Human Factors Engineering Considerations For the Home Office

By: Cindy Leggett Woolard

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Instructor: Jim Clauson

Course: QAS-515 Human Factors in Quality Assurance

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Introduction

In today's fast paced world and increasing technology in the home; many of us are finding that we take work home with us. According to the U.S. Department of Labor, Bureau of Labor Statistics census performed in May of 2001 indicated that there were 19.8 million people who performed work in their home as part of their primary job.[1] People often set-up shop in their own homes, especially since there are now tax perks for the existence of a home office. Thus, all of us are subject to the same problems one will face in the office at a business office. The same issues with ergonomic problems and safety will arise at home. The topic of this paper is focused on bringing to light some of those considerations and suggested resolutions to office work place problems that are transformed from the business environment to the home address.

The lack of ergonomic considerations goes unnoticed because your bedroom or spare bedroom now becomes your evening office. The boss gave us this nice new laptop computer and it's convenient to finish work or get a jump on the next day by taking it home with you. This alternate work site if not evaluated can lead to the same long-term stresses that cause most CTDs, safety hazards, and negative behaviors found at the work site. We must learn to recognize and plan to assess our work area to fit us. Some solutions are simple and very low in cost while other home office designs are only limited to what one wants to spend.

The first consideration is to determine if you spend time on a computer in the home or do if you bring home your laptop to do work after hours. If the answer is yes - You have a home office. For tax related reasons there may be other criteria like a separate room designated as the home office. That's for tax related purposes and not to be confused with determining if the area you perform your work is fit for your personal health and safety. So be wise to your work environment and perform a self-evaluation of your time

[1] www.bls.gov, "US Department of Labor"

spent and typical activities performed in that area. Once you've performed a self assessment of your at home work habits you may need to fix your current work area or make a designated room or corner of a room as your home office. The remainder of this paper will focus on topics of interest that need to be considered in a home office work environment along with some references where you can get good advice for personal ergonomic safety along with some general common sense considerations.

Building Considerations (Real Estate Advice)

If you're planning to build a home office, a common sense approach is to consider the possibility of reselling your home at a later time. The erection of addition of an office should easily converted to a guest bedroom with adoring bathroom. If you plan to have clients come into your home you need to check city or county zoning ordinances along with subdivision by laws to determine if it is legal to have a business in your home where clients come to the office for a visit. Having the comfort of a quiet work area away from the family in the house will allow uninterrupted work and or separation from the remainder of the home from clients visiting. On the other hand a corner of the family room or den may be enough to provide a work area.

Health and Safety Concerns

The following table comes from the CSA International Guideline on Office Ergonomics suggesting evaluation of Health and Safety concerns that come from poor office design based on the environment.

