threat can be very difficult. Other sources of emotional fatigue are mentioned under the headings of 'work organisation' and 'psychosocial factors'.

1.2

WHAT ARE THE SOURCES OF THESE HEALTH ISSUES?

Contributory factors thought to lead to the presence of discomfort, pain and injury in computer users can be grouped into seven categories, as in the diagram below.

FIGURE 3. CONTRIBUTORY FACTORS FOR DISCOMFORT, PAIN AND INJURY



Contributory factors are not listed in any order of importance, as the impact of each group will vary for different work situations.

You can read more about the seven groups of contributory factors in 'Preventing and Managing Discomfort, Pain and Injury' (ACC) and 'HabitAtWork: Managing Discomfort, Pain and Injury in the Office' www.habitatwork.co.nz.

We explain these factors below to help you to identify them and recognise the different responses computer user can have to computer work when it is over-demanding. We also include advice to help you put measures in place that will eliminate or minimise the risks these factors pose.

All these factors need to be considered together to prevent or reduce the incidence of discomfort, pain or injury, and it is known that making small, positive changes to several of these factors will have the greatest benefit.

It is also known that human responses to a given situation vary. Different people will respond to situations in different ways, and each individual may respond differently at different times. Some days we feel great and are very resilient, other days we may feel low and be more vulnerable.

Computer work involves a complex interaction between computer users, other people in the work environment, computer equipment, furniture, workstation equipment and the physical and psychosocial aspects of the work environment. The combination effect of these contributory factors alters the overall impact of computer work on the individual.

For example, a data entry computer user may manage a work role without discomfort for many years, but with the added pressure of a sick family member they may begin to experience discomfort. Other contributory factors for discomfort might include family stress and job-related issues, such as task invariability, workplace layout and a range of work organisation factors.

Examples of some of the factors to consider in each category are outlined below. These factors may be listed in more than one category, and this helps to ensure that risks are addressed fully. As an example, note how often 'monotonous work' comes up.

INDIVIDUAL FACTORS

All individuals are different and some are more likely than others to develop health issues. For each individual there are factors that you can control and some that you can't. For example, a person's age, body size, gender and genetic makeup can't be altered. But a person can influence factors such as smoking, diet, exercise and their ability to perform certain skilled actions.

Individual factors that you need to take into account when planning and organising computer work include:

- » The balance of males and females in the workforce, or whether children or young people will use the computers (i.e. it is important to consider the range of sizes of users). This will influence the selection of the sizes, types and adjustability of desks, chairs and other equipment;
- » The physical characteristics of computer users (e.g. body weight) as these may affect the selection of equipment – for example, ensuring the strength and stability of a chair are appropriately matched to the weight of the individual;

Individual factors are closely associated with the other contributory factors. For example, if someone has poor knowledge (individual factor) of healthy work practices, they may adopt poor posture (workplace layout and awkward postures) and not take adequate breaks (task invariability).

Information on access and mobility design for people with disabilities can be found in NZS 4121:2001 'Design for Access and Mobility – Buildings and Associated Facilities'.

- » People with disabilities and the accessibility/suitability of the work environment. For example, will computer user with hearing aids cope with the sound levels and acoustic conditions in the office?;
- » Computer users who use corrective eyewear and the adequacy and control of lighting levels to cater to their needs;
- » The general health of computer users, e.g. do they tend to have an active or sedentary lifestyle? Fit and healthy people are likely to be more resilient and to cope better with work demands;
- » The attitudes individuals have towards work and discomfort, pain and injury. Are they positive in their approach to preventing and coping with discomfort, or tend to be reactive and injury-focused?;
- » People's ability to adapt to change and how they might adapt to an open plan style office or prefer smaller offices;
- » People's ability to cope with stress or high workloads.

PSYCHOSOCIAL FACTORS

Psychosocial factors are factors that affect computer users' perceptions of their work and workplace conditions. These factors can lead to both physical stress (such as tense muscles, altered breathing) and psychological stress (loss of creative thinking, forgetfulness, irritability). Psychosocial work factors often include:

- » Lack of personal control over workload management;
- » Monotonous and unfulfilling tasks;
- » Deadlines, and tasks with too much (or too little) demand;
- » Awkward or illogical work processes and tasks;
- » Poor social support from managers, supervisors and co-workers;
- » Poor communication between departments;
- » Lack of job security or job development opportunities.

Psychosocial factors can also arise from outside the workplace and may include:

- » Conflicting demands between work and home;
- » Lack of support for work problems at home or home problems at work;
- » Finance or health concerns;
- » Family and relationship issues.

Individuals with strong and supportive relationships both in and out of work, and those who are fit and healthy, tend to be more physically and psychologically resilient.

Researchers believe that the management of psychosocial factors is at least as important as the management of physical factors in preventing discomfort, pain and injury.

WORK ORGANISATION

Work organisation is about the organisation and management of computer work and the jobs involving computer work. This encompasses job design and job training, and the many aspects of work that are the responsibility of managers. Computer users managing their own workloads and managers of computer users must have a good understanding of these issues.

Features of good work organisation that may reduce the risk of computer-related health issues include:

- » Work schedules with flexibility, rather than rigid or strict rosters and routines;
- » Work shifts that are well organised and of suitable duration to reduce the effects of fatigue;
- » Work hours that are predictable and that accommodate outside-work commitments, such as family care and recreational activities;
- » The ability for staff to take regular and consistent breaks for rest, micropauses, stretches and exercises. Take care that computer users do not miss breaks owing to high work demands, and that they do not skip breaks in order to finish early;
- » Well managed workloads that accommodate weekly, monthly or annual peaks in activity;
- » Systems that reinforce healthy work practices. Avoid piece-rate payment schemes and/or reward systems as these can reinforce unhealthy choices and actions;
- » Good communication within the organisation;
- » New employees given adequate time and training to acquire skills;
- » Computer users given adequate time to acquire the necessary skills following changes to software, hardware or work processes;
- » Recognition of challenging tasks, such as activities requiring high mental demand and work that is emotionally demanding;
- » Tasks that are varied and/or interesting that promote feelings of fulfilment and value.

WORK LAYOUT AND AWKWARD POSTURES

The design and layout of the workstation have an important influence on the postures and work efficiency of computer users. However, even 'ideal' set-ups are not ideal if the operators have not been trained how to, or do not choose to work in, a range of suitable postures. Aspects of workplace layout and posture that may contribute to computer-related health issues include:

- » Poor workstation set-up, e.g. desk and/or chair at the wrong height, or a poorly positioned mouse or keyboard;
- » Inappropriate selection of computer hardware and software;
- » Using a laptop/notebook/netbook in an awkward position frequently or for a long period of time (in a vehicle, at a coffee table, on the kitchen table);
- » Using the wrong furniture for the tasks;

- » Poor layout of workstations, e.g. in an open plan office, workstations that are too close; or commonly used reference material placed where it is hard to access;
- » Working in awkward postures, e.g. over-reaching, bent wrists while typing.

Ways to address issues arising from poor workplace layout and awkward postures are covered in Section 3 of these guidelines.

TASK INVARIABILITY

Task invariability refers to the physical and mental aspects of repetitive work tasks. Making sure computer users have enough variation in their work is an important part of preventing computer-related health issues. Note, however, that some computer users find highly variable work prevents them getting any 'task flow' (physical rhythm or smoothness, or 'getting into' thinking tasks).

Work that has a high degree of invariability may involve:

- » Tasks with frequent repetition of the same actions;
- » Those involving high mental demands or monotonous, under-stimulating, meaningless tasks;
- » Tasks that involve holding the same posture(s) for long periods;
- » Using just one hand to perform most tasks, e.g. mouse movements, writing, answering the phone and drinking.

LOADS AND FORCEFUL MOVEMENTS

Loads and forceful movements relate to the way muscles and joints are used and how much work they are required to do. Examples of excessive loads or forceful movements that may contribute to computer-related health issues include:

- » Forceful key strokes;
- » Gripping the mouse tightly or holding the mouse when not using it;
- » Working with the mouse or keyboard too far from your body, requiring shoulder muscles to work hard to keep your arm and hand in position;
- » Using a mouse that is awkward to use e.g. the mouse sticks or the surface on which the mouse is used is poor;
- » Having your screen too high, which leads to your lifting your chin up and causes discomfort in your neck;
- » Mouse movement settings that are very sensitive and lead to additional muscle tension to control the mouse.

ENVIRONMENTAL ISSUES

Environmental factors are those associated with your surrounding environment, such as ventilation, temperature, lighting and noise. Computer users may have limited control over these factors, and levels of comfort may vary between individuals. Environmental factors that increase the risk of developing computer-related health issues include:

- » Excessive noise, or noise with a particular sound quality (e.g. high pitched);
- » Low or high humidity;
- » Uncomfortable temperature, i.e. too hot or too cold;
- » Poor lighting;
- » Poor air quality.

1.3 ARE COMPUTER-RELATED HEALTH ISSUES SOLELY RELATED TO WORKPLACE COMPUTER USE?

Computer-related health issues are not only work related – many people use computers at home, when travelling or for gaming. The problems that may develop from computer use can also be caused by domestic or recreational activities that use similar muscle groups or positions, e.g., knitting, model making. Health issues may arise as an accumulation of all activities undertaken.

Although people using computers at home run similar risks of health issues to those described in these guidelines, they often have control over their computer use and when they can stop or take breaks from the computers.

1.4 BENEFITS OF WORKING SAFELY WITH COMPUTERS

People vary enormously. This means you need to ensure that the tasks, working environment and the way you organise work are flexible enough to cater for a range of different computer users. If you incorporate best practice for computer use into your workplace, you will reduce the risk of health issues. The benefits can include:

- » Less discomfort, pain or injury;
- » Reduced absenteeism;
- » Increased efficiency (work completed more quickly and with fewer errors);
- » A harmonious work environment.

Consequences of not working safely with computers:

If you don't manage computer work properly, the consequences may be:

- » Discomfort or pain;
- » Loss of earnings;
- » Inability to work;
- » Problems in quality control and productivity;
- » Decreases in efficiency;
- » Sickness absences;
- » Costs of staff replacement and training;
- » Risk of litigation;
- » Risk of bad publicity;
- » Increase in ACC premiums.

1.5 MANAGEMENT COMMITMENT

If you want your programme of managing and reducing the hazards of computer-related health issues to work effectively, you need to demonstrate your commitment to the whole process. This requires:

- » Both you and senior managers in your organisation to be involved in health and safety management;
- » An open management style;
- » Two-way communication between staff and management, which encourages ownership of problems and better management of them;
- » An appropriate balance between health and safety and business goals;
- » An environment that encourages the early reporting of discomfort and any computer-related issues.

Although workplace design and good working practices are important, so are the example you and your managers set and how you show your company's commitment to health and safety. For example, you might show your commitment by consulting your computer users and acting on their concerns, and by yourself promoting good working practices in the workplace.

Employer commitment is a central element of the joint standard (AS/NZS4801:2001) on Occupational Health and Safety Management Systems.

The requirements for employee participation are described in Section 19 of the Health and Safety in Employment Act 1992.

ACC has developed a 'Cost Calculator' that can help you determine the costs of injuries and benefits of making changes to your workplace (www.acc.co.nz/preventing-injuries/at-work/injury-cost-calculator/PI00079)

2

Assessing potential hazards

The hazards arising from computer work reflect many of the contributory factors for discomfort, pain and injury identified earlier in this document.

Hazards associated with computer work are not listed in any order of importance, as the impact of each group will vary for individuals and different workplace situations.

Assessing the hazards involved with computer work requires a systematic process of identifying hazards, prioritising their importance, and developing an action plan to control them. You can do this any time: when your workplace is already set up, when you plan to move to new premises, or when you update your existing premises.

Changes in technology or work processes are likely to bring about the biggest changes in computer users' exposure to hazards. As the work changes, the impact of associated hazards may also change, so you need to complete hazard assessments regularly.

2.1

HAZARD IDENTIFICATION

The hazards likely to arise from computer work can be grouped according to:

- » The way the work is organised;
- » The work environment, e.g. lighting, noise, thermal comfort;
- » Postures and practices;
- » The selection and arrangement of furniture and equipment;
- » The selection and arrangement of computer hardware;
- » Education and training.

When identifying hazards you need to:

- » Review early report forms;
- » Review records for previous health issues, e.g. accident reports, ACC claims;
- » Observe the ways computer users actually perform their computer work, as these may differ from those reported by the computer users or others involved in the work;
- » Consider the types of task that will be required and the set-up of the workstation;
- » Take account of the preventative or control measures you already have in place. If existing measures are not adequate, you may need to identify further measures you can put in place;
- » Work jointly with computer users.

In the following section (Controlling the hazards) we list the possible hazards arising from computer use. For each of the hazards we explain the risks it poses and provide recommendations for creating the best possible conditions for computer work. We recommend you read this section before you move on to the hazard assessment process.

HAZARD ASSESSMENT CHECKLIST

One way to highlight hazards within your workplace is to use a hazard assessment checklist. A checklist is a particularly valuable tool as it provides a systematic approach to hazard identification so that none of the hazards is overlooked.

A suitable checklist needs to include all significant hazards. It should look beyond obvious physical hazards and consider hazards that are created as a result of the way the work is organised, the training and education of the user, management processes and the culture within the organisation. Make sure you consider and include the hazards that are specific to your workplace. You may even find you need to adapt your checklist to suit specific work situations.

2.2 PRIORITISING HAZARDS

The computer workplace can present a number of different hazards. While you may be able to eliminate some hazards, in many cases it may only be possible to isolate or minimise hazards. Here are some practical examples.

Your first aim must be to:

Eliminate the hazard from the workplace

If glare from a window is contributing to a computer user suffering migraines, to eliminate the hazard you could block all light from the window.

If eliminating the hazard is not practicable, every effort should be made to:

Isolate the hazard

Where noise from a printer or other equipment is a source of stress, to isolate the hazard relocate the printer or equipment to a separate room.

If it is not practicable to eliminate or isolate the hazard, you must:

Minimise the likelihood that the hazard will be a cause or source of harm as far as possible

Where a small person is forced to adopt awkward or stressful postures owing to an inappropriately matched desk height, using a footrest could be considered an initial step to minimise the hazard.

Sections 6-10 of the Health and Safety in Employment Act 1992 outline the requirement to eliminate, isolate or minimise hazards in the workplace.

Significant hazard means a 'hazard that is an actual or potential cause or source of:

- a) Serious harm; or
- b) Harm (being harm that is more than trivial) the severity of whose effects on any person depend (entirely or among other things) on the extent or frequency of the person's exposure to the hazard; or
- c) Harm that does not usually occur, or usually is not easily detectable, until a significant time after exposure to the hazard.'

Health and Safety in Employment Act 1992

You'll find that you can actually deal with most hazards quickly and easily. However, it may take some time before you can put effective measures into place to control some of them. For example, purchasing new furniture is often costly and may require financial planning. You therefore need to prioritise hazards, and your computer users should be involved in this process. The hazards you prioritise first should include those that:

- » Are most likely to cause injury or illness;
- » Can be addressed quickly and easily;
- » The computer user feels are most important;
- » Provide clear benefits in relation to the costs involved in implementing solutions.

Owing to the nature of computer work it may be difficult to eliminate or isolate hazards. As such, many of the items in your action plan will involve minimisation strategies. The use of minimisation strategies means that it is important to monitor the effectiveness of the hazard controls.

2.3

DEVELOPING A HAZARD CONTROL PLAN

Once you've determined how you are going to tackle the hazards, you need to draw up an action plan. The action plan should record significant findings from the hazard identification and should include:

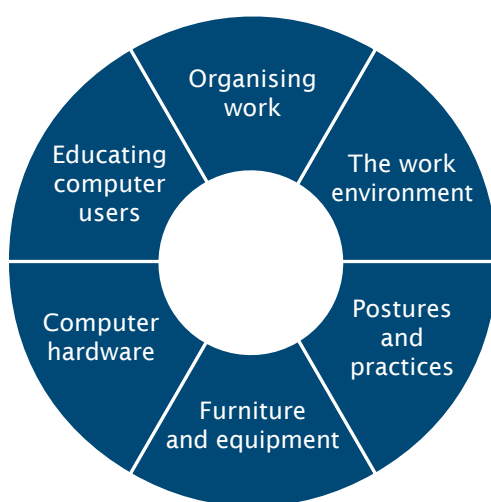
- » Preventative and protective measures you will implement to eliminate, isolate or minimise the potential harm associated with each hazard;
- » What further action, if any, is needed to eliminate, isolate or minimise each hazard;
- » The timeframe in which you will implement these preventative or protective measures.

You need to review and monitor your action plan regularly to ensure that proposed measures are being implemented and/or re-prioritised.

Controlling the hazards

This section offers a guide to the most common factors that give rise to hazards associated with the use of computers (Figure 4). We have included information about how hazards can lead to potential health issues and recommendations on how you can prevent or reduce the risks arising from these hazards.

FIGURE 4. FACTORS TO CONSIDER WHEN USING COMPUTERS



Our recommendations are based upon the best research evidence currently available and are primarily drawn from national and international standards and major scientific publications.

Owing to the nature of this type of work, it may be difficult to eliminate or isolate hazards. Accordingly most of the controls listed are minimisation steps. Because they do not necessarily prevent harm (but minimise the likelihood of it occurring), they require ongoing monitoring and evaluation.

3.1 ORGANISING WORK

How work is structured and managed is one of the most important aspects affecting the use of a computer. Work organisation determines whether jobs are varied, stimulating and provide opportunities for people to develop or, instead, are fragmented, monotonous and draining. Psychosocial stressors associated with computer use can be decreased by making sure work is well organised and well managed over time.

3

The order in which each group of factors that give rise to hazards of computer use is presented does not reflect their relative importance. Hazards associated with computer work will vary depending upon individual work situations.

‘User participation in the implementation process is of particular importance with respect to effective implementation and functioning of the system.’ ISO 9241-2:1992

Well organised work should:

- » Recognise the experience and capabilities of computer users and match work demands to these;
- » Ensure that there are sufficient resources and time to do the work at all times;
- » Allow each user to apply a variety of skills and capabilities and undertake a range of activities;
- » Give the computer user a sense of the contribution they are making to the overall output of the organisation;
- » Allow the user appropriate control over the priority, pace and procedure;
- » Encourage two-way communication and participation and provide sufficient feedback on task performance and management;
- » Provide opportunities for the user to develop their existing skills and build new skills;
- » Develop a supportive workplace culture through encouraging participation, initiative, cooperation, feedback and teamwork.

Things to avoid:

- » Overload or underload, which can lead to unnecessary or excessive stress or fatigue;
- » Undue repetitiveness, which can lead to excessive strain, monotony or dissatisfaction;
- » Undue time pressure, which can lead to stress, fatigue or errors;
- » Working alone without opportunities for contact with others within or outside the organisation;
- » Conflicting communication and/or expectations.

JOB REQUIREMENTS

Computer users need to have clear descriptions of what their jobs require. This will remove uncertainty, clarify goals and help people to better understand their tasks. Think about the nature of the tasks and the jobs, and any training that may be required to enable people to do their jobs. Monotonous tasks, tasks requiring a high degree of specialisation or where computer users have limited control over workflows can all impact negatively on health.

If people are undertaking monotonous or boring tasks, consider rotating a range of varied tasks. It is also worth considering whether the job is interesting to the particular person and, if not, if there is someone else who has a greater interest in it.

