

APPENDIX 5

Recommendations

APPENDIX 5

This Appendix corresponds with Step 5: Recommendations. It provides information on:

- Implementing Minor Modifications (Section A.5.1);
- Using Design Criteria to Implement Major Purchases (Section A.5.2); and
- a Sample Completed Level I Ergonomics Assessment Summary and Recommendations form.

The *Implementing Minor Modifications* section provides you with guidance on how to actually make or implement the minor modifications - changes and adjustments to existing workstations, chairs, equipment, etc. - that you would have already identified using the case studies. The “Implementation Reference” column on the Corrective Action List refers directly to the information provided in this section. The information complements that provided in the case studies and it will be helpful each time you apply the Level I process.

The *Using Design Criteria to Implement Major Purchases* section is to be used in situations where you are asked to provide ergonomics criteria for selecting a new, potentially major piece of equipment such as a chair, monitor support, or other item. Since the focus of this section is on design and selection criteria for major purchases, and since a shop may not be able to implement this type of recommendation right away, you may only need this in special situations. Each time you do an assessment, you may still want to make the shop supervisor aware that you can provide assistance in helping to evaluate future purchases to help them select equipment with features that provide the most benefit to employees while providing the most value to the shop. Again, the “Implementation Reference” column on the Corrective Action List refers directly to information provided in this section.

IMPLEMENTING MINOR MODIFICATIONS

A.5.1 IMPLEMENTING MINOR MODIFICATIONS

This section is presented as a concise “how-to” manual for constructing (or working toward) an ergonomically correct workstation given different types of furniture, different types of tasks, and different sizes of people.

A.5.1.1 Adjusting Administrative Workstations. When contemplating changes to a computer workstation, the initial evaluation needs to focus on the posture of the employee. Figure A.1 illustrates the recommended posture for computer work. Note the following:

- Front edge of work surface perpendicular to the employee’s line of vision.
- Monitor directly in front of employee.
- Front edge of work surface wide enough for keyboard (and mouse pad if in use).
- Mouse directly adjacent to keyboard.

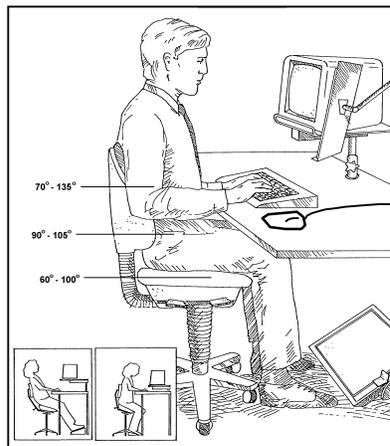


Figure A.1
Recommended Posture for Computer Work

It is important to provide appropriate space such that equipment can be accommodated and flexibility to perform a variety of job tasks is maintained. Most importantly, the configuration needs to provide adequate space to allow the employee to change postures frequently throughout the day.

An important goal is to make each workstation as flexible as possible for performing the required tasks. To that end, the following guidelines are provided.

- Single-height surface workstations tend to be more flexible than multiple-height surface workstations.

- Employees should have the option of using a palm rest and/or pushing the keyboard back at least 10 inches (25.4 cm) on the work surface so that resting the forearms on the work surface is possible.
- Corner workstations are usually preferred by intensive computer users because they take advantage of dead space by placing monitors in corners of workstations to provide the maximum workspace. However, a monitor should only be placed in a corner workstation if the workstation is designed as a corner workstation.
- Traditional desk-shape configurations will properly accommodate a monitor only if at least 30 inches (76.2 cm) of depth exists.

A.5.1.2 Task Types. The type of task performed determines the requirements of the furniture and workstation.

- **Keying and Paper Tasks Combined**

For tasks that involve substantial writing and referring to multiple documents in addition to keying, the workstation needs to have enough workspace to allow the employee to simultaneously perform paper tasks and computer tasks. This generally indicates that the work surface should be larger than for data entry tasks.

The total depth of the workstation generally should be at least equal to 20-22 inches (50.8 to 55.88 cm), plus the overall depth of the monitor (including clearance for cabling and ventilation).

For example, for a monitor which is 17 inches (43.18 cm) in overall depth, the total workstation depth should be at least 37 inches (93.98 cm).

- **Keying and Paper Tasks Separate/Data Entry Only**

If the employee's tasks involve primarily keying and data entry with little additional paperwork performed simultaneously (e.g., the employee performs primarily data entry tasks from a single document) then less work surface is required.

The total depth of the workstation generally should be at least equal to 8-10 inches (20.32 to 25.4 cm) plus the overall depth of the monitor (including clearance for cabling and ventilation).

For example, for a monitor which is 17 inches (43.18 cm) in overall depth, the total workstation depth should be at least 25 inches (63.5 cm).

A.5.1.3 Correct Work Heights

A.5.1.3.1 The “Bottom- Up” Strategy. In order to take advantage of the bottom-up strategy, the employee must have the following equipment:

- A height-adjustable work surface (note: adjustments may need to be made by maintenance personnel)
- A work surface that is no more than 2 inches (5.08 cm) thick.
- A chair in which the seatpan is adjustable in height 16 to 20.5 inches (40.64 to 52.07 cm).

If these conditions exist, try the following procedure to correctly position the height of the chair.

- **Step 1:** Have the employee set the chair height so that:
 - a) The employee can comfortably place heels and toes simultaneously on the floor;
 - b) The employee’s weight is distributed evenly across the legs (avoid creating pressure on underside of knees or on buttocks). This is usually characterized by the thighs being parallel to the floor (horizontal); and
 - c) A substantial portion of the employee’s upper body weight is supported by the back rest.

The recommended position is shown in Figure A.2

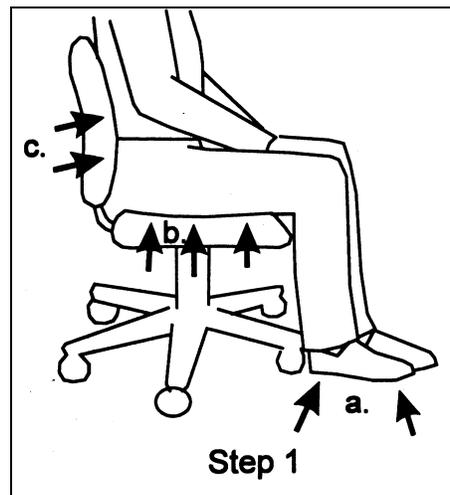


Figure A.2
Correct Work Height
Bottom-Up Strategy

- **Step 2:** Set the workstation height so that the home row of the keyboard is at elbow height and the forearms are horizontal. The goal is to allow the person to key with the wrists straight. This usually means that you need to get the work surface as low as possible without interfering with leg clearance as shown in Figure A.3.

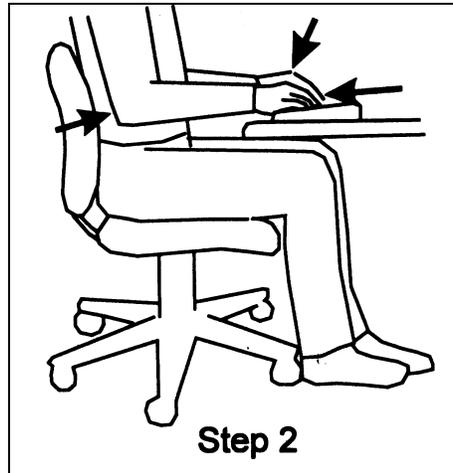


Figure A.3
Correct Keyboard Height
Bottom-Up Strategy

This strategy is generally preferred for providing the correct work heights. Because the use of a footrest is not required, the employee can move around the workstation more freely.

A.5.1.3.2 The “Top-Down” Strategy. In order to take advantage of the top-down strategy, the employee must have the following equipment:

- A work surface that is fixed in height between 28 and 30 inches (71.12 and 76.2 cm)
- A work surface that is no more than 2 inches (5.08 cm) thick
- A chair in which the seatpan is adjustable in height with a range of at least 16 to 20.5 inches (40.64 to 52.07 cm)
- A footrest which is at least 2 inches in height (with the ability to raise the overall height of the footrest to at least 6 inches (15.24 cm))

If these conditions exist or can be created, use the following procedure to correctly position the height of the employee:

Step 1: Set the seatpan height so that the home row of the keyboard is at elbow height and the forearms are horizontal (the goal is to allow the person to key with their wrists straight). This usually means that you want to raise the person as high as possible without interfering with leg clearance as shown in Figure A.4.