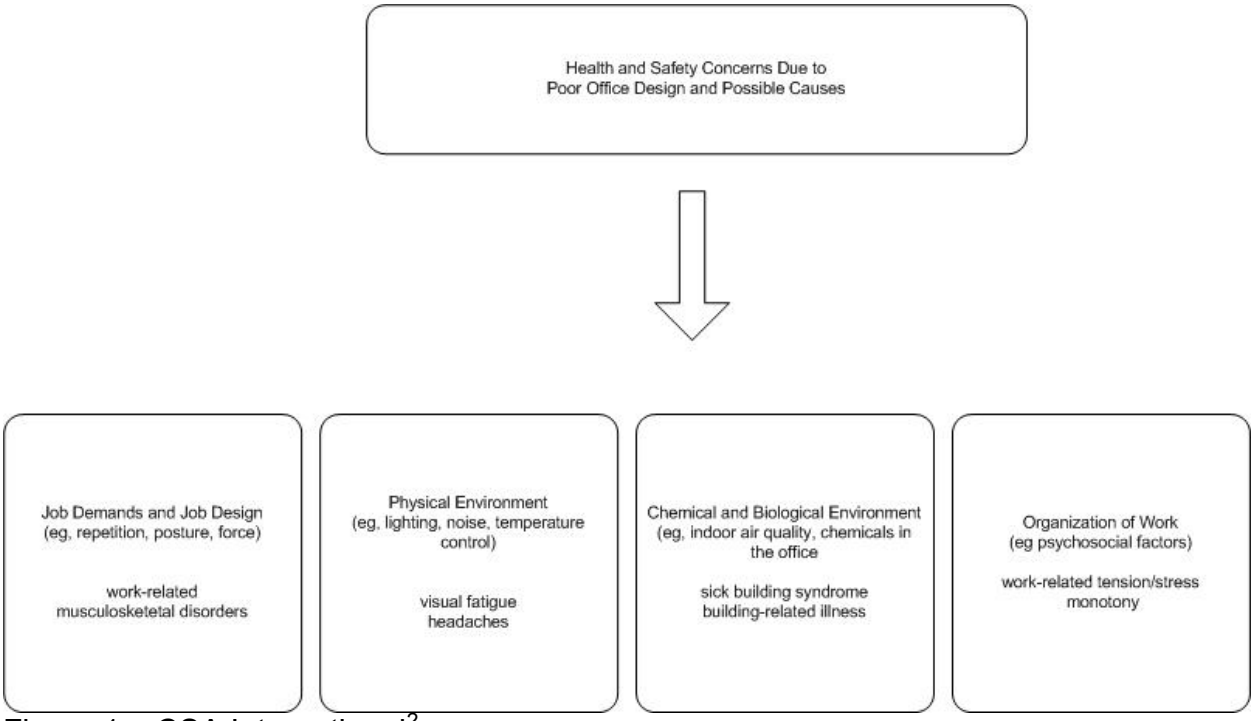

Figure 1 – CSA International[2]

Evaluation of these health and safety concerns is better if done prior to design and layout of your office area. Each item in the table above leads down a separate train of thought for your office design and layout. While some are design issues, others are procedural or organization of the work to be performed in your office and how you go

[2] Canadian Standards Association - International

about performing those activities. Appendix B has a checklist that can be used to evaluate your current work area. Once areas that need improvement are identified, the remaining appendices can be used to help fix the identified problem areas or used to provide training to others.

Organization of Work/Job Design and Demands

Most office areas in the home will consist of the computer workstation, desk, phone and chair as the center of activity. One article on ergonomics in the office by Ergoboy[3] suggests that the materials used for work be set-up in zones based on the frequency of use. Thus, to prevent a worker from wasting energy with unnecessary motions and interruptions that ultimately cause CTDs (Cumulative Trauma Disorders).

> Zone 1 is the area containing materials most frequently accessed and therefore within a 12-inch reach. Those materials less frequently used are in Zone 2 or within a 20-inch reach. Those materials seldom used are in Zone 3 or any greater than 20-inches away from the worker.[3]

Even with the best designed workstation or office area, the worker needs to recognize long periods of static posture and repetitive tasks should be frequently interrupted with breaks where job position or task is exchanged for another and/or office exercises are performed. See Appendix F for examples of office stretches and helpful tips on preventing muscle ache and pain due to repetitive tasks and static postures found while working at a computer workstation.

These examples found in the appendices of this paper are labeled available for display as EROGONOMIC INFOGRAM E-B06 and supplied from the CCOHS (Canadian Centre for Occupational Health and Safety) organizations guidelines.

During a personal interview and viewing of a PowerPoint presentation developed by Scott Jenkins, Serentec Sr. Safety Coordinator, entitled, “Office Ergonomics Awareness” [4], Jenkins stated that the most common CTDs associated with computer workstation usage are CTS (Carpal Tunnel Syndrome) and tendonitis. At some point in

[3] www.ergoboy.com

[4] Scott Jenkins, Serentec, Inc.

time it was believed that the computer workstation wrists rests would prevent the pressure on the underside of the wrists that ultimately causes these CTDs. A study done by Alan Hedge, director of the Human Factors and Ergonomics Laboratory at Cornell University, reported in Occupational Health magazine[5] suggests that the wrist rest does not prevent the pressure and is no different than resting the wrists on a table top. In his laboratory exercises, the palm rests proved to reduce symptoms of users who were diagnosed with CTS.