When tasks change, you will need to reassess the job for potential problems.

SUPERVISION

Where possible, create clear and unambiguous lines of reporting. Try to make sure that each computer user has only one supervisor. If it's unavoidable that a computer user has more than one supervisor, there needs to be a system that avoids conflicts. For example, a person with two supervisors may find themselves with conflicting deadlines. The computer user should not be the person deciding which one to meet.

WORKLOADS

It is important that computer users and managers establish a reasonable balance between the amount of work that has to be done and the number of computer users available to do it. If there has been downsizing or cutbacks on staff, overloading of remaining Computer users is a potential issue.

Computer users also have a responsibility to set reasonable limits for themselves and to talk to managers when the demands are too high. People often find this difficult to do and management may need to take steps to make it possible. Stress arising from recurring deadlines can be avoided by carefully scheduling work flow:

- » Plan work to avoid constant, recurring deadlines. People are usually more able and willing to work harder when presented with deadlines that are genuinely urgent (monthly accounting returns, for example);
- » Try to anticipate peak workloads. Then, in slack periods, use the downtime to prepare work for those times when deadlines become urgent.

Be aware that using bonuses and overtime to increase the productivity of computer users can lead to an increased risk of health issues, as people are tempted to exceed their capabilities. Workloads need to be discussed and agreed on by all parties involved to help reduce these effects.

When some staff are absent, workloads should be managed so that the remaining computer users are not exposed to excessive workloads, as this can increase the risk of health issues. This may mean reducing workloads or temporarily replacing the staff who are absent.

And, remember, you need to allow a gradual build-up to the normal work rate when a person is new to a job or when returning to work after being away, e.g. on holiday or sick leave.

3.2 THE WORK ENVIRONMENT

Maintaining the best possible work environment is essential to ensure the health and productivity of all computer users. Even if you have selected and arranged the furniture and computer equipment correctly, health issues may still occur if the working environment is poor.

Physical aspects of the work environment you need to consider include:

- » Working space;
- » Location of workstations;
- » Lighting;
- » Décor;
- » Atmospheric conditions;
- » Noise;
- » Housekeeping.

The design and arrangement of the work environment are governed by a combination of factors, including work organisation, communication and an individual's personal environment. ISO 9241-6:1996

For purposes of fire safety, a minimum space requirement of 10 square metres is recommended for offices and staffrooms. Department of Building and Housing (2010).

WORKING SPACE

You need to make sure that each computer user has the working space they need to carry out their tasks safely and comfortably. The amount of working space needed will depend on the individual user, the nature of their work and the hardware and furniture being used, but you also need to take into account the human need for 'personal space'. Overcrowding caused by placing workstations too close together can contribute to stress and reduced productivity.

Space requirements depend on a number of factors such as:

- » The nature of the work;
- » The hardware used;
- » The extent to which facilities are shared;
- » Storage space;
- » Access and egress;
- » Individual requirements.

Make sure that:

- » The space and design of the workstation allow a range of comfortable working postures.
- » Computer users have easy, unobstructed access to and from their workstations.

LOCATION OF WORKSTATIONS

It is important to think about the visual environment when planning the workstation layout. The arrangement of lighting, types of light fixture used and locations of windows are all important points to consider. You should aim to provide the appropriate light level to the workstations for all computer users, at the same time accommodating any sources of glare and reflection that may only be apparent in different seasons and at different times of the day.

Open office spaces are often divided into smaller or closed offices that rarely account for uniformly positioned overhead lighting. The office layout should be planned around the position of light fixtures to prevent walls or partitions blocking or creating shadows over the work area. Alternatively, lighting configurations should be designed to match the floor plan.

Certain office equipment (e.g. photocopiers and printers) and other people can affect concentration. Computer users who sit near photocopiers and printers may be distracted by the noise and heat of the equipment and the constant coming and going of the people using them.

Draughts created by ventilation ducts, office equipment or open doors may cause discomfort for computer users. Computer workstations should be positioned to avoid these situations. The division of an open-plan office area into smaller enclosed rooms may not allow the ventilation and airflow to function as originally engineered, and therefore should be considered in the planning of the office workstation layout.

When you locate a workstation within a room, make sure there is good access to any hardware, wiring or power points that may require maintenance. There need to be enough well positioned power points to prevent the use of multi-plug boards and eliminate trailing power cables.

LIGHTING

Lighting is particularly important to the comfort, performance and safety of computer users. Poor lighting can cause symptoms of visual discomfort, headaches and migraines. Lighting that causes shadows or glare can also result in awkward working postures as computer users try to get a clear view of their screens or documents.

You can use solely artificial sources to provide lighting, but it is preferable to use a combination of natural and artificial light. Lighting intensity falling on a surface is called the 'illuminance' and is measured in units of lux.

Illuminance levels

For most computer tasks, the average illuminance level should be at least 320 lux. An acceptable lighting level may require a compromise between the amount of light needed to enhance the computer screen visibility and reduce reflections and glare and the amount needed to perform other office reading and work tasks.

Light needs to be distributed uniformly. In other words, the amount of light falling on horizontal surfaces (the desk top) and vertical surfaces (a sheet of paper on a copyholder) needs to be uniform.

In some instances, higher levels of lighting (600 lux or more) may be appropriate, e.g.:

- » For visually demanding tasks;
- » When liquid crystal display (LCD) screens are used;
- » For users who require higher levels of lighting, such as older users.

Lighting requirements will vary with tasks. More lighting may be needed when other source documents are also viewed.

Higher levels of lighting can increase glare and reduce the relative contrast of the screen, making text or characters difficult to read. If additional illuminance is required, the most practical solution is to provide individual task lighting such as a desk lamp. Make sure that task lighting:

- » Is adjustable in direction and intensity levels;
- » Does not produce excessive contrasts in different regions of the workstation;
- » Does not result in glare or screen reflections at nearby workstations.

If you are using a negative polarity display screen (light characters on a dark background), you may need to reduce the workstation illuminance below these recommended levels to avoid screen reflections. If you lower lighting levels, you need to provide task lighting for reading hard copy/print-based work.

For further information on the lighting of interior workplaces, refer to AS/NZS 1680 (Parts 0-4), ISO 8995 2002, and ISO 9241-6:1996.

'The arrangement of lighting, the lighting characteristics of the luminaires and the location of the windows can be important variables to consider while selecting the workplace layout.' ISO 9241-6:1996

Light meters (or lux meters) are often used to measure illuminance. Illuminance should be measured at positions for the task(s) being performed (e.g. level of the screen, document holder).

'Rapid spatial changes in illuminance around the task area may lead to visual stress and discomfort.' ISO 8995:2002

‘The light and luminance distribution of luminaires is the major factor taken into consideration to achieve visual comfort.’ ISO 9241-6:1996

Uniform illumination

Computer workstations should be illuminated as uniformly as possible. The difference between the dimmest and brightest areas of the workstation should not be less than 0.8:1, and this includes illumination in the different working planes. This means that the lighting of the screen (vertical plane) should be similar to the lighting of the desk surface (horizontal plane) when the user is in their normal working position. You need to watch particularly for shadows.

A difference of 0.8:1 between the brightest and dimmest areas on a workstation would mean that if the light falling on the desk was 400 lux, the illuminance of the computer screen should not be more than 500 lux.

You should also try to avoid creating large differences in lighting between the wider surroundings and the workstation, as this can cause visual discomfort. The difference between the illuminance of the wider surroundings and the workstation illuminance should not be less than 0.6:1.

A difference of 0.6:1 means that if the workstation illuminance is 500 lux then the illuminance of the wider surroundings should be at least 300 lux.

Colour appearance

Colour appearance is the colour of light coming from an overhead light fixture or task lamp. This is expressed in terms of correlated colour temperature (Tcp). Take care when you choose the colour appearance of artificial lighting as it can affect computer users' wellbeing and productivity.

If you use daylight for lighting in part of your workplace, you need to make sure that any artificial lighting blends with the natural light. Lamps with a Tcp greater than 4000 K (Kelvin) are best for these situations. However, if a lot of work is done at night, a Tcp less than 4000 K may be more desirable. You can check the Tcp on the design specifications of the light fixture, which you can get from your lighting supplier or the manufacturer.

Colour rendering

Computer users' visual performance is better, and they enjoy greater comfort and wellbeing, when colours appear as natural and as accurately as possible. Artificial lighting can affect this. An objective measure of colour rendering is the general colour rendering index (Ra). The poorer the quality of colour rendering, the lower the value.

The maximum value of Ra is 100. Lighting for computer workstations should have a minimum of 80 Ra. You can check the Ra in the design specifications of the light fixture, which you can get from your lighting supplier or the manufacturer.

Glare and reflection

You need to prevent or minimise glare and reflection as much as possible. Glare is produced when one area in a person's visual field is much brighter than another. Glare can result directly from bright light sources that are in the computer user's line of vision (looking through a window at a bright white wall opposite), or indirectly from surface or screen reflections.

Glare may cause visual discomfort and headaches, as well as reduce the computer user's performance. Some screen types, particularly those on laptops and notebooks, use technology that gives clear, bright colours, but often at the expense of providing a screen surface that is highly reflective. These may be problematic for users and unsuitable for work environments where the ability to control glare is limited.

Think about how you have positioned workstations in relation to windows or skylights:

- » Where possible, position workstations at right angles to windows;
- » Windows and skylights should have adjustable blinds or drapes to control excess light;
- » Consider window coatings that can reduce glare.

You also need to think about how the workstation is positioned relative to overhead lighting. As far as possible, position the workstation:

- » Parallel to, and between, rows of overhead lights (Figure 5);
- » So that overhead lights are not directly within the user's visual field when looking at the screen;
- » So that overhead lights are not directly behind the computer workstation (to avoid reflections) (Figure 5).

'It is important to limit the glare to avoid errors, fatigue and accidents.'
ISO 8995:2002

'Reflections in the task or its surroundings interfere with visual efficiency and comfort by reducing task contrast and/or causing distraction and annoyance.'
AS/NZS 1680 2.2:2008

'The prerequisite to achieve glare control is through the use of screen equipment with an anti-reflection treatment appropriate for the task and the intended environment.' ISO 9241-6

**FIGURE 5. EXAMPLES OF WORKSTATION POSITIONING IN
RELATION TO OVERHEAD LIGHTING**



In some instances, you may need to use other measures to reduce glare or reflections:

- » Ensure lights near computer screens are fitted with diffusers, cube louvers or parabolic louvers (Figure 6);

FIGURE 6. EXAMPLES OF LIGHTING DIFFUSERS



- » Screen visors or hoods may be suitable in certain environments, such as outdoors;
- » A glare filter should be a last resort, after all other measures fail. (Note that many modern computer screens come with anti-glare coatings.) Glare filters may not provide a significant improvement and often make it harder to read the screen, reducing image clarity and brightness.

Flicker perception

You need to eliminate any flicker from artificial lighting. Not only is it annoying, it may cause problems such as visual fatigue and headaches. Some individuals are more sensitive to or aware of flicker than others.

If flicker is apparent in older fluorescent luminaires it may be due to the magnetic ballast and/or to the lower operating frequency of the luminaires. In such instances, the luminaires and/or the ballast should be replaced. Modern fluorescents with electronic ballasts operate at high frequency and flicker is typically beyond the range of human sensitivity.

Maintenance of lighting

Proper maintenance of lighting systems will ensure that they operate efficiently.

Clean lamps and light fixtures regularly as this will help to maintain a good level of light. Also make sure that you replace fluorescent luminaires as soon as they age beyond their design lives. You can get the design lifetime specifications from the manufacturer or supplier.

Modern fluorescents with electronic ballasts are becoming important for building management systems (BMS) that switch or dim lighting dependent upon the building

Lighting should be cleaned regularly to maintain good lighting levels. Six-monthly cleaning of lights and luminaires is recommended.

The reflectance of room surfaces for good seeing conditions is based on the recommendations of AS/NZS 1680.1:2006.

occupancy or the contribution of daylight. If sensors are outside the area of occupancy (e.g. in an enclosed office installed subsequent to the BMS design) inadequate lighting levels may result.

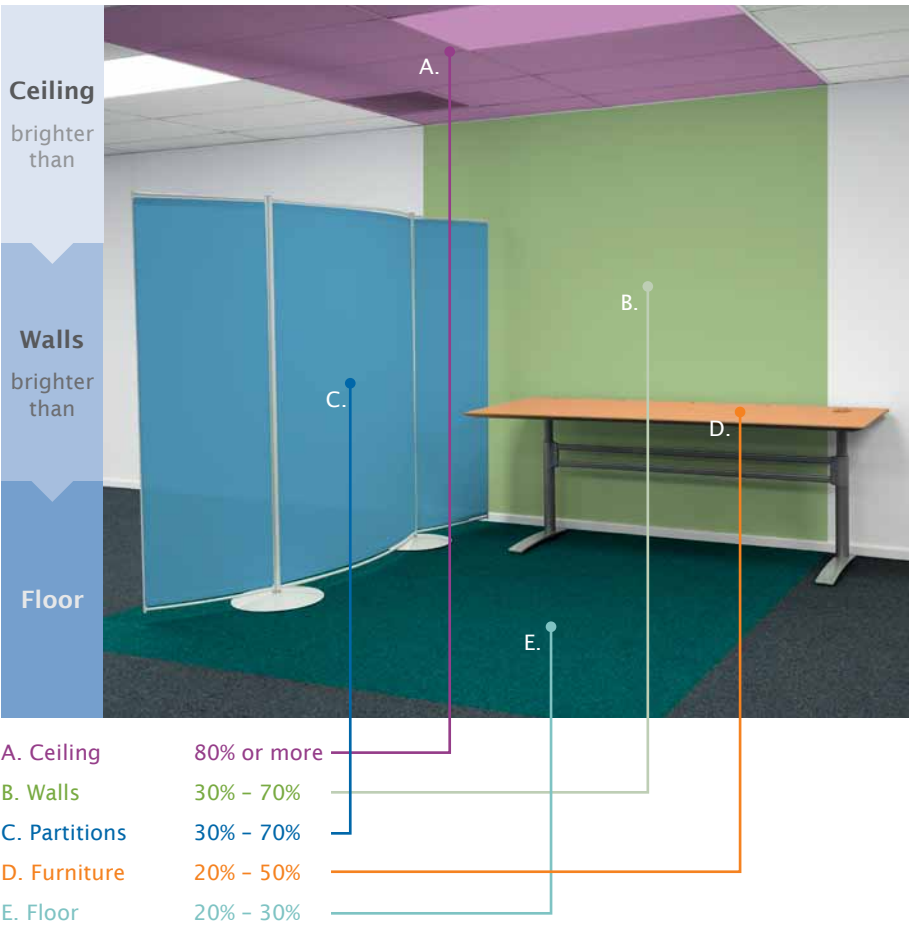
Energy conservation efforts may result in inadequate illumination if, in the interests of saving power, lights are turned off or lower-wattage and less effective luminaires are installed.

DÉCOR

Décor is an important part of the visual environment. Give some thought to décor as you plan the workplace lighting, as the degree to which room surfaces reflect light influences many aspects of lighting. For example, overly dark colours in the décor can create contrasts in brightness so that additional lighting may be required to provide uniform illuminance. This is because dark surfaces do not reflect light as well as lighter surfaces.

As a general rule, ceilings should be brighter than walls and walls brighter than floors. The reflectance of room surfaces should be within the ranges recommended in Figure 7. If you are using interior designers, make sure they take this into account at the design stage.

FIGURE 7. DÉCOR – RECOMMENDED % REFLECTANCE (LUMINANCE) OF SURFACES



ATMOSPHERIC CONDITIONS

Thermal comfort

Thermal comfort refers to a person's satisfaction with their thermal environment. If computer users are not comfortable with their thermal environment they may become tired or irritable and less productive, and this can result in a higher number of errors.

Air temperature alone doesn't determine a person's comfort. A combination of factors influence thermal comfort, including:

- » The level of activity during work;
- » Air temperature;
- » Speed of air movement;
- » Humidity;
- » Radiant sources of heat and heat from office equipment;
- » Insulation from clothing;
- » Personal preferences.

The values for temperature, airflow and humidity that we recommend in the following sections apply mainly to computer users undertaking sedentary work. You may need to adjust these where the work involves more physical activity (e.g. warehouse work) or is in extreme thermal environments (e.g. food distribution).

Temperature and airflow

Thermal comfort can be very subjective, with people's perceived levels of thermal comfort varying significantly. You may find it difficult to suit everyone's preferences. The recommended temperature and airflow values given below should suit the majority of people.

- » For summer (when computer users wear light clothing):
 - air temperature: between 23°C and 26°C;
 - average airflow velocity: 0.1 m/s-0.25 m/s.
- » For winter (when computer users wear heavy, winter clothing):
 - air temperature: between 20°C and 24°C;
 - average airflow velocity: 0.1 m/s-0.15 m/s.

In both cases the difference in air temperature from 0.1 metre (ankle height) to 1.1 metres (neck height) above the floor should not exceed 3°C.

If the work involves more physical activity (e.g. warehouse work), air temperature may need to be lowered and airflow increased to suit the individual user. In extreme thermal environments, appropriate clothing may need to be provided.

Humidity

Humidity is the amount of water vapour in the air. Relative humidity is the current level of water vapour in the air compared with the level of water vapour that would completely saturate the air. Relative humidity is expressed as a percentage.

A minimum flow rate of 10 litres per second per person is based on recommendations of NZS 4303:1990. More recent research involving a review of the scientific literature on the ventilation of indoor environments by the European Multidisciplinary Scientific Network on Indoor Environment and Health (EUROVEN, 2002) suggests that flow rates should be closer to 25 litres per second per person.

The relative humidity of the working environment directly affects people’s perceptions of comfort. Humans need a relative humidity of 40% to prevent the mucous membranes in the mouth, nose and eyes drying out. Humidity levels that are too high can lead to feelings of stuffiness and fatigue.

The recommended relative levels of humidity at specific air temperatures are:

Air temperature	Recommended relative humidity range
20°C	60-80%
22°C	50-70%
24°C	45-65%
26°C	40-60%

If the work involves more physical activity, you may need to lower the relative humidity to suit the individual user.

Radiant heat

The most common sources of radiant heat in the workplace are likely to be direct sunlight and equipment such as photocopiers, printers and computer hardware. While radiant heat warms the air, work surfaces and people heat up much more quickly. Often the design of office buildings allows for high levels of radiant heat. For example, buildings may lack insulation in the roof or have large windows that let in large amounts of direct sunlight. Air-conditioning systems that have to compete with high levels of radiant heat will have difficulty maintaining a comfortable thermal environment.

You need to minimise sources of radiant heat as much as possible. Use outdoor window shades, adjustable blinds, drapes or similar devices to control sunlight, and position workstations to reduce computer users’ exposure to sources of radiant heat.

Air quality and ventilation

People react strongly when they think the air is stuffy, stale or polluted and may express this as general dissatisfaction with the environment.

Sources of pollution in buildings may be internal, external or structural. Office machinery and fittings, such as photocopiers and laser printers, carpets, wall coverings, particleboards and cleaning materials may emit a variety of substances such as ozone, formaldehyde and solvent vapours.

