

A fact sheet prepared by the Ergonomic Committee of the National Telecommunications Safety Panel

## INTRODUCTION

Office work is visually demanding and has always required good lighting for preventing eyestrain, improving comfort, and increasing productivity. Poor lighting in today's office can mean anything from lighting that causes glare, to overly bright lights, improperly placed lights or dim lighting. "Good" lighting means providing enough illumination in specific areas so people can see printed, handwritten or displayed documents clearly, while not over illuminating areas where computer work is performed.



This fact sheet discusses the ergonomic, safety and health aspects of office lighting and does not address energy saving aspects of designing or retrofitting office lighting.

## WHAT IS LIGHT?

- The simplest definition of light is "visually perceived radiant energy".
- As visually perceived radiant energy, light powers the mechanism of sight.
- It is light, reflected from objects to our eyes that allow us to see.

## HOW DO CONDITIONS AFFECT OUR VISUAL PERFORMANCE?

The ability to "see" at work depends not only on lighting but also on:

- The motion of an object. Fast moving objects are more difficult to see.
- The size of an object. Very small objects are hard to see.
- Brightness. Too much or too little reflected light impacts the perception of the object.
- Contrast between an object and its immediate background. Too little contrast makes an object hard to distinguish from the background.

## WHAT ARE THE RISK FACTORS ASSOCIATED WITH OFFICE LIGHTING HAZARDS?

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## Awkward Posture

Trying to correct a lighting problem such as glare can inadvertently cause a person to assume an awkward position such as tilting the neck side to side or backwards.

This may lead to shoulder and neck discomfort

Contributing Factors include:

- Glare from the un-shaded or un-diffused lighting fixtures or windows.
- Poor lighting, involving illumination levels that are too high or low and cannot be adjusted.
- High intensity overall office lighting that washes out images on the screen.



Additional contributing factors include:

- Monitors that are either too far away or poorly angled in relation to the location of the user's eyes.
- Characters/letters that are too small on the monitor

## Vision Problems

Reduced visual ability and eye discomfort are the predominate vision problems associated with improper lighting. They have collectively been termed Computer Vision Syndrome (CVS) in the media. This can lead to:

- Dry, irritated or burning eyes
- Blurred vision
- Headaches
- Upper back, neck and shoulder discomfort

Contributing factors include:

- Focusing your eyes on objects at the same distance and angle for prolonged periods of time
- Poor contrast between the characters on the screen and the background on the monitor or between the brightness of the monitor and the brightness of the office space behind the monitor
- Inadequate breaks while working with a computer
- Uncorrected vision may be an additional source of eye discomfort.
- The ability to focus on objects at various distances decreases with age (presbyopia). Commonly, by age forty, people start having trouble clearly seeing objects at close range with the naked eye. This is a gradual change, and has to be regarded as an important component in designing visual

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environments, particularly when the job involves computer work

### WHAT ARE RECOMMENDED SHORT TERM STRATEGIES TO ADDRESS THESE RISK FACTORS?

Short term strategies represent something the worker can do to improve comfort themselves. These include:

#### Adjust the Monitor

- Use a light color for the screen background and dark characters / letters.
- Angle the monitor away from lights and windows.
- If using a task light, make sure that the task lamp illuminates the document and not the monitor.
- Clean the monitor screen regularly to remove dust particles which can reduce legibility.
- Adjust the brightness and contrast according to your Preference.
  - Fairly sharp images and adequate contrast ratios of approximately 10:1 (image brightness to background) are typically required to make a display easier to read.
  - What is acceptable to an individual will depend on character size, viewing distance and the type of task being done.
- Consider using a hood over the top of the monitor to reduce the amount of light that hits the screen.
- Consider using LCD monitors which are less susceptible to the effects of excessive ambient light.
- Use an anti-glare screen if other adjustments don't eliminate the problem.



#### Make Personal Vision Corrections

- Check your vision every one or two years, as recommended by your eye specialist.
- Provide your eye examiner with information about your job.
- Every few minutes, look away from the screen for a few seconds.
- Consider using task-specific computer glasses.
- Depending on the amount of time you work at a computer, the kind of vision correction you need, and your personal preferences, your eye specialist may recommend bifocals, trifocals or even a separate pair of glasses for computer work.

- Use moisturizing eye drops if your eyes begin to feel dry or gritty. NOTE: This means “moisturizing eye drops” not the products that contain vasoconstrictors designed to “get the red out”.
- Frequently exercise your eye muscles as follows to prevent feelings of fatigue.
  - Look around.
  - Focus your vision on distant objects.
  - Blink frequently

#### Maintain Lighting Fixtures

Replace bulbs on a scheduled basis. Old bulbs tend to flicker more and they are not as bright.

#### Training

In addition, Management should provide training regarding the proper use of computer workstations.

### WHAT ARE RECOMMENDED LONG TERM STRATEGIES TO ADDRESS THESE RISK FACTORS?

If the existing lighting system cannot effectively be adjusted or maintained to improve worker comfort and productivity, a long term strategy should be considered. This may involve modification to existing lighting or a new overhead lighting system may be warranted. These activities are best performed by the Property Management personnel for the office.