Another common stress in the office is back pain from poor posture. After review of several recommendations there are differences in what is proposed to correct improper posture. The CCOHS Guideline found in Appendix D of this document suggests makes common sense advise on the Chair and work surfaces where tasks are performed. In some of my resource readings it was suggested that we often fail to maintain proper posture and have not been trained to sit with correct posture in the work environment. Kroemer[6] suggests that there is no one correct posture. Office chairs should be designed for use and comfort to the individual. The ASSE (American Society of Safety Engineers)[7] recommends adjustable chairs with padded armrests and back lumbar support along with a 5 point base for stability, adjustable backrest, seat padding and height on back and armrests are needed to prevent fatigue and stress on the musculoskeletal system.

Other Zone 1 activities require proper height of the computer display screen, adjustable document holders or document trays and proper lighting. Some lighting considerations may be a problem in the home if an alternate location other than a regular room with window and overhead lighting was used. Lighting may not be the only problem if you chose to put your home office in an attic or basement. Other things like the airflow, moisture content and temperature may affect your work performance or even put you at risk of exposure to mold and other chemicals potentially stored in areas like basements or garages.

[5] Occupational Health, November, 1995
[6] Kroemer, Karl et al Ergonomics: How to Design for Ease and Efficiency
[7] www.asse.org/press58.html

When evaluating for the best vision health, Jeffrey Anshel suggests evaluating the computer terminal, eye position, glare and luminance in his article on Vision Health in Occupational Health, April, 1994[8]. The computer display needs proper adjustment for dimming and brightness along with color specifications that ease vision. Because the eye position is so different when viewing data on a screen than when reading one's eyes are often stressed and fatigued from the eye travel from a source document to the computer display and the balance from adjusting to graphical representations and flickering associated with the computer terminal.

In a personal interview with Lynda Tyndall, Site Safety Officer at DSM Pharmaceutical, inc.[9], she stated that each persons comfort with eye positioning in relation to their document holder and computer display was often hard to determine. Lynda suggests determining each person's dominate eye and position the document holder on that side of the computer terminal. In recent years she has seen document holders that lie flat in front of the computer terminal to locate the source document at a normal reading stance of 15 degrees below the normal horizontal line of sight. CCOHS also provides visual environment suggestions found in Appendix E.

"Improperly positioned lamps, fluorescent lights, outdoor light, highly reflective surfaces or any illuminated object,"[7] are all sources of glare causing visual stress. Some relief can be found in wearing computer glasses, designed specifically for combating the light reflected in glares from the screen, along with lens panels for flourcent lights that are adjustable. Computer filters or anti glare spray can be used on the computer terminal. Anshel also suggests the "3Bs of Self Eye Care". These are: "Blink", "Breathe", and "Break". Appendix C discusses the VDT or Video Display Terminal suggestions and basic specifications for vision health and posture. See Appendix A for appropriate posture and lighting set-up of the Zone 1 area.

Lighting is a very important element in any office area. Proper lighting increases productivity and decreases vision fatigue. Light is measured in lumens. Chase-Pitkin[10] states that most visually demanding tasks require at least 2500 lumens in a given room. The following table was listed in the Chase-Pitkin web site to reflect common output of

[8] Occupational Health, April, 1994
[9] Lynda Tyndall, DSM Pharmaceutical Inc.

[10] www.chase-pitkin.com

various size incandescent and fluorescent light bulbs:

Incandescent Light:	
Watts	Lumens
60	870
75	1190
100	1750
50/100/150	580/1670/2250
Fluorescent Light:	
Watts	Lumens
20	820
40	2150

Lighting and equipment such as phones, faxes, copiers, computers, printers and other peripherals, extra HVAC considerations add a load to your typical household electrical requirements. Power considerations or separate circuits for the home office also need to be considered to avoid overloading the typical household appliances that could lead to unsafe conditions in the home.