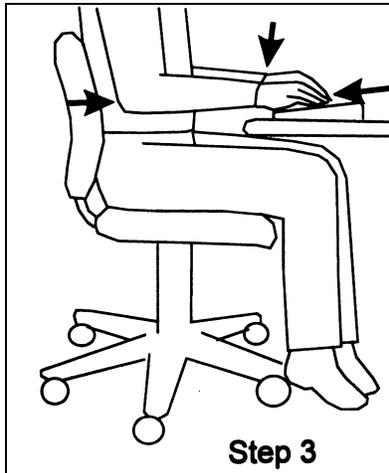


Figure A.4
Correct Positioning for the “Top Down” Strategy

Step 2: Adjust the footrest to the appropriate height so that (See Figure A.5):

- a) The employee can comfortably place heels and toes simultaneously on the floor;
- b) the employee’s weight is distributed evenly across the legs (avoid concentrating pressure on underside of knees or on buttocks). This is usually characterized by the thighs being parallel to the floor (horizontal); and
- c) a substantial portion of the employee’s weight is supported by the back rest.

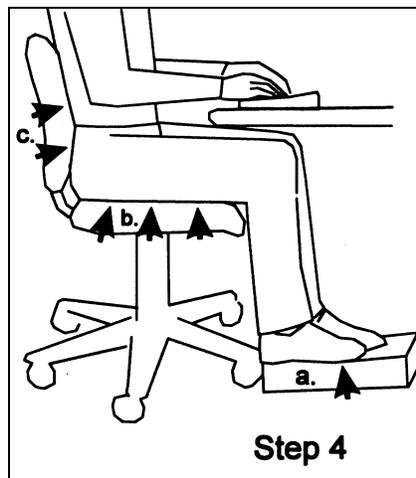


Figure A.5
Adjusting the Footrest Height

Top-Down Strategy

If the work surface height is fixed and is lower than 28 inches (71.12 cm), it may be necessary to raise the entire workstation for larger employees to provide sufficient leg clearance. One disadvantage to this approach is that the use of a footrest may restrict mobility at the workstation, since support is only available where the footrest is located. This method is less effective for small employees because of the height of the feet from the floor, and it may encourage twisting while reaching for items at workstation because feet are on footrest. As a result, this method works best if the employee does not have to frequently move around the workstation.

A.5.1.4 Adjusting the Chair. In order to properly adjust the chair, you must evaluate how the employee's body fits with the depth of the seat pan, and the height and the tilt of the back rest. You can usually adjust all three to accommodate the employee and increase comfort.

- **To Adjust the Depth of the Seat Pan**

When assisting the employee:

- Adjust the seat pan so that it supports the entire length of the thigh and buttocks without placing pressure on the back of the knee
- Check the adjustment. The employee should be able to insert no more than two fingers between the back of the knee and the front edge of the seat pan.

- **To Adjust the Height of the Back Rest**

When assisting the employee, adjust the back rest so:

- The back rest supports the lower lumbar region of the back
- The lumbar support is close to the employee's waist as shown in Figure A.6
- The outward lumbar curvature is not positioned in the middle or upper back regions.

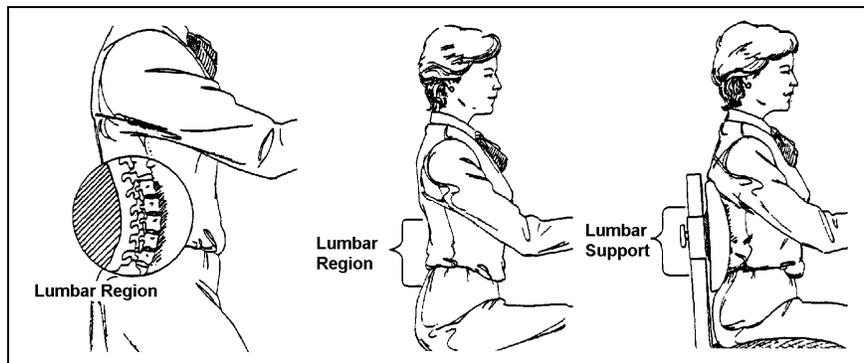


Figure A.6
Positioning for the lumbar support

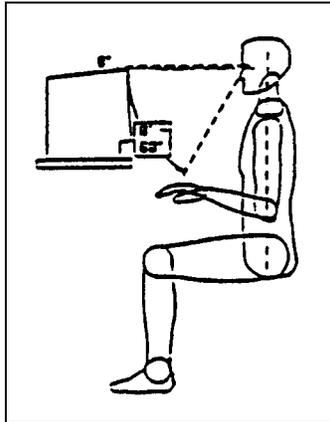
- **To Adjust the Tilt of the Seat Back**

When adjusting the tilt and tension of the seat back:

- The employee should be encouraged to allow the seat back to tilt back so that he/she can lean against the back rest while working
- Set the appropriate tension; a lighter tension on the seat back tilt will make it easier to lean back in the chair.

A.5.1.5 Adjusting the Monitor/Documents

- **Adjust the Monitor Height (refer to Figure A.7)**
 - Raise or lower the monitor (use books, blocks, etc.) so that the top line of text on the screen is no higher than eye level. The bottom of the screen should not be below 60 degrees downward from eye level.
 - For bifocal wearers, place the monitor directly on the work surface so they can view it at a downward angle.



**Figure A.7
Proper Monitor Height**

- **Adjust the Eye-to-Monitor Distance**
 - The eye-to-monitor distance to between 18-30 inches (45.72 to 76.2 cm) (22 to 24 inches (55.88 to 60.96 cm) is comfortable for most employees) can be obtained by sliding the monitor backward or forward.
 - If the work surface is not deep enough, consider adding an articulating keyboard tray.

- **Adjust Light Levels**

For best conditions when working at a computer workstation minimize ambient light. This can be accomplished by adjusting ambient light sources to provide between 20-50 foot candles (200-500 lux) of light overall. Eliminate light bulbs, if necessary, but only in pairs. Task lights can be added inside the workstation to increase lighting for paper tasks (if necessary) to provide between 50-100 (500-1000 lux) foot candles on the documents.

- **Adjust the Document Location**

- Provide a document holder (e.g., sometime propping up the document on a 3-ring binder will do until a proper holder can be obtained) if the employee frequently keys information directly from a document.
- Provide an angled work surface for intensive writing tasks.

- **Adjust the Position of the Monitor**

Placement of the monitor to avoid glare is also critical. You can accomplish this by:

- Moving the monitor so it is perpendicular to windows and between light fixtures (caution: do not place the monitor directly below a shelf that has lighting under it)
- Adjusting the monitor height and tilt to redirect spectral glare from ceiling fixtures or task lighting
- Encouraging the employee to adjust window coverings frequently during the day
- Encouraging the employee to remove excess white paper posted or lying about the immediate workarea of the monitor screen
- Creating and attaching a monitor hood (provide anti-glare screens only as a last resort).

USING DESIGN CRITERIA TO IMPLEMENT MAJOR PURCHASES

A.5.2 USING DESIGN CRITERIA TO IMPLEMENT MAJOR PURCHASES

In this section, design criteria has been “converted” into evaluation criteria which you may use when selecting new or replacement equipment or furniture. Criteria is provided for:

- Chairs (adjustment ranges, backrest design, armrest design, etc.);
- Work Surfaces (including keyboard surfaces, and layout specifications);
- Storage;
- Footrests;
- Document Holders;
- Wrist/Palm Supports;
- Monitor Supports;
- Task Lighting; and
- Keyboards.

To enable you to use this information correctly and efficiently in the future, a “Product Evaluation Checksheet” is provided for each item. The checksheets are provided at the end of the section as “forms” which you may copy. In the past, some individuals have sent similar checksheets to product manufacturers or vendors to request information on the ergonomics features of their products. The remainder of this section provides you with the important information upon which the checksheets are based.

A.5.2.1 Criteria for Chairs. Chairs for performing administrative tasks are plentiful, but selecting the chair most appropriate to the task and the person can be a challenge when the requirements are not known up front. For example, chairs are designed to operate effectively based on a load maximum. If heavier employees will be using the chair, the weight range should be specified. The goal, whether you are considering weight or other measures of size, is to accommodate the widest range of people possible. In addition to office chairs being made adjustable, many manufacturers now offer some designs in small, medium, and large sizes.

Not only does the chair need to fit the person, the chair must be appropriate for the task and the work station. For example, if an employee performs a wide variety of tasks at the same work station, flexible/adjustable arm rests may be needed. Armrests, although usually important, may be less critical for other work stations.

