Human Resources and Skills Development Canada
Ressources humaines et Développement des compétences Canada

Now and Tomorrow
Excellence in Everything We Do

Departmental Occupational Health and Safety Program

Ergonomic Guideline

Version 1.0

Canada

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1. INTRODUCTION

Human Resources and Skills Development Canada (HRSDC) is committed to providing a healthy and safe workplace.

The Departmental Occupational Health and Safety (OHS) *Program Module III: Integrated Ergonomics Program* (IEP) focuses on preventing ergonomic related injuries through information, guidelines, standards and adjustments.

This ergonomic guideline describes how to adjust furniture and equipment in accordance with the ergonomic technical standards.

For additional information on the adjustment and use of the furniture and equipment outlined in these guidelines, refer to the *Ergonomics Guide to Departmental Office Furniture and Equipment*.

1-1 SCOPE

This guideline applies to all employees within the HRSDC portfolio, including Service Canada and the Labour Program, hereafter referred to as the Department, and every person granted access to the workplace.

1-2 AUTHORITIES AND REFERENCES

The Departmental OHS Program is developed in accordance with the following:

a) *Canada Labour Code*, Part II

b) *Canada Occupational Health and Safety* Regulations

c) *Safety and Health Committees and Representatives* Regulations

d) Treasury Board Secretariat / National Joint Council OHS Directive

e) Treasury Board Secretariat OSH Policy

f) HRSDC Departmental OHS Policy

1-3 ENQUIRIES

Questions regarding this guideline, or its interpretation, should be directed to the Regional Occupational Health and Safety Advisors (ROHSAs). ROHSAs who require clarification regarding this guideline must contact the National OHS Office.

1-4 EFFECTIVE AND REVIEW DATE

This guideline takes effect on July 1st 2011 and replaces previous departmental information on ergonomic function and guidelines for departmental furniture and equipment. This guideline will be reviewed every three (3) years, or as required, to ensure consistency with the IEP and industry standards.

2. VERSATILITY AND FLEXIBILITY

How a worker interacts with the various components of the computer workstation and other equipment should be considered in the selection of equipment and furniture, and in the design and layout of his or her workstation. Workstations should be designed to allow workers to perform their assigned tasks comfortably and efficiently.

3. SITTING POSTURE

The purpose of well-designed seating is to provide stable support that allows movement, comfort and efficient accomplishment of tasks

3-1 *Design reference posture for sitting*

To understand the best way to set up a computer workstation, it is helpful to understand the concept of neutral body positioning. This is a comfortable working posture in which joints are naturally aligned. Working with the body in a neutral position reduces stress and strain on the muscles, tendons, and skeletal system and reduces the risk of developing a musculoskeletal disorder (MSD).

The design reference posture for sitting is as follows:

- Thighs positioned approximately in a horizontal position and the lower legs vertical; the seat height should be at, or slightly below, the popliteal height of the user (while feet are resting on the floor or a footrest); the joints such as hips, knees and ankles should be open slightly;
- Keep upper arms between vertical and 20° forward;
- Shoulders should be relaxed, elbows tucked in at an angle between 90° and 120°, with forearms parallel to the floor;
- Wrists should not be bent;
- Head is level, forward facing, and balanced; it should generally be in-line with the torso;
- The back angle should be 110° to 130° when keyboarding, or an erect and upright spine when writing;
- The soles of the feet should make an angle of 90^{o} with the lower legs;
- There should be no twisting of the upper torso;
- The he working object should be placed so that it can be seen at a viewing angle of between 10° to 30° below the line of sight;
- Alternate crossed legs;
- Avoid bending to the side and bending forward; and

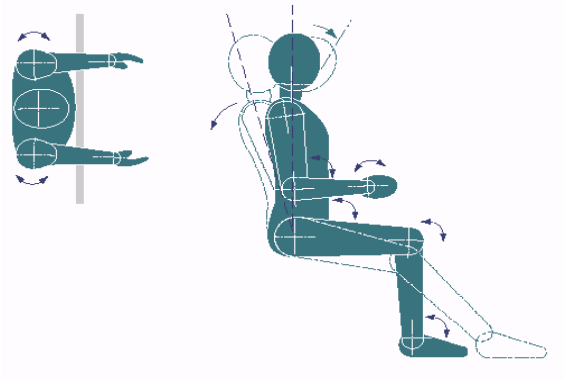
- Incorporate dynamic posture during the day.

Office chairs and furniture procured by the Department should be designed to promote the above postures.[1]

3-2 *Dynamic sitting posture*

No single sitting posture can remain comfortable if maintained for long periods of time. The workstation design, chair design, and the job organization should all allow dynamic sitting. Movement may include slightly altering the angles at the neck, shoulders, elbows, wrists, hips, knees, and ankles.

Figure 2 – Dynamic sitting posture



4. SIT-STAND POSTURES

4-1 *Standing workstations with high stools for sitting*

There are two important considerations in this workstation design.

-Ensure there is sufficient leg clearance to allow the stool to be pulled close to the work surface.

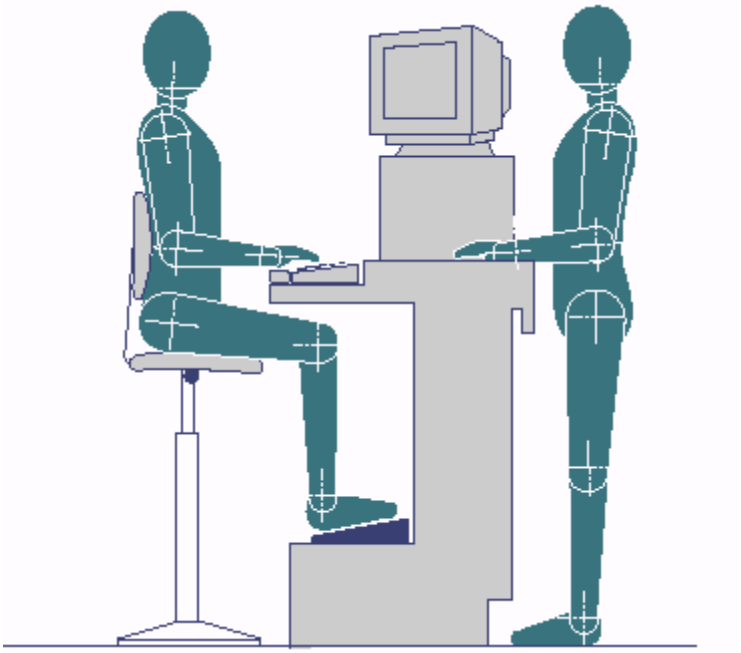
- Ensure appropriate support for the feet, such that they can be placed flat and solidly on a foot support, with knee and ankle angles at not less than 90^{o}.

Sometimes high stools result in the knees being considerably bent, and this can affect comfort and circulation in the legs. A foot support designed underneath the work surface can also provide better posture and support for the lower legs. The worker needs to be at eye level with clients , to minimize awkward neck postures.[2]

[1] Sitting posture: CSA-Z412, Guideline on Office Ergonomics (December 2000)

[2] Sit-Stand Postures: CSA-Z412, Guideline on Office Ergonomics (December 2000)

Figure 3 – Standing workstation with high stool for sitting

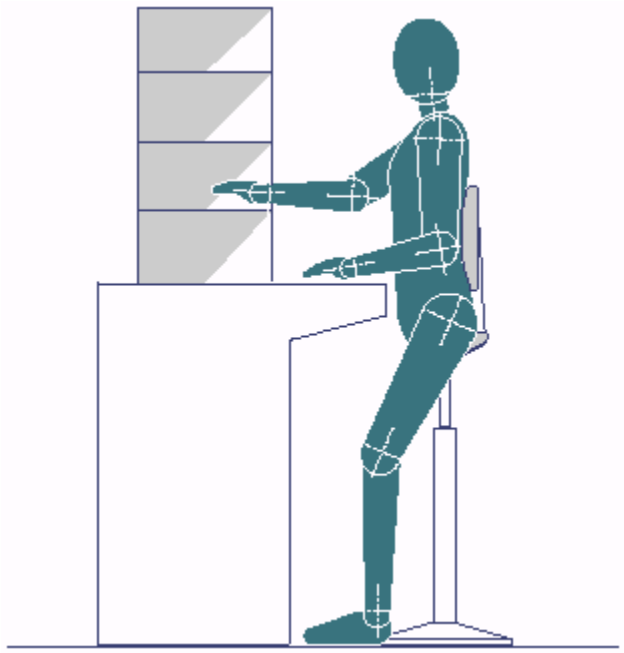


4-2 Standing Workstations with Leaning Postures

When there is little if any clearance underneath the work surface to accommodate a fully seated posture such as in a high stool, workers can benefit from a leaning stool that allows some of their weight to be transferred to the stool in a partially supported or "leaning" posture. The seat of the stool is often sloped downward, rather than horizontally, to facilitate leaning. The benefits of this posture include being readily able to stand and move from the leaning posture as the task requires it and being able to better handle loads in the more upright posture.[3]

[3] Standing Workstations with Leaning Posture: CSA-Z412, Guideline on Office Ergonomics (December 2000)

Figure 4 – Standing workstation with leaning posture



4-3 Standing workstations

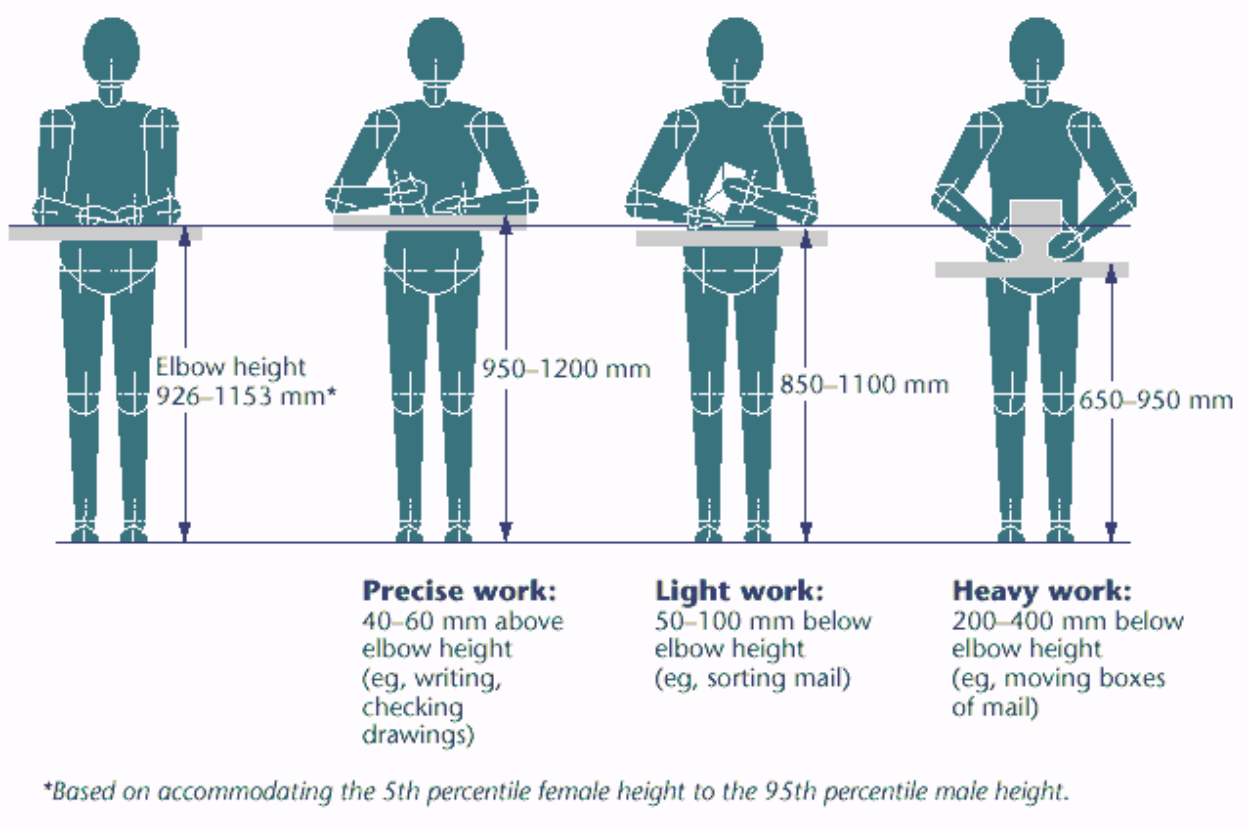
Workplace design should fit the variety of workers' shapes and sizes and provide support for the completion of different tasks.

