

## **MONITOR / SCREEN CHARACTERISTICS INFORMATION**

The recent concern in Call Centres is with increase in visual and neck fatigue. However, the ergonomic controls are important when evaluating the monitor, the keyboard, training issues, and other peripheral equipment being used in Call Centres. For the purpose of this information, we will concentrate on the monitor design guidelines

### **I. Monitor Placement**

#### **Viewing Distance**

For the majority of office-related tasks, the design viewing distance should be no less than 40 cm. Certain applications, such as touch screen monitors, may necessitate reducing the viewing distance to 30 cm (ISO 9241-3, 1992). Viewing distances should not exceed approximately 71 cm (CAN/CSA-Z412-M89, 1989).

A more generic approach for establishing viewing distance can be achieved through the use of the following equation:

$H = D/200$ , where:

H = character height in mm

D = horizontal viewing distance in mm.

#### **Comment - Viewing Distance**

It has been noted by Ankrum (1996) that guidelines that place an upper limit on viewing distances have little scientific basis. Common upper limits (e.g., “arm’s length” rule, approximately 71 cm) is derived from cockpit designs where the limiting factor is reach distance versus viewing distance. Ankrum argues that farther is better. There is no upper limit for viewing monitors except for the ability to see the characters on the screen. Increasing font sizes is the proposed solution versus moving monitors closer to the Agent to accommodate small font sizes.

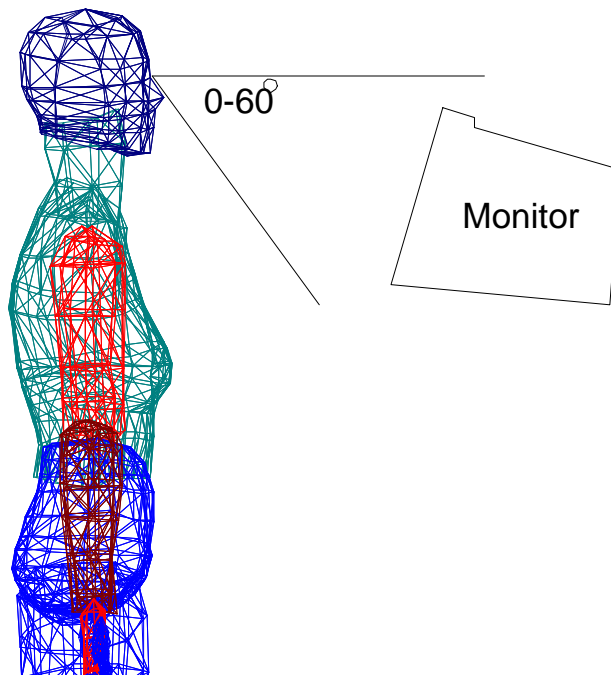
### Line-of-Sight Angle (Vertical Placement of Monitor)

The display should be positioned such that it can be viewed with a line of sight angle between horizontal and 60 degrees below horizontal. Stated another way, the top line of the screen should be no higher than the horizontal line of sight. This will cause the eyes to naturally fall towards the centre of the screen. Figure II.B.4 depicts this guideline.

If the agent is not available as a reference to determine acceptability of line-of-sight, Sanders and McCormick (1987) recommend that the vertical distance from floor to the mid-point of the monitor be in the range of 84-106 cm.

**Comment: Vertical Placement of the Monitor.** There is growing consensus that the monitor should be placed as low as possible within the prescribed line-of-sight angle. Ankrum, et al (1995) report that neck discomfort was minimized when the monitor was positioned so that the top of the monitor was approximately 20 degrees below seated eye level. Strategies to be discussed, such as removing the CPU from underneath the monitor, allow the monitor to be lowered to its fullest extent. Of course this will be difficult when using a larger screen. Please make sure of the minimum depth requirements for monitor placement.