Alternative Seating: Other chairs include laboratory stools (used for higher height work stations or desks) or sit-stand chairs. These are generally recommended for shorter tasks or tasks in which the worker is rotated through on a regular (several times a shift) basis. For these alternatives more care and considerations should be taken to fit the best chair to the worker. Stools can have several disadvantages:

1. They can be difficult to mount or dismount and can create a slipping, falling or tripping hazard;
2. They can be difficult to move;
3. They have footrests which typically consists of a metal ring which is not adjustable to different workers; and
4. they are typically not designed for long periods of sitting.

While alternative seating on stools may provide some advantage, you are encouraged to contact AL/OEMO or an expert to discuss the work situation and chair.

There are four major parts to a chair that should be considered. They are:

- 1) Seat Pan;
- 2) Backrest;
- 3) Support Base; and
- 4) Armrests (optional depending on type of work).

A.5.2.1.1 Seat Pan Specifications. The following criteria is recommended for the seat pan. Figure A.8 shows the requirements.

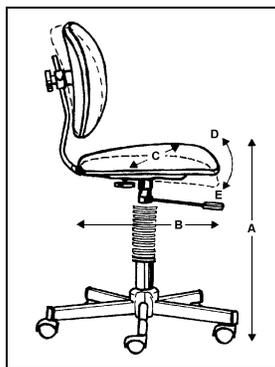


Figure A.8
Seat Pan Specifications

Seat Pan

1. **Height** should be adjustable to accommodate the widest range of employees possible. This range is approximately from 16 to 20.5 inches (40.64 to 52.07 cm) and is measured at the center of the seatpan. Height adjustment is critical as it affects many other work station variables. (Caution: if the chair must be raised to accommodate the work surface for a shorter employee, a footrest may be necessary.)
2. **Depth** of the seatpan is measured from front to back of the seatpan at the longest point. Typical ranges, depending on population, are from 15 to 17 inches (38.1 to 43.18 cm). Seatpans that have greater depth than this generally press into the back of the employees knees.
3. **Width** of the seatpan is measured from side to side of the seatpan perpendicular to the depth. It is measured to the edge of the seat and not the edge of the fabric. Typical ranges, depending on population, are from 18 to 19 inches (45.72 to 48.26 cm).
4. **Angle** of the seatpan with respect to the floor either fixed at 0° or be up to 10° front down. Adjustable seatpans should cover this range. Ensure that if the seat pan is not used at a 0° then a non-slip fabric cover should be provided for safety.
5. **Waterfall front** is the roll-off of the front edge. The amount of roll-off is a function of the height of the chair and the nature of the work being performed. A waterfall front is preferred.
6. **Upholstery** should be breathable. Long-wearing fabrics are commonly wool and wool-blends. These also provide sufficient friction to keep the person from sliding off of the chair under most conditions. (Note: Fabric may not be allowed in specialized environments like biological labs).
7. **Padding** of 1 to 2 inches (2.54 to 5.08 cm) in depth should cover the seat pan and back rest. The padding should be of sufficient quality to remain resilient over years of use.

A.5.2.1.2 Backrest Specifications. The following criteria is recommended when specifying the back rest. Figure A.9 shows these requirements. The backrest needs to be separate from the seat pan and have the characteristics listed below.

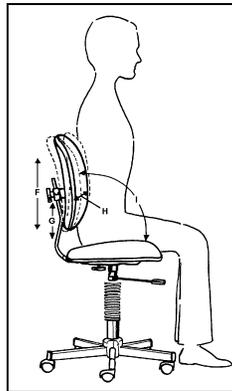


Figure A.9
Backrest

1. **Height** should be adjustable to accommodate the widest range of employees possible. This range is approximately from 12 to 15 inches (30.48 to 38.1 cm) and is measured at the longest vertical range.
2. **Width** of backrest should be a minimum of 12 inches (30.48 cm) in the lumbar region (low back curve or “small of the back”).
3. **Vertical placement** should be adjustable over a range of at least 2 to 4 inches (5.08 to 10.16 cm). The top point should be measured from the L3 to L5 range to the seatpan surface, a range of typically 6 to 9 inches (15.24 to 22.86 cm).
4. **Lumbar support** height should be 6-9 inches (15.24 to 22.86 cm) above the seatpan. The lumbar support should be contoured to encourage the appropriate lumbar curve adoption in users.
5. **Tilt forward** adjustment should allow at least 10° of movement forwards (*see Seatpan/backrest angle below*).
6. **Tilt backward** adjustment should allow at least 5° of movement backwards (*see Seatpan/backrest angle below*).
7. **Seatpan/backrest angle** should remain in the area of 90°-105°.
8. **Upholstery** should be breathable, if allowed (biological laboratory where biologic fluids may come into contact with the upholstery). Long-wearing fabrics are commonly wool and wool-blends. These should provide sufficient friction to keep a person from sliding about while using the chair.
9. **Padding** of 1 to 2 inches (2.54 to 5.08 cm) in depth should cover the backrest. The padding should be of sufficient quality to remain resilient over years of use.

A.5.2.1.3 Support Base Specifications. Specifications for the base should include the criteria below.

1. **The Base** should be wide enough and designed such that it is unlikely to tip over when reasonably used. This is typically accomplished using a 5 legged design. Keep in mind that the usual design criteria is at a specific weight for tip over resistance.
2. **Casters**, if utilized, should be of sufficient size and material such that they will not catch or stop when rolling over small particles and function properly on the surface of their intended use. This is important as casters can help or hinder getting into and out of the chair, and mobility. The caster operation should be quiet and smooth.

A.5.2.1.4 Arm Rests Specifications. Care should be taken to ensure that person can get close enough to work area or that they can properly move about with the armrests.

Adjustable armrests should be provided whenever possible. Important features include:

- horizontal movement (extend forward and retract)
- vertical movement (up and down)
- rotation (pivot inward to provide arm support for employees whose hip breadth is significantly wider than shoulder span)

Many manufacturers now offer chairs with adjustable armrests. These types of arm rests can be valuable in solving employee complaints of neck and shoulder fatigue, or where multiple types of tasks occur during the workday from the same chair.

Important features are listed below.

1. **Length** should be approximately 8 inches (20.32 cm). This can change as a function of the task; longer if more precise work is involved and shorter if more dynamic movement is needed.
2. **Upholstery** should be breathable, if allowed.
3. **Width** should be at least 2 inches (5.08 cm) wide and up to 3 inches (7.62 cm) wide.
4. **Height above the seatpan** should be adjustable from 7-12 inches (17.78 to 30.48 cm) to allow support for different tasks, different body types, and to build in opportunities for movement.
5. **Minimum distance between armrests** should be 18 inches (45.72 cm). This distance may need to be increased for larger employees with special needs.
6. **Padding** should be similar to that used for the seatpan and for the backrest. The covering can be a leather, soft plastic, or similar to the upholstery of the rest of the chair.

Unicor Examples of Chairs



Figure A.10
Unicor Chair Examples

A.5.2.1.5 Knee Space/Clearance Specifications. Clearance envelopes are shapes that are provided in the ANSI/HFS 100-1988 standard. These shapes are scaled to the minimum clearances necessary to accommodate 95th percentile male (e.g. larger employees). When establishing clearance always begin by considering the larger employee.

These clearances do not include adjustments for clothing other than low heel shoes. However normal business clothing is not expected to change the requirements. Adjustments or accommodations should be expected when specialized clothing is required (e.g., the wearing of a G-flight suit, the need for arctic clothing, or the use of other personal protective equipment).

Chair Evaluation Checksheet

Table A.1 presents a checklist to evaluate chairs for a specific job.

A chair evaluation checksheet is provided to help you systematically evaluate various chair designs.

**Table A.1
Chair Evaluation Checksheet**

Date:			Evaluator:		
Job:			Type:		
Manufacturer:			Model Number:		
Model Name:			Price:		
Category	Parameter	Measure	Meets Criteria		N/A
			Yes	No	
Seat Pan	Height	Seat Pan is adjustable between 16.0 - 20.5 inches (40.6 - 52.1 cm.) above the floor			
	Depth	Depth of the seatpan is from 15-17 inches (38.1 - 43.2 cm.)			
	Width	Width of the seatpan from 18-19 inches (45.7 - 48.3 cm.)			
	Angle	Angle of the seatpan with respect to the floor either fixed at 0° or be up to 10° front down.			
	Waterfall	Waterfall front is the roll-off of the front edge.			
	Padding	Padding of 1-2 inches (2.5 - 5.1 cm.) in depth should cover the chair.			
	Upholstery	Upholstery should be breathable.			
Backrest	Height	Backrest height should be adjustable from 12-15 inches (30.5 - 38.1 cm.)			
	Vertical Placement	Backrest vertical placement should be adjustable over a range of 2-4 inches (5.1 - 10.2 cm.)			
	Width	Backrest width should be a minimum of 12 inches (30.5 cm.) in the lumbar region			
	Lumbar Support	Backrest lumbar support should be 6-9 inches (15.2 - 22.9 cm.) above the seatpan.			
	Tilt Forward	Backrest tilt forward should allow at ear 10 degrees of movement.			

