

Visual Display Terminals

Visual Display Terminals (VDTs) have been a subject of some concern as their use in business and industry has become almost universal. VDT technology improves productivity and simplifies work, but it also has the potential to cause problems when poor workplace design is coupled with high keying rates. Most of the reported problems have involved dedicated or full-time operators who use their VDTs for four or more hours a day.

Complaints have included back, neck, and wrist pains, eye strain, headaches, and stress. These symptoms are often associated with the fatigue and discomfort that can result from poor installation of VDT equipment. Applying ergonomic principles to the design of VDT workstations can alleviate many of these problems.

A well-designed VDT workstation will allow the operator to sit with good posture, see the screen clearly, and reach the keyboard and document easily. Operator comfort and sufficient room to work are key factors in improving productivity and reducing complaints. The best workstation designs allow independent height adjustment of the screen, keyboard, and chair. Many manufacturers now offer workstations and furniture, designed specifically to meet the ergonomic needs of VDT users.

The diagrams and guidelines on the following pages give ergonomic considerations for selecting, installing, and adjusting VDTs and VDT workstations.

Seating and Viewing Considerations

The preferred chair type is a swivel chair on a five-point base, with a rounded front edge on the seat, easily height-adjustable by the opera-

tor. Position the monitor so that the gaze angle to the center of the screen ranges between 15 and 20 degrees below horizontal eye level. Always take into account the vision requirements of VDT operators who wear glasses or bifocals.

The items that follow correspond to the numbered dimensions illustrated in Figure 1.

1. **Seat Height:** Seat height should be adjustable by user within the recommended range of 15 to 22 inches (38 to 56 cm). If the operator is too short to keep both feet flat on floor in the suggested height range, provide a foot rest.
2. **Seat Depth:** Adequate seat depth supports the thighs and allows user to sit back far enough to use the lower portion of backrest without creating pressure on back of the knees. If nonadjustable, seat depth should be no greater than 17 inches (43 cm). If adjustable, seat pan adjustment range should include 17 inches (43 cm) or less.
3. **Seat Pan Angle:** Seats may be designed with a fixed or adjustable seat angle (e.g. recline backward or forward from horizontal). If fixed, seats should be within the range from 0° (horizontal) to 4° rearward. If adjustable, seats should include some part of the range from 0° to 4° rearward.
4. **Backrest Height:** The backrest provides support for the back in various postures. The top of the backrest should be at least 18 inches (45 cm) above the compressed seat height.
5. **Lumbar Support:** This helps maintain the natural curvature of the spine at the small of the back. The lumbar support area of the

