

# Design Considerations for Future Offices and Data Entry Workstations

## Why design for both sitting and standing?

The use of VDT's/personal computers (PC's) is increasing and is a major health issue. There are over twenty million American workers using VTD's/PC's daily and it is estimated that by year 2000, over fifty percent of American workers will be using VDT's/PC's at work. Because of Carpal Tunnel Syndrome (CTS), neck, shoulder, and back injuries, as a result of using VDT's/PC's there is increased regulatory emphasis:

- San Francisco Ordinance
- Over twenty states considering introduction of office ergonomic legislation
- European DIN standard limiting VDT usage to 4 hours/day
- National Institute of Occupational Safety and Health study of keyboards
- OSHA General Industry Standard for ergonomics -- announced proposed rule making

A quick review of "Why We Sit?" and "Why We Stand?" follows:

### Why Do We Sit?

- Stability for precision work
- Less fatigue
- Use foot controls

### Why Do We Stand?

- Cover larger areas
- Use larger forces

The vast majority of VDT workstations have been designed for either sitting or standing, with most office and data entry workstations for sitting only.

The sitting *and* standing concept at the same workstation is recommended for future office and data entry workstations.

### Why?

Because contrary to the UPS workers in HUB's, feeders, and package cars where we are trying to reduce physical work load and posture changes in , in VDT office data entry workstations we are trying to encourage physical movement and posture changes.

Therefore designing a VDT workstation that one can sit and/or stand allows introduction of strategies to encourage or require movement which yield the following benefits:

- Movement promotes fatigue relief from sedentary jobs by:
  - removing lactic acid
  - providing nutrients to discs and muscles
  
- Standing allows more stretching and exercise which increase metabolism and provides stress relief; both physical and mental.

Additional benefits of designing for both sitting and standing are:

- More likely to be at or near the workstation
- Allows postural changes easily (i.e., easier, safer, more efficient-- removes fatigue)
- Gives worker the feeling of control to sit or stand (most likely the worker will spend time 80%-85% sitting and 15%-20% standing)
- Standing and making easy chair adjustments burns more calories (i.e., less likely to produce feed lot syndrome "sit, eat, sit, eat, sit, sleep")

Additional thoughts regarding the sitting and standing concept is to develop:

- Educational programs regarding:
  - managing stress at a VDT/PC
  - wellness
  - stretching/exercise
- Design in postural changes by the relocation of items used at the workstation (i.e., move printer to a shelf to force a worker to get out of his/her chair)

**In Appendix A, design implications for sitting and/or standing are:**

Worksurface Height Range

Worksurface Thickness

Worksurface Depth

Worksurface Width

VDT Monitor Adjustment

Ergonomic Chair Specifications:

    Seat Height Adjustment

    Seat Angle Adjustment

    Backrest Height Adjustment

    Backrest Depth Adjustment

    Backrest Angle Adjustment

    Armrest Height Adjustment

    Armrest Width Adjustment

Lighting

Acoustic Noise

Temperature

*Why design for sitting and/or standing? Because it is the way YOU prefer to work.*

## Workstation Dimension Specifications

### Workstation Standing:

#### 95th Male

115.28 cm (ERH)  
+2.00 cm (HH)  
- 2.00 cm (S)  
+3.81 cm (KA)  
119.09 cm (HRH)  
-4.45 cm (K&WH)  
114.64 cm (45.13 in) (WSH)

#### 5th Female

92.63 cm (ERH)  
+2.00 cm (HH)  
-2.00 cm (S)  
+0.00 cm (KA)  
92.63 cm (HRH)  
-4.45 cm (K&WH)  
88.18 cm (34.72 in) (WSH)

### Workstation Sitting:

#### 95th Male

47.63 cm (PH)  
+27.37 cm (ERH)  
+2.00 cm (HH)  
+3.81 cm (KA)  
-3.00 cm (S)  
77.81 cm (HRH)  
-4.45 cm (K&WH)  
73.36 cm (28.88 in) (WSH)