**Table A.1
Chair Evaluation Checksheet (Cont'd)**

Category	Parameter	Measure	Meets Criteria		N/A
			Yes	No	
	Tilt Backward	Backrest tilt backward should allow at least 5 degrees of movement.			
	Seatpan/backrest angle	Seatpan/backrest angle should remain in an area of 90-105 degrees.			
	Upholstery	Backrest upholstery should be breathable.			
	Padding	Padding of 1-2 inches (2.5 - 5.1 cm.)			
Support Base	Base	Base should have a five castor base of support.			
Armrests	Length	Armrest length should be approximately 8 inches (20 cm.)			
	Upholstery	Upholstery should be breathable.			
	Width	Armrest width should be at least 2 inches (5.1 cm.)			
	Height from Seatpan	Armrest height from seatpan should be adjustable between 7 and 11 inches (17.8 - 28.0 cm.)			
	Minimum Distance between Armrests	Minimum distance between armrests should be 18 inches (45.7 cm.)			
	Padding	Armrests should be padded			
Comments: _____					

A.5.2.2 Criteria for Work Surfaces. The dimensions of the work surfaces should be consistent with the ANSI standards. The selection of a work surface is dependent upon several variables listed below.

- Type and sequence of the work being performed
- Types, number and sizes of equipment and materials
- The layout relationship of the work station in relation to the surrounding work stations.

The work stations that are illustrated on the following pages suggest worksurface layouts for various types of jobs. Ideally workstation layouts and dimensions should be based on specific task requirements.

A Level 1 Assessment should be performed to identify the most appropriate layout for an administrative work station. If multiple tasks are performed by the individual, the critical tasks should be used as the primary basis for work surface design and layout.

Two types of worksurfaces are common: one-level and two-level surfaces. The one-surface level allows for maximum flexibility for placement of keyboards and other input devices. For work stations that have two separate work surfaces, users should be able to adjust one surface lower for keying and another higher for writing and other activities. The overall work surface height should be adjusted to user needs.

The appropriate work station layout considers work zone principles and frequency of equipment and material use. The primary zone is closest to the worker and is for equipment and materials used most frequently or for the longest period of time. The secondary zone is for items that need to be reached or seen on a daily basis, but for shorter periods of time. The reference zone is the area for items occasionally used and usually requires a move from the normal position to access them.

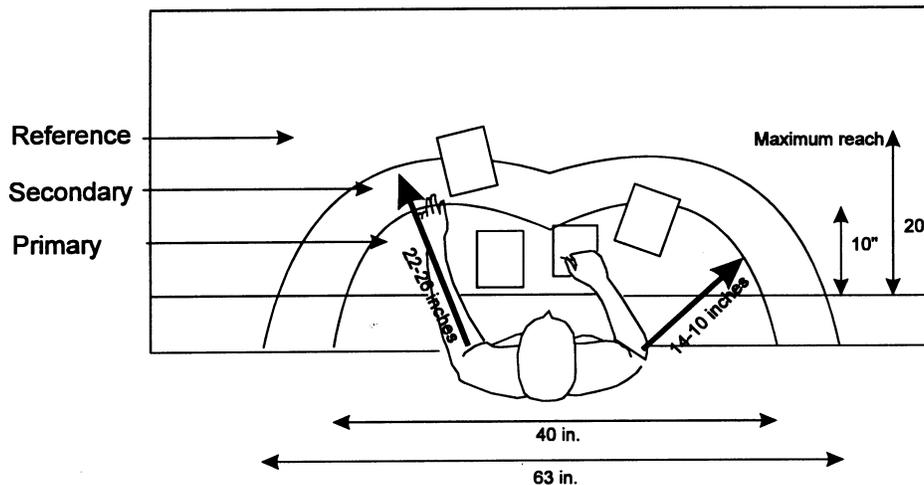


Figure A.11

**Overhead view of the desk surface showing primary, secondary and reference zones
(metric conversion 1 inch=2.54 centimeters)**

- Primary zone: surface area represented by arcs drawn from the shoulders-close reach envelope
- Secondary zone: surface area represented by arcs drawn from the shoulders - far reach envelope
- Reference zone: surface area represented by the grid - exceeds the length of a full reach

Special Needs

There are a number of situations which will require special requirements, in particular, bifocal wearers and users of large-size displays. The work surface needs to accommodate those users.

A.5.2.2.1 Work Surface Specifications. The following additional criteria should be considered when selecting a work surface.

1. All work surfaces should have a matte finish.
2. Work surfaces should be neither black nor white.
3. Edges should be rounded rather than square or sharp.
4. The height of the work surface should be adjustable between 28 and 31.5 inches (71.12 to 80.01 cm).
5. The surface should be available in a variety of widths.
6. The surface should be no more than 2 inches (5.08 cm) thick.
7. The minimum criteria for clearances under work surfaces are:
 - Depth 18 inches (45.72 cm) (to prevent the knees/feet from hitting the back of the desk);
 - Width 28 to 30 inches (71.12 to 76.2 cm) (for side to side leg room);
 - Height 28 to 30 inches (71.12 to 76.2 cm) (between floor and underside of surface);
8. The work surface should be stable.
9. If a work surface is composed of more than one leaf or section, then there should be no gaps between work surfaces.

A.5.2.2.2 Keyboard Support Surfaces. The following additional criteria should be considered when selecting keyboard support surfaces.

1. Height should adjust between 23 to 28 inches (58.42 to 71.12 cm) above the floor. The surface should allow for a 70 - 135 degree angle at the elbow, with the wrist flat.
2. Surface should be no more than 1 inch (2.54 cm) thick.
3. Horizontal depth and width should be determined based on equipment (such as keyboard and mouse).

Note: Articulated keyboard supports/shelves may not be acceptable in some situations.

A.5.2.2.3 Task Specific Work Surface Layouts. The following layouts are provided as a starting point. Not all typing/keying tasks are the same. Therefore some modification or customizing of the layout for specific jobs may be necessary.

Typing /Keying

Typical jobs in which keying is performed include (not necessarily limited to):

- heavy data entry;
- customer service/record keeping; and
- general administrative support.

The recommended “starting point” layout for this job is shown in Figure A.12

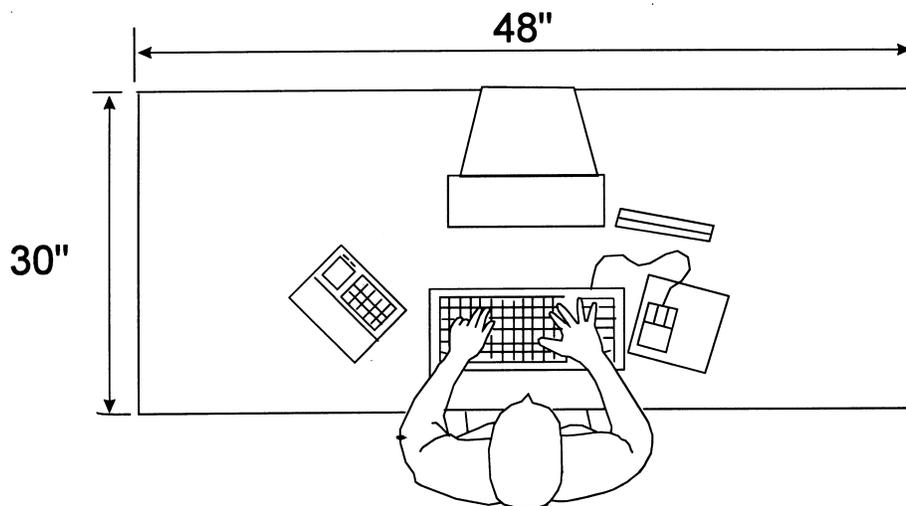


Figure A.12
“Starting Point” Work Surface Layout-Typing/Keying
(metric conversion-1 inch = 2.54 centimeters)

- Writing and Illustrating

Typical jobs in which writing and illustrating is performed include:

- customer service/record keeping contracts
- contracts

The recommended “Starting Point” layout is shown in Figure A.13.