Different tasks require different work surface heights:

1. Precision work, such as writing or electronic assembly – 4-6 cm [1.5-2.3 in] above elbow height; elbow support is needed.
2. Light work, such as assembly-line or mechanical jobs - about 5-10 cm [2-4 in] below elbow height.
3. Heavy work, demanding downward forces - from 20-40 cm [8-16 in] below elbow height[4]

[4] Standing workstations: CCOHS, Basic Information, 2008

Figure 5 – Guideline for standing work heights



5. CHOICE OF POSTURE

When considering whether to design or redesign a workstation for a sitting posture or standing posture, careful consideration must be given to the tasks to be performed. From the task description, which conditions apply to the job should be determined. Most important, the combination of task variables present need to be considered.[5]

6. LINE-OF-SIGHT ANGLE

In an upright, seated posture, the normal vertical line of sight angle is 15° below the horizontal. The optimal vertical line of sight angle can range between 5° above and 30° below the horizontal. When a line of sight angle is greater than 35° below horizontal, the worker will flex their neck forward to view items. Vertical line of sight angles greater than 5° above the horizontal should be avoided because they produce neck extension. Neck extension quickly produces fatigue and discomfort to neck muscles.

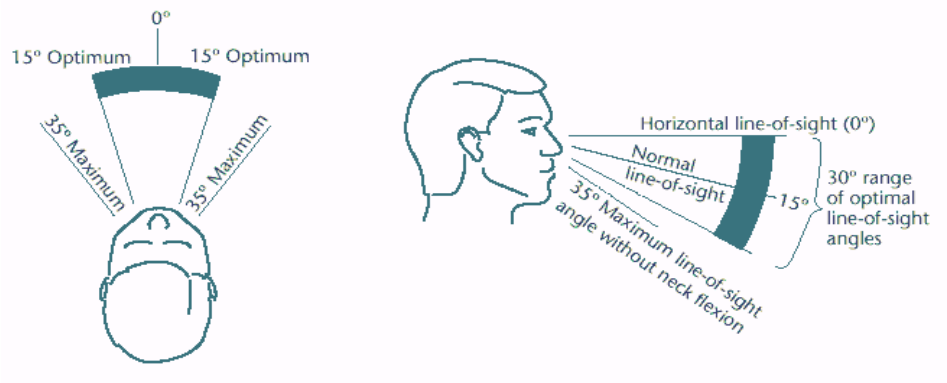
Similarly, the lateral line of sight angle has an optimal range 15° to the left or right of neutral. An angle greater than 35° will require the worker to rotate or twist their necks

[5] Choice of Posture:CSA-Z412, Guideline on Office Ergonomics (December 2000)

and should be avoided The line-of-sight should fall within the range of 15° to 35° while the worker is seated in comfortable working postures.

When the monitor is the primary object in a worker's field of view, the monitor should be positioned 40-74 cm [16-29 in] away from the worker's eyes (approximately anarm's length). Usually this can be achieved if the top line of text on the computer monitor screen is placed slightly below the horizontal line-of-sight. The monitor should be adjustable in height to accommodate the line-of-sight angle.[6]

Figure 6 – Line-of-sight angles



7. SEAT PARAMETERS

Reference in this section to actual chair dimensions and methods for measuring chairs and assessing their performance are from CGSB Standard CAN/CGSB-44.232 and BIFMA publication BIFMA/CMD-I. The specification and ranges in this section should accommodate users with 5th percentile female body dimensions to 95th percentile male body dimensions. However, these specifications and ranges will not accommodate at least 5% of the users for any particular dimension. In these cases, refer to the guiding principles and design requirements in CSA Standard CAN/CSA-ISO 9241-5 for guidance on achieving an appropriate fit.

7-1 Seat height

The appropriate seat height for a user sitting in the upright position is the popliteal height plus the thickness of footwear. Popliteal (or knee) height is defined as the vertical distance between a footrest surface and the back of the knee when sitting.
CSA Standard CAN/CSA-ISO 9241-5 states that for seat height, work chairs shall achieve fit for the intended users. This means that the range of seat height adjustability needs to accommodate the lower to the higher percentile popliteal heights of the intended workers. It is also important to allow for footwear and variation in sitting postures.

[6] E.K. Gillin & Associates Inc., 2007

Within a selected range of adjustability, seat height shall be readily adjustable by the user. A seat height range of 38-51 cm [15-20 in] accommodates the 5th percentile female popliteal height to the 95th percentile male popliteal height
Users should be able to sit with their feet comfortably on the floor without undue pressure on the underside of the thighs. The thigh-to-torso angle should be not less than 90°.

If the seat cannot be lowered (for example, it would make the keyboard or monitor too high), a footrest should be used to provide stable support for the feet.

7-2 Seat depth

This dimension is important both to ensure that the legs can be positioned without compression at the back of the knee and to enable the buttocks to be positioned to enable full use of the back rest. A free space between the back of the knee and the seat pan should be about 5-10 cm [2-4 in] to encourage leg movement.[7]

Seat depth fit can be achieved either by adjustability or by using different sizes of chair. CGSB Standard CAN/CGSB-44.232 specifies three seat depth dimensions:

1) Shallow seat: a seat depth no less than 38 cm [15 in] up to and including 42 cm [16.5 in];

2) Medium seat: a seat depth greater than 42 cm [16.5 in] up to and including 46 cm [18 in]; and

3) Deep seat: a seat depth greater than 46 cm [18 in].

The seat depth should adjust by at least 5 cm [2 in] and should include the range from 42-46 cm [16.5-18 in]. Users should be able to sit in the chair without undue pressure against the back of the knees, with their back properly supported by the backrest and with adequate buttock and thigh support.

7-3 Seat width

For seat width, fit is achieved when the seat width is wider than the width of the hips. Seat width should exceed the seated hip breadth of the largest worker in range. Allowances for clothing and extra width for movement should be added if there are armrests.

The seat width should be between 40-48 cm [15.75-19 in].[8] Note, however, that a user with narrow hip and shoulder width may find armrests too far apart. Armrests that adjust inward will help accommodate users with narrow hips and shoulders.

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[7] [8], E.K. Gillin & Associates Inc., 2007

7-4 Back support

7-4.1 General Principles

The backrest should be capable of providing support to the back of the worker in all sitting postures.
Low-level backrests should commence at a level that clears the major protuberances of the buttocks, have a maximum prominence in the mid-lumbar region to support the lower back, and conclude below the shoulder blades, so as not to inhibit upper body movement.

The need for freedom of movement of the shoulder blades depends upon the type of job being done. In many instances, the upper body leans forward when the arms are being used, and the shoulder blades are not in contact with the backrest. In circumstances where the worker rotates frequently in the chair, the backrest should be lower than the shoulder blades to facilitate the movement.

For some types of work in which reclining postures are desired, higher backrests, which also provide support for the upper back, are recommended. Higher backrests also need a forward curvature in the lumbar region, which gently merges into a plane surface of concavity.

In jobs requiring prolonged seating postures such as computer work, a higher backrest can have advantages in terms of added support for the upper back. This transfers more of the upper body weight onto the chair back, thereby reducing muscle activity.

7-4.2 Backrest Height

The height of the backrest must be designed to ensure adequate support for the back and an acceptable curvature for the spine. This is important for minimizing static loading and reducing the likelihood of back pain.

CGSB Standard CAN/CGSB-44.232 specifies two backrest heights:

1) Standard back: the top of the backrest should not be less than 45 cm [17.75 in] and not greater than 55 cm [21.5 in]; and

2) High back: the top of the back rest should be at least 7.5 cm [3 in] higher than the standard back.

When free arm movement is necessary, backrest cushion height should be a minimum of 12 cm [4.75 in], and preferably15-23 cm [6-9 in]. Chairs with height-adjustable backrests are preferable.

7-4.3 Lumbar Support

The lumbar support should be vertically convex and horizontally concave for side support. The optimal conditions of a chair for decreasing disc pressure and muscle activity are when the backrest is inclined 110^{o}-130^{o}.[9]

[9] E.K. Gillin & Associates Inc., 2007

The lumbar support should be adjustable by at least 5 cm [2 in] within the range of 15 to 25 cm [6 to 10 in] above the seat. For boardroom chairs, if the height of the lumbar support is fixed, it should fall within the range of 15 to 25 cm [6 to 10 in] above the seat.

7-4.4 Backrest width

The backrest cushion width should be between 30-36 cm [12-14 in].[10] Lateral concave curvature of the backrest should not be uncomfortable for larger workers. This can be evaluated with user trials. When free arm movement is necessary, backrest cushion width should be between 32-38 cm [12.5-15 in].

7-4.5 Backrest angle

For chairs of high-use computer workers, the backrest angle shall be adjustable a minimum of 10^{o} within a range of 110^{o} to 130^{o}[11]. The backrest angle adjustment mechanism, when unlocked and activated with a load, should allow the backrest to tilt backward, and when activated without a load, should allow the backrest to return to the forward position. The backrest should be lockable at various positions within the backrest angle adjustment range.

7-4.6 Backrest-to-seat angle

The angle of the seat pan should allow the user to support their feet on the floor or footrest. When the backrest-to-seat angle is fixed, the backrest-to-seat angle should not be less than 90° nor greater than 130^{o}[12]. 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.

7-5 Armrests

7-5.1 General principles

In some tasks and workstations, armrests may not be desirable, such as where swivel movements are frequent or where armrests prevent the worker from sitting close to the desk. Where armrests are provided, they should:

1) Be set back at least 15 cm [6 in] from the edge of the seat;

[10,11,12] E.K. Gillin & Associates Inc., 2007

2) Not restrict the worker's preferred posture. If armrests obstruct the worker they should be adjustable or detachable;

3) Not restrict ease of access to the workplace. In particular, the height should not prevent the work chair from being slid under the work surface; and

4) Preferably provide comfortable padded support, and not be a source of contact stress to the forearms.

Chairs should be made available with or without armrests. Armrests should be made adjustable in height, angle, and width (clearance) or any combination of these. When removable, they should be detachable using commonly available tools.

7-5.2 Armrest height

Armrest height is derived from the height of the elbow above the seat and is described technically as elbow sitting height. The armrest height is related to the worker's elbow position, the thickness of the work surface in conjunction with thigh height, and armrest separation. The armrest height interacts with the width of the seat and the distance between the armrest. For example, a small user will have to raise the upper arm to the side to reach the armrest, or lean over to one side if the seat pan is too wide because this puts the armrest at an inappropriate distance for the user.

The armrest height adjustment range should be at least 5 cm [2 in], and include the range from 16 to 25 cm [6 to 10 in].[13] Adjustable height armrests will accommodate the greatest number of workers.

7-5.3 Armrest length

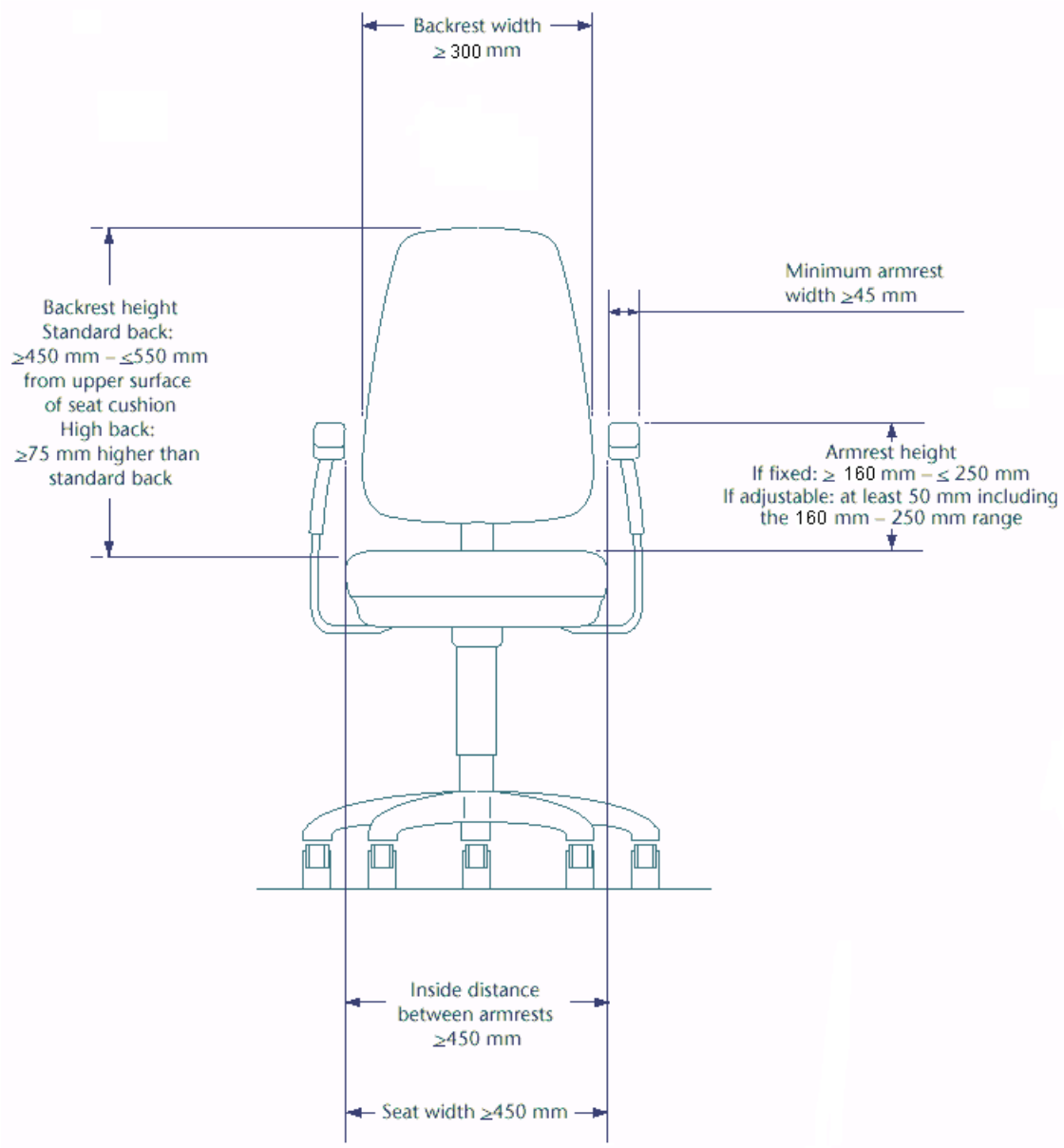
Armrest length is important in maintaining the ability of the worker to get as close as possible to the work surface while maintaining the effective use of the backrest. If the armrest is too long, the small user is unable to sit close to the work surface and gain support from the backrest of the chair. The total length of the armrest shall be between 15-28 cm [6-11 in].