#### 5th Female

35.13 cm (PH)  
+17.57 cm (ERH)  
+2.00 cm (HH)  
+0.00 cm (KA)  
-2.00 cm (S)  
52.70 cm (HRH)  
-4.45 cm (K&WH)  
48.25 cm (19.00 in) (WSH)

*Worksurface Height Range of Adjustment: (48.25 cm - 114.64 cm) (19.00 in - 45.13 in)*

## Workstation Dimension Specifications (continued)

*Worksurface Thickness: Less than 3.81 cm (1.5 in)*

### Workstation Depth:

*95th Male (Clearance)*

66.74 cm (B-K-D)

+29.2 cm (FL)

95.94 cm

\*75% (ANSI)

**71.96 cm (28.33 in) -- minimum**

+41.25 cm (Popliteal Height \* sin(120°))

**113.21 cm (44.57 in)\*\* -- maximum**

\*\* This may cause problems because the forward functional reach of a 5th percentile female is 67.67 cm (26.64 in) and a 95th percentile male is 86.70 cm (34.13 in).

*Workstation Width: 116.84 cm (46 in) recommended*

ANSI recommends 60.96 (24 in) minimum, based on 95th percentile female thigh breadth 43.7 cm (17.2 in) with an additional 17.27 cm (6.8 in) for clothing, freedom of movement, and personal comfort. This workstation width provides enough room to accommodate the monitor, phone, mirrors, and note pads.

## Workstation Dimension Specifications (continued)

### *VDT Monitor Adjustment:*

#### **Standing:**

##### *95th Male*

174.29 cm (EH)

+2.00 cm (HH)

-2.00 cm (S)

**174.29 cm (68.62 in) (VMH)**

##### *5th Female*

141.52 cm (EH)

+2.00 cm (HH)

-2.00 cm (S)

**141.52 (55.72 in) (VMH)**

#### **Sitting:**

##### *95th Male*

47.63 cm (PH)

+84.80 cm (EH)

+2.00 cm (HH)

-3.00 cm (S)

**131.43 cm (51.74 in) (VMH)**

##### *5th Female*

35.13 cm (PH)

+68.46 cm (EH)

+2.00 cm (HH)

-2.00 cm (S)

**103.59 cm (40.78 in) (VMH)**

***Monitor Height Range of Adjustment: 103.59 cm - 174.29 cm (40.78 in - 68.62 in)***

### ***Worksurface Supporting VDT Monitor***

Because the top of the monitor must be located at 174.29 cm (68.62 in) to accommodate the tallest male and 103.59 cm (40.78 in) to accommodate the smallest female, the monitor support must range from:

**(174.29 cm (68.62 in) -- (top of monitor to base height)) to**

**(103.59 cm (40.78 in) -- (top of monitor to base height)).**

**Example:** If the top of monitor to base height is 30.48 cm (12 in), the support surface must range from 174.29 cm - 30.48 cm = 143.81 cm (68.62 in - 12 in = 56.62 in) to 103.59 cm - 30.48 cm = 73.11 cm (40.78 in - 12 in = 28.78 in)

## Ergonomic Chair Specifications

*Seat Height Adjustment: 12.50 cm (4.92 in)*

*95th Male*

47.63 cm (PH)

+2.00 cm (HH)

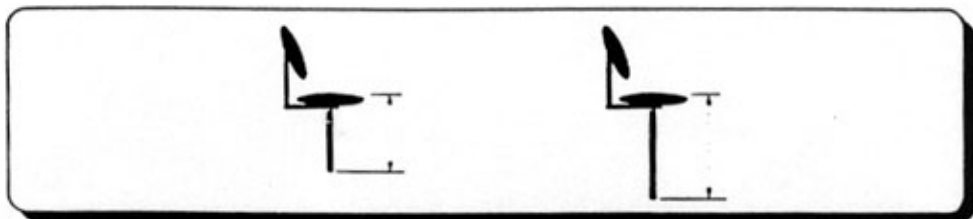
49.63 cm (19.54 in)