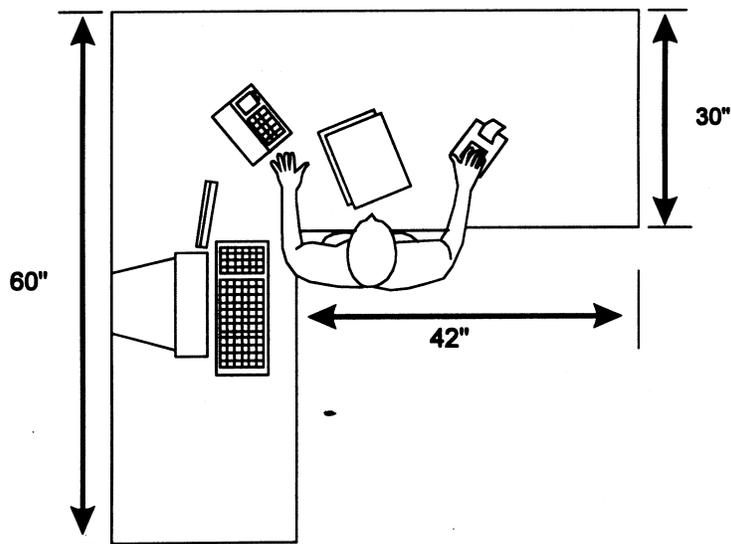


Figure A.13
“Starting Point” Worksurface Layout-Writing/Illustrating
(metric conversion 1 inch=2.54 centimeters)

Mousing

Typical jobs in which mousing is performed include:

- desktop publishing; and
- technical/administrative tasks.

The recommended “Starting Point” layouts are shown in Figure A.14.

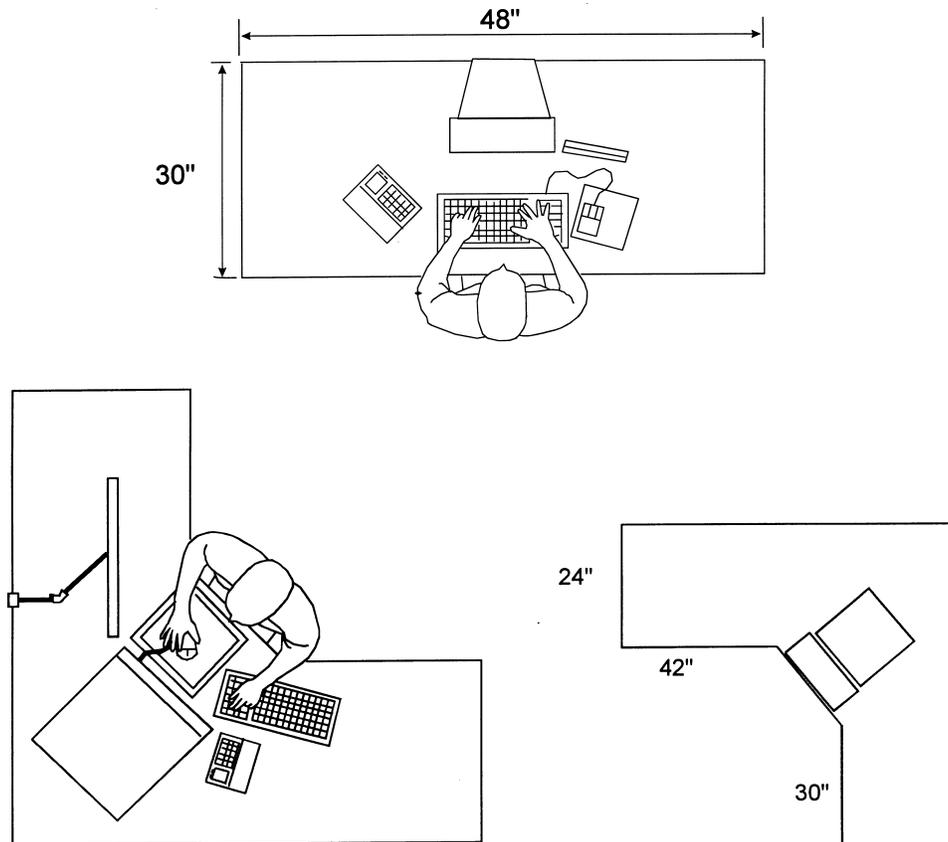


Figure A.14
“Starting Point” Work Surface layout-Mousing
(metric conversion 1 inch=2.54 centimeters)

Monitoring (diligence tasks)

Typical jobs in which monitoring is performed include:

- weather station; and
- radar control.

The recommended “Starting Point” layout is shown in Figure A.15

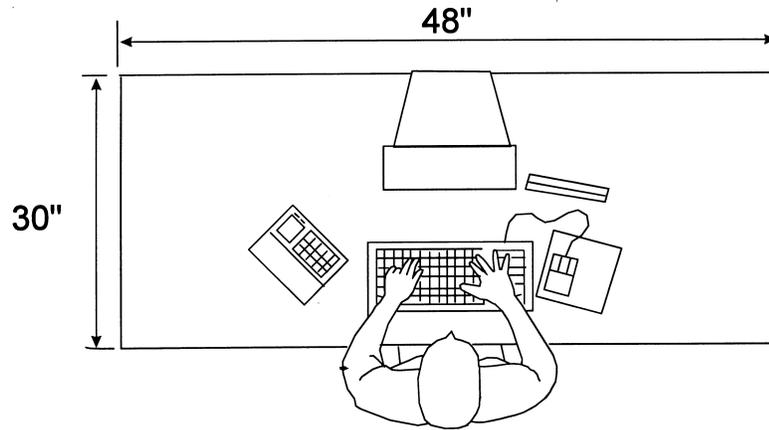


Figure A.15
“Starting Point” Work Surface Layout Diligence Tasks
(metric conversion 1 inch=2.54 centimeters)

Using the Telephone

Typical jobs in which calling is performed include (not necessarily limited to):

- customer service; and
- general administrative support.

The recommended “Starting Point” layout is shown in Figure A.16.

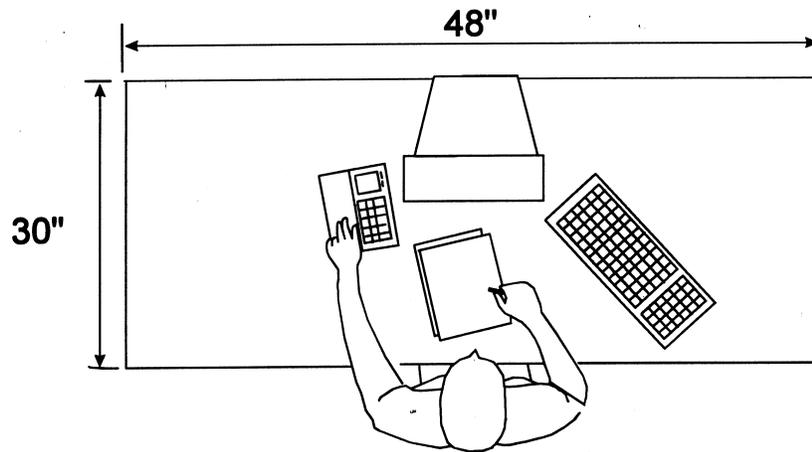


Figure A.16
“Starting Point” Work Surface Layout-Heavy Telephone Use
(metric conversion 1 inch=2.54 centimeters)

CAD Drafting

Typical jobs in which CAD drafting is performed include:

- Engineering; and
- Drafting.

The recommended “starting point” work surface layout for CAD operation is shown in Figure A.17.

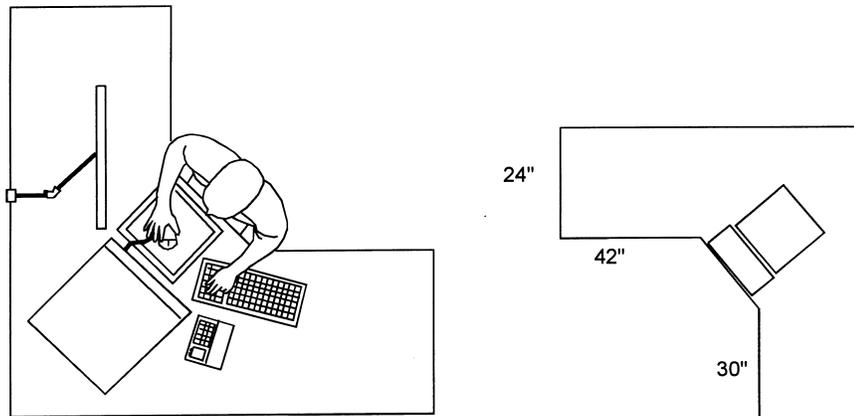


Figure A.17
“Starting Point” Work Station Layout-CAD Operation
(metric conversion-1 inch = 2.54 centimeters)

Calculator or use of numeric key pad

Typical jobs in which calculating is performed include (not necessarily limited to):

- heavy data entry;
- finance; and
- contracts.