7-5.4 Armrest width

The inside distance between armrests should be 45-56 cm [18-22 in]. The range of adjustment should include this width requirement. The armrest cap width itself shall not be less than 4.5 cm [2 in].

[13] E.K. Gillin & Associates Inc., 2007

Figure 7 - Chair dimensions (front view)



7-6 Seat parameters important for movement

7-6.1 Seat angle

Seats may be designed with a fixed or adjustable seat angle. When the seat angle is adjustable independently of the backrest, it should be adjustable to a minimum of 3° forward and 4° rearward from the horizontal position. It should also be lockable in various positions.

7-6.2 Movements of the seat and backrest

The angle between the seat and the backrest should allow the user to achieve a torso-to-thigh angle of 90^{o} or greater.

In chairs where computer use is the primary task, the seat height, seat angle, backrest height, and the backrest angle should be adjustable independently of each other. This provides the greatest opportunity for individual customization.

In chairs where computer use is not the primary task, the seat and backrest may be designed to tilt concurrently. The angle between the seat and backrest opens up by simultaneous movement of the seat and the backrest in a pre-set ratio. The suggested ratio for the tilt mechanism is not less than 1.5:1, so that the backrest reclines at least 1.5^{o} when the seat reclines 1 ^{o}.

Where the computer use is occasional, the chair may be designed to allow the seat and backrest to tilt in unison rearwards at least 15 ^{o} while the occupant's feet remain flat on the floor. The chair should be lockable within the tilt range.

7-6.3 Casters

There should be 5 casters/wheels over a diameter between 40 and 45 cm [15.75 and 17.75 in] to prevent the chair from tipping. The maximum radius depends on the size of the chair but should not produce a trip hazard.[14]

The casters should be single-wheel casters. Casters on hard surfaces such as hardwood, ceramic tile, etc. should roll easily so as to protect surfaces. They are designed with soft rubber wheels, easily swivelling threads on the wheel and sealed ball bearing for stability. It is recommended to have a gray soft rubber wheel in an office chair caster to ensure that concrete, linoleum, vinyl and tile will not be marred with unsightly streaks.[15]

Note: Plastic mats are not recommended, the user should change the casters to the required surface.

The work chair shall not travel unintentionally when occupied or unoccupied. The work chair shall not move away easily when unoccupied. Casters with a low resistance cannot be used safely on a hard floor surface.

7-6.4 Swivel

The swivel should enable a user to easily and safely route his or her body without rotating his or her spine or twisting the torso to get close to equipment or materials.

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[14] E.K. Gillin & Associates Inc., 2007

[15] Caster Wheels, www.casterwheel.com, 2010

7-7 Other considerations in chair design

7-7.1 Controls and ease of adjustment

Controls should be convenient and designed so that they encourage correct use. They should:

1) Preferably be operable from the usual seated working position, with the exception of seat height and tilt tension, which should be operable semi-seated or standing when the chair is in the upright position;

2) Be logical in their placement and direction of activation, requiring a positive action to operate;

3) Not require undue force for activation;

4) Not require any special training or special tools before adjustment can be made; and

5) Be designed to prevent unintentional actuation.

The controls should also be designed so as not to pose a safety problem during actuation.

7-7.2 Front edge of seat

To minimize compression on the underside of the thigh, the seat cushion should have a waterfall-shaped front edge. When measured without compression, the vertical height of the seat front edge curve should not be less than 4 cm [1.5 in], and the radius of the front edge curve not less than 4 cm [1.5 in] or greater than 12 cm [4.7 in].

7-7.3 Cushioning material

When foam cushioning materials are used in the seat and backrest, they should be expanded flexible urethane foam of flat slab, sculpted slab, or moulded construction. The seat cushion should be neither too hard nor too soft, with a compression of about 2.5 cm [1 in] to allow comfort in multiple positions when a foam cushioning is used. The cushion (and the seat pan) should have minimal contouring to allow easy shifting of position.

The seat covering should be a permeable fabric that is not slippery and allows ventilation and absorption of perspiration. There should be no local pressure points or lines. Refer to CGSB Standard CAN/CGSB-44.232 for cushioning compliance requirements. Preferably, armrests should be made of self-skinned moulded polyurethane or other soft material.

Office chairs procured by the Department should be designed to promote the above postures.

Note: A minimum one week trial period is highly recommended before the purchase of a chair to ensure suitability.

7-7.4 Boardroom chairs

The seat height, seat depth, seat width, backrest height, backrest width, armrests, casters/wheels and the seat cushion should meet the basic ergonomics requirements.

7-8 *Steps to Properly Positioning Chair*

1. Locate all adjustments – seat pan (height, depth, and angle), backrest (height, angle), armrest (height, width), and tilt.
2. Stand in front of chair facing backrest and position the seat pan height to just below the knee cap.
3. Sit in chair and ensure feet firmly on floor with thighs parallel to the ground (adjust if necessary).
4. Inspect behind the knee and ensure adequate space present (approximately the width of clenched fist and no less than two finger width – adjust if necessary).
5. Determine types of activities done in seated posture and adjust tilt accordingly or to preferences (forward for close proximity tasks or backward for increased distance tasks – adjust if necessary) Note: Height of seat pan may need to be adjusted to ensure feet firmly on floor if seat pan tilt affected this position.
6. Inspect backrest angle and ensure it is 110°-130° with seat pan when doing computer work and 90° or less when writing at a desk.
7. Inspect backrest height and ensure lumbar support is positioned in the middle of the lumbar curve.
8. Hold arms at their side with elbows bent 90° (forearm parallel to floor) and shoulders relaxed (no elevation, flexion or abduction).
9. Adjust armrest height and width to support the arms in this position.[16]

8. STOOLS

Note: Stools are generally not recommended for use as task seating but if purchased they must meet the following standards:

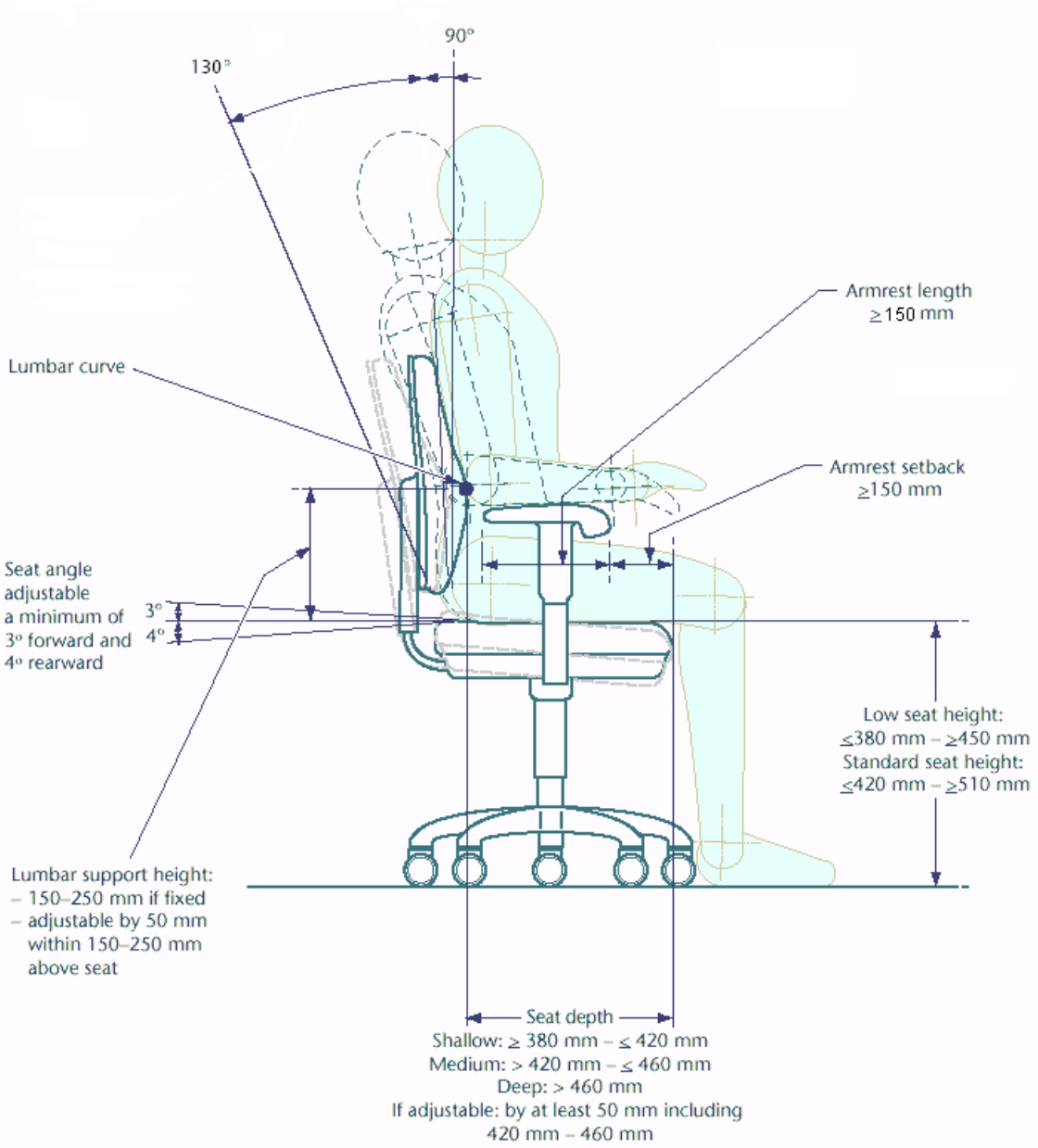
Stools have the same seat pan and back support requirements as a chair. Seat height depends on work surface height, and thigh clearance should be 20 cm [8 in] minimum.

[16] E.K. Gillin & Associates Inc., 2007

To bring the upper leg parallel to the floor, all stools require footrests. Separate footrests (see section 16) are preferred, because they are more stable and do not require a backward angle of the lower leg. Attached footrests may be a ring or sector shape and adjustable from 38 to 53 cm [15 to 21 in] below the top front of the seat. The front of the footrest should extend at least 5 cm [2 in] in front of the edge of the seat. The stool base must be large enough to ensure that standing on the footrest will not tip the stool.
The base should have five points in contact with the floor, and a minimum base diameter of 68 cm [27 in] is recommended (or a sleigh base). If the base is fitted with casters, they should be the locking type that does not roll unless there is no load on the stool. Otherwise, the stool can slip out from under the user.[17]

[17] Stools:CSA-Z412-M89, Guideline on Office Ergonomics (December 2000)

Figure 8 - Chair dimensions (side view)



9. STEP STOOLS

When the step stool is in the open position the angle of inclination of the front section shall be not more than 75° and the angle of the inclination of the back section not more than 80°. The minimum clear width between side rails at the top step shall be 30 cm [12 in] as well as the minimum outside width at the top cap. Excluding the interval between the bottom step and the support surface, the steps and top cap shall be uniformly spaced at an interval of between 20 to 30 cm [8 to 12 in] and the minimum width of the step or tread for step stools shall be 7.5 cm [3 in]. The top cap shall be of sufficient

strength and slip resistance to permit use as a climbing surface and its size shall be not less than 30 cm [12 in] in width and 13 cm [5.25 in] in depth. The top cap shall not be hinged for folding the ladder and a metal spreader or locking device of sufficient size and strength, to securely lock the front and back sections in the open position, shall be a component part of each step stool. The bottoms of the four rails shall be provided with slip-resistant material.