You can use natural or mechanical ventilation, or a combination of both, to remove these substances. Inadequate flow rates are associated with a decrease in perceived air quality, increased short-term sick leave and reduced productivity. You may need to seek expert advice to sort out air quality problems, especially if your buildings are air-conditioned.

Be wary of office modifications where the addition or removal of walls and partitions may impact on ventilation and airflow. Modern office buildings are generally designed with air-conditioning appropriate to the initial building layout, and subdividing open spaces into closed office areas rarely takes the position of the air-conditioning inlets and outlets into account. Such disruption to the engineered air-circulation path often leads to ineffective ventilation.

NOISE

In most cases, noise in the office environment (e.g. office equipment, ringing phones, air conditioning/fans, work colleagues) is unlikely to reach levels that are hazardous to hearing. However, office noise can make communicating and concentrating difficult, and may consequently be a source of stress. Generally, the more difficult or complex a task, the lower a user's tolerance for noise.

Noise is particularly problematic in open-plan offices, with common complaints about interference from nearby conversations and telephones. Special problems arise when the noise has a particular quality. For example, the throbbing of a ventilation duct need not be very loud to be annoying.

Measures you can use to reduce noise:

- » Padding under machines;
- » Enclosing noisy machines in acoustic hoods;
- » Carpeting the floor;
- » Installing sound-absorbing partitions;
- » Installing acoustic ceiling tiles;
- » Repairing, replacing, isolating or relocating noisy equipment;
- » Lowering the ringer volume on telephones;
- » Using telephone headsets rather than speakerphones;
- » Providing specific meeting areas that are isolated from normal work areas.

Recommended noise levels:

The recommended maximum average level for background noise is 45 dBA (decibels) at the position of the computer user. However, you should aim to have background noise at as low a level as possible. If the noise level is much higher than 45 dBA, people will start to report annoyance and communication problems.

Sound level meters measure the noise level at one instant, in a particular location. Noise levels will vary throughout the day, so you need to take a series of measurements at regular time intervals. You then average the readings to determine the noise exposure during the course of a work shift.

Another way of measuring noise is with a dosimeter. This is a lightweight piece of equipment that can be worn by a computer operator during a normal working day, e.g. for eight hours.

HOUSEKEEPING

Good housekeeping should be promoted as a standard practice of managing health and safety in the workplace. For computer areas, this means keeping floors tidy and access ways clear. Make sure power and communication cables don't present a tripping hazard.

Recommendations regarding noise levels primarily apply to computer users working in an office environment. Noise levels within a factory setting, for example, are often difficult to control and exceed these values. In these instances you need to refer to the Approved Code of Practice for the Management of Noise in the Work Environment (2002).

‘Users require frequent movement and postural changes to achieve and maintain comfort and productivity.

The four reference postures are intended to illustrate the diversity of body positions observed at computer workstations.’ ANSI/HFES 100-2007

‘Movement should be encouraged by considering job content and furniture design. This means that prolonged static sitting posture is minimised and that more or less continuous voluntary adjustments of the position of the lower limbs and upper body can be made.’ ISO 9241-5:1998

3.3 POSTURES AND PRACTICES

The postures and practices a person adopts throughout the day can have a significant impact on their risk of developing computer-related health issues. These risks can be reduced by maintaining good postural habits and working practices and by having an appropriate workstation set-up.

A workstation that is arranged for maximum efficiency and comfort in all respects should encourage computer users to adopt a range of well supported postures. Staying in the same posture for prolonged periods is undesirable, as people naturally need to change position and move around.

REFERENCE POSTURES

Maintaining the body in neutral positions while working reduces stress and strain on the musculoskeletal system. (A neutral body position is a comfortable working posture where joints are naturally aligned.) Note that this is only one factor of many that can help to reduce a computer user’s risk of developing discomfort, pain or injury related to their use of computers.

Figure 8 shows a range of acceptable postures that computer users may adopt as starting positions to move in and around, but note that there is no uniquely correct posture that would suit any user for an extended period of time.

Humans are designed to move and change position, and their work environment should enable and accommodate changes in posture. Computer users should also be encouraged to change their working position frequently throughout the day.

FIGURE 8. REFERENCE POSTURES



Recommendations for computer users who sit to work:

Legs and feet:

- » The feet are fully supported by the floor. If the feet cannot be supported on the floor, a suitable footrest should be used;
- » The knees are the same height as, or just below, the hips with the feet slightly forward of the knees;

- » The bottom and thighs are supported by a well padded seat approximately parallel to the floor.

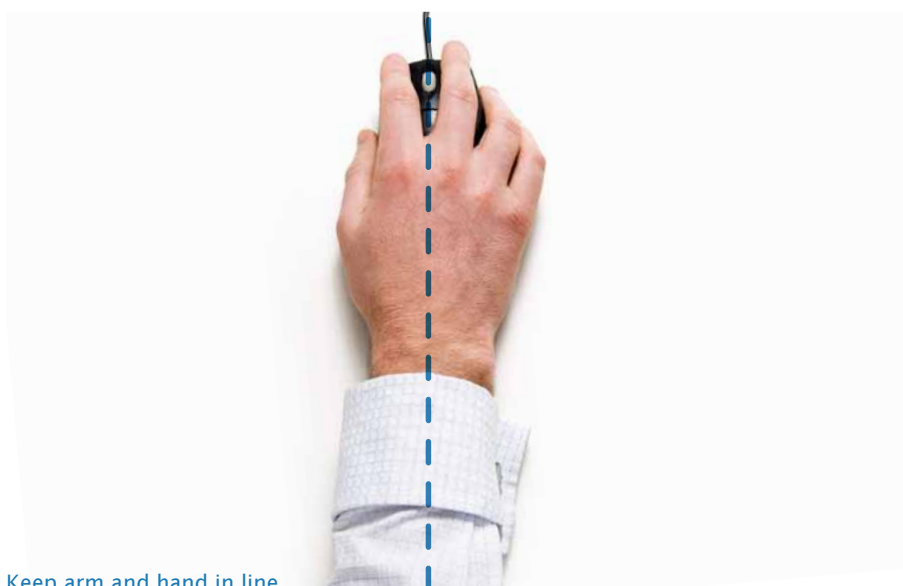
Neck and back:

- » The head is level or bent slightly forward, forward facing and balanced. Generally it should be in line with the torso and not turned to one side;
- » The back is positioned so that the natural curves of the spine are maintained in both the upper and lower regions of the back;
- » The back is fully supported with appropriate lumbar support when sitting upright or leaning back slightly.

Arms and hands:

- » Shoulders are relaxed;
- » Elbows are hanging comfortably by the user's sides;
- » Elbows are close beside the body and at approximately right angles. If the user is reclining in their chair, a greater elbow angle is appropriate. Recommended elbow angles range between 70° and 135°;
- » The hand or forearm is supported;
- » Wrists are as straight as possible, within 30° up or down (extension and flexion);
- » Avoid sideways bending of the wrist (ulnar/radial deviation);
- » Direct pressure on the under surface of the wrist should be avoided while typing or using a mouse or pointing device;
- » Fingers should remain relaxed and slightly curved rather than excessively arched or extended during typing;
- » When in use, a mouse should be held loosely in the hand, with the fingers and thumb relaxed so that they are gently resting against the mouse.

FIGURE 9. EXAMPLE OF HAND POSITION WHEN USING A MOUSE



Keep arm and hand in line.

‘Any work done standing upright should be of a short duration. The posture is advantageous and recommended only if it can alternate with a sitting position.’
ISO 9241-5:1998

‘Working in the standing position requires sufficient knee and foot room. It should be possible to move the feet in the forward direction. In addition, a person leaning forward can support his upper body better if his legs are bent.’
ISO 9241-5:1998

STANDING TO WORK

Many people find standing a comfortable way to work. However, prolonged periods of standing can be uncomfortable and may make certain back conditions worse. Where people stand to use a computer, make sure the time they need to do so is short and that they can easily move their legs. It is recommended that standing to work at a computer be alternated with a sitting position.

Recommendations for computer users who stand to work:

Working posture:

- » Follow the same guidelines for upper body postures as outlined for the seated position, e.g. head level, relaxed shoulders, arms hanging by side, elbows close to side (see page 37);
- » Provide sufficient knee and foot room. It should be possible to move the feet forward or bend the knees to allow the user to lean forward and support their upper body against the work surface;
- » Provide sufficient space behind and to the side of the user to allow them to move around freely;
- » Provide a footrest that allows the user to raise one foot off the ground to provide some relief from the effects of standing continuously in the same posture;
- » Provide a suitable chair for prolonged work involving standing to allow the user the option to sit;
- » A tall footrest is essential if a high office chair is to be used comfortably at a standing work surface;
- » The floor should be even and free of tripping hazards;
- » Provide shoe or floor cushioning such as a rubber mat, but ensure that it is also suitable for use with a chair (i.e. stable and safe).

FIGURE 10. EXAMPLE OF A STANDING WORKSTATION



WORKING PRACTICES

A well designed workstation within an appropriate work environment does not on its own eliminate user discomfort. To prevent fatigue and discomfort, it is important to organise computer work appropriately. Computer users should learn and be able to apply good working practices that include taking regular breaks (in addition to lunch and tea breaks) and mixing alternative work tasks with computer work throughout the day. Good keying and mousing technique is also important.

Regular task breaks

People using computers intensively for long periods need to have structured and well managed breaks. Those who have considerable variation and freedom in their working day need less support to ensure they take breaks. Short breaks away from the computer are recommended to prevent the build-up of fatigue.

A 'break away from the computer' can be an alternative, non-mouse/keyboard task, rather than a non-productive rest break. Breaks are easiest to remember and take if they fit the natural work flow, e.g. after entering details from files (sedentary keyboard and mouse work), the files are taken and placed into storage (walking, standing).

Recommendations for task breaks:

Task breaks involving changes from regular work should:

- » Be frequent to prevent fatigue and be taken more often than the regular morning, lunch and afternoon breaks;
- » Be at least five to ten minutes every hour or timed to match a natural break or change in the work;
- » Involve a complete break away from the computer, i.e. the break should not involve surfing on the Internet or dealing with emails;
- » Involve undertaking alternative tasks or exercises with the opportunity to move about the work environment.

Some organisations use break-monitoring software packages, particularly for 'high-risk' computer users, to ensure that breaks are taken regularly. There is considerable variation in the style of this software, including 'pop-up' reminders at preset intervals, computer lockouts after a given number of keystrokes, and keystrokes and mouse-click monitoring with break reminders provided only when natural pauses and breaks are not taken.

This software can cause increased frustration and stress if it is not appropriate to the task and the work situation, and the individual user. Consider options carefully and trial them before purchasing break-monitoring software.

Micropauses (brief pauses)

Micropauses are brief pauses taken at the workstation and built in to the natural rhythm of the work. They allow for periods of muscle relaxation and frequent changes to body and eye position during the work. Micropauses are about relaxed work techniques, rather than taking breaks.

Research shows that regular breaks help decrease worker discomfort and fatigue (physical and mental) and increase keystroke accuracy and speed without significantly reducing work productivity. In fact, some studies show increases in productivity.

The legislation requires employers to provide employees with paid rest breaks and unpaid meal breaks. Employees are entitled to: one paid 10-minute rest break if their work period is between two and four hours; one paid 10-minute rest break and one unpaid 30-minute meal break if their work period is between four and six hours; two paid 10-minute rest breaks and one unpaid 30-minute meal break if their work period is between six and eight hours; or where the work period is greater than eight hours, the pattern commences again, starting at the end of the eighth hour. Employment Relations Act 2000

Research has shown that users' preferences are important in selecting software that prompts breaks from using the computer. Organisations should not restrict themselves to one particular type of software, but allow the computer user to select break-reminder software that best suits them in encouraging micropauses.

Learning to relax the hands and arms when working with computers, and often without an interruption to normal work pace, is an important component of micropauses. Also important is changing the focal length of the eyes, which can be achieved by looking at an object in the distance. During computer work, these micropauses can involve resting the hands on the lap or desktop hand-rest when re-reading material on the screen, looking up to speak to someone, or looking out the window to alter the focus of the eyes when using the phone.

Micropauses are of most value when working muscles are able to relax fully, so some people may need training in relaxation.

Recommendations for micropauses:

- » Frequent and regular pauses built into the work;
- » Taking the hands from the keyboard and hanging the arms down by the side;
- » Complete relaxation of the shoulders, arms, hands and fingers;
- » Changing eye focus by looking away from the screen at distant objects (at least two to three metres away), for example looking out the window.

Alternative tasks

Varying tasks can have similar benefits to breaks and micropauses as it exposes people to different demands in mental and physical workloads. Providing a variation in tasks will help prevent fatigue and allow users to change body positions.

Where appropriate, computer users need to plan for task variations to regularly 'interrupt' their computer use, particularly where the work is intensive. Think about including alternative activities such as filing, making phone calls while standing, photocopying and scheduling meetings throughout the day, although this may not always be possible. Some work, such as data entry, has little variation and in these cases it is important that regular additional breaks are provided.

Recommendations for alternative tasks:

- » The 'interruption' should have a different visual and physical nature from the computer work;
- » The alternative task should require the computer user to use different postures, preferably standing up and walking around (presuming that the computer work is seated);
- » The 'interruption' should take the user away from the computer workstation.

Keyboard use

Forceful pressing on the keys can lead to muscle fatigue. A computer user should not hold a pen while keying, or hold a telephone between the ear and shoulder. Watch for resting positions or micropauses that do not allow complete relaxation of the hand and forearm. One common posture error is continuing to hold the hands up after typing has ceased.

Learning to touch-type or at least use 'all-finger' keying methods will increase keying speed and reduce loading on the neck muscles, as well as share the use of the muscles and tendons between hands.

Recommendations for keyboard use:

- » The standard keyboard should be positioned so that the 'g' and 'h' keys are centrally aligned (in the vertical axis) with the body (in line with the nose, or alternatively remember 'b' in front of bellybutton);
- » The weight of the arms/hands should be supported between episodes of keying;
- » When pausing or resting between keying, the muscles of the hands and forearms should be relaxed. One way to do this is to adopt a neutral position of the wrist on the space in front of the keyboard, or on the hand-rest if one is used.

Mouse use

The mouse is one of the most commonly used types of pointing device. Other pointing devices and their selection are discussed later (page 67). Whilst people often default to using their dominant hand when operating a mouse, there is good reason to learn to alternate the mouse between both hands. This will help to share the workload between hands.

For dual-handed operation, it is important to select an appropriate mouse (shaped for use with either hand) or to have two – one for the left hand and one for the right hand.

As the non-dominant hand is often less able to perform controlled or sensitive movements, when alternating between hands it is best to adjust the control settings for the mouse accordingly. The place to make these adjustments can usually be found in the computer software (e.g. within 'Control Panel' under 'Mouse' control settings).

Changes to the mouse settings often involve:

1. Swapping the functions of the mouse buttons so that the index finger of the hand in use carries out the main 'click' function;
2. Slowing down the double-click speed;
3. Slowing down the speed of the pointer.

It is important that computer users learn how to make mouse adjustments quickly and for themselves, as people who set up computers or other users of a shared computer may use different mouse settings. Several adjustments may be required before a user feels comfortable using their non-dominant hand, but after a short period of time they often become proficient and can 'speed up' their mouse settings.

Using the mouse with the non-dominant hand often frees up important desk space for writing or other tasks that require the use of the dominant hand. As most keyboards have numerical keys to the right of the keyboard, left-handed mouse use can help with achieving a more central positioning of the alphabetic keys.

"The operation of a mouse is highly software dependent. The most important change users can make is adjusting gain to suit his or her personal preferences." ISO 9241-410:2008

An important feature of workplace design is to facilitate and encourage workers to move and change their postures. Furniture and equipment that allow operators to change posture, and an environment that has some built-in 'need to move', help to counteract the negative effects of sedentary office work.

Care should be taken to avoid postures with fingers 'hovering' over the mouse controls. These postures require sustained contraction of the muscles of the fingers and hand, which can contribute to discomfort. Ideally, the hand should be taken off the mouse when not in use, or the hand should be relaxed and supported.

As with keyboard use, the concepts of taking regular rest breaks and micropauses apply.

Recommendations for using a mouse:

- » When using the mouse for extended periods, look to move the position of the mouse to the opposite side of the keyboard and change the hand used to operate the mouse;
- » Consider keyboard 'shortcuts' as a way of reducing and varying the time spent using the mouse;
- » Alternate between different pointing devices;
- » Ensure micropauses are built in to the work tasks.

3.4 FURNITURE AND EQUIPMENT

Furniture and equipment should be designed for use in a seated and/or standing position. The workstation itself needs to be designed to support several tasks, such as screen viewing, keyboard input, mouse use, writing and reading. Furniture design and organisation should also encourage movement so that computer users aren't regularly sitting in one position for long periods, but are able to move freely and can easily adjust their body positions. The more easily that furniture, especially desks and chairs, can be adjusted, the more easily computer users can be positioned appropriately.

There is a large range of furniture and equipment suitable for using with computers, in a range of types and styles. In order to select the most appropriate furniture and equipment, it is first necessary to assess the work environment and the type of work undertaken.

ASSESSING THE WORK

When assessing the work consider:

- » Design features of the building that restrict the positioning of workstations, such as the locations of windows that may create sources of glare, columns or pillars that would restrict access, areas with draughts, and noise from the street or corridors;
- » The best position for noisy activities/equipment. You may need to fit partitions or suitable soundproofing surfaces (ceilings, floors, walls, partitioning, furniture, machine hoods etc) to reduce noise levels;
- » Computer users or work groups that regularly interact;
- » Whether workstations will be used for regular meetings. Attaching a 'meeting end-table' to a workstation and the suitable positioning of this workstation will be important;
- » Potential changes to the work or work teams, as ideal office furniture is easily reconfigured to accommodate change;

- » Those computer users who frequently work from home or are 'on the road' and may only return to the office for parts of the day or week. Will 'hot-desks' (workstations used by different computer users) be necessary or will these computer users be allocated their own office spaces? (See page 44);
- » Whether 'hot-desking' fits well within your work culture and with your employees;
- » Whether height-adjustable workstations are appropriate and what additional space is required to accommodate them. Height-adjustable workstations make it easier to accommodate a range of different people and work practices and enable people to adjust their work postures;
- » Storage of files and other resources. Do they need to be in the immediate vicinity of the workstation or can they be located elsewhere? Storage zones away from the workstation encourage computer users to take short breaks away from their regular work tasks.

Understanding the organisational aspects of the work will assist in determining the most appropriate office layout. Understanding the tasks carried out by your computer users will enable you to select the most appropriate furniture and equipment.