The recommended starting point layout station for numeric key pad usage is shown in Figure A.18.

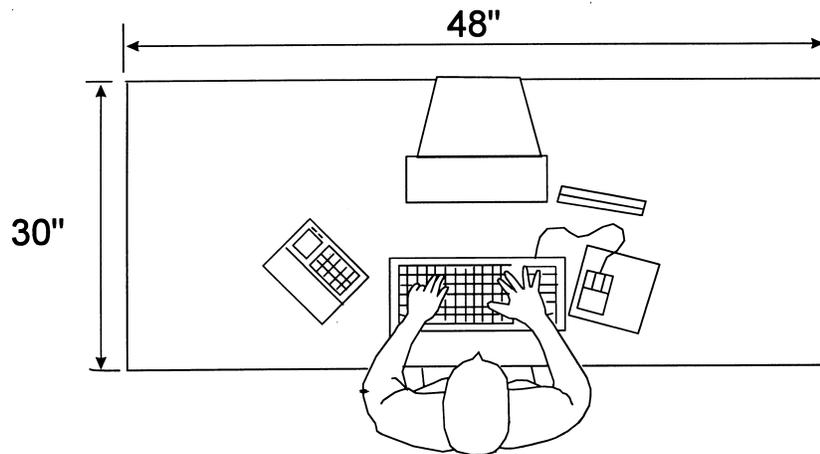


Figure A.18
“Starting Point” Work Station Layout-Numeric Key Pad Use
(metric conversion-1 inch=2.54 centimeters)

Microscope Use

Typical jobs in which microscope work is performed include (not necessarily limited to):

- hospital laboratories; and
- environmental testing laboratories.

The initial design of the microscope work station may be based on that provided for the keying/typing work station - - exchange the microscope for the computer. Due to the special nature of microscope work, a Level I analysis may be required prior to developing a final work station layout. Particular attention must be given to chair height in relation to the microscope to avoid having the user lean forward causing neck fatigue.

Work Surface Evaluation Checksheet

**Table A.2
Work Surface Evaluation Checksheet**

Date:			Evaluator:		
Job:			Type:		
Manufacturer:			Model Number:		
Model Name:			Price:		
Category	Parameter	Measure	Meets Criteria		N/A
			Yes	No	
Work Surface	Finish	Work surface should have a matte finish.			
	Color Finish	Work surface should neither be black nor white.			
	Edges	Edges should be rounded rather than square.			
	Height	Height of the work surface should be adjustable between 28" and 31.5" (71.1 - 80.0 cm)			
	Surface	Surface should be available in a variety of widths.			
	Thickness	Surface should be more than 2" in (5.1 cm) thickness.			
	Clearance under desk	Depth 18" (45.7 cm)			
		Width 28"-30" (71.1 - 76.2 cm.)			
		Height 28"-30" (71.1 - 76.2 cm.)			
	Stability	Surface should be stable.			
	Uniformity	If work surface is composed of more than one leaf or sectioned, then there should be no gaps between work surface.			
Comments: _____					

A.5.2.3 Criteria for Storage. Storage is an important issue that is often overlooked. Analysis of the workstation needs to focus on the factors listed below.

- Size of storage required, depends on:
 - amount of paper, supplies
 - size of files
 - number and size of reference materials, etc.
 - amount of personal belongings
- Type of storage
 - drawers (size and number)
 - shelves (overhead, free-standing)
- Location
 - frequency of use
- Size and Weight

Specifications for Storage

1. Shelving over the workstation should not be located above 65” (165.1 cm) from the floor.
2. Shelving below the workstation should not be located below 13” (33.02 cm) from the floor.
3. Wall files with top reference indexing should have their information tabs placed between 22 and 52 inches (55.88 and 132.08 cm) from the floor.
4. If an item weighs more than 40 lb. (18.1 kg), it should be stored on a shelf which is no deeper than 20” (50.8 cm) and which is located between 27.5 and 49 inches (69.85 and 124.46 cm) from the floor.
5. The space between a wall and the front of a vertical filing cabinet should be a minimum of 42” (106.68 cm).
6. The space between a wall and the front of lateral filing cabinet should be a minimum of 32” (81.28 cm).
7. The space between a wall and the front of a bookshelf should be a minimum of 36” (91.44 cm).

Storage Evaluation Checksheet

Table A.3 is the Checksheet to which you can use to determine if current storage is adequate or if changes are needed.

**Table A.3
Storage Evaluation Checksheet**

Date:			Evaluator:		
Job:			Type:		
Manufacturer:			Model Number:		
Model Name:			Price:		
Category	Parameter	Measure	Meets Criteria		N/A
			Yes	No	
Shelving	Over Work Station	Shelving over work station should not be located above 65" (165.1 cm.) above the floor			
	Below Work Station	Shelving below work station should not be located below 13" (33.0 cm.) from floor.			
	Wall Files	Wall files with top tabs should have reference tabs placed between 22-52 inches (55.9 - 132.1 cm.) above the floor.			
	Items weighing over 40 lb.	Items weighing more than 40 lb. (18.1 kg.) should be stored on shelves no deeper than 20 inches (50.8 cm.) and located between 27.5-49 inches (69.9 - 124.5 cm.)			
	Space - Vertical Cabinets	Space between a wall and the front of a vertical filing cabinet should be a minimum of 42 inches (106.7 cm.)			
	Space - Lateral Cabinets	Space between wall and front of lateral filing cabinet should be a minimum of 32" (81.3 cm.)			
	Space - Wall and front Bookshelf	Space between a wall and the front of a bookshelf should be a minimum 36" (91.4 cm.)			
Comments: _____ _____ _____					

A.5.2.4 Criteria for Footrests. Footrests provide a wider range of adjustability at a workstation. For small individuals working at fixed work surface height, the footrest is required to support the feet when the chair height is raised to accommodate proper positioning at the keyboard.

For taller individuals, a footrest, although not required, may enable them to assume a variety of positions. In addition, for workers who may be using chairs that do not meet ergonomic standards, a footrest can help promote a neutral seated posture and /or relieve pressure on the underside of the leg. Footrests are often an inexpensive addition which may improve employee comfort in many work stations.

Height and angle adjustable footrests are recommended as they accommodate day-to-day changes in shoe heel height and provide flexibility of moving the footrest between variable workstation heights.

Specification

1. The footrest should sit firmly on the floor without slipping.
2. The footrest should be covered with a non-slip material.
3. The footrest should be at least 20” (50.8 cm) wide.
4. The footrest should be 12” (30.48 cm) deep.
5. A footrest which is adjustable in angle from 10 to 15 degrees is desirable.
6. A footrest which is adjustable in height (approx. 2” (5.1 cm)) is desirable but not mandatory.

Footrest Evaluation Checksheet

Table A.4 is the Footrest Evaluation Checksheet.

**Table A.4
Footrest Evaluation Checksheet**

Date:		Evaluator:			
Job:		Type:			
Manufacturer:		Model Number:			
Model Name:		Price:			
Category	Parameter	Measure	Meets Criteria		N/A
			Yes	No	
Footrest	Width	Footrest should be at least 20" (50.8 cm.) wide			
	Depth	Footrest should be at least 12" (30.5 cm.) deep			
	Angle	Footrest if adjustable should be from 10 to 15 degrees.			
	Height	Footrest if adjustable in height (approximately 2" or 5.1 cm.) is desirable but not mandatory			
	Covering	Footrest should be covered with a non-slip material.			
	Sturdiness	Footrest should sit firmly on the floor without slipping.			
Comments: _____					

A.5.2.5 Criteria for Document Holders. A document holder can assist in accommodating both the musculoskeletal and visual needs of the VDT user. If the device has the appropriate adjustability features, the user can position the document adjacent to the screen or in another viewing position that allows for comfortable postures and visual access. Bifocal wearers usually need the documents placed nearer to the work surface.