10. WORK SURFACES FEATURES

10-1 General Considerations

The work surface should provide support for equipment such as the display and input devices, as well as other equipment and material, in addition to providing support for the hands and arms of the user. The main considerations when choosing work surfaces are the tasks or activities to be performed, the equipment to be accommodated, and, in multiple-use situations, the adjustability needed to meet the range of different workers using the surface.

Work surfaces also need to allow adequate clearance for the worker's lower limbs and for postural changes. The height of the work surface is important for the upper limbs. To ensure a relaxed and natural shoulder posture when writing or reading at the work surface, the work surface should be no more than 5 cm [2 in] above the employee's elbow height. Recommended dimensions for work surfaces in this section are based on CGSB Standard CAN/CGSB-44.227.

10-2 Types of work surfaces

10-2.1 Height adjustable work surfaces

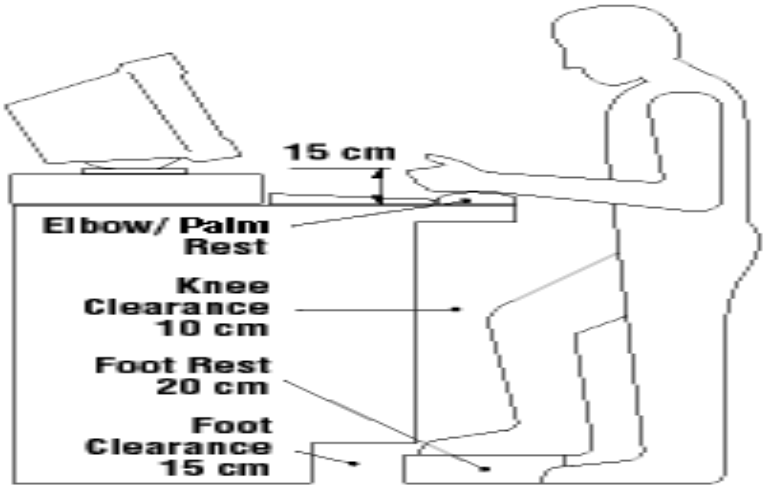
Readily adjustable work surfaces are designed to raise or lower so workers can position their work at comfortable and efficient heights. They are well-suited to multi-use workstations, where different workers use the same surface, or where there is considerable staff turnover. They are also useful in single-user workstations where a range of different tasks are performed that require different heights on the same surface. Some height-adjustable work surfaces raise sufficiently to accommodate work in both a sitting and standing posture. **Note:** Fixed-height work surfaces are not recommended.

10-2.2 Standing Workstation

- The height of the work should be adjustable from 90 to 120 cm [36 to 52 in] vertically above the standing surface.
- Workstations that cannot be adjustable must have adjustable platforms provided so that the work is performed between 90 and 130 cm [36 and 52 in] in height.
- Provide anti-fatigue mats with bevelled edges for the entire area where standing work is required whenever such mats do not interfere with moving equipment or carts.

- A minimum knee clearance of 10 cm [4 in] is required.
- There must be an overhead clearance of 210 cm [83 in] between walking surface and any obstruction.
- Provide a minimum foot depth clearance of 15 cm [5 in].
- Provide a minimum foot height clearance of 10 cm [4 in].

Figure 9 – Standing work heights dimensions



10-2.3 Sit/stand workstation

A sit/stand workstation should be designed as specified:[18]

- Knee clearance must be at least 30 cm [12 in] in depth and 65 cm [26 in] across the workstation and be free from obstructions.
- The height of the work above the seat must be between 30 to 60 cm [12 to 24 in]
- The height of the work above the floor must be between 100 to 120 cm [39 to 47 in]
- The range of adjustability of the seat pan height must be between 80 to 100 cm [31 to 39 in].

A sit/stand workstation should be used[19]:

- Adjustability: the sit/stand workstation should be easily adjustable in order to accommodate the employee with limitations without adding extra stress on the employee's back.

[18] E.K. Gillin & Associates Inc., 2007

[19] Sit/Stand Workstation:*CSA-Z412, Guideline on Office Ergonomics (December 2000)*

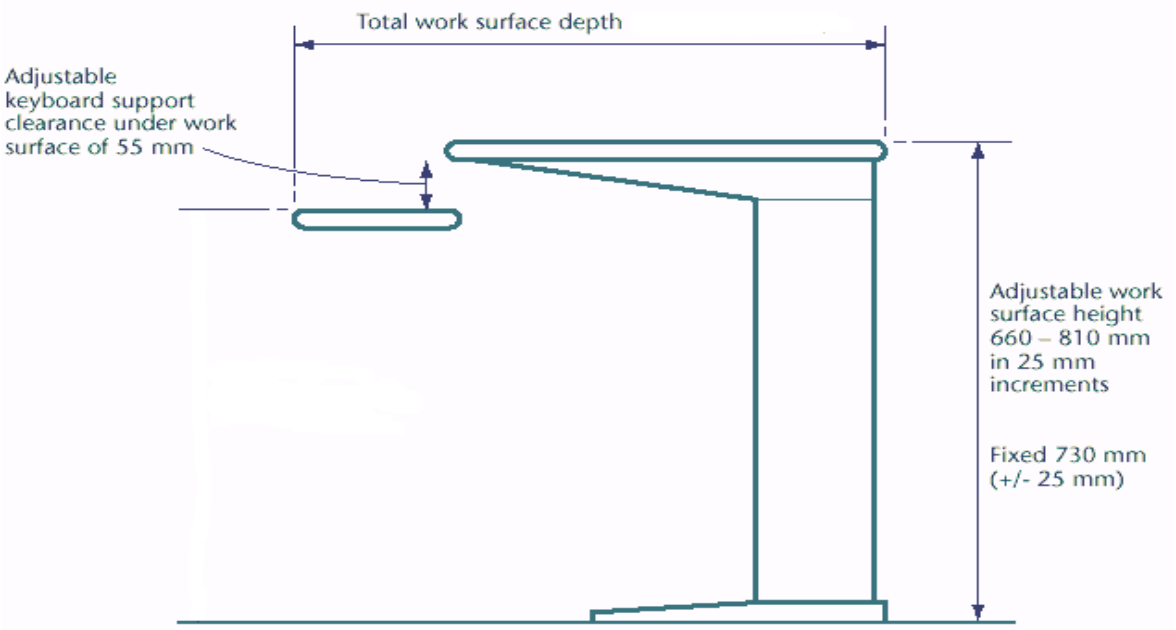
- Keying: the height of the work surface should be easily adjusted so that the keyboard is at the employee's elbow height. Ensure that the shoulders are relaxed and that the wrists are straight.
- The feet should be placed at a comfortable distance and knees should remain unlocked. Similar to the sitting posture, the employee should stay close to the work surface when standing and avoid reaching and twisting of the trunk, head and arms.

Note: Sit/Stand workstations are only available when medically indicated by a health professional.

10-2.4 Seated Workstations

- A seated workstation must be designed to meet the task requirements.
- Precision work height should be performed at 79 to 109 cm [31 to 49 in].
- Workstation height for reading and writing should be performed at 66 to 81 cm [26 to 32 in].
- Workstation height for keying and light assembly should be performed at 53 to 71 cm [21 to 28 in].
- The area should allow for adequate placement of equipment to minimize reaching.
- The work surface thickness must be at most 5 cm [2 in].
- The leg clearance must be at least 61-76 cm [24-30 in].
- Knee clearance must be at least 38 cm [15 in].
- Foot depth must be at least 23 cm [9 in].
- Foot height must be at least 23 cm [9 in].

Figure 10– Dimensions for seated work surfaces



10-2.5 Split work surfaces

Typically, this component has two separate work surfaces, one to support a monitor and one to support the input devices. The monitor support surface may be fixed-height or adjustable. Usually the keyboard support surface is adjustable. The keyboard support surface may be part of a 4-sided rectangular component or placed in a corner as part of a 5-sided component. These work surfaces help to accommodate different tasks in the same workstation. They work well when they are matched to the tasks a user will perform and to the work environment at the particular workstation. Care must be taken to ensure that the user does not bump his or her legs and knees on the adjustment mechanisms for the keyboard support.

10-3 Heights for work surfaces

Work surfaces may have a fixed height (traditionally set at 73 cm ± 2.5 cm [28.75 in ± 1 in] when measured from the floor), continuous height adjustment capability or incremental adjustment capability. The vertical adjustability range for continuous and incremental work surfaces should be at least 66 to 81 cm [26 to 32 in]. Incremental work surfaces should be adjustable in increments of no more than 2.5 cm [1 in].

Also, precise jobs that require high visual demands and detailed finger and hand manipulations should be elevated above elbow height by about 4-6 cm [1.5-2.5 in]. For manual jobs that require minimal visual demands and fairly light activities, the working height should be at or slightly below elbow height by about 5-10 cm [2-4 in]. If the job involves forceful activities such as downward exertions, lifting, and/or handling, the working height should be lowered below elbow height by about 20-40 cm [8-15.75 in]. Ultimately, jobs that are done regularly and/or by different people at the same workstation should be height adjustable. For regular workers, adjustability would change

the tissue recruitment leading to different demands on the worker for various heights even though it is the same task.[20]

10-4 Work surface depth

The choice of work surface depth will depend upon a number of variables including tasks performed, presence and size of monitor, presence or absence of a separate surface for the keyboard and other input devices, and other equipment or materials stored in the workplace. A minimum depth of 40 cm [15.75 in] is suggested for writing tasks (no computer). A minimum depth of 61 cm [24 in] for a single task worker and a minimum depth of 61 cm [24 in] for a multi-task worker are suggested. These dimensions are suggested for computer work surfaces, based on sufficient viewing distance and room for the keyboard, other input devices, and with a 14-15 inch monitor. Larger monitors will require more depth or a bridging section to attain a comfortable viewing distance. **Note**: CRT monitors require a minimum depth of 90 cm [35.5 in][21].

10-4.1 Working Reaches

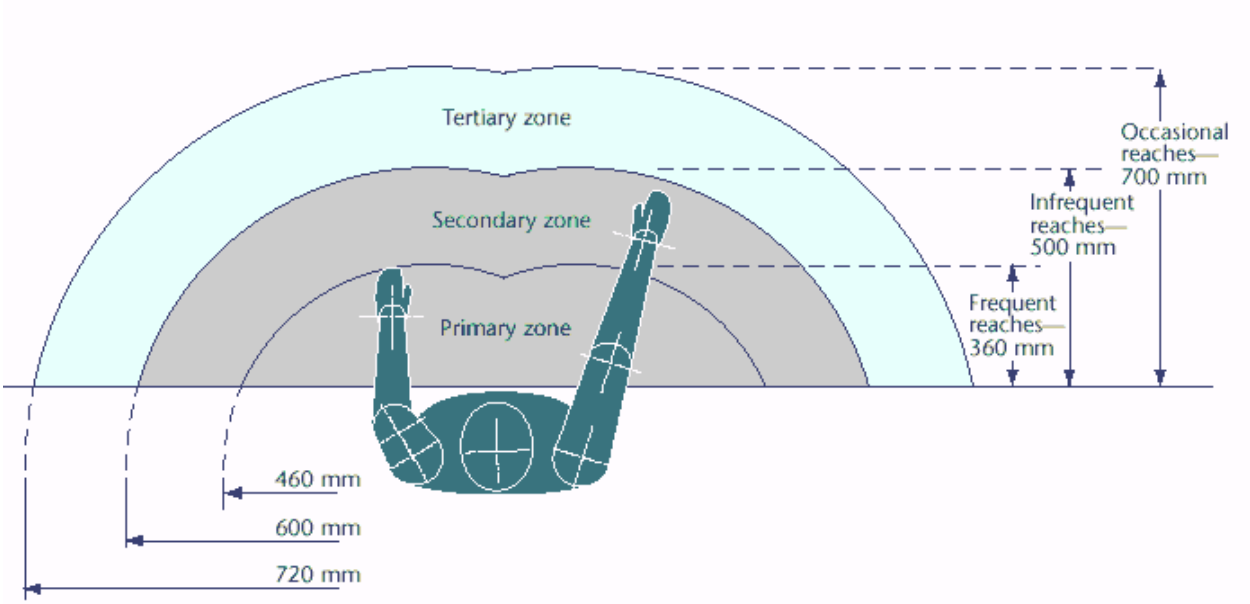
The 3 zones are defined by their distance from the seated position (or standing position if the workstation is a standing one). Items required for tasks that are of highest priority, highest frequency, or longest duration, should be placed closest to the worker which is called the “primary zone”. Items which the worker requires to reach or see on a daily basis but for a short period of time can be arranged in the “secondary zone”. A third zone, called the “tertiary zone” is the area for items the worker uses occasionally and usually requires that he or she moves from the normal position to access them.[22]

[20] Heights for work surfaces: E.K. Gillin & Associates Inc., 2007

[21] Ergonomic Office Australia, Ergonomic information, 2010

[22] Working Reaches: *CSA-Z412, Guideline on Office Ergonomics (December 2000)*

Figure 11 – Working reaches



10-5 Clearance under work surfaces

For seated work, sufficient vertical, horizontal, and lateral clearance is needed between the torso and lower limbs of workers and workstation components such as the underside of the work surface, desk drawers, table legs, etc. (legroom height, width, and depth). The considerations are for:

- Postural changes and comfort;
- Ease of use of the computer equipment and performing associated tasks;
- Safety (stability, structural integrity, lack of injury); and
- Ease of standing and sitting.