ASSESSING THE TASK

When assessing tasks consider:

- » How frequently the tasks are performed (daily, weekly, monthly or annually), and give priority to those tasks performed most frequently;
- » The types of task performed. Work that involves just emailing or Internet access may only require a small workstation, whereas computer work combined with tasks involving regular reading or handling paperwork may be better suited to a larger workstation;
- » The height of the tasks. When keying, the surface of the keyboard is the effective work surface height, whereas for other desk-based tasks, such as writing, this is normally the desk surface. Using a low-profile (thin) keyboard can reduce differences in work surface height, as can adjusting the height of the chair between keying and desktop tasks;
- » What computer hardware will be used, such as the type (desktop computer or laptop) and range of equipment needed (keyboard, mouse, plug-in screen(s)). Using an alphabet-only (or split alpha/numeric) style keyboard may help to free up space;
- » Whether computer work and telephone work are carried out simultaneously. A telephone headset or hands-free system should be provided for this type of work;
- » The layout of the desktop space, to ensure that the most frequently used items are placed closest to the computer user – in the primary work zone (Figure 11);

FIGURE 11. WORK ZONES



A. Repetitive Access – Primary work zone

B. Occasional Access – Secondary work zone

C. Seldom Access – Tertiary work zone

- » Avoiding awkward working postures and over-reaching via good workplace design and equipment selection in tandem with good work habits;
- » The design and position of shelves, mobile bureaux, cabinets, lockers, carousels and other filing and archiving systems. Rather than having computer users stretch to reach heavy files, consider moving the files to a suitable location to encourage computer users to change posture and move around the work environment;
- » Personal preferences for file storage and accessibility. Taller people may be comfortable with over-desk storage of items, but some may find this difficult to access and prefer lower storage options.

SHARED WORKSTATIONS AND ‘HOT-DESKING’

Factors to consider when using shared workstations:

- » The user should be able to adjust the desk height easily, without having to move hardware off the desk;
- » The chair should have a suitable range of adjustment so it can be raised high or low enough for the comfort of all the people using it;
- » The user should be able to adjust the screen height, eye-to-screen distance and screen tilt easily, from the seated position;
- » The user should be able to adjust the keyboard position and slope from the seated position;
- » The mouse shape should be symmetrical so that it can be used easily with either the left or the right hand. Alternatively, two styles of mouse (left and right handed) should be provided;

- » There should be sufficient space on the desk so that the mouse is easily transferable from side to side;
- » If each 'hot-desk' user has a unique set of reference and file material, mobile storage units may be required. These should be stored nearby, and move easily into a suitable position adjacent to the desk;
- » When the workstations are used by several users during the course of a day, it is important that the workstation can be adjusted quickly and easily. For example, providing a support arm for the screen, rather than a riser, will allow for easy and fast repositioning.

Following these recommendations will make it easier for users of shared computer workstations to make adjustments to the set-up. If adjustment is difficult, users are unlikely to make changes, which may lead to poor working practices and postures.

TELEWORKING AND WORKING FROM HOME

The Health and Safety in Employment Act 1992 does not distinguish between computer users carrying out work in the workplace and those carrying out work for their employers from home (or other non-workplace settings). In both cases the employers are responsible for their health and safety. Computer users working from home (whether teleworkers or self-employed) need to apply the same principles as at any other workplace.

Employers should be satisfied that teleworkers are taking account of the potential hazards associated with their home work environment (or other setting), the equipment being used, and work practices. A home workplace assessment may be required. The self-employed who work from home must take responsibility for their workplace set-up and the adoption of healthy work practices. Because employers don't have direct control of teleworkers, they should ensure computer users are well trained to self-manage safe working practices.

Users of home computers for recreational, study and other non-work purposes are also encouraged to follow these guidelines for computer set-up and use. These operators may expose themselves to considerable risk of discomfort, pain and injury by working from furniture and equipment that does not fit their postural needs, for long periods of time without taking breaks, and in addition to the demands already placed on them from their employment.

PLANNING FOR NEW FURNITURE, EQUIPMENT AND HARDWARE

Moving to new premises or upgrading current premises provides an ideal opportunity for you to plan the work environment properly. This planning may include the purchase and installation of new furniture and equipment, remodelling existing equipment and layouts, and making changes in the organisation of work tasks. It is important to begin identifying your needs well ahead of moving dates, as the process of identifying new equipment and processes can take some time.

Legal obligations relating to the use of computers at home can be found in Appendix A.

Before you purchase new furniture and equipment:

- » Assess the work and tasks;
- » Draw up a purchasing checklist to identify important features of equipment design, including user requirements;
- » Determine whether any existing furniture and equipment will be re-used – it may be desirable to re-furnish or recycle office furniture. Desks can be made shorter or taller, be fitted with adjustable legs, and have old adjusting keyboard platforms fixed to provide a single flat surface. Chairs can have castors replaced and gas-lifts repaired or replaced (with shorter or taller units), and can be re-covered;
- » Consider and trial new or updated equipment, and mock up a prototype of the new workstations or workplace layout. Have your employees ‘user test’ these and provide feedback on the proposed furniture and workplace arrangement. Obtaining computer user ‘buy-in’ is likely to have benefits for improved efficiency and a reduction in the likelihood of health issues;
- » Evaluate whether the design of the equipment is suitable and appropriate for the computer users and their tasks. It may be necessary to have a number of designs to accommodate all users.

DESKS

The desk on which the computer sits plays an important role in determining working postures. Typically, there are three types of desk set-up:

- » Easy, self-adjust desks suitable for multi-users;
- » ‘Techie’ or ‘technician’ adjust desks, which are often more difficult to adjust and require assistance when being set up for the individual user;
- » Fixed-height desks, which are of a height appropriate for the individual user.

Important features of a desk include:

- » It being of an appropriate height for the user;
- » Ease of adjustment. If adjustment controls are present, they should be clearly marked and not cause injury or damage to clothing, nor should it be possible to operate them accidentally. Controls should be designed to operate smoothly and not move unexpectedly;
- » A strong and stable surface;
- » Rounded upper and lower edges and corners, to avoid injury and contact stress;
- » A surface with a light, neutral colour that is non-reflective, i.e. matt finish.

Recommended desk specifications:

Height:

Because of their important influence on work postures, desks should preferably be adjustable in height, particularly if there is more than one user. Where different operators use the desk and frequent daily adjustments are necessary, it needs to be easy to adjust the desk with all its usual equipment on it. A height-adjustable desk should:

- » Be adjustable from 610mm to 760mm from the floor to the top surface of the desk for seated work;
- » Be adjustable from 650mm to 1100mm for work performed both while seated and standing;
- » Have a minimum height adjustment range of 150mm;
- » Have step increments of no more than 25mm. A continual range of adjustment is best.

Adjustable-height desks are the most suitable design, but if you can only provide a fixed-height desk, it should:

- » Be between 680mm and 735mm or at the correct height for the user.

Width:

The desktop should be wide enough for the user to perform all routine tasks comfortably. If use of the desk is restricted solely to computer work, it should have a minimum width of 1200mm. Where work includes writing and reading, the width should be at least 1600mm.

There are some situations where equipment configurations and their design allow for the use of narrower desks. For example, some desks come with a keyboard 'garage', which allows the keyboard to be put away while reading and/or writing tasks take place.

Depth:

The desktop should be deep enough from front to back to contain all the computer equipment and allow for good working postures. If the computer has a liquid crystal display (LCD) flat-panel screen, we recommend a minimum depth of 800mm. For cathode ray tube (CRT) screens, a minimum of 950mm is needed. Large CRT screens may require more space.

The ultimate test of a suitable desk dimension is whether the desk fits the user and the tasks being carried out by the user. For some individuals the desk will need to be taller or shorter than the dimensions stated.

'Selection and design of furniture and equipment requires a fit to be achieved between a range of task requirements and the needs of users. The concept of fit concerns the extent to which furniture and equipment... can accommodate individual users' needs.'

ISO 9241-5:1998

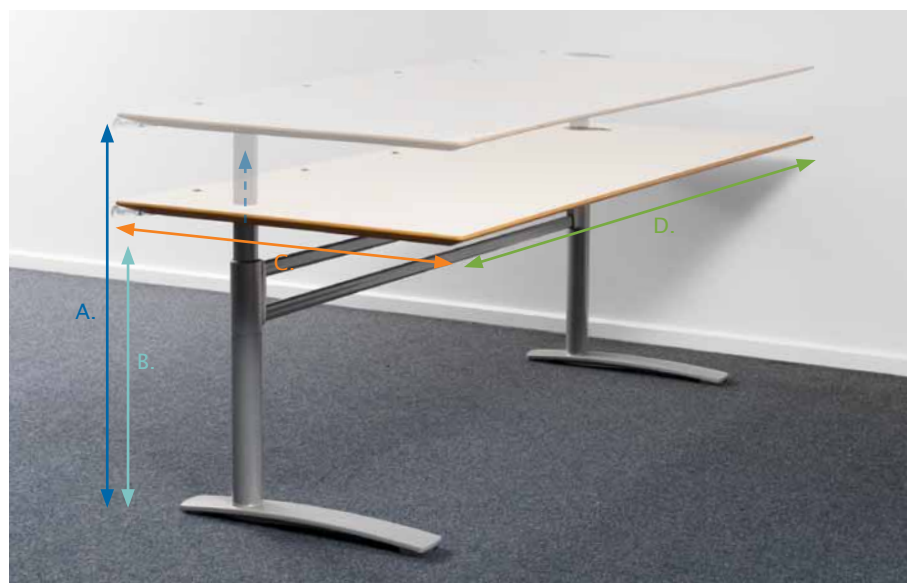
It is important for a work table to permit the user to adopt different postures. TCO'04

Desk dimensions are based on recommendations in AS/NZS 4442:1997. Some international bodies have suggested work surface heights as low as 560mm (ANSI/HFES-100 2007) and as high as 1250mm (TCO'04).

‘The work surface area should be adequate for the tasks to be performed at the desk. It should be large enough to accommodate a screen, keyboard and associated equipment and leave sufficient room for writing and for resting of hands and arms.’ AS/NZS 4442:1997

Test methods and guidelines for the strength and stability of office desks can be found in AS/NZS 4442:1997.

FIGURE 12. RECOMMENDED DESK SPECIFICATIONS



- A. 650 to 1100mm** adjustable for both seated & standing work
- B. 610 to 760mm** adjustable for seated work only
- C. 800 to 950mm** 800mm minimum for flat screens, 950mm minimum for CRT screens
- D. 1200 to 1600mm** 1200mm minimum when used solely for computer work, 1600mm minimum when used in combination with reading and writing

Strength and stability:

Desks must be strong enough to support the weight of equipment placed on them. It is important to check the load-bearing capacity of the desk when purchasing or setting up a workstation.

The positioning of equipment on the surface of the desk and forces applied to the desk by the users should not lead to instability. Keyboard platforms and/or pull-out trays fitted to some desks can lack strength and stability, or be prone to failure from repeated use.

Desk shape:

Corner workstations or 'L'-shaped desks can make effective use of space. These desks are often placed in the corners of rooms and consist of a central section joining two desk surfaces that are set at right angles to each other. When using these desks, the computer should be placed in the central section of the desk because it is often the only part of the desk that provides the necessary depth to accommodate a computer.

You need to be careful when selecting corner workstations, as their design often makes them more difficult to adjust. Some corner workstations don't have any central 'corner in-fill' and this can make it difficult for users to work comfortably at them. A 'desk-bridge' (an in-fill that goes across the internal right angled corner) can make these desks easier to use.

Desktop thickness:

The desktop should be as thin as possible without compromising strength and stability. The thickness of the work surface, including any supporting structure, should not exceed 33mm.

Leg space:

Ample leg space is needed under the desk to allow movement for postural changes and comfort and the ease of use of computer equipment and associated tasks, for safety and for ease of standing and sitting. There needs to be enough room so that mobile storage units don't protrude from the front of the work surface. If kept under an adjustable desk, mobile storage units must not restrict height adjustment or interfere with the computer user's ability to position and move their legs.

Leg space should be unrestricted and have a minimum:

- » Knee width of 650mm;
- » Depth of 450mm just below desktop;
- » Depth of 600mm at 120mm above the floor;
- » Toe space clearance of 120mm between the bottom of the modesty panel and the floor, for the feet;
- » Knee space height (fixed-height desks) of 650mm.

FIGURE 13. RECOMMENDED LEG ROOM



A. Modesty panel

B. 120mm Toe space clearance between the modesty panel and the floor

C. 650mm Knee height (fixed height desk)

D. 650mm Knee width

Clearances under work surfaces should take into consideration: postural change (standing and sitting) and comfort; the ease of use of computer equipment and associated tasks; and safety.' ISO 9241-5:1998

The height of a standing workstation is based on recommendations in AS/NZS 4442:1997. For standing, it is recommended that the desk be close to standing elbow height. Some international bodies have suggested work surface heights up to 1250mm (ICO'04).

Keyboard platform

Keyboard platforms have been a popular means of providing some desk adjustability. However, their use is declining owing to:

- » Difficulty in accommodating the mouse and keyboard at the same level;
- » Non-uniform work surface limiting the range of desk use options;
- » A tendency to mechanical failure;
- » The mechanism interfering with leg and knee positions.

Preference is for the entire desk surface to be height adjustable. However, in some situations a keyboard platform may be suitable. If a keyboard platform is provided, it should:

- » Be large enough to accommodate both a keyboard and a pointing device, such as a mouse;
- » Provide sufficient leg and foot clearance – a knee space height of 650mm is recommended;
- » Have supporting mechanisms that protrude no more than 80mm into the knee space;
- » Be vertically adjustable within a 120mm range under the desk;
- » Be adjustable in tilt;
- » Be free from sharp edges.

Pull-out keyboard trays

Space-saving, pull-out keyboard and mouse trays may be suitable for occasional home use where space is at a premium. However, they should not be considered suitable as a permanent workstation owing to the:

- » Often restricted height adjustability of these units;
- » Often unstable work surfaces;
- » Reduced distance between the user and the screen;
- » Restricted options for repositioning the screen;
- » Limited space available for the user's legs and feet.

Modesty panel

This is a panel located at the front of the desk to provide the computer user with privacy below the work surface. If a modesty panel is fitted it should:

- » Finish no higher than 400mm from the floor when the desk is in the highest;
- » Not interfere with adjustments of desk height.

When standing to work

For standing workstations:

- » The height of the work surface should be at approximately elbow height;
- » Where the height of the work surface is adjustable, a range of adjustment between 900mm and 1100mm above the floor is recommended. In certain circumstances (e.g. for tall individuals) elbow height will be above 1100mm. In such cases, some standards suggest that up to 1250mm is appropriate.

CHAIRS

You should provide adjustable chairs for computer use so that different users can get comfortable and adopt a range of different postures. You may need to make special provisions in particular circumstances, for example for pregnant women, people with disabilities, obese people, people with a history of back problems, and very short or tall people.

Important features of a chair include:

- » Adjustable seat pan height, seat pan angle, backrest angle and backrest height. Users should be able to operate the controls easily when sitting;
- » Good support for the lower back. This requires a suitable backrest and a seat pan that is not too deep. Back support should minimise loading on the spine and maintain a modest degree of curvature to the lower back with minimal muscular tension;
- » No restriction to circulation in the back of the thighs from the seat pan;
- » Support for feet. The user's feet must not be unsupported or hanging, but be able to either rest comfortably on the floor or be supported by a footrest;
- » A swivel range of 360°;
- » A stable five-base support;
- » An overall design that is comfortable and requires minimum muscular effort to maintain and change the posture;
- » Cushioning that is soft enough to be comfortable, but firm enough to provide support for a variety of postures. Fabric should allow heat and perspiration to escape and have a medium level of friction. For this reason, we don't recommend the use of vinyl, although this may be the best choice where hygiene and cleaning are important (e.g. hairdressing chairs);
- » Fabric covering and castors that minimise static charge (the right carpets and suitable humidity levels will also help);
- » No sharp edges.

Recommended chair specifications:

Height:

Seat height refers to the level of the under surface of the thigh behind the knee (plus the thickness of any footwear). The height adjustment of a chair should accommodate a range of at least 420mm to 515mm. To cater for people of widely differing heights, this range may need to be as much as 370mm to 560mm. Height adjustment for any one chair is typically limited to 125mm, so you may need to provide chairs with different ranges of adjustment.

Seat pan depth:

The seat pan should allow a comfortable leg and back posture and should be less than the distance from the back of the buttock to the back of the knee. The adjustment to seat pan depth should accommodate a range between at least 380mm and 480mm, although small people may require shorter seat pans.

'Proper seat height(s) ensure the comfort of the lower limbs by avoiding pressure on the underside of the thigh caused by a seat pan that is too high, or decreased thigh-to-torso angle if the seat pan is too low. Seat height is also important in setting the hand position and, given that it dictates sitting eye height, is a critical factor in determining line of sight.'
BIFMA G1-2002

'The range of seat height adjustment needs to cater to the intended user population. Allowances should be made for footwear and variations in sitting posture.'
BIFMA G1-2002

The height of the chair should allow the user to sit with their feet comfortably on the floor without undue pressure on the underside of the thighs and allow for the range of seated reference postures. Whilst the minimum range of adjustment (420mm to 515mm) is based on recommendations of AS/NZS 4438, some international bodies have suggested seat heights as low as 380mm and as high as 560mm.
ANSI/HFES-100 2007

'Adjustable seat depth can be achieved either by adjusting the back rest in relation to the seat or by moving the seat pan in relation to the back rest.'
ISO 9241-5:1998

‘The angle of the seat pan should allow the user to support their feet on the floor or footrest. Seat pan angles should not cause the user’s torso-to-thigh angle to be less than 90 degrees.

Forward seat pan angles should not cause users to shift excessive weight to their feet or experience the sensation of sliding out of the chair.’

BIFMA G1-2002

Seat pan width:

The seat should be wider than hip breadth and allow space for movement and clothing. The seat width should not restrict the ability to use the armrests comfortably. The recommended minimum seat pan width is 400mm.

Seat pan angle:

The seat pan should be adjustable in angle between at least -7° and $+3^{\circ}$. To accommodate a range of different seated postures, adjustability of between at least -7° and $+10^{\circ}$ is recommended. The front edge of the seat pan should not interfere with the back of the thighs and calves. A ‘waterfall’ (downward curved) front edge is recommended.

FIGURE 14. RECOMMENDED CHAIR SPECIFICATIONS

Back Rest Angle 25° backwards to 5° forwards

Seat Pan Angle -7° to $+3^{\circ}$



A. Seat Pan width 400mm minimum recommended

B. Seat Pan Depth 380 – 480mm recommended

C. Back Rest Width 360mm minimum recommended

D. Back Rest Height 170 – 230mm minimum recommended

Backrest height and adjustability:

The backrest should fit the natural curve of the spine and should be adjustable to suit the individual. A low-level back rest should start at a level that clears the major projection of the buttocks. It should provide maximum supporting contact in the middle of the lower back and not limit upper body movement.

The overall length (height) of an adjustable backrest (Figure 14) should be greater than 220mm, although higher backrests are common and generally preferred. The distance through which the height of the backrest can be adjusted is best defined (although not absolutely correct) as being from the seat pan to the centre point of the low back support area. A range of adjustment between at least 170mm and 230mm above the seat pan is recommended.

Backrest width:

The backrest should not interfere with the elbows or restrict rotation of the upper body. The minimum recommended width is 360mm, but note that some slender people may find this unsuitable.

Backrest angle:

The backrest angle should be adjustable to suit the individual. The angle between the seat and back should allow the user to achieve a torso-to-thigh angle of at least 90° and should be able to adjust rearward of the vertical. Adjustment of the backrest that is independent of the seat pan is preferred.

Armrests:

Armrests are generally not required for most computer tasks and in some instances they can lead to problems if they are not suitable for the task, the user or the workstation. For example, armrests can prevent the user moving close to the desk or encourage the user to adopt awkward postures.