Specifications

1. The document holder should have a matte finish.
2. The document holder should be available in size 8.5" X 11" (21.59 X 27.94 cm).
3. A document holder for large documents should be available in size 11" X 14" (27.94 X 35.56 cm).
4. The document holder should have an adequate means of securing the document.
5. The document holder should be stable when attached or placed on the workstation.

6. The device should be adjustable vertically (up/down).
7. The device should be adjustable horizontally (forward/back).

Note: For some tasks, a document holder that is positioned between the keyboard and the monitor may be appropriate.

Document Holder Evaluation Checksheet

Table A.5 is the Checksheet for evaluating document holders.

Table A.5
Document Holder Evaluation Checksheet

Date:			Evaluator:		
Job:			Type:		
Manufacturer:			Model Number:		
Model Name:			Price:		
Category	Parameter	Measure	Meets Criteria		N/A
			Yes	No	
Document Holder	Size - letter	Document holder should be available in size 8.5" x 11" (21.6 x 27.9 cm.)			
	Size - larger documents	Document holder should be available in 11" x 14" (27.9 x 35.6 cm.)			
	Adjustability	Document holder should be adjustable vertically (up/down)			
		Document holder should be adjustable horizontally (forward/back)			
	Finish	Document holder should have a matte finish.			
	Document Security	Document holder should have an adequate means of securing the document.			
	Stability	Document holder should be stable when attached or placed on the workstation.			
Comments: _____					

A.5.2.6 Criteria for Wrist/Palm Supports. Devices referred to as wrist-rests or palm-supports can be helpful under certain circumstances in dealing with musculoskeletal issues. For optimum comfort, the wrist should be as flat as possible while the person is keying. This position should be achieved **by adjusting the height of the chair in relation to the keyboards home-row keys** rather than relying on a wrist rest. A wrist-rest may be a helpful accessory under the following circumstances:

- The chair cannot be adjusted to the appropriate height;
- The keyboard height exceeds the recommended height 2" (5.1 cm) to home-row); and
- There is not enough room to position the keyboard back from the edge of the surface.

If a wrist-rest is provided, it should conform to the requirements listed below. In addition, users should be trained to use the wrist-rest when not keying, i.e. at rest.

If a wrist-rest causes the wrist to be extended (bent up more than 10 degrees) or flexed (bet down) while keying, its use should be discontinued because it may restrict movement and lead to further tendon irritation and disorders.

Specifications

No definitive criteria have been established for wrist or palm supports. However, the following guidelines should be considered.

1. The wrist/palm support should be at least 2" (5.1 cm) wide and extend the length of the keyboard.
2. The edges should be rounded and the entire surface padded.
3. The height should not exceed the height of the front of the keyboard to which it is attached.

Wrist/Palm Support Evaluation Checksheet

Table A.6 is the Wrist/Palm Support Evaluation Checksheet.

Table A.6 - Wrist/Palm Support Evaluation Checksheet

Date:		Evaluator:			
Job:		Type:			
Manufacturer:		Model Number:			
Model Name:		Price:			
Category	Parameter	Measure	Meets Criteria		N/A
			Yes	No	
Wrist/Palm Supports	Width	Wrist/palm support should be at least 2" (5.1 cm.) wide and extend the length of the keyboard			
	Edges	Edges of wrist/palm support should be rounded and the entire surface padded.			
	Height	The height should not exceed the height of the front of the keyboard.			
Comments: _____					

A.5.2.7 Criteria for Monitor Supports. The primary purpose for supplying monitor support arms is to provide for flexibility and adjustability to address both musculoskeletal and visual issues. These have the following benefits:

- Free up space in existing workstations where work surface space is limited; and
- Increase flexibility/accommodate different size employees in workstations where the entire work surface is one height.

The use of monitor supports is also an excellent way of adapting existing workstations that are too small, or that have seating that is not adjustable.

Specifications

1. The device should have a matte finish.
2. The device should be able to hold the weight of a terminal approximately 50 lb. - 60 lb. (22.7 - 27.2 kg.) (Color monitors are heavier).
3. The platforms should have a lip to prevent the terminal from slipping off.
4. The device should be adjustable vertically (up/down).

5. The device should be adjustable horizontally (forward/back).
6. The device should be able to swivel (rotate in the horizontal plane).

Monitor Support Evaluation Checksheet

Table A.7 presents the Monitor Support Evaluation Checksheet

**Table A.7
Monitor Support Evaluation Checksheet**

Date:		Evaluator:			
Job:		Type:			
Manufacturer:		Model Number:			
Model Name:		Price:			
Category	Parameter	Measure	Meets Criteria		N/A
			Yes	No	
Monitor Support Arm	Adjustability	Monitor support arm should be adjustable both vertically and horizontally.			
	Swivel	Monitor support arm should be able to swivel (rotate in the horizontal plane).			
	Finish	Monitor support arm should have a matte finish.			
		Platform should have a lip to prevent the terminal from slipping off.			
	Weight	Monitor support arm should be able to hold the weight of a terminal approximately 50-60 lb. (22.7 - 27.2 kg.) (Color monitors are heavier)			
Comments: _____					

A.5.2.8 Criteria for Task Lighting. The need for task lighting is determined based on the overall ambient light level, the amount of time the user spends viewing source documents or reference materials, the condition of the documents, and the individual requirements of the users. (Generally, a person 60 years of age requires three times as much light as a person 20 years of age.)

Task lighting is recommended for workstation layouts where ambient light levels are 50 foot-candles (500 lux) or less.

Note: If the form of task lighting that has been provided in existing workstations is the under-shelf type, then it is critical **not** to place the monitor beneath those lights, as diffused glare on the screen is likely.

The free-swinging arm lamp (clamped to the side of the table or hooked onto the paneling) is preferable to the lamp attached underside a shelving unit, because of its flexibility. However, extreme care should be taken to keep the bulb out of the worker's direct line of sight. To control the potential for glare, it is desirable that task lamps be covered with diffusers.

Specifications for Task Lighting

1. The light casing should have a matte finish.
2. The light should be adjustable vertically, horizontally, and should be able to rotate.
3. The bulb should not protrude from the bottom of the light fixture.
4. The light should (ideally) clip onto the work surface or panel.
5. Under-shelf lighting is acceptable; however, the VDT should not be placed directly underneath.

Task Lighting Evaluation Checksheet

Table A.8 is the Task Lighting Checksheet.

**Table A.8
Task Lighting Evaluation Checksheet**

Date:			Evaluator:		
Job:			Type:		
Manufacturer:			Model Number:		
Model Name:			Price:		
Category	Parameter	Measure	Meets Criteria		N/A
			Yes	No	
Task Lighting	Adjustability	Task lighting should be adjustable vertically, horizontally, and should be able to rotate.			
	Finish	Task lighting should have a matte finish.			
	Bulb	The bulb should not protrude from the bottom of the light fixture.			
	Security	Task light should ideally clip onto the work surface or panel.			
Comments: _____					

A.5.2.9 Criteria for Keyboard Design. A number of ergonomic risk factors which have been identified in office work may be associated with to keyboard design and use. Factors such as: repetitive work (keying), forceful exertions, awkward positions of the hand, wrist and arms, direct mechanical pressure and prolonged constrained postures, have been observed in many administrative tasks

In the office environment, the alphanumeric keyboard is used by most data entry and word processing operators. An alphanumeric keyboard is an array of keys organized into functional groups. There are two primary types; the Dvorak and the Qwerty. The Dvorak keyboard layout places most frequently used keys in the English language in the area of the keyboard where the strongest fingers are located during touch keying. The Qwerty name keyboard layout is the traditional design that most typists and computer users are familiar with. The Qwerty is used because the six keys on the second row from the top (left) spell Q-W-E-R-T-Y.

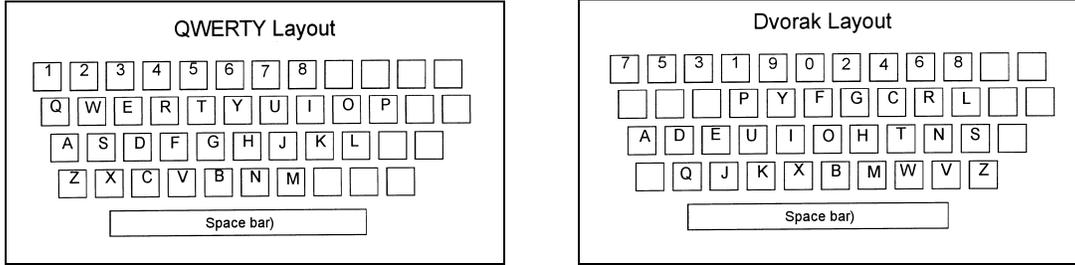


Figure A.19
Keyboard Types - Qwerty and Dvorak Layout

Keyboards can be presented in a number of profiles - positive slope (rises away from the front of the surface), negative slope (falls away from the front of the surface), a dished profile (represents a continuous concave curve) and a flat profile (continuous height throughout key layout).