As specified in CSA Standard CAN/CSA-ISO 9241-5, furniture shall achieve “fit” for clearances, including vertical, lateral, and horizontal legroom. If fit is to be achieved by adjustable surfaces, it shall accommodate the 5th percentile female clearance envelope dimensions to the 95th percentile male clearance envelope dimensions. Where a worker’s dimension is larger than the 95th percentile male dimension and smaller than the 5th percentile female dimension, special accommodations may be required.

10-6 Finish of the work surface

The finish of the work surfaces should be a non-glare finish, to minimize specular reflections.* Reflectance values for the visible parts of the work surfaces should be

selected to avoid undue luminance contrast with the equipment and other items within the field of view.

There should be no sharp edges or corners on work surfaces and their supporting framework that could cause injury or discomfort to workers. The minimum radius on edges and corners designed for a worker to rest the forearm or wrist should be 0.3 cm [0.12 in].

Furniture procured by the Department should be designed to promote the above specifications.

**CGSB Standard CAN/CGSB-44.227 recommends that unless otherwise specified, 60° of specular gloss of work surfaces should not be more than 45 units when tested in accordance with ASTM Standard D 523.*

10-7 Safety and Stability Aspects of Workstations

The work surface, when loaded with equipment, should not tip over if a person leans on any side or sits on the edge. Parts of the workstation should not tip over when loaded and used with intended work items such as paper, visual display units, etc. If tables are height-adjustable, the adjustment shall be stable and safe. If drawers are part of the workstation, it shall not be possible to pull a drawer out unintentionally so that it falls. Refer to CGSB Standard CAN/CGSB-44.227 for specifics on safety, stability, and testing requirements.

11. MONITORS

11-1 General characteristics

Visual displays or monitors should be designed to ensure that information is legible, readable, and comfortable to use. CSA Standard CAN/CSA-ISO 9241-3 provides design requirements, recommendations, and test methods for evaluating new visual displays. Compliance with CSA Standard CAN/CSA-ISO 9241-3 will ensure that the monitor meets the above design objectives. Note that CAN/CSA-ISO 9141-3 provides minimum standards. It is important to regularly clean the screen to remove dust and fingerprints that may hamper legibility.

11-2 Screen Size

A variety of screen sizes are available. The critical factors for determining the appropriate minimum screen size are the task requirements, screen resolution, the normal viewing distance selected by the worker, and the time the worker will spend viewing the display. For editing the text of a typical document, over a limited duration of time, with a character height of 0.3 cm [0.12 in], a minimum screen size of 29 cm [11.5 in], a recommended screen size of 38 cm [15 in], and a maximum screen size of 56 cm [22 in] are suggested. See table 1 below when choosing the screen resolution versus the screen size.

Table 1 – Monitor resolution vs. screen size[23]

Monitor Resolution	Screen Size
800x600	12" - 14"
1024x768	15"
1152x870	17"
1280x960	17" - 19"
1600x1200	21"- 24"

11-3 Monitor adjustments

Most monitors have adjustments for swivel and tilt. For LCD monitors tilt is very important as this can be used to increase visual comfort or to reduce or eliminate unwanted glare. Tilting the screen upwards slightly can increase visual comfort, but it can also increase the appearance of indirect glare from some light fixtures. If glare is seen on the screen from overhead lights, the monitor should be positioned between overhead lights. To decrease direct and indirect glare from a window, the monitor should be placed at 90° to the window.

Many monitors and software programs also permit adjustments to the monitor's brightness, contrast, and colour. The choice of settings depends upon the type of task being performed, the luminance environment, and the visual needs of the worker. The chosen screen brightness should be similar to other sources of visual information in the office, such as hard copy documents, to reduce eye strain. For CRT monitors, if flicker is noticed when looking at the screen, increase the monitor's refresh rate. (For most computers: right click on the desktop and click **Properties** – **Settings** – **Advanced** – **Monitor** – **Screen Refresh Rate** and choose the highest setting. Consult the IT department if this does not work.)

11-4 Monitor Placement

The monitor should be at arm's length from the body (40 to 70 cm) when seated in front of it. The monitor's angle should not exceed 15 degrees to ensure visual comfort and reduce reflection on the screen (glass surface of the monitor). The top of the screen should be at eye level. In addition, when looking at the monitor, the head should be in

[23] Proaxis, Resolution to Monitor Size Chart, 2000

line with the body and in a neutral position (i.e. without requiring movement of the head or neck backwards or forwards).

If the workstation is close to a window, the monitor should be perpendicular to the window whenever possible. This arrangement reduces the risk of light reflecting from the window on the screen. In addition, the monitor should be placed parallel to and between ceiling lights, and not directly under a light. Note that the department's premises are equipped with reflectors that reduce the risk of glare in the field of vision, and reflection on the screen.

11-5 Preferred support surface for computer monitors

Computer monitors may be placed on a fixed-height, height adjustable, or split height work surface, on a monitor stand, or on a swivel arm. The preferred support surface would be height adjustable. Adjustable-height monitor stands are most useful in multi-user workstations or where a variety of tasks are performed. Adjustment is usually made by the worker, using a crank or hydraulic mechanism.

As mentioned above**,** the neck is most comfortable if visual information is placed at the horizontal line of sight (eye level) and within 30^{o} downward from this. Note that bi- and trifocal wearers will likely need the monitor lower than this to prevent uncomfortable upward tilting of the head and neck.

11-6 Optional support surfaces for monitors

In choosing the most appropriate support surface for the monitor, the following should be considered: seated eye height of the worker above the floor and foot support, size of monitor, visual capability of the worker, type of work surface (e.g. split work surface), length of time spent on the computer, and other aspects of furniture design and layout.

11-6.1 Primary work surfaces

Depending upon seated eye height of workers, their visual capability, and the size of the monitor, some workers will be able to achieve the dynamic sitting posture and line-of-sight angles by placing the monitor directly on the work surface (fixed-height, adjustable-height, or split-height). This may achieve fit for an individual, but may not be appropriate for workstations with multiple users.

11-6.2 Fixed-height monitor stands

When the height of the monitor on a fixed-height surface or the rear surface of a split-height work surface is too low (i.e. more than slightly below horizontal line of sight), a monitor stand may be required to raise the height. Fixed-height monitor stands are suitable for workstations dedicated to a single worker. The height of the monitor should be adjusted based on seated eye height of the individual worker.

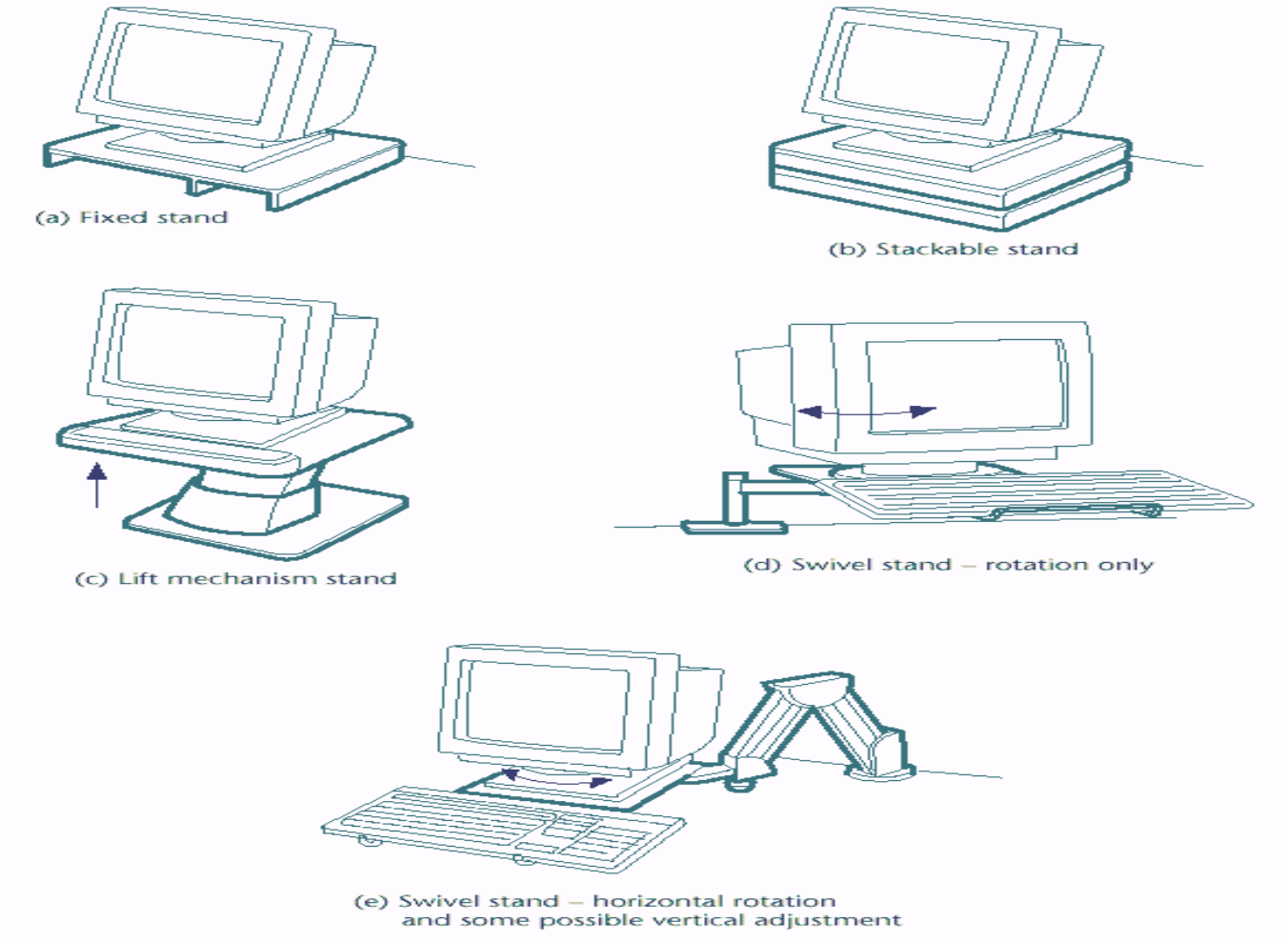
11-6.3 Swivel-arm stands

Swivel-arm monitor stands usually clamp to the work surface. They may provide rotation and horizontal and/or vertical adjustability. When a swivel arm is used, it is important to ensure that

- The height of the top line on the display is not higher than eye height;
- The design mechanism and height adjustment ensures mechanical stability;
- The dimensions of the support on the swivel arm are commensurate with the size of the visual display unit and provide a secure base for the equipment (for example, in the form of recesses for the feet or raised edges); and
- The keyboard can be positioned on the swivel arm when not in use, in a stable, easy-to-reach location. For operation, it should be placed on the work surface.

Monitors procured by the Department should be designed to promote the above postures.

Figure 12 – Monitor stands



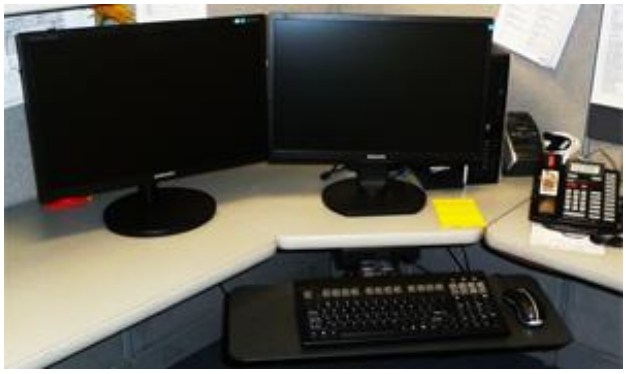
12. DUAL MONITORS

As dual monitors become more common in the workplace, it is important to ensure the two monitors are adjusted to suit the user and the tasks they perform.