Potential benefits of armrests are that they can provide support for the upper body and allow for changes in posture. If armrests are considered appropriate, they should be:

- » Adjustable by the user;
- » Designed so that the chair can be drawn up to the desk. They can be set back from the front of the chair or set low, or both;
- » Far enough apart and low enough so as not to interfere with the elbows;
- » More than 460mm apart (inside distance between armrests);
- » Removable and free from sharp edges;
- » No more than 350mm in front of the seat backrest;
- » Adjustable in height and width.

‘The height of the backrest is posture dependent. For tasks that involve upper body mobility, the backrest should provide adequate support but not interfere with movement. For users who prefer to recline, the backrest should provide support for the shoulders.’ BIFMA G1-2002

‘The width of the backrest should provide adequate support for the curvature of the user’s back without causing localised pressure points.’ BIFMA G1-2002

‘The movement of the seat pan and the back support should allow users to vary their posture to suit user comfort and changes to task requirements.’ ISO 9241-5: 1998

‘The height of the armrest should allow users to sit in a variety of postures while supporting their forearms and/or elbows in a manner that avoids lifting the shoulders or leaning to the side to reach the armrest.’ BIFMA G1-2002

‘The length of the armrest is important because it affects the user’s proximity to the work surface.’ BIFMA G1-2002

FIGURE 15. RECOMMENDED ARMREST SPECIFICATIONS



A. Removable and free from sharp edges

B. Armrest Width Wider than 460mm

Strength and stability

Consideration should be given to both the strength and the stability of chairs that are used for computer tasks, particularly those chairs used at shared/‘hot-desking’ workstations. They should also be considered in the trial and evaluation process that precedes any purchasing decision.

As chairs are likely to be used by a range of people in the course of their design lives they need to be strong enough to carry people of varying heights and weights comfortably.

Stability is another important safety issue. Two actions with which to test chair stability are moving in the chair around the workplace and adjusting the backrest angle, particularly for taller people.

Castors

The type of castor on the chair should suit the properties of the floor surface and the nature of the task. It is generally preferred that a chair remains mobile when occupied, but does not move easily when a user is sitting in the chair, or getting on or off the chair. It is important to test the chair on your office flooring to ensure that it meets your needs.

Soft-wheeled castors are usually suitable for hard floor surfaces, and act to soften the noise of castor movement as well as reduce the ‘hardness’ of the ride. However, on soft floor surfaces they may make the chair difficult to move.

Hard-wheeled castors will be more suitable on soft floor surfaces such as carpet, but when used on these surfaces it is important to ensure that the diameter of the castor is large (up to 60mm).

Specialist castors are available that either lock or unlock when weight is on the chair. Castors with small brake levers are another option.

Test methods and guidelines for the strength and stability of height-adjustable swivel chairs can be found in AS/NZS 4438:1997.

‘Chair castors and flooring interact with one another to affect the mobility and safety of seated operators.’ ANSI/HFES-100 2007

‘Regular maintenance of castors is critical for continued acceptable performance.’ ANSI/HFES-100 2007

A hard-surfaced 'chair mat' under the castors of the chair can make it easier to move on carpeted surfaces. In some situations (such as on concrete or wooden flooring) a chair mat will soften the ride and reduce the noise of castor action when the chair is moved.

Glides are an alternative to castors. These wheel-less castors may be most suited to tasks where a taller 'architectural height' chair is used. Glides prevent the chair moving when the user is reaching for tasks or applying forces such as stapling, or hole-punching.

If you have problems stabilising the chair when carrying out tasks, alternative castors or alternatives to castors should be considered (or change how you do the task).

Alternative seating

A range of alternative seating options enables computer users to sit in a way that is thought to reduce pressure on the lower back, or may be more suited to a particular work task or workstation. Some people may have a preference for these alternatives. Examples are the:

- » Kneeling chair;
- » 'Swiss ball', 'Physio ball' or 'fit ball';
- » Sit-stand or 'architectural height' chair;
- » Perching stool;
- » Saddle chair;
- » 'Executive chair'.

Alternative seating options may not necessarily be better than the conventional office chair and may introduce new hazards for the computer user or those around them. For this reason it is important to assess the risks associated with the use of these chairs before you purchase them.

While some types of alternative seating do provide adjustments and include support for the back, the common problems often associated with these types of seat are:

- » They may not provide the best support for long periods of sitting;
- » Most models do not provide lumbar support. The back and abdominal muscles are required to work harder to maintain an upright posture and fatigue and discomfort of these muscles may result;
- » The seat may not be adjustable to accommodate different leg lengths or seat angles;
- » Getting on and off the chair can be difficult;
- » They may restrict movement around the workstation or present a tripping hazard.

The decision as to whether alternative seating options are used should be made jointly by you and the computer users who will use them.

'Architectural height' chairs are standard chairs on tall gas-lift bases that are typically used by tellers or counter staff at standing workstations. They should only be used with an adjustable foot-ring and/or a footrest of a suitable height.

The workstation should be set up to allow the feet to be placed flat on the floor. Only when a chair height has to be set that does not allow the user to rest their feet flat on the floor should a footrest be used.

‘The height of the footrest should allow the user to sit with their feet comfortably on the footrest without undue pressure on the underside of the thighs and allow for a range of seated postures.’ ISO 9241-5 pg21

FOOTRESTS

A footrest can be an additional support to obtain a comfortable leg and foot position, and a means to create variations in working postures. Where the desk and chair cannot be adjusted to provide optimum comfort, a footrest may be useful. Footrests help ensure proper posture. The support they provide affects the posture of the entire body, including the lower back and neck.

Be aware that wearing high-heeled shoes may affect a user’s ability to obtain a comfortable foot posture when using a footrest.

Important features of the footrest include:

- » Good stability;
- » Sufficient friction so that it does not slide easily on the floor;
- » A flat upper surface that is non-slip;
- » A weight that makes repositioning easy when required;
- » Easily adjustable slope and height.

Recommended footrest specifications:

Size:

The footrest surface should be large enough to allow the user to vary their foot positions. The recommended minimum dimensions are 350mm deep by 450mm wide. The footrest width may need to increase when used with larger work surfaces.

Height:

The footrest should be adjustable in height. A minimum range of height of adjustment of 0mm to 160mm is recommended for seated work. If fixed in height, the footrest should be suited to the person at that workstation. When a person is seated at a high bench, a height adjustment range of 135mm to 450mm is recommended. If the adjustment mechanism uses set steps, each step should be no more than 50mm.

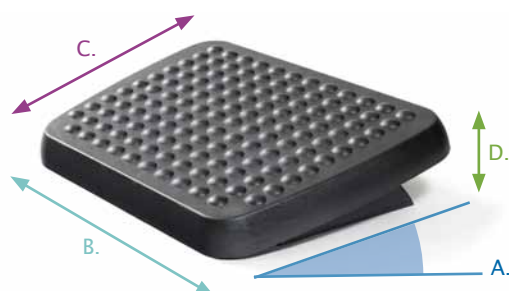
Slope:

The footrest slope should be comfortable for the user. The angle of the slope should be adjustable between 0° and 15°. Each step in slope angle adjustment should be no more than 4°.

Adjustability:

Computer users should be able to adjust their footrests while they are seated, preferably using their feet. The height and slope should be adjustable independently.

FIGURE 16. RECOMMENDED FOOTREST SPECIFICATIONS



- A. Foot Rest Slope Comfortable for the user, adjustable between 0° and 10°
B. Foot Rest Width 450mm minimum recommended
C. Foot Rest Depth 350mm minimum recommended
D. Foot Rest Height Adjustable range of 50mm – 185mm recommended for seated work

DOCUMENT HOLDERS

The primary purpose of a document (or copy) holder is to allow the computer user to view documents without twisting or bending the neck. Some document holders also double as a temporary work surface for documents that must be written on or stamped when processing, and others act as a positioning device for laptop or notebook computers. The document holder therefore needs to be carefully selected to be suitable for the required range of tasks.

For document viewing the optimal position of the document holder is between the keyboard and the screen. This eliminates any need to turn the head away from the midline, and places the document at an angle where enough light falls on it to make reading easy. Alternatively, if reference documents are only lightweight they can be positioned immediately to the side of the screen, although care must be taken to ensure that the higher copy position is not affected by background glare or contrast, or background activity that is visually disturbing.

General recommendations for a document holder:

- » Large enough to support the documents placed on it and preferably 10mm smaller than the size of the documents to allow easy access to the documents;
- » Stable in all positions and able to support the weight of any items placed on it, without loss of the set position;
- » Adjustable in both angle and distance to allow for documents that are harder to read and differences in individual user requirements;
- » The surface of the document holder and any attachments, such as a ruler, should have a matt finish.

Document holders that must also act as work surfaces are required for a range of tasks. These combination copyholders, often referred to as 'microdesks' or 'keyboard garages', usually allow the keyboard to slide under the front edge of the document holder, allowing more room in front of the operator. Some are angle adjustable and some are height adjustable. Care must be taken to avoid using the upper work surface for long periods of activity as this may lead to unfavourable postures.

'The document holder reduces the amount of head, neck and eye movement required when scanning between different visual objects.'
ISO 9241-5:1998

FIGURE 17. EXAMPLES OF DOCUMENT HOLDERS



TELEPHONE HEADSETS

Headsets are useful for computer users who need to talk on the telephone and use the keyboard at the same time. Both hands are left free to operate the keyboard and other input devices, and to handle paperwork.

The use of a headset eliminates any need to cradle the telephone handset between the ear and the shoulder, which can lead to physical discomfort in the neck and upper shoulder. This practice is particularly problematic for mobile phone users owing to the increasingly small and slim design of mobile phones.

Each user should have their own headset. Note that ear cushions, ear buds and voice tubes can be replaced when an old headset is given to a new user.

Many types of headset are available and the user's preference should be taken into account when selecting one. Models may be:

- » Single or double ear;
- » In ear (earplugs, ear buds or ear tips, with or without over-ear hooks);
- » Over-ear (cushioned earpieces, with ear hooks, overhead bands or neck bands);
- » Wired or wireless (Bluetooth).

Many of the modern styles are suitable for a wide variety of equipment, including iPhones and other mobile phones, iPods, MP3 players and computer equipment.

When selecting a suitable headset, it is important to consider all aspects of the work, including communication with colleagues and the need to hear important alarm signals, such as fire alarms.

Speakerphones are an option for some phone users where background noise and interference to or from adjacent computer users are not an issue. Speakerphone solutions include landline options and other 'hands-free' technology.

Technical advice should be sought to identify the most appropriate solution for your telephone headset needs.

3.5 THE COMPUTER HARDWARE

SCREENS

Types of screen

Two kinds of screen are available: the newer LCD flat-panel screen and the older CRT screen.

FIGURE 18. EXAMPLES OF LCD AND CRT SCREENS



LCD screens have certain benefits when compared with CRT screens:

- » LCDs take up less desk space than CRT screens and are easier to adjust owing to their smaller footprint, lighter weight and decreased bulk;
- » Flat LCD screens are less susceptible to glare than the generally convex CRT screens;
- » LCD screens are not affected by flicker or 'swim';
- » LCDs increase the total screen viewing area – there is no loss of image quality at the boundaries of the screen as there can be with CRT screens;
- » LCDs use less power and produce less heat than equivalent CRTs;
- » LCDs provide better screen privacy as they have a narrower viewing angle than CRT screens.

Although LCD screens are generally considered better than CRT screens, some LCD screens, particularly older models, may have some limitations:

- » Moving images may be displayed at a slower speed, which can distort images;
- » Screen contrast ratios may be lower than in CRT screens;
- » Colour may be less accurate than in CRT screens.

Therefore certain users, such as graphic designers, may prefer the superior colour accuracy, response time and quality of CRT screens.

‘Older people can experience a number of complex age effects on their eyesight, not all of which are presently understood. For older people, avoid low contrast, low background luminance and small character sizes.’ ISO 9241-303:2008

Important features of a screen include:

- » A screen size that is appropriate to the requirements of the individual user and the task being performed. For example, employees involved in graphics or design work may require larger or dual screens;
- » Easily adjustable positions, including height, swivel and tilt, so that the user can maintain a comfortable work posture and reduce sources of glare and reflection;
- » Easily adjustable brightness and contrast. These settings may need to be adjusted in response to the variability in workstation illuminance throughout the day;
- » Sharp and clear screen images;
- » No perceived flicker or jitter of the display image;
- » Easily readable characters;
- » A screen surface that is clean and dust free.

Recommendations for computer screens:

Choice of polarity

A positive polarity display (dark characters on a light background) is best for most computer tasks. Positive polarity produces sharper characters and reduces reflections. For users with poor eyesight or when flicker is a problem, a negative polarity display (light characters on a dark background) may be preferable.

Choice of colour

Certain colour combinations of characters and characters versus backgrounds should not be used when viewed for extended periods of time. Some colour combinations may place excessive strain on the retina of the eye and are likely to cause discomfort. Colour combinations likely to cause problems are:

- » Saturated blue used with saturated red;
- » Saturated yellow used with saturated violet;
- » Saturated yellow used with saturated green.

Image stability

To reduce screen flicker in CRT screens, you should set the screen display refresh rate as high as possible (85 Hz or higher is recommended). Usually you can adjust this through the display screen settings. Also ensure screens are isolated from electrical equipment, such as other screens, mobile phones and mains electrical wiring that may distort the display image and affect its legibility.

SCREEN PLACEMENT

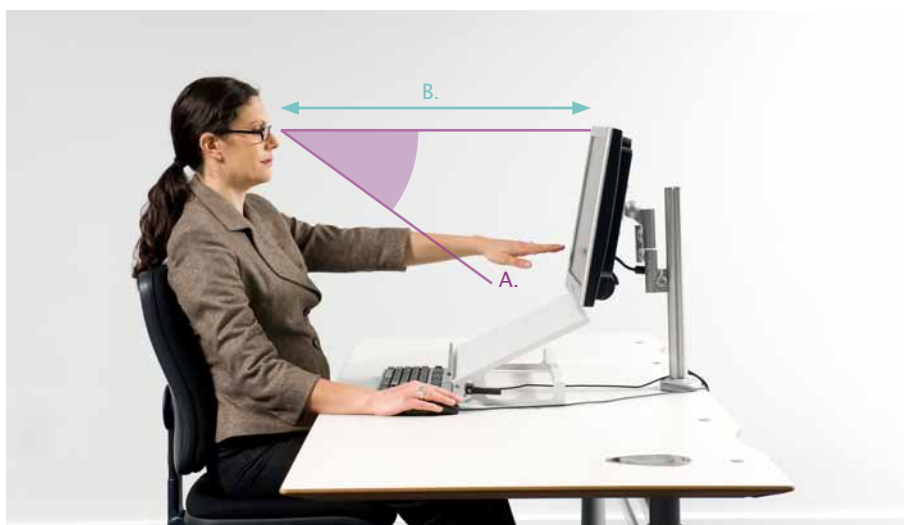
There are a number of factors to consider relating to screen placement:

Height (vertical placement)

Eyes are more comfortable with a downward gaze for near work, so a low screen is better for the eyes and neck than a high screen. Make sure that:

- » The top of the screen is at or below eye level;
- » The viewing angle of the screen is between 0° and 65° below the horizontal eye level (Figure 19). No part of the screen should fall outside this viewing angle.

FIGURE 19. RECOMMENDED SCREEN HEIGHT, DISTANCE AND VIEWING ANGLE



A. Monitor Height Viewing angle of screen is between 0° and 65° below horizontal eye level

B. Monitor Distance At least 500mm from eyes

For spectacle wearers

Bifocal, trifocal and progressive lens wearers tend to view the screen through the lower part of their glasses. This often means they tilt their heads back to see the screen, which can result in undue strain being placed upon the neck. This may be problematic when using larger screens. For this reason, it may be beneficial for them to:

- » Replace a large screen with a smaller screen;
- » Place their screen lower to obtain a comfortable viewing angle;
- » Bring the screen closer and adjust the viewing angle;
- » Consider using single-vision lenses with an appropriate focal length for their computer work.

Screen risers and monitor arms

You may need to provide screen risers to achieve a comfortable viewing height if the screen itself is not height adjustable. Users need to be able to adjust screen risers easily while sitting.

‘A number of viewing conditions are important for achieving fast, error-free and comfortable viewing. These include the viewing distance and direction, and the required gaze and head tilt angle.’ ISO 9241-303:2008

You can use monitor arms to allow for the adjustment of computer screens. They may be particularly useful when there is limited space on the desk or at a shared workstation where regular repositioning of the screen may be necessary. If you provide a support arm, make sure it is easily adjustable, mechanically stable and will allow the screen to be viewed at an appropriate distance and angle for each user.

FIGURE 20. EXAMPLE OF A MONITOR ARM AND A SCREEN RISER



Horizontal placement

The ideal horizontal position for the screen is directly in front of the user so that their head, neck and torso are not turned to one side. This prevents the user placing unequal strain on one side of the body. However, users working primarily from a printed document can instead place the document directly in front of them, and position the screen slightly off to the side. For tasks involving this type of work, it is recommended that:

- » The screen and document are positioned as close as possible to each other;
- » The screen(s) is not placed more than 35° to the left or right of the user.

Eye-to-screen distance

The best viewing distance depends on a number of factors and varies from user to user. The eyes struggle to converge and focus on objects that are too near, particularly if the object is at eye level or above.

- » Position the screen between 400mm and 750mm away from the eyes of the user. Many users may find larger viewing distances more comfortable;
- » Place the screen at a distance at which the user can easily read the displayed text. If the user prefers a greater viewing distance, increase the text size or zoom, e.g. from 100% to 150%.

‘The viewing distance is dependent upon the task and the visual display and should not be less than 300mm. For visual displays used in offices, a longer viewing distance (400mm to 750mm) is recommended as this leads to less strain on the eyes and allows greater freedom to move the head.’
ISO 9241-303:2008

Tilt

The height and tilt of the screen should be easily adjustable to maintain an appropriate viewing angle. The bottom of the screen should be slightly closer to the user's eye than the top as our eyes are accustomed to higher objects being further away. The degree of tilt will always depend on the height of the screen; for example, a tilt greater than 15° will be necessary if the user likes a particularly low screen.

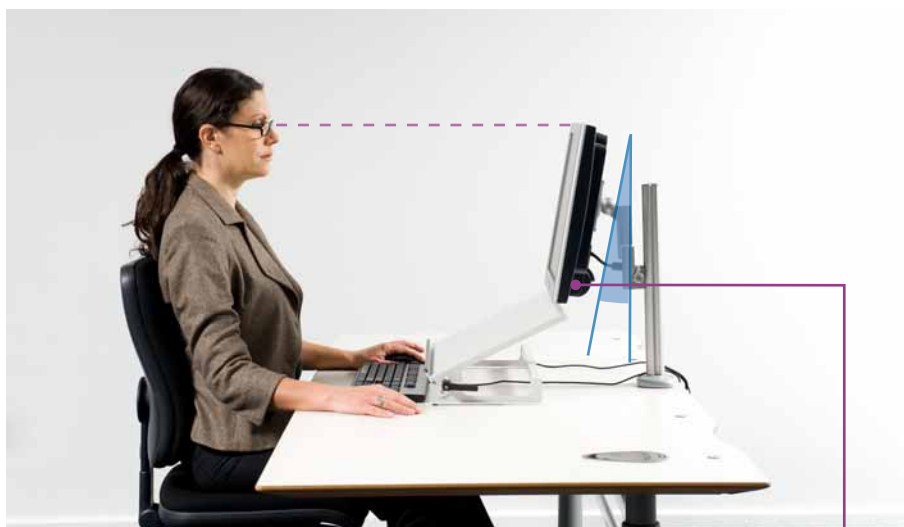
Note that tilting the screen forward to avoid glare problems on the screen is not an acceptable solution to lighting problems. It is recommended that:

- » CRT screens have a minimum tilt adjustability of 0° to 15°;
- » LCD screens have a minimum tilt adjustability of 0° to 20°;
- » The top of the screen not be closer to the user's eye than the bottom;
- » Tilt be adjusted together with the height of the screen.