Conclusion

Failure to evaluate the Home Office environment prior to construction or erection can lead to costly modifications or an arrangement that is not ergonomically safe for use. Planning ahead will save your health and money when allotting monies for the ideal ergonomics design, remembering never to fit the person to the job, but fit the job to accommodate the person at home or at the plant site.

Along with the considerations presented in this paper; one needs to keep in mind the job demand. Common sense needs to be applied to remind oneself to take a break every so often and/or change positions or tasks being performed to complete your safety effort. The best office design will not replace good judgment and awareness of health and safety concerns.

Other Available References

During my research for this paper I searched US and Canada websites for government related documentation and standards to follow for ergonomic suggestions. The following is a list of helpful websites and additional reading that you may want to visit other than those already listed in the bibliography. It is my opinion that for conciseness and ease of reading and understanding the material, the Canadian Guidelines were better organized and to the point for readily available information.

Other building ideas for layout and design – determining if your office needs to be an L-shaped design or conference room style can be found in the references below. These considerations are beneficial to the functionality of your home office design. The more efficient we are in our work, the less likely we are to suffer from fatigue related illnesses.

An updated copy of the Canadian Standard CSA Z412 - Guideline On Office Ergonomics can be purchased from WWW.csa-international.org.

An updated copy of "Office Ergonomics" can be purchased from the Canadian Centre for Occupational Health and Safety at their website: www.ccohs.ca

National source of Ergonomic, Occupational Health and Safety products can be found at the AliMed Ergonomic Division – catalog online at website: www.alimed.com

AMAZON recommended publications (www.amazon.com):

Designing and Building a Healthy Home or Office: Optimum Environments for Optimum Health & Creativity. By William J. Rea, MD

Ergonomic Living by Gordon Inkeles

Home Office Design by Neal Zimmerman

The Home Office Book by Donna Paul, et al

At Work At Home by Neal Zimmerman

The Custom Home Office by Niall Barrett

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"For Labor Day, American Society of Safety Engineers Provides Ergonomic Tips for the Office." ASSE URL: http://www.asse.org/press58.html (1, September, 2000).

Jenkins, Scott, Serentec, Inc. Personal Interview and PPT: "Office Ergonomics Awareness". 30 July 2003.

Kroemer, Karl, Henrike Kroemer, and Katrin Kroemer-Elbert. Ergonomics: how to design for ease and efficiency. 2nd ed., *New* Jersey: Prentice-Hall, Inc., 2001.