12-1 If one is used more frequently – use the following guidelines (See photo 1)

1. The primary computer screen should be in direct line of sight with sitting position
2. The secondary screen should be positioned immediately to the right or left (depending on preference)
3. Use shifting eye position (minimal neck rotation) when looking at the secondary screen.
4. Dual monitor screens should be the same size and model and have the same fixation method to the desk top; if this is not possible, adjust to the same height and depth
5. Both monitor screens should be at the same height and at the same distance, adjacent to and in line with each other with minimal angling
    a) Monitor screen depth should be about an arm's length away from the seated keying position
    b) Arrange the monitor screen (height and angle) to allow normal gaze to fix within the top third to the middle of the screen
6. Adjust both monitor screen settings so that text size, font, colour brightness and contrast are the same

Photo - 1



12-2 If both are used equally – use the following guidelines

(See photo 2)

1. Centre the two monitors in line with the seated keying position.
2. Dual monitor screens should be the same size and model and have the same fixation method to the desk top; if this is not possible, adjust to the same height and depth
3. Both monitor screens should be at the same height and at the same distance, adjacent to and in line with each other with minimal angling
    a. Monitor screen depth should be about an arm's length away from the seated keying position

   b. Arrange the monitor screen (height and angle) to allow normal gaze to fix within the top third to the middle of the screen
4. Adjust both monitor screen settings so that text size, font, colour brightness and contrast are the same

Photo - 2

12-3 If one is used more frequently and one is a notebook – use the following guidelines (See photo 3)

1. When one of the screens is a notebook and it is used less frequently than the main computer monitor, position the notebook on a monitor riser or sturdy base
2. The secondary screen should be positioned immediately to the right or left (depending on preference)
3. Use shifting eye position (minimal neck rotation) when looking at the secondary screen.
4. Dual monitor screens should be the same size and model and have the same fixation method to the desk top; if this is not possible, adjust to the same height and depth
5. Both monitor screens should be at the same height and at the same distance, adjacent to and in line with each other with minimal angling
   a. Monitor screen depth should be about an arm's length away from the seated keying position
   b. Arrange the monitor screen (height and angle) to allow normal gaze to fix within the top third to the middle of the screen
6. Adjust both monitor screen settings so that text size, font, colour brightness and contrast are the same

Photo - 3

13. BIFOCAL OR TRIFOCAL EYEWEAR USERS

Their use generally necessitates a lower positioning of the monitor to achieve a neutral head and neck angle. Since bi- and trifocal users often view through the bottom portion of the lens, monitor height should be lowered, so that the neck is in a neutral position when looking at the top row of text on the screen (or printed material).[24] Glasses adapted for work at a computer are now also available on the market. An optometrist can help determine which glasses are best suited for a worker's needs.

14. KEYBOARDS

14-1 General Characteristics

Adequate keyboard design should be considered along with the design of work surfaces, chairs, and other input devices, training for workers, the design of tasks, and the organization of work.

Design specifications for keyboards are outlined in CSA Standard CAN/CSA-ISO 9241-4. This Standard contains guidance for keyboard layout arrangements of alphabetic and numeric keys, the physical characteristics of individual keys (such as displacement and force, feedback, and legends), and the overall design of the housing that contains the keys (such as slope and profile). Keyboards should be of appropriate size and key-spacing to accommodate most users. Generally, the horizontal spacing between the centres of two keys should be 1.8-1.9 cm [0.71-0.75 in], the vertical spacing should be between 1.8-2.1 cm [0.71-0.83 in] and the keyboard slope should be no greater than 15° to prevent wrist deviation.[25]

It also specifies methods for testing conformance by measuring the physical attributes of a keyboard. Certain characteristics of the keyboard can influence the posture people adopt when working at a computer. Design elements interact in such a way that optimizing one feature can sometimes degrade another. Trade-offs may be required to achieve an acceptable balance. For example, the height (thickness) of the keyboard, combined with the height and thickness of the work surface supporting it, can lead workers to adopt poor postures.

Efficiency, effectiveness, and worker satisfaction depend on the selection of keyboard design suitable to the task of the worker and the use of additional input devices. For example, provision of a separate numeric pad can help a data input task. When selecting a keyboard for a specific task, one must consider the functions of the keyboard and other input devices.

Note: Fatigue increases rapidly as the shoulder is abducted over 30°. Therefore the only shoulder positions that are acceptable for both strength and fatigue are at or below shoulder abduction of 30°.

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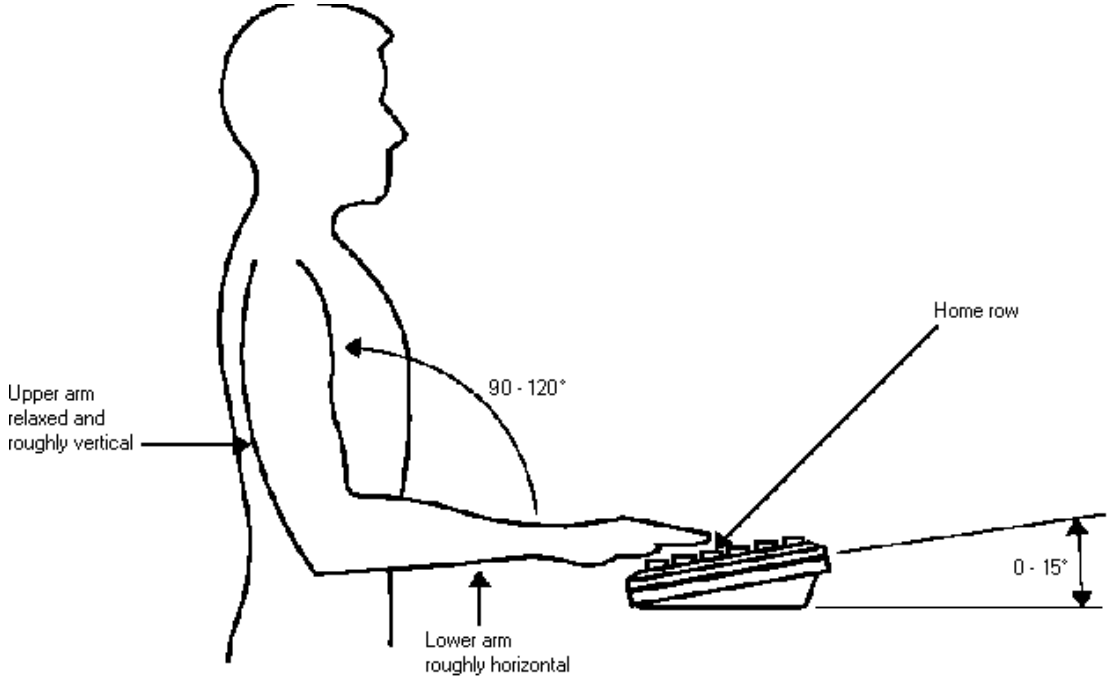
[24] Bifocal or Trifocal Eyewear Users:CSA-Z412, Guideline on Office Ergonomics (December 2000)

[25] United States Department of Labour, Occupational Safety & Health Administration, Computer Workstations, 2010

Figure 13 – Relationship between keyboard and arms



14-2 Alternative Keyboards

Where an alternative keyboard differs from the standard, it should be subject to usability testing. This testing can help designers and manufactures of innovative keyboards to assess the usability of their designs, thus encouraging the exploration of new keyboard concepts.

The test can also be used by organizations that need to determine whether a particular keyboard meets the objective of satisfactory performance, with ease of effort and maximum comfort. Annex A of CSA Standard CAN/CSA-ISO 9241-4 specifies a usability test for the performance and comfort of keyboards that do not meet all the requirements of CSA Standard CAN/CSA-ISO 9241-4, Clause 6.

14-3 Support surfaces for keyboards

The keyboard can be placed on various work surfaces. The objective is to ensure a range of comfortable dynamic postures. In some cases, specially designed keyboard support surfaces may be required.

It is important to consider the tasks performed by the worker, whether the workstation is shared by multiple workers, characteristics of the office layout such as lighting, proximity to other equipment and materials, and the design of the furniture. It should be adjustable in height and angle both towards and away from the employee especially in shared workstations. The keyboard support surface should be at least 48 cm [19 in] wide and 18 to 23 cm [7 to 9 in] deep, and (if present) a second connected mousing platform should be

20 cm wide by 20 cm [8x8 in] deep. When present as a single tray, the support surface should be 68 cm [27 in] wide and 18-23 cm [7-9 in] deep.[26]

Where workers share a workstation, adjustability in keyboard support, monitor surface height and, ideally, tilt can provide flexibility to accommodate different sizes and preferences of workers. The keyboard work surface should be independent of the computer work surface unless the computer work is of short duration or the employee's stature permits suitable posture.

Regardless of the type of surface chosen for the keyboard, it should be stable and secure and support the weight of the keyboard and other input devices, as well as the arms and hands of the users. It also must be wide enough to accommodate a mouse, on either side of the keyboard, or other input devices if need be. The adjustment mechanisms should allow adequate leg clearance under the tray to prevent bumping.

14-4 Heights for surfaces for keyboards

The surface heights for keyboards, if adjustable, should be in increments of no more than 2.5 cm [1 in] within the same range. When raised, they should be flush with the primary work surface, be capable of being adjusted downward by at least 10 cm [4 in], and be lockable in continuous or incremental positions within that range. Surfaces for keyboards and other input devices should allow clearance under the work surface of at least 5.5 cm [2 in] for the keyboard and input devices.

***Note**: According to a BIFMA analysis of the Natick "1988 Anthropometric Survey of US Army Personnel" (Gordon et al.) adjustable height keyboard support surfaces should include the range of 56.3-72.4 cm [22-28.5 in], as measured from the top of the surface (based on input device thickness of 2.5 cm [1 in], and a support surface thickness of 3.8 cm [1.5 in]) Fixed-height support surfaces are not recommended.

As BIFMA has yet to formally publish its findings, CGSB has yet to consider adjusting heights for work surfaces and surfaces for keyboards in accordance with BIFMA's findings. Keyboards procured by the Department should be designed to promote the above postures.

15. POINTING DEVICES/MOUSES

15-1 General Characteristics

Sensor location: the motion-sensing point should be optical and located under the fingers, rather than under the palm of the hand.

Button motion: the device should be designed in such a way that during intended use the fingers can make contact and actuate buttons without excessive deviation from a neutral posture.

[26] Keyboard Trays, Ergonomic Adjustable Computer Keyboard Tray Guide, 2010

Button actuation: it should be possible to press the buttons on the mouse without reducing control of the device.[27]

15-2 Size

A conventional mouse should support the whole hand and therefore correspond to the hand's shape and size (tip of the third digit to base of the palm). This will help to eliminate pressure points at the wrist and/or avoid excessive hand gripping of the mouse as well as provide proper palm support.[28]

15-3 Location

The mouse should be placed on a support next to the keyboard on the left or right side, depending on the worker's preference. It should be positioned to maintain a straight extension of the arm (i.e. in line with the shoulder). Ideally, it should be placed slightly towards the centre of the worker's body, but this is not always possible because of the keyboard position. The mouse should be at the same height as the elbow.

Use of a mouse pad is also recommended, even for an optical mouse. The mouse pad should be smooth and free from wear and tear to avoid useless movements of the wrist and hand. A small mouse pad is preferred because a large pad requires the keyboard to be set off-centre.

15-4 Mouse Use

The mouse should not be held tightly. Rather, the hand should be relaxed and holding the mouse gently. The mouse should be moved using the entire arm and not just the wrist. While moving the mouse, the forearm and elbow should be barely touching the arm rest. Pressing on the elbow will hinder arm movement. It is important to keep the wrist in a neutral position and in a straight line with the forearm. Avoid resting the hand on the mouse when not in use. . Instead, rest the forearm on the arm rest or rest the palm on the palm rest.

15-5 Limit Repetitive Nature of Mouse Use

It is suggested:

- Alternate use between the right and left hand should the pointing device permit (change mouse settings to allow neutral wrist/finger posture);

[27,28,29] Canadian Standards Association. Z412-00(R2005) Guideline on Office Ergonomics. CSA International. 2000

- Alternate between computer and non-computer tasks;
- Learn and use keyboard shortcut keys.

15-6 Alternate Pointing Devices

There are several alternatives to the conventional mouse (trackballs, pucks, tablets and overlays, touch-sensitive screens, etc). The size, posture and activation method (finger, thumb, or forearm/shoulder) will vary depending on the type of pointing device being used. All alternative pointing devices procured by the Department should keep the wrist in a neutral posture.[29]

Pointing devices/mouses procured by the Department should be designed to promote the above postures.

16. SUPPORT FOR THE HANDS AND FOREARMS

In addition to the importance of proper positioning of the keyboard and of other input devices, there may be a need for some workers to obtain support for the hands and forearms. This type of support has a number of functions:

- To reduce static loading, that is, the work of neck and shoulder muscles in holding the weight of the arms;
- To reduce contact of the wrists and arms with sharp or hard surfaces; and
- To reduce the need for bending the wrist.