Swivel

The screen should swivel from side to side at least 45° in each direction.

FIGURE 21. EXAMPLE OF SCREEN TILT



The bottom of the screen should be slightly closer to the eye than the top

MULTIPLE SCREENS

Increasingly, people use two screens in their normal work. In some specialist work environments (e.g. control rooms), several screens may be used. Two or more screens are often useful when the person uses multiple software applications at the same time, helping to segregate work between screens and reduce the number of mouse operations. Multiple screens may also be used when people work together in groups.

‘For text input with only little numeric input a keyboard with full-size alphanumeric section but without a numeric section is appropriate because it facilitates a more relaxed and neutral mousing position.’ ISO 9241-410:2008

Two or more screens are usually better than one large screen and often prove to be more cost effective. When using two or more screens, determine how much time is spent on each screen as this will affect how they are positioned. For screens that are used for the same amount of time, screens should be placed directly in front of the person and as close as possible to each other. Screens that are referred to less frequently (e.g. alarm monitoring) can be placed further to the side, with the primary screen(s) placed central to the person.

Recommendations when using multiple screens:

- » Minimise the gap between screens to ensure a seamless flow between them;
- » Screens should be wrapped around the user in a semi-circle so that the distance between the user and screens is kept relatively constant;
- » Unless there is a large number of screens they should be positioned horizontally around the person rather than stacked vertically;
- » The distance of the screens from the person and the height of the screens should be the same as for one screen;
- » Consider adjusting the font size of the text.

When working in groups, you should agree on the position and adjustment of the screens for the different people and agree on the uses and positions of the keyboard and mouse.

KEYBOARD

Important factors to consider when using keyboards are their design and placement, as well as the postures and techniques the user adopts. The keyboard should allow the user to work with maximum possible comfort and efficiency.

Types of keyboard

The conventional keyboard is rectangular and flat, with alphabetic, numeric and other function keys laid out in a fairly generic way. Older ‘standard’ keyboards may be thicker (deeper) and angled so that the rear of the keyboard is considerably higher than the front of the keyboard.

Important features of a keyboard include:

- » Keyboard thickness of no more than 30mm at the ‘asdf...’ row of keys;
- » An adjustable slope within the range of 0° to 15°;
- » Keys with a matt finish to prevent reflections from overhead lighting;
- » Key tops with concave or flat strike surfaces;
- » Good stability so that the keyboard does not move during use;
- » Keys with easily legible characters;
- » Appropriate key pressure – not so firm that the user’s fingers tire when typing for long periods, or so light that it is too easy to depress a key in error;
- » A feedback mechanism to indicate when the keystroke is successful – such as a ‘click’;
- » The same spacing of adjacent keys on keyboards used for fast or continuous input.

A key separation (the distance from centre to centre of adjacent keys [centreline spacing]) of 19mm is typical for most keyboards and considered suitable for most adults. Certain users with special needs or keyboards used in certain environments (e.g. cold environments where protection equipment is worn) may require greater distances between keys. Keyboards used by children or females with small hands may require smaller distances between keys (12mm to 14mm), as is often the case with portable or handheld devices with integrated keyboards.

A number of alternative keyboards designed to promote neutral wrist and forearm positions are also available. The suitability of the different keyboard styles will depend on the individual user and the nature of the work tasks. Computer users suffering from physical conditions may benefit from trialling alternative keyboards, or even considering software options such as voice-recognition software.

The keyboard is not the only factor affecting wrist, forearm and shoulder posture. Other important factors include desk and chair height, along with the positioning of the keyboard on the work surface and how the work is organised. These will affect posture regardless of whether a conventional or alternative keyboard is used.

Split and rotated keyboards

Split and rotated keyboards (such as in Figure 22) may suit touch-typists or those carrying out intensive keyboard work. They may particularly suit those with broader shoulders who feel cramped using regular keyboards, as the wider and angled key arrangement allows them to work with their arms and hands in a more relaxed position.

Some (usually shorter) computer users may find that split and rotated keyboards that are very thick in the middle section force them to work with their shoulders elevated. A working posture with this sort of tension is not recommended. Many users find that these keyboards reduce fatigue and discomfort as a result of the alternative work position, but it is important that they are selected for good fit with the user and work tasks.

Separate alphabetic and numeric keypads

Separate alphabetic and numeric keypads may suit computer users with certain task demands. The smaller size of the alphabetic-only keypad may benefit some operators in some situations. Those doing intensive numeric data entry – whether intermittently or consistently – may find that the separate numeric keypad allows them to work more comfortably and efficiently.

Examples of situations where separate keypads can be used effectively are:

- » Users with high demand for the work area on the right of the keyboard and very little use for the numeric pad. These users may find a smaller alphabetic keypad with the numbers in the upper row adequate for their purpose;
- » Putting the numeric keypad out of the way for the three weeks of the month when no numeric data entry work is done;
- » Moving the alphabetic keypad out of the way to allow paperwork to be positioned immediately next to the numeric keypad for intensive numeric entry tasks;

‘The most important property of keyboards for accommodating the anthropometric characteristics of a user population is the centreline spacing, i.e. the distance of adjacent keys measured from centre-to-centre.’
ISO 9241-410:2008

- » Allowing both left- and right-handed operators to select their preferred work positions for numeric data entry;
- » For laptop or notebook users who wish to take separate keyboards with them for optimum positioning when working out of the office, slim alphabetic keypads may be the most practical.

FIGURE 22. EXAMPLES OF KEYBOARDS



Conventional keyboard

Split keyboard

Other keyboard features

There are a wide variety of keyboard layouts and labelling. Some keyboards are suited to specific computer activities or specific users. These might include those with low vision, users who are children, and disabled users with specific needs.

Recommendations for keyboard positioning:

The position of the keyboard on the work surface is important as it influences the posture of the entire body. The keyboard should be central, and close enough to the user so they don't have to reach forward to use it. It should be usable with a relaxed and 'neutral' posture.

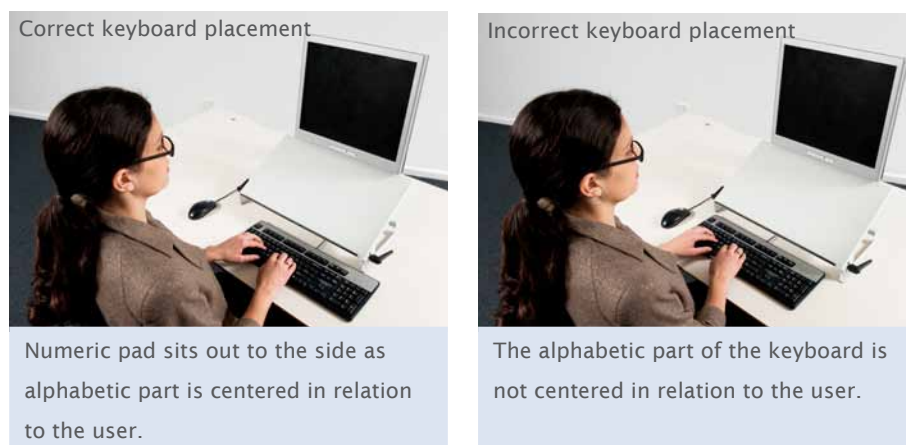
It is recommended that:

- » The alphabetic section of the keyboard be positioned directly in front of the user. The 'g' and 'h' keys are usually considered the centre of the keyboard, and these should be aligned to the midline of the body (in front of the nose);
- » The keyboard be at or just below elbow height when the shoulders are relaxed and the arms are hanging by the sides. This is dependent on the chair and desk set-up;
- » There be a minimum of 150mm between the keyboard space bar and the front edge of the desk so the user can rest their hands and forearms between keystrokes. This should span the width of the keyboard and may be occupied by a hand-rest (some keyboards have attached hand-rests);
- » Keyboard slope should allow the user to adopt a neutral wrist position when typing. A slope of 0° is generally preferable to a 15° slope as it may reduce upward bending of the wrist.

Most flat keyboards are provided with small rear 'legs' that can be clicked into position to provide an angled keyboard, or be left flat. Some keyboard users may even find that they are more comfortable working with the keyboard sloping away from them (a negative slope). A hand-rest is usually provided at the level of the spacebar.

Provided this set-up is used correctly, it may further help to reduce bending at the wrist. Note that the way the user is sitting may alter the keyboard slope needed for a neutral wrist position. In a reclined sitting position, a flat or slightly positive slope may be required to keep the wrists in a neutral position.

FIGURE 23. EXAMPLES OF KEYBOARD POSITIONING



MOUSE AND OTHER POINTING DEVICES

For many computer users, muscular pain and discomfort is often attributed to the use of a mouse or similar pointing device. The design of the device, the placement of it on the work surface and the technique adopted by the user (e.g. the tightness of the grip) are all important factors you need to consider. Users should be encouraged to reduce their use of pointing devices as much as possible.

The type of pointing device used will be dependent upon the task and user preference. Research suggests that the performance and accuracy of the pointing device change according to the type of pointing device used.

'Input devices should be operable by the use of either hand; alternatively, right and left-handed devices should be available.' ISO 9241-410:2008

When using a mouse, care should be taken to avoid postures with fingers 'hovering' over the mouse controls as these postures require sustained contraction of the muscles of the fingers and hand, which can contribute to discomfort. Ideally, the hand should be taken off the mouse when not in use, or the hand should be relaxed and supported.

Where a computer user has a physical condition that is worsened by mouse use, and the use of a mouse can't be avoided, you can:

- » Consider changing the hand used to control the mouse;
- » Encourage regular changes in posture;
- » Consider other software options, such as voice-recognition software or keyboard short cuts;
- » Consider an alternative pointing device. For certain tasks (e.g. graphics-based tasks) or to accommodate particular user characteristics (e.g. large hands), these may be more appropriate.

Types of pointing device

The mouse is the most common pointing device. Alternatives include devices such as trackballs, joysticks, touch pads, touch screens and styli. There are a number of factors you need to think about before buying alternatives:

- » Can it be used by either hand?;
- » Will the device be suitable for the task, particularly with regard to speed and accuracy?;
- » Is it suitable in size and shape to fit the user's hand?;
- » Is it compatible with the current hardware and software?;
- » Is there enough space to allow the computer user to use a range of comfortable working postures?;
- » Can the settings (e.g. 'click' /scrolling speed) of the device be easily adjusted?

Before purchasing an alternative input device, trial the different options available so you can select the most appropriate device for the task(s).

FIGURE 24. EXAMPLES OF DIFFERENT INPUT DEVICES



Mouse

A traditional mouse uses roller balls to detect motion, but newer models feature no moving parts and use light to detect movement over the work surface. Wireless mice are also beginning to replace those that have a direct cord attachment to the computer. While wireless mice offer unrestricted placement and movement about the work surface, they often have batteries fitted inside them, which adds to their weight and can increase the forces the hand must exert to move them.

Important features of a mouse include:

- » Being large enough to support the natural arch/curve of the hand. This allows the user to avoid a cramped hand posture and encourages the use of larger arm muscles;
- » A reasonably flat shape to avoid excessive wrist extension;
- » Sufficient size, shape and surface texture to prevent the hand slipping during use;
- » Buttons located so that the fingers are not cramped or spread too far apart;
- » Button designs that require a force neither so firm as to be tiring when used continuously nor so light that it is too easy to activate the buttons in error;
- » A 'drag lock' or 'click lock' function;
- » Adjustable speed and sensitivity in relation to the resulting cursor movement, to allow for the individual user's preference and capability. You can make these adjustments through the mouse software or, on older models, through the hardware;
- » A cord length (if fitted) that allows unrestricted movement;
- » A shape that allows a full range of movement and variations in arm position and permits both left- and right-handed use;
- » A motion-sensing point (e.g. the roller ball or laser light of a typical mouse) situated under the fingers/thumb rather than under the palm of the hand.

Recommendations for mouse use:

Position

The mouse should be positioned so there is a minimum distance of 150mm between the mouse and the front edge of the desk to allow forearm support. The arm used to operate the mouse should be relaxed and close to the side of the body. The mouse should be at the same depth and at a similar height to the keyboard.

As the numeric keypads of most keyboards are to the right of the alphabetic keys, right-handed use of the mouse pushes the mouse to the extreme right of the work surface. Alphabetic-only keyboards allow a more midline position. Consideration should also be given to left-handed mouse use, to the left of the keyboard.

'There is no conclusive evidence to support any one particular size of mouse or whether an adult mouse is suitable for children or users with smaller hands. The design of the mouse should accommodate relaxed and neutral wrist and finger postures for different hand sizes, while keeping muscle forces low.' ISO 9241-410:2008

FIGURE 25. EXAMPLE OF MOUSE POSITIONING



Work surface

The work surface on which the mouse is placed should be stable and of a suitable material to allow smooth operation of the device, e.g. mouse pad. The user should avoid placing direct pressure on the underside of the wrist when resting their forearm on the work surface.

Keyboard shortcuts

Users can reduce their mouse use by making use of shortcut keys. These shortcuts are easy to learn and for many functions are faster and easier than using a pointing device. Some applications allow you to assign functions manually to keys that don't have set shortcuts.

Alternating mouse use between hands

Whilst people often default to using their dominant hand when operating a mouse, there is good reason to alternate between hands or always use the non-dominant hand. This may provide a more efficient work set-up and reduce the risk of discomfort, pain and injury.

For mouse use with the non-dominant hand, the mouse should be repositioned to the opposite side of the keyboard. It may also be necessary to adjust the control settings of the mouse, which can often be achieved through software. These settings are often found in the 'Control Panel' under 'Mouse' control settings.

Changes to the mouse settings for non-dominant hand use might involve:

- » Changing the mouse setting to the opposite hand so that the appropriate finger carries out the main clicking function;
- » Slowing down the double-click speed – usually a drag-and-click control allows the speed to be altered;
- » Slowing the speed of the pointer (usually under 'Pointer options').

It is important that computer users learn how to make mouse adjustments quickly and for themselves, as people who set up computers or other users of a shared computer may use different mouse settings. Several adjustments may be required before a user feels comfortable with using their non-dominant hand, but after a short period of time they often become more proficient and can 'speed up' their mouse settings.

Maintenance

Encourage your computer users to clean their pointing devices regularly. Moving parts such as a mouse ball and the surface of lights may need to be cleaned to get the best possible performance.

HAND-RESTS

Hand-rests (also known as wrist/palm rests) are designed to reduce sustained tension in the muscle tissues of the top of the forearm. This is usually caused when the hands are bent up at the wrist while using the keyboard or mouse. Hand-rests used with both a keyboard and mouse should be separate so that the position of the mouse can be varied and the computer user can change their hand-arm posture.

FIGURE 26. EXAMPLE OF A HAND-REST



A hand-rest is intended for use only when resting between bouts of keyboard or mouse use, and if used incorrectly is a potential source of harm. As such, you must make sure all computer users using them are trained in their correct use.

The base of the hand or end of the forearm – not the wrist – should rest on the hand-rest. On the underside of the wrist the tendons are close to the surface. Prolonged pressure on them may place the user at increased risk of developing discomfort, pain and injury.

Important features of the hand-rest include:

- » That the top of the hand-rest should be no higher than the space bar;
- » A minimum depth of 150mm, measured from the space bar to the edge of the hand-rest closest to the user;
- » That it extends the full length of the keyboard;
- » That it is firm enough so as not to constrain the hand position;
- » That it is easily adjustable in position to suit the user and task;
- » That an appropriate surface friction to allow free arm and hand movement.

LAPTOPS AND OTHER PORTABLE COMPUTER DEVICES

Portable computers such as laptops, notebooks and netbooks are increasing in popularity. They allow easy and immediate access to computing facilities across a range of work environments, both within and outside the office. However, some aspects of portable computer design can make their extended use harmful to the posture and comfort of the user.

When used on their own, portable computers should be used for short, intermittent periods of work. For longer periods they should be used with additional, external hardware such as a keyboard, mouse (or other pointing device), screen and/or other laptop positioning equipment. Portable computers on their own may not be suitable replacements for adjustable desktop PCs, unless a means of improving the relationship of the keyboard and screen to the user is provided.

With a laptop, notebook or netbook it is usually impossible to achieve an appropriate screen viewing angle while maintaining correct keyboard posture. Laptop use is associated with shorter viewing distances and greater leaning forward of the head and bending of the neck than when working with a desktop computer.

Portable computer pointing devices – touch pads or ‘nipples’ (isometric joysticks) – are different from those used with most desktop computers and may be awkward to use. Usually the positions of these devices can’t be adjusted, which may encourage fixed working postures, increasing the risk of discomfort, pain and injury.

The use of laptops and notebook computers away from the work environment may be associated with special problems. They are often used in inappropriate workspaces with unsuitable furniture and in a poor working environment.

Types of portable computers

When selecting a suitable portable computer, you will probably need to make tradeoffs between portability (particularly weight, but also bulk) and usability (features that make the unit comfortable and practical to use).

If possible, trial the equipment and seek advice from specialists familiar with computers and their use. Colleagues who already have similar equipment and don’t experience health issues may be a useful source of information.

Laptops, notebooks and netbooks are the most common types of portable computer. However, there are a number of other, smaller, handheld devices such as palmtops, personal digital assistants (PDAs), PocketPCs and smartphones that can be used as portable computers. The sizes of these products generally make them unsuitable for extended use, although they may be convenient for a range of mobile communication and other computer tasks.

Keep the use of palmtops or similar small devices to a minimum. However, computer users in certain occupations (e.g. parking wardens, freight handlers, courier drivers) may need to use these devices. It is important that you select handheld devices based on the design features required for the tasks. Generally desirable features include:

- » As light as possible;
- » Large, easy-to-read display screens and keys;
- » Appropriate user-friendly software that reduces unnecessary data input;
- » Enhanced glare reduction and waterproofing if used in an outdoor environment.

Important features of a portable computer include:

- » A height- and angle-adjustable screen or a detachable keyboard. Alternatively, the facility to plug in a conventional keyboard and computer screen, or the use of positioning equipment to place the portable computer screen in an optimal position (see page 74);
- » The facility to plug in an external mouse (or other pointing device);
- » As large a screen as possible with a positive polarity display (dark letters on a light background) to decrease glare and enhance readability;
- » A non-reflective screen. Some 'brightview' screens may be difficult to use outdoors or where glare and lighting are a problem;
- » Large keyboard with key size and spacing similar to those of a desktop keyboard, and a feedback mechanism, such as a 'click', to indicate when the keystroke is successful;
- » Keys with a matt finish to prevent reflections from overhead lighting;
- » A slope-adjustable keyboard. If it is not adjustable, the slope should be between 0° and 15°;
- » A thin keyboard. The height at the 'asdf...' row should be no more than 30mm;
- » A sufficient space between the keyboard and the front edge of the laptop to rest the base of the hand when not typing;
- » Friction pads on the base of the computer to increase stability;
- » Light and durable enough to carry without undue strain;
- » A long battery life.