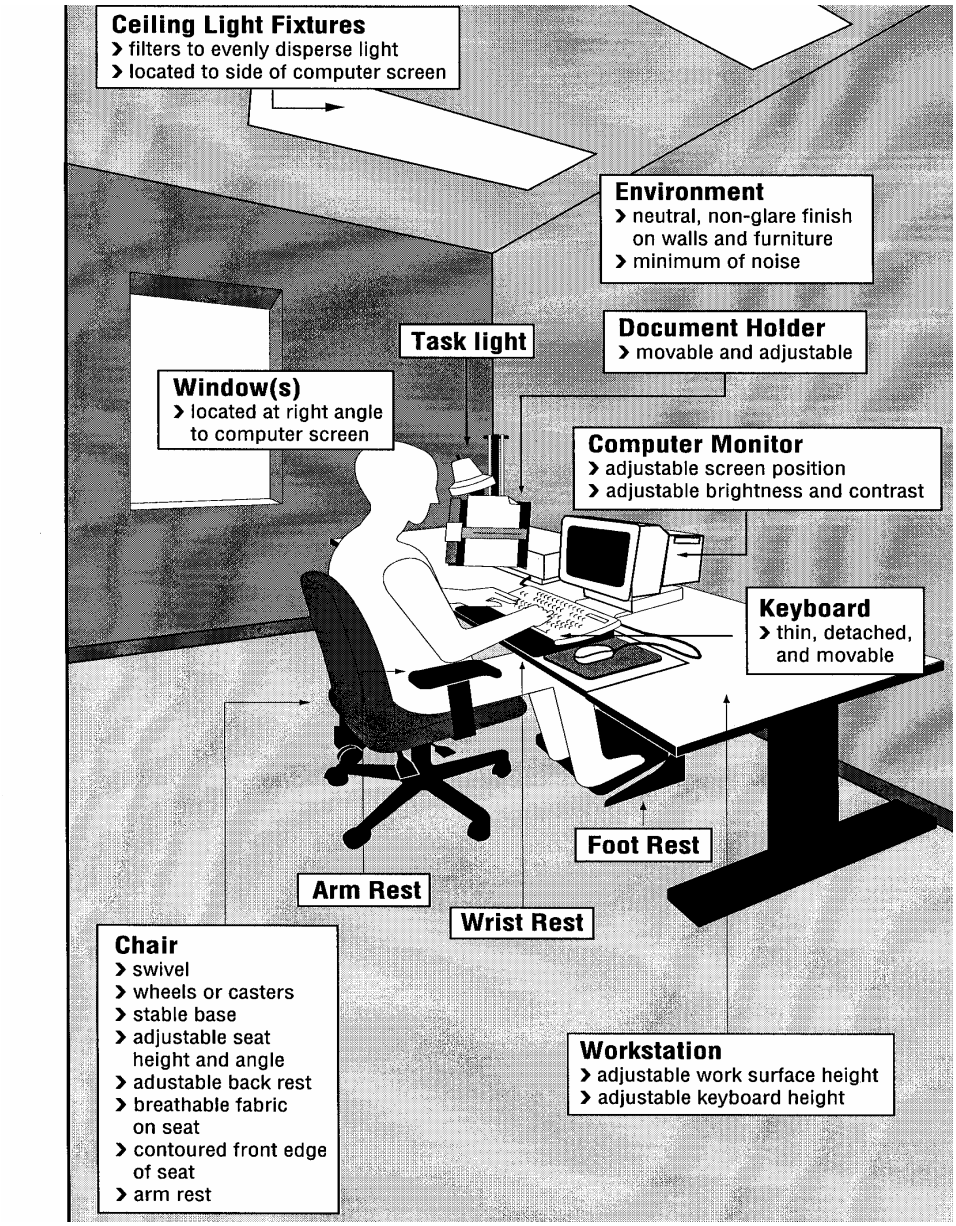
Tyndall, Lynda, DSM Pharmaceuticals, Inc. Personal Interview with DSM Safety Officer. 17 July 2003.

"Vision Health Management: Visual Ergonomics in the Workplace" Occupational Health, April, 1994: 55-56, 58.

"Z412-00 Guideline on Office Ergonomics." CSA International. (December 2000).

APPENDIX A

Scanned from purchased copy of Z412-00 Guideline on Office Ergonomics
Labeled: "Available for display as ERGONOMIC INFOGRAM E-B06"
Reference CSA International Canadian Standards – updated with free sample available from WWW.ccohs.ca.



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APPENDIX B

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Checklist

VDT workplaces must be flexible enough to accommodate the various individuals using them.

Use this checklist to identify problems in a VDT workplace.

"NO" answers indicate a potential problem and should be followed up. They may indicate the need for adjustment or changes in the workplace or job design.

VDTS

__ Top surface of the keyboard space bar (or bottom row of keys) is no higher than 6.5 cm (2.5 in.) above the work surface.

__ During keyboard use, the forearm and upper arm form an angle of 80°-100°, with the upper arm almost vertical. The wrist is relaxed and not bent. Wrist rests are available.