It is important that the support does not put undue contact pressure or stress on the resting portion of the body. Prolonged contact, especially if the support is not well-rounded and padded, can contribute to the damage of muscles, tendons, nerves, and other underlying tissues.

Support for the hands and forearms can be provided in a number of ways:

- Using armrests on the chair to support the forearms;
- Incorporating a hand support into design of the input device, for example, some keyboards have a built-in support surface; and
- Providing a hand support separately from the input device.

The necessity and usefulness of a hand support will depend upon the characteristics of the workstation (especially design of the keyboard), the keying skill of the user, the type of task performed (e.g.straight data entry compared to stop-and-go interactive computer user), and the preferred posture of the worker. Resting the heel of the hand on a support while keying is not recommended, as it results in lateral wrist bending and stretching of

the fingers. Prolonged contact can contribute to the damage of soft tissues such as muscles, tendons and nerves.

The design of a separate hand support should incorporate the following features:

- Since the hand support is used only occasionally or intermittently while the hands are resting, the design should not restrict the keying action or preferred working posture (particularly the wrist posture) of the user in any way;
- The surface geometry should match the height, length and slope of the keyboard surface; the depth should be 5-10 cm [2-4 in], depending on the design of the specific input device;
- The leading edges should be designed so as not to cut into the wrist or hand;
- The width should be at least that of the keyboard (or mouse) or adequate for the task; and
- Support should be stable during use.

Support for the hands and forearms procured by the Department should be designed to promote the above postures.[30]

17. HEADSET

If simultaneously referencing hard copy and/or electronic documents while on the telephone or talking on the telephone for a prolonged amount of time, it is recommended to use a headset in order to prevent the development of musculoskeletal disorders of the shoulder and/or neck. It is also recommended to involve both employer and employee in the choice of headset to ensure employee satisfaction and use. When selecting a headset, the following features should be considered:

Tasks: The type of tasks performed will impact the choice of headset styles.

Sound quality: Influenced by type of working environment, length of the boom arm, noise-cancelling microphone, amplifier and quality of headset.

Hearing protection: Some headsets have features that may help protect employees' hearing. Ensure that the volume can be controlled.

Length of Microphone: If working in a noisy and/or open environment a longer arm (the microphone should be roughly two fingers from the corner of the mouth) and a noise-cancellation microphone are suggested.

Adjustability: Maximum adjustability should ensure proper fit. Wearing style/options can be interchangeable (e.g. over-the-ear, in-the-ear, ear-hook, under-the-chin, over-the-head band).

[30] Support for the hands, wrists and forearms: *CSA-Z412 Guideline on Office Ergonomics (December 2000)*

Headset (single or double): In a noisy environment, a double headset may provide better sound quality.

Weight & Durability: Should be light weight. The material should be flexible and durable. Review supplier's parts replacement policy (e.g. ear cushions).

Wireless vs. Wire: Wireless promotes greater mobility and eliminates wire-tangling issues. Also, wire extenders can be used depending on the travel distance.

Compatibility: Review with Innovation, Information and Technology Branchand Facilities Management prior to purchase.

Accessories: Review various options such as remote handset lifters, clothes clips, headset stands or base, mute button, amplifiers, volume control and battery (i.e. chargeable, weight, operation time).

Hygiene: Sharing headsets should be avoided for hygienic reasons. If sharing is required, handset mouth-piece and ear-piece should be cleaned after each use (as per manufacturer's cleaning instruction), or, employees should use their own interchangeable components (i.e. mouth-piece and ear piece cover).
Headsets procured by the Department should be designed to promote the above postures.[31]

18. TELEPHONE

Location of the telephone is less important for infrequent use and very important for high-frequency use. It should be located on the side corresponding to the hand most likely to pick up and hold the telephone, to minimize reaching across the body or shifting the telephone between hands. If many telephone calls are made (rather than received), it may be preferable to locate the telephone on the same side as the dominant hand, so that this hand can comfortably operate the numeric and function buttons. Either way, the telephone should be located close to the worker (within 30 cm [12 in]).

Learning about and making use of the various functions on the telephone, such as redial and storage of commonly used numbers, can improve efficiency and minimize time on the telephone.

Raising the shoulder and bending the neck sideways to cradle the headset between the head and shoulder contributes to strain in the neck and shoulder muscles, due to the awkward and static contractions of the muscles. To prevent this situation a number of options are available:

- Use a headset, enabling the hands to work freely.
- Use a speaker telephone, if in a private office, or if the noise does not disturb others.
- Hold the telephone in one hand, and when the computer work is required, place the telephone down briefly to use both hands.

[31] Headset: *Canadian Standards Association. Z412-00 (R2005) Guideline on Office Ergonomics. CSA International. 2000*

Note: A telephone cradle that attaches to the hand-held portion of the telephone is not a preferred solution. It still requires raising the shoulder muscles and bending the neck to hold the phone in place. It reduces awkward postures, but does not eliminate them.[32]

19. DOCUMENT HOLDER AND ANGLE BOARD

19-1 General Characteristics

In order to minimize the risk factors to which the neck and back may be exposed, it is recommended to use a document holder when referencing hard copy documents while working at the computer station. A document holder should be used to locate the documents at such a height that the worker is not excessively bending his or her neck. If both the monitor and documents are viewed during the task, the documents should be positioned so both can be viewed in the primary visual zone with little or no head movement.

19-2 Selecting a document holder

The following should be considered:

- Easily adjustable in height and angle;
- Sturdy and able to support the documents used;
- Light coloured and non-glossy;
- Independent of the equipment; and
- Type and duration of tasks/job demands (i.e. frequency of hard copy document referencing; weight and size of hard copy documents).

For frequent referencing, a central document holder is recommended, as for occasional referencing, either a side or central document is recommended.

19-3 Type of document holder

<u>Central document holder:</u>

- Enables the documents to be placed between the keyboard and the monitor in order to limit neck and back rotation;
- Accommodates large or oversized documents, multiple sheets, books and binders; and
- The base may vary in height and may raise the monitor.

<u>Side document holder:</u>

- Should be placed as close as possible to the monitor, and at the same height and plane as the screen;
- Accommodates smaller and lighter documents (e.g. 21.5 cm x 28 cm [8.5” x 11”] sheets); and

[32] Telephone: *CSA-Z412 Guideline on Office Ergonomics (December 2000)*

- It is suggested to alternate the side on which the side document holder is placed.

19-4 Angle Board

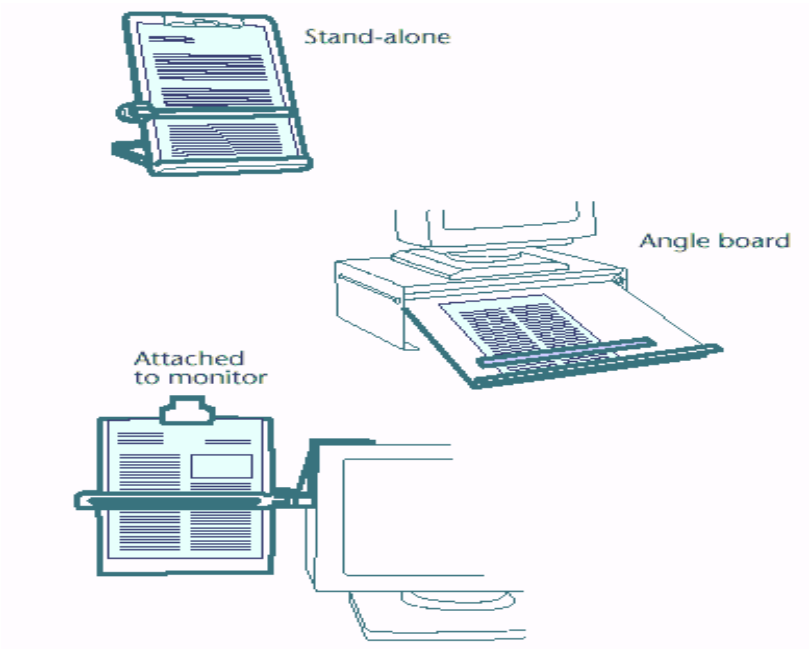
In order to minimize the risk factor to which the neck and back may be exposed, it is recommended that an angle board be used when reading and writing at the work surface for long periods of time.

When selecting a reading/writing stand the following should be considered:

- Adjustable in angle between 0^{o} to 75^{o};
- Sturdy and able to support the documents used;
- Light coloured and non-glossy;
- Lower ledge should be made of a soft/supple material; and
- Weight and size may vary; should be lightweight if frequently moved.

Document holders and angle boards procured by the Department should be designed to promote the above postures.[33]

Figure 14 – Document holders and angle board



[33] Document Holder and Angle Board: *CSA-Z412 Guideline on Office Ergonomics. (December 2000)*

20. FOOTRESTS

In order to minimize the risk factors to which the upper and/or lower body may be exposed, a footrest is recommended under the following circumstances:

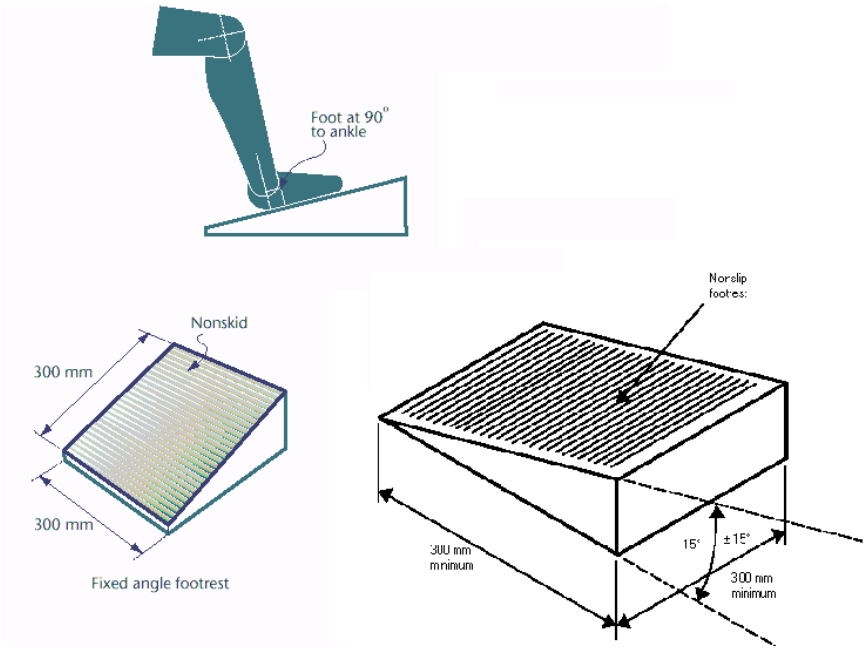
- A footrest should only be used when the desk height is not adjustable and if the chair is raised for a user to reach a work surface and feet are not supported.

The sitting footrest should:

- Be adjustable in height and inclination, unless otherwise indicated by a health professional;
- Have a non-skid surface for the feet;
- It should not move away unintentionally while in use;
- Be large enough to hold both feet with the heels spaced 12 cm [4.75 in] apart when sitting;
- Have a minimum dimension of 30 cm [12 in] wide and 30 cm [12 in] deep;
- Have an adjustable height of 2 to 23 cm [0.79 to 9 in] and inclination angle between 10° and 20°; and
- The height of the foot rest may vary depending on the employee's height.

Footrests procured by the Department should be designed to promote the above postures.[34]

Figure 15 – Footrest dimensions



34 Footrests: *CSA-Z412 and CSA-Z412-M89 Guideline on Office Ergonomics. (December 2000)*

21. NOTEBOOK AND LAPTOP COMPUTERS

Several potential problems arise when using notebook or laptop computers for long periods of time:

- If the monitor and input devices cannot be separated, the worker may place the laptop at an angle that is comfortable for the hands, arms, and shoulders, but which causes neck fatigue from bending downwards to view the monitor. Alternatively, the worker may raise the monitor to make viewing easier, placing hands, arms and shoulders at risk of awkward postures.
- The display quality and size may result in difficulty reading, which may in turn result in increased bending of the neck and upper back.
- Smaller keys and closer spacing between keys can result in cramped and awkward postures for the hands, arms, and shoulders.
- Often workers will angle the monitor upwards to compensate for the low height. This results in increasing glare on the monitor and more difficulty in reading.
- The notebook or laptop is often used in settings (such as hotels, cars, or the home) where the furniture is non-adjustable.

21-1 Dedicated Users

The best solutions to the potential problems listed above are:

- Use a computer docking station. A docking station usually has a full-size monitor, keyboard, and input device such as a mouse. The laptop or notebook can be easily connected to the “dummy” terminal. If the docking station is for multi-users, it must be adjustable to allow various workers to work comfortably.
- Rather than a full docking station, plug a regular-size keyboard and mouse into the laptop.
- Transfer information from the notebook or laptop to a desktop computer for more extensive periods of work.