Recommendations for laptops:

In-office use

Computer users using laptops in the office or work environment where the equipment is used regularly should use them together with regular hardware.

The office set-up should mimic a normal workstation.

When plugging a regular keyboard and mouse into the laptop:

- » Place the keyboard and mouse on the same level and at a comfortable height on the work surface;
- » Raise the level of the screen above that of the keyboard and mouse so that it is at a comfortable viewing height. You can do this by placing the laptop on a platform/riser or angled support stand, or by plugging a regular screen into the laptop.

There are various 'docking stations', USB hubs and other systems that allow easy connection of a portable computer to external hardware devices (e.g. separate screen, keyboard and mouse). Some docking stations position the laptop so the screen can be used directly (reducing the need for a separate screen). A discussion with a computer specialist will identify the most appropriate and cost-effective technology for your needs.

Other laptop users position their screens for use via laptop or notebook stands. Some of these are lightweight and portable, while others are larger and more rigid, providing a robust surface that acts like a 'microdesk'. Note that they require the use of a separate keyboard and mouse (or other input device).

Changing portable computer design has seen changes in the access points for cables, discs and other devices, and these items need to be selected with care to ensure a match between the computer and the laptop or notebook stand.

FIGURE 27. EXAMPLE OF A LAPTOP WITH DOCKING STATION, EXTERNAL KEYBOARD AND MOUSE



Out-of-office use

When laptops are used away from the office, the working environment is likely to be less than ideal. Out-of-office use is likely to place more strain on the body than when sitting at a regular, well set-up workstation. Users may need to take more frequent breaks of a longer duration and vary their postures more frequently. The use of portable computers in vehicles can be particularly problematic, and careful consideration should be given to suitable equipment and an optimal work environment.

You need to provide users with training in how to:

- » Assess the specific workplace and environment with which they are faced;
- » Make the necessary adjustments to obtain the safest working set-up, e.g. the chair used, the work surface, mouse placement;
- » Vary their posture regularly.

Temporary modifications to the work environment might include:

- » Placing the laptop and screen on books, files or a laptop bag to lift the screen to a better viewing position;
- » Plugging in a small alphabetic keyboard and mouse;
- » Using a cushion on the seat so the user is at a suitable height to use the computer;
- » When a laptop is used in a stationary vehicle, sitting in the passenger seat to operate the laptop.

3.6 EDUCATING COMPUTER USERS

An important part of managing computer users and their work is ensuring that they are appropriately trained. Computer users who do not receive adequate training about how to recognise hazards and reduce them are at a greater risk of harm than those who don't.

Your training goal is to ensure that each computer user is able to carry out their work without causing harm to themselves or to anyone else.

Be aware that computer users may not initially appreciate or recognise the key principles within a training programme. Therefore, you need to monitor each computer user's reaction to the training until they know how to put the lessons learned into practice.

Training is only one factor that will help you to reduce the likelihood of computer-related health issues. It is likely to have limited benefits for computer user comfort and productivity unless you also take other measures to address a range of relevant hazards and contributory factors (see page 23).

Even well trained computer users may not be able to practise safe work habits without the provision of appropriate and well designed furniture, lighting and equipment, along with manageable work levels and appropriate job conditions.

Important components of a training programme include:

- » Work management – arranging or organising work to avoid peak pressures and repeated urgent deadlines;
- » The use, maintenance and adjustment of computer equipment and furniture to accommodate individual requirements;
- » Computer skills training – training in the use of software and basic keyboard/mouse skills to promote effective, relaxed and competent use;
- » Good working postures;
- » Working techniques – break management, micropauses and preventative exercises;
- » Recognition of signs and symptoms of computer-related health issues and the importance of reporting these early.

Recommendations for training:

Work management

Training your computer users in time and priority management skills will help them to organise their workloads effectively and work efficiently. This training may include information about:

- » Desk management – working smarter, conquering paperwork, phone calls and email;
- » Planning processes – positive goal-setting and diary management;
- » Prioritising workload – effective techniques and processes for managing and setting priorities;
- » Identifying where time is wasted and developing strategies for dealing with time-wasting activities;
- » Effective processes for decision-making, delegation, communication and meetings;
- » Understanding individual personalities so that time and priority management approaches can be matched to suit the individual;
- » Self-discipline for effective time management – how to say ‘NO’, handle interruptions and prevent procrastination;
- » Understanding the signs and symptoms of stress and developing coping strategies.

The use, maintenance and adjustment of computer equipment and furniture

Computer users need to know how to adjust their:

- » Chair;
- » Work surface height;
- » Keyboard and mouse;
- » Viewing distances and angles;
- » Work area layout.

Special training may be needed for computer users who use laptops, particularly on how to use them safely outside the workplace.

Computer skills training

You need to provide basic training in the use of software, including:

- » The use of function keys;
- » Organising and managing files;
- » Positioning icons on the desktop for easy access;
- » How to access the control panel display to adjust various functions, such as the timing of the mouse 'click';
- » Using a mouse (or similar pointing device) with both the left and the right hands.

Remember, when you upgrade or introduce new software your computer users will need training and time to up-skill before you can expect them to return to their regular workloads and pace.

Think about providing touch-typing training to all computer users. Ideally it's best to provide basic keyboard skills training when users first start using computers. That way you can prevent possible problems developing.

You should provide touch-typing training even to very skilled 'two-finger' typists, because they can't operate without looking at the keys. You can provide this training through the short but frequent use of tutorial software programs.

Working postures and practices

Your computer users need to understand the importance of good working postures (see page 36). It is also important to teach them about break management, micropauses and preventative exercises (see page 39).

Recognition and reporting of signs and symptoms of computer-related health issues

When symptoms are recognised and reported early, the underlying problems can be dealt with quickly before they become severe or chronic, so you must create a workplace climate that encourages early reporting. Your managers and safety representatives need to emphasise to computer users the benefits of early detection of possible problems. Put systems in place that encourage the early reporting of discomfort and train your computer users to use them.

Educating your computer users about the signs and symptoms of the health issues associated with computer use will help this process. Symptoms are what you feel internally. Signs are what can be seen or heard or felt externally.

Resources and information to help prevent discomfort, pain and injury associated with computer use can be found on www.habitatwork.co.nz

Physical discomfort

The symptoms associated with physical discomfort are:

- » Pain;
- » Aching;
- » Tenderness;
- » Swelling.

Abnormal sensations that may occur are:

- » Numbness;
- » Tingling;
- » Pins and needles;
- » Burning sensation;
- » Feeling of warmth that is localised to a particular area of the body;
- » Cramp.

There may also be:

- » Stiffness or tightness;
- » Impairment of movement;
- » Weakness;
- » Reduced grip strength;
- » Muscle spasms.

Signs of physical conditions can be minimal or absent. Signs to look for include:

- » An appearance of swelling or deformity;
- » Changes in skin colour;
- » Tenderness on touching the affected part;
- » A sensation of 'crackling' (crepitus) when tendons are moved;
- » Restricted and painful joint movement;
- » Loss of muscle power in functions such as grasping and gripping;
- » Reduced or lost response to stimulating the skin (loss of sensation to touch);
- » Physical guarding of the painful site;
- » Redness of the eyes.

Visual discomfort

The symptoms of visual discomfort include:

- » Blurred vision;
- » Irritated eyes;
- » Dry eyes;
- » Tired eyes;
- » Burning eyes;
- » Headaches.

Stress and fatigue

Computer users affected by stress and fatigue may experience the following symptoms:

- » Increasing distress and irritability;
- » Decreasing ability to relax or concentrate;
- » Difficulty thinking logically and/or making decisions;
- » Less enjoyment of, or less commitment to, their work;
- » Tiredness, depression or anxiety;
- » Difficulty sleeping;
- » A range of health issues, such as:
 - headaches;
 - discomfort, pain or injury (such as low back and upper limb pain);
 - disorders of the digestive system.

Signs of stress and fatigue to look for include:

- » Irritability;
- » Increased blood pressure;
- » Aggression;
- » Errors;
- » Decreased performance;
- » Increases in smoking, drinking and substance abuse;
- » Increase in the number of complaints.

4

Managing health issues

Controlling the hazards associated with computer work will go a long way to preventing computer users experiencing computer-related discomfort and health issues. However, as some hazards can only be minimised and individual users will respond differently to stressors, it is not possible to prevent all discomfort, pain and injury problems. Therefore systems need to be in place to manage computer-related health issues. This is an important element of the hazard management cycle (see page 5).

The first step in managing health issues should be a robust early reporting system for discomfort and pain, with appropriate early intervention. This is followed by referral for additional professional input if serious injuries are suspected, or if the early intervention has not been successful. Programmes that help keep a computer users at work or return them to work after a period of absence with more debilitating health conditions should be put in place with input from the appropriate health professional/s.

4.1 EARLY REPORTING

Early reporting of discomfort and pain assists workplaces to prevent and manage the more serious problems that may arise if action is not taken until later. Early reporting systems focus on a 'stay at work' approach to coping with discomfort and pain, with the main aim being to control pain whilst maintaining appropriate activity and work attendance. The response to managers receiving an 'early report of discomfort' form should be rapid and positive, but without overreaction to mild or resolving issues.

Early reporting forms allow employees to document their discomfort or pain, and to consider the contributory factors using the broad approach of the Discomfort, Pain and Injury Programme. The computer user, supervisor/manager and/or health and safety personnel are then able to consider an appropriate range of early intervention actions to resolve the early signs of discomfort, and to allow the computer user to remain comfortably and productively at work.

The early interventions should be written up in an action plan and should look towards removing or reducing the impact of potential stressors. These interventions might include workstation adjustments, attention to break practices, task rotation, stretching, and/or the appropriate management of workloads. Sometimes the presence of stressful life events can be addressed via an Employee Assistance Programme, or simply a compassionate approach to the computer user's situation and needs.

Some computer users may not want to 'cause trouble', or may be reluctant to make early reports of discomfort for fear of job security. In order for the early reporting of discomfort to occur, employers and employees must create a workplace with a positive and supportive climate that encourages openness. The focus is on reassurance and empowerment, heading off negative beliefs and behaviours, and preventing withdrawal from activity and resultant physical de-conditioning.

For notification of serious harm and other queries, the Department of Labour can be contacted on 0800 LABOUR or www.dol.govt.nz.

Evidence suggests that: 'For most individuals, working improves general health and wellbeing and reduces psychological distress. Even health problems that are frequently attributed to work – for example, musculoskeletal and mental health conditions – have been shown to benefit from activity based rehabilitation and an early return to suitable work'. Australasian Faculty of Occupational and Environmental Medicine and the Royal Australasian College of Physicians (2010)

4.2

REFERRAL

If a computer user develops signs or symptoms of a computer-related health problem that isn't remedied using early intervention strategies, they should be referred to an appropriate health professional. If the report also includes any serious indicators (see 'red flags' below) that suggest a more serious or specific condition, referral to an appropriate health professional for further investigation is indicated.

The indicators ('red flags') of serious health issues are:

- » Severe unremitting night-time pain;
- » Severe burning pain with associated pins and needles;
- » Significant loss of weight over a period of weeks to months;
- » Feeling systemically unwell – experiencing fevers, night sweats, flu-like symptoms;
- » Obvious swelling or lump/s;
- » Redness – especially around joint/s;
- » Several different joints being affected at the same time;
- » Skin rash with associated joint pains;
- » Significant visible bruising in the affected area;
- » Paralysis or significant loss of function of the limb or part of the limb;
- » Significant trauma (e.g. fall from a height, motor vehicle accident, crush).

The types of professional that may be useful are:

- » Ergonomist;
- » General practitioner;
- » Health and safety consultant;
- » Occupational health nurse;
- » Occupational therapist;
- » Occupational physician;
- » Optometrist (for visual problems);
- » Physiotherapist;
- » Psychologist/counsellor.

If a computer user must stop work or is unable to carry out normal duties because of a computer-related health problem, they may have experienced serious harm. As a general guide, if a computer user has been unable to carry out normal duties for seven days, this may be evidence of serious harm and you should report the occurrence to the Department of Labour.

ACC actively encourages employees recovering or managing discomfort, pain or injury in the workplace: 'Stay at Work' and 'Better@Work'.
www.acc.co.nz/for-business/small-medium-and-large-business/managing-employee-injuries

'ACC have Injury Management Consultants who are able to assist employers to develop adequate injury management procedures and strategies to allow for better management of injuries in the workplace. Assisting people to stay in the workplace following discomfort, pain or injury improves outcomes for both workplace and employee.'
www.acc.co.nz/for-business/small-medium-and-large-business/managing-employee-injuries/injury-management-return-to-work-rehabilitation-processes

4.3

INJURY MANAGEMENT – 'STAY AT WORK' AND 'RETURN TO WORK' PROGRAMMES

After it has been recognised that a computer user has a computer-related health problem, you need to determine its possible causes. You should consider reviewing your existing hazard assessment and control procedures to determine whether these are adequate. This is particularly important if other computer-related health issues have also been reported.

Successful early intervention requires continued activity with involvement from the employee, with an emphasis on coping. This should be promoted in the first instance by employers and clinicians, but also supported by friends and family.

Regular reviews of progress with the early intervention plan should occur, with work activity and other interventions reviewed and modified if needed. Reviews should continue until full recovery occurs.

The employer should remain in contact with an employee who is absent from work owing to a computer-related health problem. This is good for worker morale and aids the return-to-work process – the worker continues to feel involved in their job, and feels supported to return. It also makes good business sense, as injuries are costly in terms of productivity, replacement labour and employment relationships, and early return to work reduces this burden.

The employer and employee should both have involvement with the decisions around the 'stay at work' or 'return to work' programme. In some cases, despite the functional impacts of injury, computer users may be able to stay at work without taking time off owing to injury. This will depend on the nature of the impairment, the skills of the computer user, the range of appropriate tasks available at the workplace, and the attitudes and knowledge of all involved parties.

If time off work is unavoidable, the timing of the return to work will depend on the nature of the problem and will be guided by the health professional(s) involved. It is important to ensure that health professionals have good communication with representatives from the workplace and get the information they need so that they are not left to make important work-related decisions in isolation.

It is common for a computer user's health problem not to be completely resolved before they return to work. It is usually advantageous for them to return before complete recovery, providing that their workload and tasks are suitable for their stage of recovery. Both 'stay at work' and 'return to work' programmes should be carefully monitored to ensure they are suitable and successful, with modifications made as indicated.

Health monitoring and programme review

5

5.1

WHAT IS HEALTH MONITORING?

Monitoring is an ongoing process that involves continually recording trends in:

- » Health issues amongst your computer users;
- » The hazards to which your computer users are exposed.

Through monitoring you can identify symptoms and hazards early on, and can therefore deal with health issues or minimise hazards before they become serious or chronic.

5.2

WHAT IS REVIEWING?

Reviewing is a less frequent, but thorough, process that involves assessing:

- » How well your current hazard management systems are working;
- » The need for changes to your hazard management system.

Reviewing considers the effectiveness of the overall management approach (including monitoring) to controlling the hazards associated with computer use.

5.3

WHY MONITOR AND REVIEW?

Monitoring and reviewing are important aspects of any management system. They provide the means by which you can check the effectiveness of your procedures.

If a computer user faces a significant hazard that you are unable to eliminate or isolate, the Health and Safety in Employment Act 1992 requires you to minimise the hazard and to monitor:

- » The exposure of the worker to the hazard;
- » With the worker's consent, their health in relation to the hazard.

5.4

MONITORING HAZARDS AND THE HEALTH OF EMPLOYEES

The monitoring process requires effective communication and a commitment to participation across all levels of your organisation.

Your computer users will need a good understanding of monitoring systems and you should encourage them to report health issues to their supervisors as early as possible.

Employers are required to undertake monitoring under the Health and Safety in Employment Act 1992.

Where hazards or health issues are identified, you must act quickly to address the problem. This should involve:

- » Addressing the hazards and assessing the effectiveness of current methods to control the hazards;
- » If necessary, making changes to better reduce those hazards.

You can then assess how effective any changes have been through further monitoring.

Recommendations for monitoring:

There are two major approaches to monitoring – ‘passive’ and ‘active’:

- » Passive monitoring relies on your existing health and safety information. This is a good way to start monitoring as it is usually inexpensive and uses information that is readily available;
- » Active monitoring, which can be used in addition to passive monitoring, requires you to actively seek data and will allow you to undertake a more in-depth analysis. You need to seek specific data on the levels of hazard exposure and signs and symptoms of the health issues experienced, both at an individual level and across the workplace.

Here are some examples of passive and active monitoring systems.

Passive monitoring:

- » Statutory reporting systems;
- » Company first aid/accident records;
- » Accident Compensation Corporation (ACC) data;
- » Absentee/illness records;
- » Time off for medical visits;
- » Staff turnover rates;
- » Health and safety meetings;
- » Employee complaints, e.g. workload, equipment and software problems, pain and discomfort;
- » Productivity measures.

Active monitoring:

- » Worker-consented health examinations;
- » Workstation assessments;
- » Hazard checklists;
- » Task analysis;
- » Workplace walkthroughs to observe actual working practices;
- » Confidential periodic self-report questionnaire surveys of computer users, e.g. body discomfort mapping, stress;
- » Confidential interviews of computer users, from time to time;
- » Computer users morale and satisfaction measures, e.g. suggestion boxes, group meetings, surveys;
- » Workplace satisfaction surveys.

To be effective, your monitoring systems should:

- » Relate to the circumstances faced by computer users;
- » Encourage the early detection of problems;
- » Be understood by all computer users, who need to be trained how to use them.

5.5 REVIEWING HAZARD MANAGEMENT

You need to review the hazard management cycle (Figure 1) as part of your health and safety management programme. It will help you to undertake a widespread, thorough evaluation of the systems you have in place to reduce the hazards associated with computer use.

Recommendations for reviewing are that it should:

- » Be undertaken on a regular basis, e.g. six monthly or annually;
- » Use a systematic approach;
- » Be included with your overall business reviews;
- » Seek to establish whether you have controlled hazards to all practicable levels;
- » Determine whether your hazard assessment and control systems are effective;
- » Consider whether you need to introduce improved control measures.

You may need to conduct additional reviews if you discover weaknesses in your hazard management systems, or when you make widespread alterations to computer workstation components and/or the organisation of work practices/workplaces.

Frequently Asked Questions

What do the terms 'RSI' and 'OOS' mean?

'RSI' and 'OOS' are acronyms for 'repetitive strain injury' and 'occupational overuse syndrome', respectively. Both of these terms are now largely redundant in New Zealand and have generally been replaced by 'gradual process injury'. However, these terms do not describe a particular condition, but are general 'umbrella' terms used to describe a range of specific conditions (eg carpal tunnel syndrome or epicondylitis) – they are not in themselves a diagnosis.

Which gradual process injuries are covered by ACC?

ACC provides cover for gradual process injuries directly linked to the person's employment. Cover will not be provided unless the problem has arisen substantially from factors arising from the workplace and an actual injury is diagnosed (as opposed to symptoms of pain on their own).

What criteria must be met in order that a work-related gradual process injury is eligible for ACC cover?

ACC provides cover for people with work-related gradual process injuries if they meet the following three-step test under Section 30(2) of the Accident Compensation Act 2001.