__ If used primarily for text entry, keyboard is directly in front of the operator.

__ If used primarily for data entry, keyboard is directly in front of the keying hand.

__ Keyboard is detached and moveable.

__ Top of the screen is about eye level.

__ Viewing distance is 30 to 60 cm (12 to 24 in.).

__ Screen is free of glare or shadows.

__ Images on the screen are sharp, easy to read and do not flicker.

Chair

__ Chair has wheels or castors suitable for the floor surface.

__ Chair swivels.

__ Backrest is adjustable for both height and angle.

__ Backrest supports the inward curve of the lower back.

__ Chair height is appropriate for the individual and the work surface height. Refer to ERGONOMIC INFOGRAM E-B04.

__ Chair is adjusted so there is no pressure on the backs of the legs, and feet are flat on the floor or on a foot rest.

__ Chair is adjustable from the sitting position.

__ Chair upholstery is a breathable fabric.

__ Footrests are used if feet do not rest flat on the floor.

Work Surface

__ Work surface height is adjustable.

__ Leg room is sufficient to change position of legs without getting up.

__ Work surface is large enough to hold work materials.

__ Commonly used items are close to and in front of the operator.

__ Infrequently used items are stored.

Visual Environment

__ Lighting does not produce glare or shadows on the screen.

__ Lighting allows workers to easily read characters on the screen and source document.

__ Wall colour is neutral and not too bright.

__ Shiny surfaces and objects are covered or removed.

__ Windows have blinds or curtains to prevent glare.

__ VDTs are located away from windows, or screens are at a 90° angle to windows.

__ Ceiling fluorescent lights are oriented lengthwise to the sides of the VDT.

__ Room lighting is uniform and slightly dimmer than usual office lighting.

__ General work areas have indirect or diffuse lighting.

__ Ceiling fluorescent lights are fitted with diffusers or parabolic louvres.

__ Adjustable task lights are available over source documents.

APPENDIX C

Note: (VDTs) – Video Display Terminals
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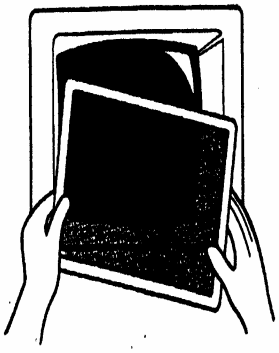
Reference CSA International Canadian Standards

VDTs

VDTs come with various features that are built in or that can be added. Use the adjustments provided.

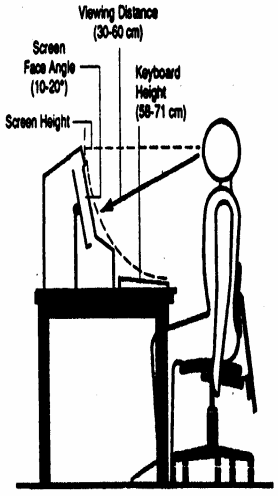
ELIMINATE glare caused by lights, windows or bright objects. If reflections can still be seen on the screen, use a mesh filter or anti-glare spray. Follow the manufacturer's instructions. Refer to ERGONOMIC INFOGRAM E-B05.



ADJUST screen brightness and contrast. It is easier to read from the screen if characters are brighter than the background. Be careful not to make characters too bright.

ADJUST the screen height so the top is just about eye level.

TILT the screen slightly backwards. Watch that this does not create glare on the screen.

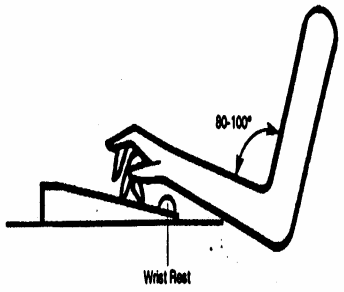


ADJUST chair, work surface and keyboard heights properly. Refer to ERGONOMIC INFOGRAM E-B04.

POSITION keyboard for two-handed "typing" directly in front of operator. Position keyboard for one-handed data entry in front of keying hand. Leave a large area free for source documents and other work materials.

MOVE the keyboard occasionally to change the arm and shoulder position.

USE a wrist rest if the heel of the hand or wrist is not supported.



USE an adjustable document holder. Place it next to the screen and at the same height. The head will have to turn less and eyes will adjust more easily. Refer to ERGONOMIC INFOGRAM E-B01.

ALTERNATE position of document holder on either side of VDT to change head position.

CONNECT keyboard to VDT with a cord that is at least 70 cm (28 in.) long.