Figure 1.
Seating and
Viewing
Considerations

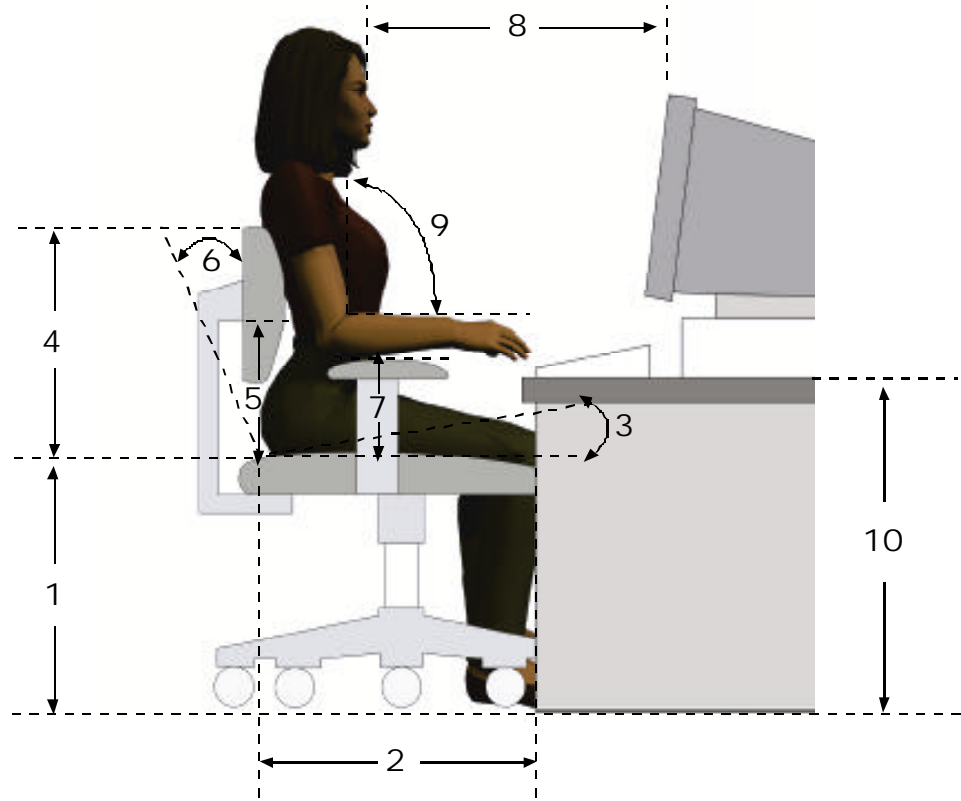
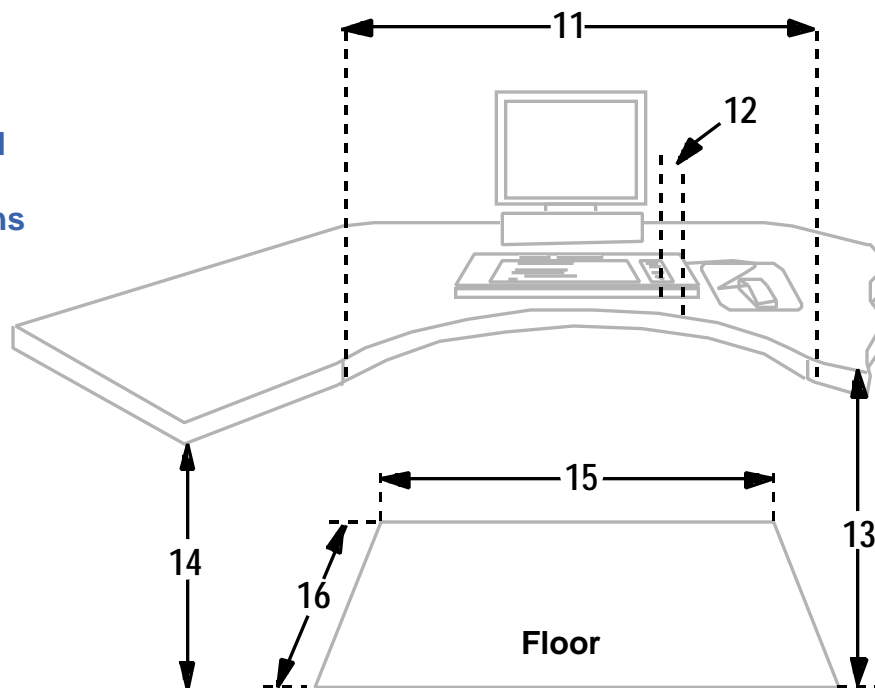


Figure 2.
Keyboard and
Work Surface
Considerations



backrest should be located between 6 and 10 inches (15 cm and 25 cm) above the compressed seat height.

6. **Seat Pan - Backrest Angle:** Studies have shown that a recline angle of 30° from vertical reduces fatigue. The torso-to-thigh angle should be at least 90°. If adjustable, the backrest should recline at least 115° from vertical.
7. **Armrest Height:** Proper armrest height supports the neck and shoulders. Armrests should be adjustable from 7 inches to 11 inches (18 to 27 cm) above compressed seat height. All armrests should be detachable.
8. **Eye-to-Screen Distance:** Preferably at least 20 inches (51 cm); minimum 12 inches (30 cm).
9. **Angle Between Upper Arm and Forearm:** Elbow angle between 70° and 135° is recommended.
10. **Work Surface Height:** Should accommodate the user population. The minimum range of adjustability should be 22 to 28 inches (56 cm to 72 cm) from floor.

Seated Postures

It is expected that VDT users will frequently change working postures to maintain comfort and productivity. Four reference postures (see Figure 3) are recognized and commonly observed at computer workstations. Movement within these postures is encouraged.

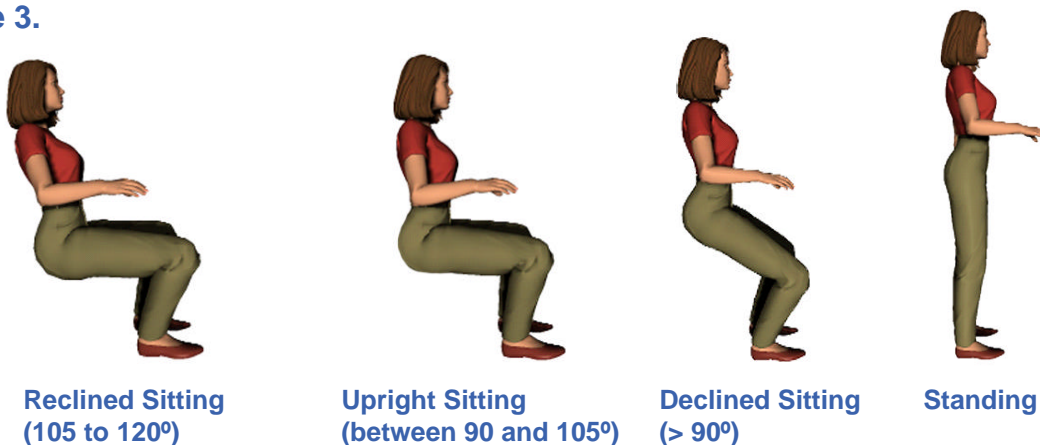
These working postures are acceptable as long as the workstation has been properly adjusted to the employee. Standing posture can occur when working at standing workstations or when getting out of a chair to do other work; such as retrieve items from a printer, etc.