#### Line of sight



## Minimizing Glare Effects

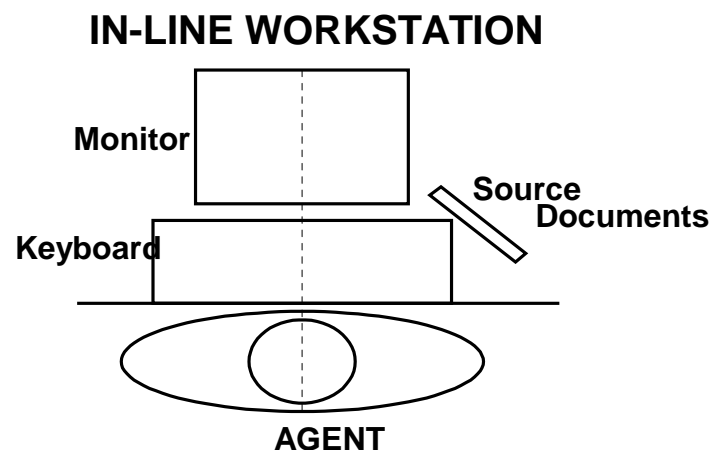
One means to reduce glare effects on the monitor is by positioning the monitor so that it is not directly in-line with sources of glare (i.e., light sources). Providing a tilt and swivel base for the monitor can often help in reducing glare effects on the monitor.

**Comment: Tilting the Monitor.** Tilting the monitor forward is often suggested as a means to reduce glare effects on the screen. However, Ankrum, et al. (1995) found that user reports of neck discomfort increased when the monitor was tilted forward. Based on this, the authors suggest that other methods be explored to reduce glare effects on the monitor.

## Minimizing Neck Rotation

The monitor should be positioned so that the agent can view the screen without having to rotate the neck. This general principle is referred to as keeping the workstation elements (keyboard, monitor, documents, etc.) **in-line** with the body. There are two specific guidelines that operationalize this general principle:

- The monitor and other viewed items (any referenced documents) should be positioned so that they are located in a 30 degree cone as measured from the mid-sagittal plane of the body.
- The monitor and other viewed items should be positioned so that the neck never has to rotate greater than 45 degrees.



## II. Monitor (Screen) Characteristics

### Screen Flicker

The refresh rate of a VDT is defined by the number of times per second (expressed in Hertz or cps) that an electron beam returns to a point on the screen to re-excite the phosphor and "repaint" the screen. **Flicker** is the perceived movement of characters on the screen, and can be a function of an inadequate refresh rate. A 60-80 Hz screen refresh rate is recommended to minimize flicker. Non-interlaced monitors (versus interlaced monitors) refresh each line with each pass, thereby reducing flicker.

### Resolution

The recommended resolution for a computer monitor will be a function of the types of tasks performed using the monitor. Three screen resolution-by-task classifications are typically offered:

- Word processing, spreadsheets: 640 x 480 Resolution
- Windows applications, graphics: 1024 x 768 Resolution
- CAD: 1280 x 1024 Resolution.

The majority of Call Centre applications will typically fall under the Windows/graphics category.

### Brightness and Contrast

The luminance of the characters or background (whichever is brighter) should be at least 10 foot-lamberts. The contrast between the brighter and darker areas of the screen should be at least 3:1, but 7:1 is preferred.

## **Characters**

The following recommendations are offered to improve screen character quality:

Character Height. 16-24 minutes of arc, or 3-5 mm, is recommended..

Matrix. A 5x7 pixel ratio of character width to height (a pixel is one of several dots that compose characters on the screen), is recommended as a minimum design criteria. A 7x9 ratio is preferred.

Fonts. Sans-Serif (simple) fonts are recommended. Among these are Helvetica, Huddleston, Lincoln-Mitre fonts.

Between-Character Spacing should be at least 10% of the character height.