CHECK for excessive noise from the VDT or printer.

CLEAN the VDT screen regularly. Follow the manufacturer's instructions.

REPORT problems with VDT controls, flicker or excessive noise.

Available for display as ERGONOMIC INFOGRAM E-B02

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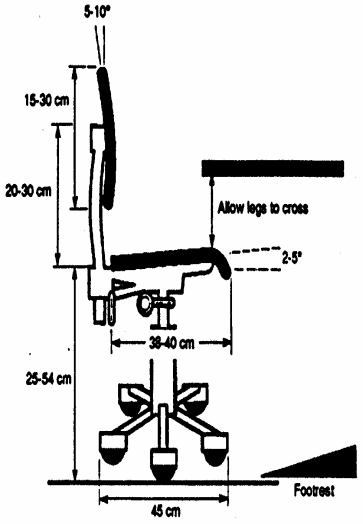
Chair and Work Surface

Well-adjusted chairs improve body position and blood circulation, reduce muscular effort, and decrease pressure on the worker's back. Chairs should swivel, have five wheels for stability, have a breathable fabric on the seat, and have a rounded front edge.



TIGHTEN the chair backrest so that it does not give way with body weight.

READJUST the chair throughout the day to vary body position.

USE only chairs with arms that do not interfere with the work surface.

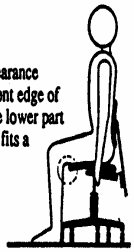
CHECK that there is enough leg room under work surface. Do not store materials under work surface.

CHECK that the work surface is large enough to hold work materials.

STORE items not used frequently.

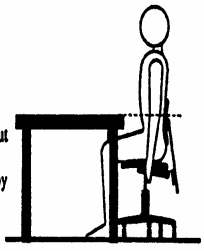
Adjustable work surfaces provide the most flexibility and accommodate the largest number of users. Adjust chair according to body size, then adjust work surface or keyboard height.

STAND in front of the chair. Adjust the height so that the highest point of the seat is just below the knee cap.



SIT so that the clearance between the front edge of the seat and the lower part of the legs just fits a clenched fist.

ADJUST the backrest of the chair so that it supports the hollow in the lower back.



ADJUST work surface to about the height of elbows with the arms hanging straight by the sides.

If temporarily using an unadjustable work surface:

ADJUST seat height so that elbows are about the same height as the home row on the keyboard.

USE a footrest if there is pressure on the back of the legs or if the feet are not resting flat on the floor. The footrest should support the whole foot and be adjustable.

APPENDIX E

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Visual Environment

Reflections from light fixtures, windows, or shiny objects cause glare. Too little light or poorly placed light fixtures cause shadows on the VDT screen.

Glare and shadows cause eyestrain and fatigue. If the operator has to adopt an awkward position to see around glare and shadows, the strain can cause neck, shoulder and back pain.

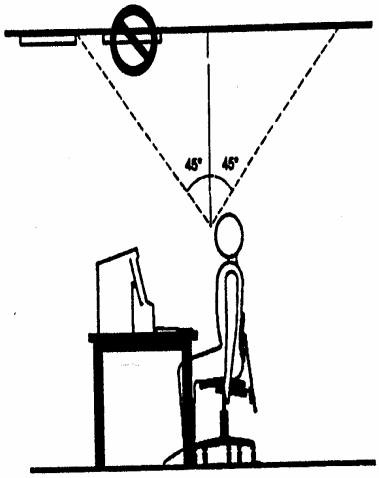
Lighting must be balanced. It must be bright enough for the operator to read source documents. It should not be so bright that it makes it hard to read from the screen. The recommended lighting level is 300 to 500 lux.

DOs

CHECK for reflections or bright spots on the VDT screen. Eliminate the source.

USE grid or parabolic filters on fluorescent fixtures to evenly disperse light. Refer to ERGONOMIC INFOGRAM E-B01.

POSITION VDT with ceiling light fixtures to the sides of the screen or at least outside of the glare zone. Refer to ERGONOMIC INFOGRAM E-B01.