Work Surface and Seated Clearance Considerations

The keyboard should be thin and detached from the console, and the mouse or track ball should be at the same level as the keyboard. Clearance guidelines are designed to accommodate upright, reclined, and declined sitting postures. The items that follow correspond to the numbered dimensions illustrated in Figure 2:

11. **Work Surface Width:** At least 27.5 inches (70 cm) wide.
12. **Palm Rest Depth:** Minimum 1.5 inches (3.8 cm).
13. **Input Device Support Surface:** For sitting postures, adjust in height per item number 10. above.
14. **Thigh Clearance (Height):** If not adjustable, no less than 27 inches (68 cm) at front edge of work surface and 25 inches (64 cm) at 17 inches (43 cm) rearward from front edge of work surface. If adjustable, it should include a height clearance of 27 inches (68 cm) as part of the adjustment range.
15. **Thigh Clearance (Width):** No less than 20 inches (50 cm).

Figure 3.



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16. **Knee and Feet Clearance (Depth):** At knee level, no less than 17 inches (44 cm) deep and no less than 23.5 inches (60 cm) deep at foot level.

Chair Selection Tips

- Chair adjustment controls should be easily operable from a seated position.
- The chair and adjustment mechanisms should be rugged.
- Supply chairs with both detachable and adjustable armrests. Remove them if they interfere with the task.
- Seat should be padded for comfort.
- Several chair styles should be available to accommodate different sizes and preferences of users. Seat pan adjustment is often an optional accessory so beware that one size chair may not fit all.
- Back-tilt tension should be adjustable.
- The chair should permit alterations in posture and freedom of movement.
- The backrest should be contoured to conform with the curve of the lower spine.
- Chair fabric should allow ventilation.
- Be sure that repair service is readily available.

Minimizing Glare

- Position screen at right angles to windows.
- Adjust the tilt and swivel of the monitor.
- Reduce bright outside light by means of curtains, drapes, or blinds.
- Adjust lighting levels to the range of 200 to 500 lux (20 to 50 foot candles).
- Use parabolic diffuser grids or indirect lighting to help reduce overhead lighting glare.
- Provide work surfaces with an antiglare (matte) finish.
- Moveable task lights are often helpful.
- Screen filters and/or hoods can also be used if necessary.

Additional VDT Considerations

- **VDT Stands:** Height adjustability is preferred. LCD displays take up much less room and are much lighter than CRT monitors.
- **Color Displays/Monitors:** Select a light high-light color that contrasts with the characters.
- **Black and White Monitor:** Rare these days, but select a light background and dark characters.
- **Flicker:** Screen should be readable with no perceptible flicker (rate at which images are “refreshed” on a screen from scanning of the electron gun). Not an issue with LCD flat panel displays.
- **Printers:** Acoustical enclosures are recommended if sound levels exceed 55 dBA.
- **Ventilation:** Additional ventilation or air-conditioning may be needed to overcome heat generated by many VDT workstations in a room. LCD flat panel displays are much more energy efficient than CRTs.
- **Cables and Cords:** Should be concealed, covered, or out of way.
- **Training:** Train all operators how to adjust chair, workstation height, and VDT position (see LP 188, *Adjusting the Computer Workstation*).

References

- BIFMA G1-2002 *Ergonomics Guideline for VDT (Visual Display Terminal) Furniture Used In Office Work Spaces*, BIFMA International, New York, NY.
- BSR/HFES 100 *Human Factors Engineering of Computer Workstations Draft Standard For Trial Use, March 31, 2002*, Human Factors and Ergonomics Society, Santa Monica, CA.
- Dainoff, M. and Dainoff, M. *People and Productivity: A Manager's Guide to Ergonomics in the Electronic Office*. Agincourt, Canada: Carswell, 1986.

The illustrations, instructions and principles contained in the material are general in scope and, to the best of our knowledge, current at the time of publication. No attempt has been made to interpret any referenced codes, standards or regulations. Please refer to the appropriate code-, standard-, or regulation-making authority for interpretation or clarification. Provided that you always reproduce our copyright notice and any other notice of rights, disclaimers, and limitations, and provided that no copy in whole or in part is transferred, sold, lent, or leased to any third party, you may make and distribute copies of this publication for your internal use.