## **Polarity**

There are two types of screen polarity:

- Standard = light characters on dark background
- Reverse = dark characters on light background

It is recommended that workers be able to switch polarities on their screens to accommodate their own visual capacities. Reverse polarity tends to work better with higher ambient lighting level (less glare), but flicker may be more evident on the display if the refresh rate is less than 80 Hz. Please note that CAN/CSA Z412 states that either polarity approach is acceptable, although there is evidence supporting the benefits of reverse polarity.

## **Color**

There are no strict guidelines in terms of preferred colors or color combinations for computers. Use the guidelines below when selecting screen colors:

- Minimize the use of colors. The visual system has to work harder when differentiating among a large number of colors on a screen. No more than 4-7 different colors should be used at one time. Also, remember that about 2.5% of the population (8% of males) are red-green color blind. Rely on shading and other methods to differentiate screen areas/contents.
- Select colors that have inherently high contrast. Blue/Yellow is a good selection in this regard.
- Avoid reliance on color alone to draw attention to areas on the screen.
- Avoid extreme color contrasts such as Red/Blue and Yellow/Purple.
- In general avoid colors at the extremes of the color spectrum, such as blue-violet and red, in that the human eye is least receptive in this range.
- Do not use White on Yellow due to insufficient contrast.
- Do not use Yellow on Green due to a potential “vibrating” effect.

## **III. Monitor Size**

The purpose of this information is to outline some of the key factors in selecting a monitor size for a Call Centre application. In general, the larger size monitors would be the preferred choice by both the manufacturers of monitors for Personal Computers and Information Technology organizations. In cases where price factors into the selection criteria, a smaller monitor would likely be chosen.

For further Call Centre applications, a number of key factors must be examined carefully and weighed in relation to their pros and cons to deliver a cost effective and quality solution. Such an assessment would need to examine the overall “ergonomics” of the solution being proposed.

## **Key Factors:**

The following outlines some of the key factors influencing the choice of monitor size for a Call Centre application.

- Location of monitor from user. In particular, a larger screen ( i.e., 21”) located too close to a Call Centre Agent may lead to severe eyestrain and neck injuries.
- Some adjustment may be required to overall font size and monitor brightness settings to compliment office lighting conditions.
- User requirements for display of information considering font size, possible further eyestrain if proper distance is an issue with the workstation.
- Display adapter within Personal Computer. In particular, the ability to display a range of font size compatible with the application functionality and overall ergonomics requirements.
- The overall location of the monitor. A twenty-one inch Monitor would require the same ergonomics guidelines for height adjustments along with depth positioning (122 cm to avoid eyestrain and neck injury from viewing angle).
- Price and overall quality of monitor.

Ergonomic issues with 21 inch monitors are further discussed below;

1. First, it should be considered critical that larger monitors, as mentioned above, not be placed on top of a CPU or any other support that would unnecessarily raise the monitor. Place the monitor on the table top. If the Agent has an adjustable height workstation lower the monitor (rear) portion of the workstation as much as possible and still allow adequate leg room.
2. Viewing distance to larger monitors should be four (4) feet away (is space restricted, no less than 30 inches).

Some additional considerations

- Line of sight to be positioned such that it can be viewed with a line of sight angle between horizontal and 60 degrees below horizontal.
- Place monitor in-line with the keyboard and mouse.
- Remove CPU from the workstations and place far under the existing stations.
- Larger screen, do not mean larger characters. It has been shown, that Agents using larger monitors will open more windows rather than minimizing each program after use. Therefore, they will be watching smaller characters and increase the risk of injuries. Further more, the eyes will constantly strain trying to focus in one area while being captive in other screen areas.

## **General Design Objectives**

The selection of visual displays and lighting systems for use in Call Centres should meet the following design objectives:

- The screen should be positioned such that the normal line of sight is accommodated.
- The screen should be positioned to minimize glare.
- The lighting system should minimize glare while accommodating all required visual tasks.
- The screen contents should be designed to minimize visual fatigue.
- One screen should be open at the time. The unused programs should be minimized.

Stéphane Trottier