*5th Female*

35.13 cm (PH)

+2.00 cm (HH)

37.13 cm (14.62 in)



**Lowest - 37.13 cm (14.62 in)**

**Highest 49.63 cm (19.54 in)**

*Seat Angle Adjustment: -15° to +8°*



- 15°

0°

+8°

## Ergonomic Chair Specifications (continued)

**Backrest Height Adjustment: 15.24 cm - 25.4 cm (6 in - 10 in)\*\***



**\*\*From ANSI Standards**

**Backrest Depth Adjustment: 5.77 cm (2.27 in)**

*95th Male*

54.55 cm (B-P-D)

-10.15 cm (PC)

44.39 cm (17.48 in)

*5th Female*

44.00 cm (B-P-D)

-5.08 cm (PC)

38.92 cm (15.32 in)



38.62 cm - 42.94 cm (15.32 in - 17.48 in)

**Backrest Angle Adjustment: -15° to +8°**



-15°

0°

+8°



## Ergonomic Chair Specifications (continued)

*Armrest Height Adjustment: 17.57 cm - 27.87 cm (6.92 in - 10.97 in)*



*Armrest Width Adjustment: 20.59 cm (8.11 in)*

*95th Male*

**62.06 cm (F-F-B)**  
**(24.43 in)**

*5th Female*

**41.47 cm (F-F-B)**  
**(16.33 in)**



**Normal Width**  
**41.47 cm (16.33 in)**



**Extended Width**  
**62.06 cm (24.43 in)**

*Armrest Rotation: 360°*



## Workplace Environment Specifications

### *Lighting: Recommended 200 - 500 lux*

Recommended range for workplaces with VDT's 200 lux to 500 lux, measured on the work area of the work surface (ANSI standards).

### *Acoustic Noise: Recommended 56 to 66 dB*

This noise level is recommended for acceptable speech and telephone communication (Eastman Kodak Vol. 1). To determine if DRC is exceeding this or if panels can absorb the excess may be difficult. The best absorbing panel material should always be used.

### *Temperature: Recommended 68° F - 78° F*

Recommended for areas where sedentary or light work is done (Eastman Kodak, Vol. 1).

### Defined Terms

ERH	Elbow Rest Height	KA	Keyboard Angle
PH	Popliteal Height	HRH	Home Row Height
HH	Heel Height	K&WH	Keyboard & Wrist Height
S	Slump	WSH	Worksurface Height
EH	Eye Height	PH	Popliteal Height
VMH	VDT Monitor Height	C	Clearance
HH	Heel Height	B-K-D	Buttock Knee Distance
B-P-D	Buttock Popliteal Distance	PC	Popliteal Clearance

Table 1-3. Body dimensions of U.S. civilian adults, female/male, in cm. Adapted from U.S. Army data reported by Gordon, Churchill, Clauser, Bradtmiller, McConville, Tebbetts, and Walker (1989).

