THE HARTFORD

Loss Control TIPS

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*Innovative Safety and Health Solutions*SM

Shedding Some Light On Lighting

Introduction

Effective office lighting produces a comfortable, productive environment. Office lighting design involves more than straight calculation of lighting levels and selection of luminaries (complete lighting units). Consideration must also be given to "people issues" such as perceptions, psychological well-being, and comfort.

Many Factors Influence Effective Lighting

From a management perspective, additional considerations include aesthetics and integration of various building systems. From a design perspective, many factors, and the *interaction* of these factors, are important. Some design factors include

- surface color
- light source color
- color variations
- surface reflectance
- luminance ratios (foreground/ background, surface/surface)
- glare
- arrangement of doors and windows (size, location, proportion)
- task and population characteristics (worker ages, speed and/or accuracy)

While we recognize the importance of these factors in the *design* of lighting systems, more often than not the requests we receive for assistance or recommendations regarding lighting have to do with *pre-existing* lighting systems. These cases may present some challenge because the solutions involve modification of existing structures or systems, rather than starting "from scratch." For this reason, practical considerations and recommendations are useful.

In general, experts agree that lighting should be adequate for comfortable task performance but should not be overbearing. The challenge is in how we define "adequate," "comfortable," and "overbearing."

What Contributes to Eye Strain?

Many factors contribute to eye strain, including inappropriate lighting level. Many have experienced the discomfort associated with straining to read by candle-light or trying to read a sign that is too far away. In addition to inadequate light levels, other factors that can cause eye discomfort are

- excessive viewing distance
- short viewing distance
- inappropriate viewing angle
- poor contrast between foreground and background
- small print
- long periods of visual concentration.

Most of these factors can be controlled through relatively simple adjustments of materials and equipment. Some training may be required to help people identify these risk factors and develop effective solutions.

In the VDT environment, the effect of many of these factors can be intensified because of the intensely visual nature of VDT tasks. Factors specific to the VDT environment which can contribute to eyestrain are:

- high level of ambient lighting
- lack of task lighting
- excessive screen illumination
- poor contrast (character/background, screen/background, screen/document)
- small font size
- prolonged visual attention demanded by VDT tasks.

Illumination Standards

The American National Standard Institute (ANSI) has co-published lighting guidelines with the Illuminating Engineering Society of North America (IESNA) and the Human Factors Society (HFS). (These and other references are listed at the end of this article.)

Note that none of these sources provide concrete, "black and white" recommendations for lighting levels. Rather, they provide an *overview* of the factors involved; some provide recommended *ranges* of illuminance levels for various activities. Because of the many factors involved, these documents are complicated, and the application of any guidelines must be approached carefully. However, one may draw some basic conclusions and develop general guidelines.

Evaluating Lighting Needs

Lighting conditions must be matched to the job function and specific task requirements. Higher lighting levels are required for reading or writing tasks and for some fine motor tasks. Examples of fine motor tasks which require high lighting levels are assembly of very small components and sewing. Lower lighting levels are required for less visually intensive tasks like moving materials. In order to match lighting needs with job functions, consider these questions when evaluating illumination requirements:

- What are the tasks?
- What are the visual requirements of each task?
- How much time is spent on each task?
- What percentage of time is spent on each task?
- How important is accuracy?
- How important is speed?
- Which tasks are more visually difficult?
- What are the operators' ages?

Recommendations for Lighting in the VDT Environment

These recommendations apply to VDT and other office operations.

Lighting levels:

- *ambient lighting* for VDT environment: 30-50 foot-candles (fc)
- *task lighting* for writing/ reading/hard copy tasks: 75 foot-candles (fc)

(Note: Common measures of lighting levels are made in lux or foot-candles, depending on the measurement tool used. The conversion formula is: 1 lux = .0929 foot candle.)

Modify published guidelines to accommodate various combinations of job functions. Where jobs involve inputting tasks exclusively, lower lighting levels in the range of 30-50 foot-candles are appropriate. More commonly, however, jobs involve a combination of VDT and non-VDT tasks. In these situations, ambient light levels should fall in the lower range of 30-50 foot-candles with supplementary task lighting to illuminate non-VDT tasks as necessary. Writing/reading/hard copy tasks require approximately 75 foot-candles. Supplementary task lighting should be mobile and adjustable.

- Position the monitor perpendicular to windows and other light sources, to minimize glare and reflection.
- Do not place the monitor directly in front of windows. If it is necessary to do so, close the window covering(s) to avoid a halo effect.
- In some cases, ambient lighting can be reduced by switching off or disconnecting individual bulbs in fluorescent fixtures.
- Overhead lights can be distracting. Avoid locating VDTs directly under or in front of overhead light fixtures. Some-times lighting fixtures can be moved.
- Glare screens or filters may be effective in some cases to reduce glare from the screen itself. As with other accessories, the need for and effectiveness of glare screens should be evaluated individually.
- Adjust brightness and contrast controls on the monitor.

Other Recommendations to Reduce Eye Strain in the VDT Environment

Other measures that can be taken to reduce the risk of eye strain include:

- ☐ Position the monitor approximately 20-26 inches from the eyes.
- ☐ Position the monitor so that the top line on the screen is slightly below eye level.
- ☐ If the monitor is the primary focus of visual attention, position it directly in front of the user.
- ☐ Adjust the screen angle for comfort and to avoid glare and reflection.
- ☐ Encourage VDT users to blink frequently. Research has shown that VDT users blink less frequently. This may cause drying of the eyes and can contribute to eye discomfort.
- ☐ Encourage VDT users to focus briefly on a distant object every 20-30 minutes.
- ☐ Educate VDT users about the importance of describing job functions and workstation configuration when they visit their eye care providers, to assure appropriate correction in prescription eye wear. Specific corrective eye wear, or "computer glasses,", may be required in some cases. For bifocal wearers, the monitor should be positioned within the range of visual correction (usually low).

Summary

Lighting, as a workstation feature, can have a significant impact on worker comfort and productivity. Visual comfort is influenced by lighting conditions and other factors, including workstation configuration and work flow. A thorough and accurate assessment of job task requirements is necessary to determine appropriate lighting.

Individual comfort is probably one of the most effective guides to appropriate lighting levels. Listen to comments and complaints, and elicit the suggestions of the individuals in the area to assist with possible solutions.

References

1. *American National Standard for Human Factors Engineering of Visual Display Terminal Workstations* ANSI/HFS 100-1988. Santa Monica, CA: The Human Factors Society, Inc., 1988.

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5. Rea, Mark S. (ed.). *Lighting Handbook Reference & Application*, 8th ed. New York: Illuminating Engineering Society of North America, 1993.

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