21-2 Occasional users

The best solutions to the potential problems listed above are:

- Keep a neutral position of the body
- Use a docking station or plug a regular-size keyboard and mouse into the laptop if it is available.

When a docking station is not available:

- If the screen is to low, raise the entire computer to eye level using books, binders or pillows
- If working at a table that is too high for proper keying, try tilting the laptop forward using an empty binder. Reclining the seat slightly will help to improve arm postures. Tilting the laptop will also help to raise the screen closer to eye level.

When on the go, the lap can become a convenient place for your notebook. This location promotes ideal wrist postures, but places the neck in a bent forward position, tuck the chin in as opposed to bending the entire neck down and take a break every 20 minutes. Place a pillow under the notebook to raise the screen, which will improve neck posture.[35]

Notebooks and laptop computers procured by the Department should be designed to promote the above postures.[36]

21-3 Carrying a Laptop

To reduce the weight to carry, only take the necessary accessories. If there are documents, put them in a different bag to distribute the weight evenly on both sides of the body. If carrying a laptop only, make sure to alternate carrying it on either side. This way, it avoids putting constant pressure on the same joints.

Choosing a laptop case model that has a handle and a strap will make it easier to change the way to carry it. When carrying a laptop for a long time, it is better to carry it in a case with wheels.

22. PRINTERS, PHOTOCOPIERS, SCANNERS AND FAX MACHINES

22-1 Printers

If it is used frequently, it may be desirable to have the printer close by in the immediate workstation. If it is used infrequently, getting up to go to a printer may provide an opportunity for postural change. The access to paper trays and location of stored paper must also be considered in the placement of printers. Ideally, paper will be stored close to the printer and at storage heights that minimize bending. Sufficient space should be available around the printer to access the paper trays and drawers and other points requiring ongoing maintenance.[37]

22-2 Photocopiers

The location of the photocopier should be carefully considered, since their noise and traffic flow around them can be a source of distraction for workers. Congestion of workers may also result around photocopiers. Consideration should be given to the appropriate air flow and ventilation for the extraction of heat and chemical vapours generated by the photocopier. As withprinters, paper should be stored within easy

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[35] Occasional users: Human Resources – Ergonomics, University of Western Ontario, 2010

[36] Notebook and laptop computers: *CSA-Z412 Guideline on Office Ergonomics. (December 2000)*

[37,38] Printers and Photocopiers: CSA-Z412, Guideline on Office Ergonomics (December 2000)

access of the copier and at heights that minimize bending. Sufficient space should be provided around the photocopier for routine maintenance tasks.[38]

22-3 Scanners and Fax Machines

Scanners and fax machine that are shared by several workers should be located in areas that do not cause distraction to workers due to noise or to congestion. Consideration should be given to the appropriate heights and space required for these machines.[39]

22-4 Controls

In the office environment, controls are usually designed for manual operation. Typical controls are:

(a) push-buttons and toggle-switches for on/off functions;

(b) knobs for continuous settings; and

(c) keys to select characters or functions.

Each control has recommended design specifications, such as size and force. (See *McCormick and Saunders, 1987)*

22-4.1 Control Layout

The following principles govern control layout:

(a) optimal locations close to the line of sight or within easy reach should be reserved for the most important controls;

(b) "importance" is determined by how often a control is used and the effect on system operation or safety;

(c) controls should not overload either hand.[40]

Printers, photocopiers, scanners and fax machines procured by the Department should be designed to promote the above postures.

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[39] Scanners and Fax Machines: CSA-Z412-M89, Guideline on Office Ergonomics (December 2000)

[40] Control layout: CSA-Z412-M89, Guideline on Office Ergonomics (December 2000)

23. PLACEMENT OF TASK LAMP

Flexibility should be designed into the task lighting so that it can be placed according to changing task requirements. An adjustable task lamp should be positioned so that it does not cause direct glare. Usually it is positioned directly over source documents.

General and task lighting shall conform to the ANSI standard for Industrial Lighting (Illuminating Engineering Society of North American Standard No. RP7). This type of lighting should be bright, since the light is used in the performance of the task. Under shelving strip fluorescents are prone to give excessive lighting levels and glare, unless very carefully designed. The following task lighting levels at work surface level are recommended to accommodate those with normal vision.[41]

Table 2 – Recommended range of luminance

Activity	Recommended range of luminance (lux)*
Corridors	50-100
Stairs	100-200
Stockrooms	200-500
Computer workstations	300-500
Traditional office tasks	500-750
Conference rooms**	300-750
Drawing offices***	750-1000

* *Lux = Lumens (quantity of light) per square metre*

***Conference room lighting should be adjustable, to accommodate projectors, and should be supplemented at white boards, flip charts, etc.*

****Task lighting should be available, to respond to visual requirements of difficult tasks.*

23-1 Types of bulbs

Compact fluorescents: fit into spaces designed for incandescent bulbs. With a screw base that fits a normal light bulb socket, they operate on a quarter of the energy used by incandescent and create the same amount of light.

Incandescent: 90 percent of the energy produced by incandescent lights is heat, not light which creates a safety hazard.

Halogen: creates four times more heat than the average incandescent bulb which creates a fire hazard.[42]

[41] E.K. Gillin & Associates Inc., 2007

[42] Types of bulbs: Consumer Energy Center, Incandescent, fluorescent, halogen & compact fluorescent, 2010

24. WORK/REST BREAKS

Workers should be encouraged, for their own benefit and for improved work productivity, to take frequent micro pauses and to perform, at least hourly, a different task that encourages them to get up from the computer. The amount of rest and recovery necessary for preserving tissue tolerance depends on the job demands and variety of work. There is no simple time equation for length of work and adequate length of subsequent resting periods. The more intense and repetitive the work, the more frequent the breaks should occur. Breaks do not have to be non-work time such as lunch or coffee breaks. Changing to a different task (especially those with movements) can provide time for rest and recovery to tissues. The following are some examples of break opportunities:

- Short pauses such as looking away from the screen, removing hands from the keyboard;
- Breaks initiated by work such as telephone ringing, co-worker/supervisor discussion;
- Breaks initiated by worker where they deliberately change tasks such as faxing, photocopying or filling; and
- Standing up while talking on the telephone.[43]

25. FLOORING

- All completion of flooring shall be smooth and even with inconspicuous joints; and
- The user should change the casters to the required flooring (See 7-6.3-Casters)

26. ANTI-FATIGUE MATS

The mats are designed to reduce fatigue that is caused by standing for long periods on hard surface (e.g. cement floors). Fatigue-reducing mats can be made of various materials including rubber, carpeting materials, vinyl, and wood. When the anti-fatigue mat is not in use it should be removed to eliminate a tripping hazard.

26-1 What should be considered first when a person stands all day at work?

When considering the use of anti-fatigue mats, there are other factors that should be considered at the same time, such as allowing changes in working/standing position, footwear, and flooring.

[43] E.K. Gillin & Associates Inc., 2007

- **Changes in working/standing position**: Work should be organized so that the worker has some choice about his/her working position and an opportunity to change position frequently.
- **Footwear**: Footwear is a factor which, if properly chosen, may further reduce the harmful effects of prolonged standing. There is no doubt that the choice of footwear is an important consideration for people who work on their feet. Shoes should ensure adequate arch and heel support and cushioning while providing comfort to the wearer.
- **Flooring**: The type of flooring used in the workplace has an equally important influence on comfort, especially on tender feet. Hard, unyielding floors, like concrete are the least comfortable surface to work on. Wood, cork, carpeting, or rubber - anything that provides some elasticity - is gentler on workers' feet. More than that, softer floor coverings reduce fatigue and improve safety by reducing slips and falls on slippery floors.

26-2 When should anti-fatigue mats be used?

Anti-fatigue mats absorb the shock due to walking and this cushioning effect reduces foot fatigue. However, the use of matting requires caution because mats can lead to tripping and falling accidents when installed improperly.

Another type of floor covering, namely, anti-slip matting, is useful in increasing foot comfort and safety. However, workers may find that their feet burn and feel sore, because the non-slip properties of anti-slip matting cause their shoes to grab suddenly on the flooring, making their feet slide forward inside the shoes. Friction inside the shoes produces heat which creates soreness. Non-slip resilient insoles can reduce this discomfort.

In summary, the use of anti-fatigue mats or placing carpeting on the floor does not eliminate sore feet by itself, but, when combined with proper work design and quality footwear, it should improve working conditions. [44]

27. DEFINITIONS

Adjustable keyboard support surface – a vertically and horizontally adjustable work surface or tray used to support a computer keyboard and, in some instances, to provide space for a mouse.

Armrest – support for the lower arms.

Backrest – part of a work chair that provides support for the back.

Caster – wheeled component on the bottom of furniture to facilitate appropriate movement on the floor surface.

Dedicated Users - spend most of their day operating a single machine

[44] CCOHS, http://www.ccohs.ca/oshanswers/ergonomics/mats.html

Design reference posture for sitting – posture specified for the purpose of workstation design to define relative positions and dimensions.

Discomfort glare – glare producing discomfort. It does not necessarily interfere with visual performance or visibility.

Dynamic sitting posture – body position which changes, with movements of the limbs or other parts of the human body in relation to one another or with respect to a fixed object (such as a workstation).

Ergonomics – The study of workplace design and the physical impact it has on workers. Ergonomics is about the fit between people, their work activities, equipment, work systems, and environment to ensure that workplaces are safe, comfortable, efficient, and that productivity is not compromised.

Glare – condition of vision in which there is discomfort or a reduction in the ability to see details or objects caused by an unsuitable distribution or range of luminance, or by extreme contrasts.

Input device – user-controlled device that transmits information to a system.

Line-of-sight – the line connecting the point of fixation and the centre of the pupil.

Lumbar – region of the back between the thorax and the pelvis

Mouse – computer input device having one or more buttons and capable of a two-dimensional rolling motion that can drive a cursor on the display and perform a variety of selection options or commands.

Musculoskeletal disorder (MSD) – a Musculoskeletal disorders are injuries of the muscles, nerves, tendons, joints or spinal discs. Common MSDs include carpal tunnel syndrome, tendonitis and tension neck syndrome.

Musculoskeletal system – the system of muscles and bones primarily involved in physical activity. The skeletal muscles are under conscious control and, when activated, provide mechanical leverage for the bones of the limbs and spine.

Neutral posture – posture describes the position of the limbs. A neutral posture is that which the body (and parts of the body) assumes when completely relaxed, without any intentional bending at the joints.

Occasional User - seldom uses office equipment for extended periods.

Palm-rest – platform placed in front of the keyboard or embedded in the keyboard on which the worker may place the palm of his or her hands.

Popliteal – of or pertaining to the back of the knee

Posture – overall position of the body, or body parts in relation to each other, with respect to the workplace and components.

Readability – the characteristics of text that allow groups of characters to be easily discriminated, recognized, and interpreted.

Reference Posture – posture specified for the purpose of workstation design to define relative positions and dimensions.

Roll-out support surfaces – a horizontally adjustable work surface or tray used to support a computer keyboard, and in some instances, to provide space for a mouse.

Screen brightness – the amount of light emitted from the non-character component of a screen display

Screen contrast – the perceived brightness difference between the characters and the rest of the screen.

Screen uniformity – the consistency, across the screen, of character brightness and shape.

Static posture – adoption of a body position that is fixed over times and where there is muscle contraction without motion.

Symptoms – any morbid phenomenon or departure from the normal in function appearance, or sensation experienced by the patient and indicative of disease.

Task description – a method for producing an ordered list of all the things a worker will do in his or her job.

Touch-sensitive screen – input device that produces a position and selection input signal from a finger touching, lifting off, or moving across a display.

VDT (video display terminal) – an electronic device consisting of an input device (e.g. keyboard), a monitor unit (e.g. CRT), and a connection to the central processing unit of a computer, on which information communicated to or stored in the computer is presented visually.

Viewing distance – the distance between the eye and the material being viewed.

Visual fatigue – a spectrum of eye complaints ranging from soreness and itchiness to difficulty in focussing.

Workspace – volume of space allocated to one or more persons in the work system to complete a work task.

Workstation - A workstation refers to a cubicle, office or space where an employee normally conducts his/her work tasks, primarily in a seated position. The workstation

usually contains standard office equipment, such as a desk, computer equipment, telephone and chair.

Work surface – surface on which equipment and task materials are used.

28. REFERENCES

a) Canadian Centre for Occupational Health and Safety
b) Canadian Standard Association-Z412, Guideline on Office Ergonomics, 2000
c) Caster Wheels
d) Consumer Energy Center
e) Ergonomic Adjustable Computer Keyboard Tray Guide
f) Ergonomic Office Australia
g) E.K. Gillin & Associates Inc., 2007
h) Proaxis, Resolution to Monitor Size Chart
i) United States Department of Labour, Occupational Safety & Health Administration
j) University of Western Ontario, Human Resources-Ergonomics