POSITION VDT screen at 90° angle to windows. Refer to ERGONOMIC INFOGRAM E-B01.

ADJUST window blinds or drapes to control light levels and glare.

USE non-glare finishes and neutral colours on walls, furniture and VDT equipment.

USE glare screen or filter on VDT screen if glare cannot be eliminated at the source. Refer to ERGONOMIC INFOGRAM E-B03.

USE task lights to eliminate shadows over source documents.

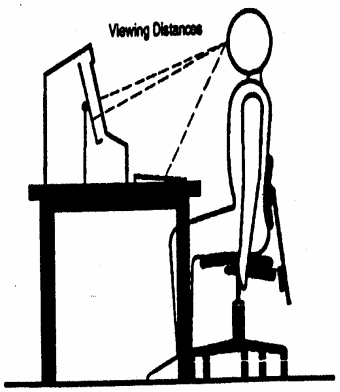
MOVE or cover shiny objects.

CHECK for flicker from fluorescent lights. Replace fluorescent tubes regularly and properly maintain fixtures.

CHECK for flicker from VDT screen.

LOOK away frequently from the VDT to rest the eyes.

ENSURE correction of vision problems by having regular eye examinations. Tell the eye examiner about VDT use and the viewing distances. Viewing distances and angles may influence the choice of lenses.



DO NOTs

DO NOT HANG glossy pictures behind VDT screen.

DO NOT USE shiny or glossy desk blotters.

DO NOT FACE windows or have VDT screen facing windows.

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Reference CSA International Canadian Standards

Job Design

No matter how well designed a workplace is, health and safety problems arise if little attention is paid to how work is done. VDT work often involves repetitive movements of the hands and few changes in body position. This can lead to muscle pain and strain.

VARY work tasks. Break up VDT work by doing non-VDT tasks that place different demands on the body by changing body position.

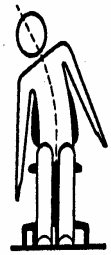
WORK at a reasonable rate. Too fast a work pace contributes to muscle strain. Too slow a work pace contributes to boredom.

LOOK away from the screen occasionally and focus on a distant object to rest the eyes.

TAKE regular rest breaks to ease muscle aches, eye strain and stress.

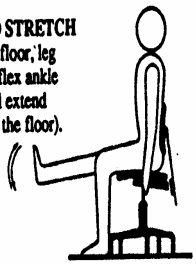
USE rest breaks to stand up, move around and change mental activity.

RELAX muscles, stretch and change position. Exercises done at the VDT help.

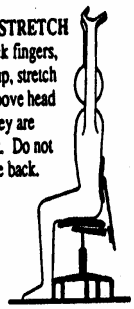


SIDE STRETCH
Drop left shoulder, reaching left hand towards the floor. Return to starting position. Repeat on right side.

BACK CURL
Grasp shin. Lift leg off the floor. Bend forward (curling the back), reaching nose toward the knee.



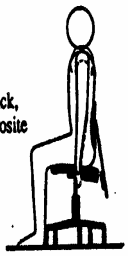
ANKLE FLEX AND STRETCH
Hold one foot off the floor, leg straight. Alternately flex ankle (pointing toes up) and extend (pointing toes toward the floor). Repeat with the other leg.



TALL STRETCH
Interlock fingers, palms up, stretch arms above head until they are straight. Do not arch the back.

TOE-IN, TOE-OUT
Place feet shoulder width apart, heels on the floor, swing toes in, then out.

LEG LIFT
Sit forward on the chair so your back is not touching the chair's back. Place feet flat on the floor. With a straight leg, lift one foot a few inches off the floor. Hold momentarily, return it to the floor and repeat with the other leg.



SHOULDER ROLL
Roll the shoulders--raise them, pull them back, then drop them and relax. Repeat in the opposite direction.

PALMING *(not shown)*
Without pressing on eyeballs, cover eyes with palms. Close eyes. Breathe deeply 8 or 9 times. Uncover eyes after a few seconds. Open by fluttering them and blinking.