1. There is a particular task or factor in the person's work environment that can be identified as having caused the condition;
2. The task or factor is not materially present outside the person's work environment;
3. The work conducted and/or the work environment is recognised as placing computer users at significantly greater risk of developing the condition.

As a computer user, am I more likely to develop eye problems?

Despite extensive research, there is no conclusive evidence that computer use can cause eye diseases or long-term changes to computer users' eyesight, e.g. cataracts. However, owing to the acute visual demands of many computer tasks, computer use may highlight pre-existing eye problems or produce visual discomfort.

Symptoms of visual discomfort may include: general aching or burning of the eyes; watering, red or itchy eyes; blurred vision or difficulty in focusing; changes in colour perception; and headaches. Visual discomfort is influenced by a number of different factors, including how good the user's eyesight is, the placement of the screen relative to the user, lighting of the workstation, humidity levels, the organisation of work and the frequency of breaks. By following the recommendations of these guidelines, users can minimise the risk of visual discomfort.

For more information on eligibility for accident cover for personal injury caused by work-related gradual process disease or infection, refer to Section 30 of the Accident Compensation Act 2001.

Is it a legal requirement for employers to pay for computer users' vision tests and prescriptions?

No, it is not a legal requirement. However, some employers find it is good for staff relations to meet some or all of the costs of vision screening and lenses, if they are necessary.

If it can be shown that a computer user faces a significant visual discomfort hazard, you should pay for the first vision screening and eye examination, if required.

If corrective lenses and/or spectacles are required exclusively for computer use, you should pay for them.

Who pays for health monitoring?

Provided it can be shown that a computer user faces a significant hazard, you are required by the Health and Safety in Employment Act 1992 to provide, and therefore pay for, health monitoring.

For work-related pain and discomfort, you must monitor the ongoing health of computer users in relation to this problem. If you use your company occupational health nurse or human resources department you are effectively covering the monitoring costs. If the monitoring involves visits to a doctor or other health professional(s), you must also pay for these.

What if a computer user has a computer-related health problem but does not report it?

If a computer user fails to report a computer-related health problem and it is classified as serious harm, you may be held liable. This would occur if it could be demonstrated that the employer had failed to take all practicable steps (such as are outlined in these guidelines) to eliminate or minimise the hazards.

If you become aware that a computer user has not reported discomfort when they should have, you need to investigate the reasons why and take all practicable steps to ensure that it doesn't happen again. Examples of practicable steps you might take include ensuring that:

- » The reporting procedures are adequate;
- » Suitable training is provided;
- » Information given to computer users in relation to the hazards is understood.

Can using a computer affect my unborn baby or cause a miscarriage?

Many people have concerns that radiation emissions from computers might result in miscarriages or foetal abnormalities. At present, there is no conclusive evidence from scientific studies that pregnant women performing computer work show a higher incidence of miscarriages or congenital malformation than pregnant women performing other types of work. The radiation levels from computers are well below those identified in international guidelines as harmful to human health.

For more information on electromagnetic radiation and computer equipment, see www.nrl.moh.govt.nz

Can I get seizures from too much computer work?

Photogenic epilepsy is a rare condition that affects one person in 4000 to 8000. People with this condition can experience epileptic attacks triggered by exposure to flickering light. The likelihood that a susceptible person will experience an attack depends on a number of factors, including their sex and age, the frequency of the flicker, and the intensity and size of the source.

This condition is normally diagnosed during adolescence and therefore people will most likely know of their susceptibility by the time they are working. Further, the flicker frequency of CRT screens is well above the level known to trigger an attack. LCD screens are not affected by flicker. Given the relatively low brightness of the computer screen, its small size and the other factors mentioned above, the chances of experiencing an attack during computer work is very low.

Are dermatitis and other skin conditions related to computer use?

A few rare cases of skin problems have been reported by computer users. Scientific investigations of dermatitis and other skin problems experienced by computer operators have not revealed any consistent pattern of association with computer use. However, there is some evidence that for a few susceptible individuals:

- » Static electric fields, when combined with high dust concentrations, may be a risk factor associated with facial skin complaints;
- » Where an existing skin condition exists, electromagnetic fields may aggravate the condition.

Increasing the level of humidity or improving the ventilation may help to lessen some symptoms.

Are there any other health issues associated with the electromagnetic emissions from computers?

Many scientific studies have investigated the relationships between users' health and radiation and electromagnetic fields. Studies have explored the relationship between health effects, such as brain cancer and leukaemia, and exposure to electromagnetic fields generated by computers. There is no clear, consistent epidemiological evidence that exposure to computers can affect users' health.

Current research evidence suggests that electromagnetic fields and radiation generated by computers do not pose serious risks to users. However, it is sensible to be careful and minimise computer users' exposure.

Do potted plants improve air quality in offices?

Evidence is conflicting as to the potential benefits offered by potted plants for improving air quality in indoor environments. In general, studies suggest that potted plants have little effect on indoor air quality. However, it is considered that flourishing plants can benefit the office environment through improved aesthetics and a healthy 'feel' to the workplace.

Appendices

A. OBLIGATIONS UNDER THE HEALTH AND SAFETY ACT 1992

B. GLOSSARY OF TERMS

C. REFERENCES

APPENDIX A.

OBLIGATIONS UNDER THE HEALTH AND SAFETY ACT 1992

The Health and Safety in Employment Act 1992 (and subsequent amendments) requires employers and employees to take responsibility for health and safety in places of work under their control. In addressing computer health issues at work, you are effectively seeking to prevent harm. As an employer, you are in the best position to monitor the effects of any preventive actions you take, and the absence of harm is an indication that such actions are being effective.

The following summarises your obligations. You need to check the wording of the Act itself if you have any doubt about how the Act applies in any particular case.

General duties (Section 6)

The Act requires you to take all practicable steps to ensure the safety and health of your employees and others while at work.

Specific duties (Section 6a-e)

You must take all practicable steps to:

- Provide and maintain a safe working environment;
- Provide and maintain facilities for the safety and health of employees;
- Ensure that machinery and equipment are safe for employees;
- Ensure that working arrangements are not hazardous to employees;
- Provide procedures to deal with emergencies that may arise while people are at work.

Hazard management (Sections 7-10)

The Act requires you to have systems in place for identifying, assessing and controlling hazards.

Step 1: Identify hazards (Section 7)

A hazard is an activity, situation, equipment or substance that is an actual or potential cause or source of harm.

Step 2: Assess hazards (Section 7)

You need to determine which hazards are 'significant' hazards. The Act defines the term 'significant hazard' as a cause or potential cause of:

- Serious harm – this includes death, serious injury or disease as defined in the first schedule to the Act;
- Harm – the severity of which depends on how often or how long a person is exposed to the hazard. For example, exposure to noise over a long period causes gradual and permanent deafness;
- Harm that can't be detected until a significant time after exposure has occurred. For example, exposure to certain chemicals may cause health issues years later.

Step 3: Control hazards (Sections 8-10)

If the hazard is significant, the Act sets out the Control Hierarchy process you must follow to control it.

In short, a significant hazard must be eliminated (Section 8), isolated (Section 9) or minimised (Section 10).

You must eliminate a significant hazard if it is reasonably practicable to do so.

If not, you must isolate the significant hazard, unless it is not reasonably practicable. Elimination and isolation are methods of controlling the hazard.

Minimisation tends to protect only the individual, for example the person who reads the warning sign, who wears personal protective equipment or who does warm-up stretches.

Step 4: Monitor hazards

If you cannot eliminate a significant hazard, you will need to meet additional responsibilities to monitor the hazard, such as monitoring the health of computer users and their exposure to the hazard.

WORKING FROM HOME

There are four likely situations when people may use a computer at home:

1. **A person uses a computer at home, but not for gain or reward.** In this case neither the requirements of the Health and Safety in Employment Act 1992 nor these guidelines apply. However, it is common sense for all computer users to apply the practices explained in these guidelines to the workstations in their homes;
2. **A self-employed person uses a computer at home.** Section 17 (duties of self-employed people) applies. Self-employed people should not act, or fail to act, in any way that causes harm to themselves or any other person;
3. **A person is required to work at home by an employer.** The provisions of the Health and Safety in Employment Act 1992 apply as if the person were at their workplace and under the direct control of their employer. Because the circumstances are different, some things that would be practicable in a working environment directly under the employer's control may not be practicable when employees work from home.

Employers need to ask questions to satisfy themselves that the hazards associated with the immediate work environment, the equipment being used and the workplace set-up are well managed at the employee's home office. However, this does not necessarily mean you need to inspect the home. You should be able to trust your employee to answer honestly.

The lack of direct control means that you need to place more emphasis on training to ensure that your employee is aware of what they should and should not be doing. You can also arrange for the employee to do a hazard assessment on your behalf;

4. **A self-employed contractor is engaged by a principal to do work and uses a computer at home to do it.** The principal is required (Section 18 of the Act) to ensure that no employee of a contractor or sub-contractor is harmed while doing any work that the contractor was engaged to do. In practice, this means that principals engaging contractors should satisfy themselves that the contractors are unlikely to be harmed while working for them. Contractors should be asked to state what health and safety measures they will take to protect themselves from harm, as a part of the tender/contract specification.

APPENDIX B. GLOSSARY OF TERMS

ACC

Accident Compensation Corporation

Bifocal lenses

A segmented lens with two areas of focus, usually one for near distance and one for far distance viewing.

C

Celsius

Colour appearance

The perceived colour of light that a lamp/light fixture emits.

Colour rendering

The effect a light source has on the perceived colour of objects.

Colour rendering index (Ra)

An international measure of colour rendering. The maximum Ra value is 100. The higher the Ra, the 'richer' that colours will appear.

Correlated colour temperature (Tcp)

A measure of colour appearance. It refers to the equivalent temperature a black body radiator would need to have in order to produce light of the same colour. Tcp is measured in Kelvins (K).

dBA (A-weighted sound pressure level)

A measure of noise, the sound pressure level can be defined as the level of acoustic pressure waves, and is expressed in decibels (dB). The sound pressure level can be 'weighted' using various filters that approximate the sensitivity of the ear at different frequencies. The A-weighting (A) is commonly used for occupational measures of noise and reflects a greater mid-frequency sensitivity in an attempt to match the response of the human ear to noise.

Drag lock

A mouse function that allows you to drag a screen object or highlight a section of text, without continuously holding down the mouse button.

Environment

The physical surroundings and conditions of lighting, heating, ventilation and noise.

Flexion/extension of wrist

See Wrist flexion and Wrist extension.

Flicker

Light that alternately brightens and dims. Flicker can occur with overhead lighting or on a CRT screen. Flicker on a CRT screen occurs at between about 50 and 80 times a second and is visible only under certain conditions. [Glare](#)

A bright light in the field of view.

Hand-rest (often referred to as a palm/wrist rest)

A support for the 'heel' of the hand placed adjacent to the keyboard at about spacebar height.

Illuminance

The amount of light falling on a surface.

Jitter

A small, jerky, repeated motion of the screen image.

Luminaires

A complete lighting unit consisting of a lamp or lamps, along with the parts designed to distribute the light, hold the lamps and connect the lamps to a power source.

Lux

A unit of illumination. One lux equals one lumen per square metre.

m/s

metres per second

mm

millimetres

Micropause

A brief pause to relax the muscles. The greater the relaxation, the more beneficial the micropause. Micropauses ought to be taken frequently – five to ten seconds every three minutes – for the greatest effect. The micropause allows blood to flow again in a muscle that has been tense.

Modesty panel

A panel in the front of a desk that is designed to hide the computer user's legs.

Negative polarity display

A method of computer screen character display that shows bright characters on a dark background (the reverse of paper).

Positive polarity display

A method of computer screen character display that shows dark characters on a light background (like white paper).

Progressive lenses

Multifocal lenses where the focus changes progressively throughout the lens, without the visible lines of bifocal or trifocal lenses.

Reflectance

The ratio of the amount of light reflected from a surface to that falling on it.

Saturated (colour)

A colour's saturation refers to the degree to which it is free from grey, at a given level of light. As saturation decreases, colours appear more 'washed-out'.

A technical definition for a saturated colour is a colour with a chromatic purity of one.

Significant hazard

Significant hazard means a 'hazard that is an actual or potential cause or source of:

- a) Serious harm; or
- b) Harm (being harm that is more than trivial) the severity of whose effects on any person depend (entirely or among other things) on the extent or frequency of the person's exposure to the hazard; or
- c) Harm that does not usually occur, or usually is not easily detectable, until a significant time after exposure to the hazard'.

Software

The programs and other operating systems used by a computer.

Swim

Swim is where the magnets controlling the colour acuity on a cathode ray screen are affected differentially allowing the colours on the screen to change in a disturbing way.

Technician adjust

Equipment, such as desks or chairs, that requires the assistance of another person(s) and may require the use of tools or other equipment.

Trifocal lenses

A segmented lens with three areas of focus, usually one for near distance, one for intermediate distance and one for far distance viewing.

Troffer

An inverted, usually metal trough suspended from a ceiling as a fixture for a fluorescent light tube.

Ulnar/radial deviation of wrist

Ulnar deviation is sideways movement of the hand in which the wrist bends toward the little finger. Radial deviation is sideways movement of the hand in which the wrist bends toward the thumb.

Viewing distance

The distance between the screen and the user's eyes.

Wrist extension

To bend the wrist backward.

Wrist flexion

To bend the wrist forward.

APPENDIX C. BIBLIOGRAPHY

ANSI/HFES 100-2007. Human Factors Engineering of Computer Workstations. Published by the Human Factors and Ergonomics Society, P.O. Box 1369, Santa Monica, C.A. 90406-1369, USA.

AS/NZS 1680.1:2006. Interior and workplace lighting. Part 1: General principles and recommendations. Standards New Zealand, Wellington. ISBN 0 7337 7264 1.

AS/NZS 1680.0:2009. Interior lighting. Part 0: Safe movement. Standards New Zealand, Wellington. ISBN 0 7337 9335 5.

AS/NZS 1680 2.1:2008. Interior and workplace lighting. Part 2.1: Specific applications – Circulation spaces and other general areas. Standards New Zealand, Wellington. ISBN 0 7337 8718 5.

AS/NZS 1680 2.2:2008. Interior and workplace lighting. Part 2.2: Specific applications – Office and screen based tasks. Standards New Zealand, Wellington. ISBN 0 7337 8718 5.

AS/NZS 1680 2.3:2008. Interior and workplace lighting. Part 2.3: Specific applications – Education and training facilities. Standards New Zealand, Wellington. ISBN 0 7337 8715 0.

AS/NZS 1680 2.4:1997. Interior lighting. Part 2.4: Industrial tasks and processes. Standards New Zealand, Wellington. ISBN 0 7337 2127 3.

AS/NZS 1680 2.5:1997. Interior lighting. Part 2.5: Hospital and medical tasks. Standards New Zealand, Wellington. ISBN 0 7337 1476 5.

AS/NZS 1680 4:1997. Interior lighting. Part 4: Maintenance of electric lighting systems. Standards New Zealand, Wellington. ISBN 0 7337 3717 X.

AS/NZS 4438:1997. Height adjustable swivel chairs. Standards New Zealand, Wellington. ISBN 0 7337 0819 6.

AS/NZS 4442:1997. Office desks. Standards New Zealand, Wellington. ISBN 0 7337 0866 8.

AS/NZS 4801:2001. Occupational Health and Safety Management Systems – Specification with guidance for use. Standards New Zealand, Wellington, ISBN 0 7337 4092 8.

BIFMA (The Business and Institutional Furniture Manufacturer's Association) G1-2002. Ergonomics guideline for VDT (Visual Display Terminal) furniture used in office work spaces. BIFMA International.

Blehm C., Vishnu, S., Khattak, A., Mitra, S. and Yee, R.W. (2005). Computer Vision Syndrome: A review. Survey of Ophthalmology, 50, 3, 253-262.

Department of Labour (2003) Healthy Work: Managing Stress in the Workplace – Health and safety is good business.

European Multidisciplinary Scientific Network on Indoor Environment and Health (EUROVEN, 2002). Ventilation and health in non-industrial indoor environments: report from a European Multidisciplinary Scientific Consensus Meeting (EUROVEN). *Indoor Air*, 12, 113-128.

European Agency for Safety and Health at Work (EASHW). Stress. osha.europa.eu/en/topics/stress.

International Labour Organisation. Safe Work: Stress at Work (www.ilo.org/safework/info/lang--en/WCMS_108557).

ISO 9241-300:2008. Ergonomics of human-system interaction – Part 300: Introduction to electronic visual display requirements.

ISO 9241-302:2008. Ergonomics of human-system interaction – Part 302: Terminology for electronic visual displays.

ISO 9241-303:2008. Ergonomics of human-system interaction – Part 303: Requirements for electronic visual displays.

ISO 9241-400:2007. Ergonomics of human-system interaction – Part 400: Principles and requirements for physical input devices.

ISO 9241-410:2007. Ergonomics of human-system interaction – Part 400: Design criteria for physical input devices.

ISO 9241-1:1997. Ergonomic requirements for office work with visual display terminals (VDTs) – Part 1: General introduction.

ISO 9241-2:1992. Ergonomic requirements for office work with visual display terminals (VDTs) – Part 2: Guidance on task requirements.

ISO 9241-4:1998. Ergonomic requirements for office work with visual display terminals (VDTs) – Part 4: Keyboard requirements.

ISO 9241-5:1998. Ergonomic requirements for office work with visual display terminals (VDTs) – Part 5: Workstation layout and postural requirements.

ISO 9241-6:1999. Ergonomic requirements for office work with visual display terminals (VDTs) – Part 6: Guidance on the work environment.

ISO 9241-11:1998. Ergonomic requirements for office work with visual display terminals (VDTs) – Part 11: Guidance on usability.

ISO 9241-12:1998. Ergonomic requirements for office work with visual display terminals (VDTs) – Part 12: Presentation of information.

ISO 9241-13:1998. Ergonomic requirements for office work with visual display terminals (VDTs) – Part 13: User guidance.

ISO/CIE 8995 2002. Lighting of work places – Part 1: Indoor.

ISO 11064-4:2004. Ergonomic design of control centres – Part 4: layout and dimensions of workstations.

NZS 4121:2001 'Design for Access and Mobility – Buildings and Associated Facilities'.

Prabhu, S. P., Gandhi, S. and Goddard, P. R. (2005). Ergonomics of digital imaging. The British Journal of Radiology, 78, 582-586.

Preventing and Managing Discomfort, Pain and Injury Programme (ACC).

TCO'04 Office Furniture: Work Tables. (2005). TCO Development, SE-114 94, Stockholm, Sweden.

World Health Organization (2003). Protecting workers' health series No.3. Work organisation and stress: systematic problem approaches for employers, managers and trade union representatives. WHO, Geneva, Switzerland.

Disclaimer

The information provided in this document is intended to provide information about injury prevention. Every effort has been made to ensure that the information is accurate. However, we advise that:

- » the information provided does not replace or alter the laws of New Zealand and other official guidelines or requirements
 - » ACC does not accept any responsibility or liability whatsoever, whether in contract, tort, equity or otherwise, for any action taken, or reliance placed, as a result of reading any part, or all, of the information in this document or for any error, inadequacy, deficiency, flaw in or omission from the information provided in this website
 - » all links and references to equipment or items are provided for convenience only and are not, and should not be taken as, endorsement of that equipment or item.
-