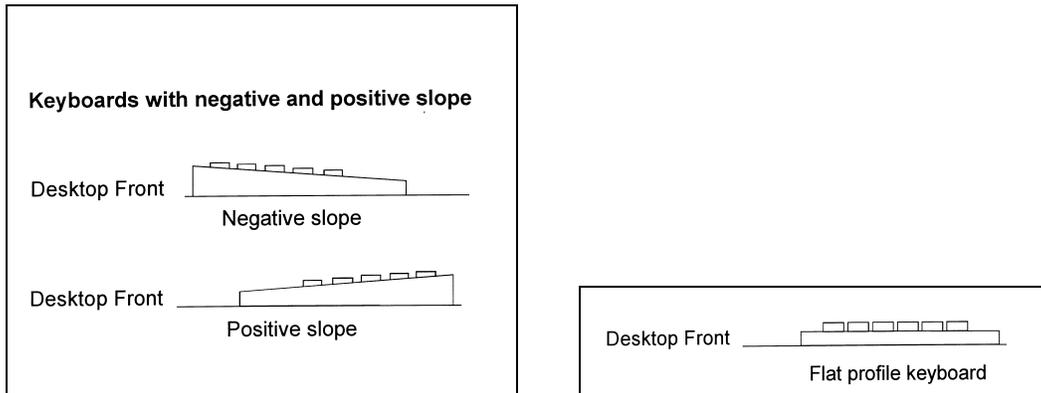


Figure A.19
Keyboard Profiles

The layout and design of the keyboard can affect the performance and the comfort of the user. Recent research has indicated that a negative slope keyboard may provide some benefit to wrist stress reduction. This is only the case, however, when use of the keyboard promoted the neutral position (flat wrist). This may also be achieved without a negative slope design.

Negative vs. Positive Keyboard Slope

The traditional keyboard slope of a Qwerty keyboard is positive. Research suggests that a negative keyboard slope as compared to the positive keyboard slope significantly decreases wrist extension. No significant change was noted between the two keyboard types when measuring ulnar/radial deviation of the wrist or elbow angle. Data suggests that a height adjustable negative keyboard slope can be used to maintain a neutral wrist position when keyboarding.

Specifications for Keyboards

- Keyboard Design
 1. The height of the keyboard shall not exceed 1.4 inches (35.6 mm). The preferred height is not greater than 1.2 inches (30.5 mm).
 2. The recommended slope is 5 to 12 degrees to the horizontal. The slope should not exceed 15 degrees.
 3. Sloped, stepped, dished, sculptured and flat profiles of keyboard rows are acceptable.
 4. The keys and visible surface of the keyboard should be a matte finish.
 5. Dark characters on a light background are recommended.
 6. No sharp edges or corners should be present on the keyboard housing.
 7. The keyboard should be detachable, stable and easy to reposition.
 8. The keyboard should be adjustable in slope.

- Key Design
 1. The horizontal and vertical distances between two adjacent keys measured center to center shall be .75 inch (19.1 mm) for the alphanumeric section.
 2. The strike surface of the keycaps of alphanumeric keys shall be at least 4.3 inch (109.2 mm.) in area, the width of the strike surface shall be between .47 inch (11.9 mm) and .59 inch (15.0 mm).
 3. Key displacement shall be between .05 inch (1.3 mm) and .23 inch (5.8 mm)
 4. The keys should provide tactile, auditory and visual feedback.
 5. The key top shape should be concave in design.
 6. The height of characters indicating alphanumeric keys shall not be less than 1 inch (25.4 mm). When an abbreviation is used the height of the capital letters shall not be less than .08 inch (2.0 mm).

The Dvorak keyboard is sometimes specified for an employee who has been experiencing discomfort in the wrist of hands. This accommodation needs to be considered only after other modifications have been made. If it is specified, adequate training and learning time must be provided since the employee must basically re-teach him or herself how to type with this type of keyboard.

Portable Computers/Laptop Computers

Laptops are often utilized in office and non-office environments due to the ease of portability. Some problems noted with laptops is the fixed height of the screen, small keyboard layout and the restrictive nature of some input devices that have replaced the mouse. Whenever possible, laptop use should be kept to a minimum. Ideally, when working in the office environment the laptop should be connected to a larger PC monitor, mouse and keyboard.

Keyboard Design Evaluation Checksheet

**Table A.9
Keyboard Design Evaluation Checksheet**

Date:			Evaluator:		
Job:			Type:		
Manufacturer:			Model Number:		
Model Name:			Price:		
Category	Parameter	Measure	Meets Criteria		N/A
			Yes	No	
Keyboard	Height	Height of the keyboard should not exceed 1.4 in. (35.6 mm). The preferred height is not greater than 1.2 in. (30.5 mm).			
	Slope	The recommended slope should be 5 to 12 degrees to the horizontal. The slope should not exceed 15 degrees.			
	Finish	Keys and visible surface of the keyboard should be a matte finish.			
	Characters on Keyboard	Dark characters on a light background should be recommended.			
	Edges	No sharp edges or corners should be present on the keyboard housing.			
	Slope	Keyboard should be adjustable in slope.			
	Distance	Horizontal and vertical distance between two adjacent keys measured center to center should be .75 in (19.1 mm) for the alphanumeric section.			
	Strike surface	Strike surface of the keycaps of alphanumeric keys shall be at least .47 in (11.9 mm) to .59 in (15.0 mm) in width.			
	Key Displacement	Key placement should be between .05 in (1.3 mm) to .24 in (5.8 mm).			
	Key Feedback	Keys should provide tactile, auditory and visual feedback.			
	Shape	Key top shape should be concave in design			
Comments: _____					

**LEVEL I ERGONOMICS ASSESSMENT
SUMMARY AND RECOMMENDATIONS
SAMPLE**

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LEVEL I ERGONOMICS ASSESSMENT SUMMARY AND RECOMMENDATIONS

Date (YYMMDD)	96-10-14	Workplace Identifier:	
<i>(use this space for mechanical imprint)</i>		Base <i>WPAFB, OH</i>	Organization
		Workplace <i>Contracts</i>	
		Bldg. No./Location	Room/Area
		AFSC/Job Series <i>Contract Specialist</i>	

CRITICAL TASKS IN PRIORITY ORDER

Task Name	Task Rating	Body Regions and Ratings <small>(Circle one for each region)</small>				
		Shoulder/Neck	Hands/Wrists /Arms	Back/Torso	Legs/Feet	Head/Eyes
1. <i>Writing/Reviewing Documents</i>	High Med	High Med	High Med	High Med	High Med	High Med
2.	High Med	High Med	High Med	High Med	High Med	High Med
3.	High Med	High Med	High Med	High Med	High Med	High Med

OVERALL JOB RATING

RATING: High Medium	PRIORITY BODY REGION: Shoulder/Neck	Hands/Wrists/Arms
<small>(Circle one)</small>	<small>(Circle one)</small> Back/Torso Legs/Feet	Head/Eyes

- Findings are consistent with results from Job Requirements and Physical Demands Survey (PHF): Yes No N/A
 Comment: Sample Job - No data previous to Level I Assessment

- Findings are consistent with AF Form 190: Yes No N/A
 Comment: Sample Job - no data previous to Level I Assessment

RECOMMENDATIONS FOR FOLLOW-UP

Modifications and adjustments	Major changes and/or purchases
<ul style="list-style-type: none"> • <u>Lower the worksurface used for writing (or)</u> • <u>Raise the chair and provide a footrest</u> • <u>Encourage employee to avoid working on "stacks" of contracts on the work surface</u> • <u>Encourage employee to stand up when using hole punch.</u> <p>Expected Benefits <input checked="" type="checkbox"/> Health/Safety <small>(Check all that apply)</small> <input type="checkbox"/> Productivity/Quality</p>	<ul style="list-style-type: none"> • <u>Relocate air conditioned units or vents</u> • <u>Install a larger worksurface for contract review.</u> <p>Expected Benefits <input type="checkbox"/> Health/Safety <small>(Check all that apply)</small> <input type="checkbox"/> Productivity/Quality</p>

BEF (Sign) _____