Nude

	Percentiles						SD
	5th		50th		95th		
<b>HEIGHTS</b>							
(f above floor, s above seat)							
Stature ("Height") <sup>f</sup>	F 152.78 / M 164.69	F 162.94 / M 175.58	F 173.73 / M 186.65	F 6.36 / M 6.68			
Eye Height <sup>f</sup>	141.52 / 152.82	151.61 / 163.39	162.13 / 174.29	6.25 / 6.57			
Shoulder (acromial) Height <sup>f</sup>	124.09 / 134.16	133.36 / 144.25	143.20 / 154.56	5.79 / 6.20			
Elbow Height <sup>f</sup>	92.63 / 99.52	99.79 / 107.25	107.40 / 115.28	4.48 / 4.81			
Wrist Height <sup>f</sup>	72.79 / 77.79	79.03 / 84.65	85.51 / 91.52	3.86 / 4.15			
Crotch Height <sup>f</sup>	70.02 / 76.44	77.14 / 83.72	84.58 / 91.64	4.41 / 4.62			
Height (sitting) <sup>s</sup>	79.53 / 85.45	85.20 / 91.39	91.02 / 97.19	3.49 / 3.56			
Eye Height (sitting) <sup>s</sup>	68.46 / 73.50	73.87 / 79.20	79.43 / 84.80	3.32 / 3.42			
Shoulder (acromial) Ht (sitting) <sup>s</sup>	50.91 / 54.85	55.55 / 59.78	60.36 / 64.63	2.86 / 2.96			
Elbow Height (sitting) <sup>s</sup>	17.57 / 18.41	22.05 / 23.06	26.44 / 27.37	2.68 / 2.72			
Thigh Height (sitting) <sup>s</sup>	14.04 / 14.86	15.89 / 16.82	18.02 / 18.99	1.21 / 1.26			
Knee Height (sitting) <sup>f</sup>	47.40 / 51.44	51.54 / 55.88	56.02 / 60.57	2.63 / 2.79			
Popliteal Height (sitting) <sup>f</sup>	35.13 / 39.46	38.94 / 43.41	42.94 / 47.63	2.37 / 2.49			
<b>DEPTHS</b>							
Forward (thumbtip) Reach	67.67 / 73.92	73.46 / 80.08	79.67 / 86.70	3.64 / 3.92			
Buttock-Knee Distance (sitting)	54.21 / 56.90	58.89 / 61.64	63.98 / 66.74	2.96 / 2.99			
Buttock-Popliteal Distance (sitting)	44.00 / 45.81	48.17 / 50.04	52.77 / 54.55	2.66 / 2.66			
Elbow-Fingertip Distance	40.62 / 44.79	44.29 / 48.40	48.25 / 52.42	2.34 / 2.33			
Chest Depth	20.86 / 20.96	23.94 / 24.32	27.78 / 28.04	2.11 / 2.15			
<b>BREADTHS</b>							
Forearm-Forearm Breadth	41.47 / 47.74	46.85 / 54.61	52.84 / 62.06	3.47 / 4.36			
Hip Breadth (sitting)	34.25 / 32.87	38.45 / 36.68	43.22 / 41.16	2.72 / 2.52			
<b>HEAD DIMENSIONS</b>							
Head Circumference	52.25 / 54.27	54.62 / 56.77	57.05 / 59.35	1.46 / 1.54			
Head Breadth	13.66 / 14.31	14.44 / 15.17	15.27 / 16.08	0.49 / 0.54			
Interpupillary Breadth	5.66 / 5.88	6.23 / 6.47	6.85 / 7.10	0.36 / 0.37			
<b>FOOT DIMENSIONS</b>							
Foot Length	22.44 / 24.88	24.44 / 26.97	26.46 / 29.20	1.22 / 1.31			
Foot Breadth	8.16 / 9.23	8.97 / 10.06	9.78 / 10.95	0.49 / 0.53			
Lateral Malleolus Height <sup>f</sup>	5.23 / 5.84	6.06 / 6.71	6.97 / 7.64	0.53 / 0.55			
<b>HAND DIMENSIONS</b>							
Circumference, Metacarpale	17.25 / 19.85	18.62 / 21.38	20.03 / 23.03	0.85 / 0.97			
Hand Length	16.50 / 17.87	18.05 / 19.38	19.69 / 21.06	0.97 / 0.98			
Hand Breadth, Metacarpale	7.34 / 8.36	7.94 / 9.04	8.56 / 9.76	0.38 / 0.42			
Thumb Breadth, Interphalangeal	1.56 / 2.19	2.07 / 2.41	2.29 / 2.65	0.13 / 0.14			
<b>WEIGHT (in kg)</b>	39.2* / 57.7*	62.01 / 78.49	84.8* / 99.3*	13.8* / 12.6*			

\* Estimated (from Kroemer, 1981)

NOTE: In this table, the entries in the 50th percentile column are actually "mean" (average) values. The 5th and 95th percentile values are from measured data, not calculated (except for weight). Thus, the values given may be slightly different from those obtained by subtracting 1.65 SD from the mean (50th percentile), or by adding 1.65 SD to it.