Specific strategies for modification and design of new lighting system include the following:

#### Proper lighting

Proper lighting is critical for a comfortable and productive work environment. It is important that the general lighting provide effective illumination for most workers in an area. The optimal lighting level will depend on the task. Too much light can be as fatiguing as not enough.

#### Choose the appropriate amount of light

- Office-based work involving computers that also use paper documents should target an illuminance in the range of 200 to 500 lux (20-50 foot-candles)
- Work using computers alone (without referencing paper documents) should target the lower range of lighting at or below 200 lux (20 foot-candles.)
- Generally the maximum lighting should not exceed 750 lux. Excessive lighting levels have a “masking” effect and make it difficult for the operator to see the display on the screen

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Note: A lux should be measured on the work surface with a light meter. It is a unit equivalent to the illumination cast on a surface by one candle one meter away, which is equal to one fifth to one tenth of a foot-candle.

Choose lighting types appropriate to the task.



- General or ceiling lighting provides fairly uniform lighting throughout the work area.
- Local lighting uses fixtures closer to the work surface in addition to ceiling fixtures to increase lighting levels for particular tasks
- Task lighting increases light levels over the work and immediate surroundings. Task lighting often allows the user to adjust and control lighting and provides flexibility for each user.

Choose lighting fixtures appropriate to the workspace  
No single type of light fixture is appropriate in every situation.

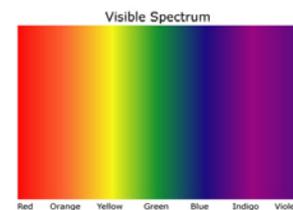
- Direct light fixtures project 90 to 100 percent of their light downward toward the work area. Direct lighting tends to create shadows 
- Direct-indirect light fixtures distribute light equally upward and downward. They reflect light off the ceiling and other room surfaces. Little light is emitted horizontally, meaning direct glare is often reduced. 
- Indirect light fixtures distribute 90 to 100 percent of the light upward. The ceiling and upper walls must be clean and highly reflective to allow the light to reach the work area. These fixtures provide the most even illumination of all the types of fixtures and the least amount direct glare. Indirect light fixtures are usually used in offices 

Choose shielded lighting fixtures where appropriate  
Shielded light fixtures use diffusers, lenses or louvers to diffuse overhead lighting.

- Diffusers are translucent or semi-transparent (see-through) covers made usually of glass or plastic. They are used on the bottom or sides of light fixtures to control brightness.
- Lenses are clear or transparent glass, or plastic covers. The lens design incorporates prisms and flutes to distribute light in specific ways
- Louvers are baffles that shield the bulb from view and reflect light.

Choose the appropriate color of light

- Light and color are inextricably connected; in a sense, light is color.
- The **color temperature (Kelvin)** of a light source is a numerical measurement of its color appearance.
- The Perception of Color is the way color groups are perceived – or the psychological impact of lighting.
  - Colors and light sources from the violet/blue end of the spectrum are referred to as “cool,”
  - Those toward the red/orange/yellow side are “warm” (soft white)
- Office lighting affects the appearance of the space and the mood of its occupants
- A visually comforting (low-glare) environment can also augment productivity and the general happiness of employees
- Several types of lighting are available
  - Full spectrum fluorescent lights are designed to mimic natural light but cost more than standard bulbs
  - Bright white bulbs (cool) offer high illumination levels, however it can increase glare, cause eye discomfort or headaches (4000 K)
  - Soft white fluorescent bulbs are warmer in color, creating less glare and are a better choice (3200 K)
  - Due to cost, most offices use standard fluorescent bulbs



### Windows and walls

Choose wall and window coverings and other accessories that do not contribute to glare:

- Cover windows with adjustable blinds, drapes, or louvers.

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- Use matte finishes on walls, floors and furniture.
- Relocate items on the wall or reframe graphics with non-glare glass

### New Lighting Design or Retrofit

A new system should be designed with great flexibility, so that lights can easily be repositioned, and brightened or dimmed at the discretion of individual users.

According to the National Lighting Bureau, modifying or installing a new lighting system includes:

- **Conducting a lighting system audit.** Ask workers whether the lighting causes problems. Do they think that improved lighting will improve working conditions? After completing an informal survey, audit the existing system. What types of lamps are used? How well are they maintained? How much light is being produced? Audits can be performed by lighting consultants, independent contractors, product manufacturers, or in-house personnel with appropriate training and equipment.
- **Identifying options.** Based on the audit, determine what changes will improve working conditions. Alternatives include: installing new types of lamps in existing fixtures, retrofitting or replacing fixtures, or installing new controls
- **Developing a plan.** Determine options, budget and timeline. Recommendations should discuss factors relevant to management goals, including quality of lighting, energy savings, cost reductions, and payback.
- **Implementing the plan.** Consider implementing in phases. Pursue those elements with the highest benefit-cost ratios first, then focus on more cost-intensive efforts. Inform management and employees of upcoming changes and benefits.
- **Monitoring and revising the plan.** Review and revise the plan, particularly given the continued development of new lighting, lamping, and controls technologies

### ADDITIONAL INFORMATION

- ❑ **Canadian Centre for Occupational Health and Safety – Lighting Ergonomics**  
[http://www.ccohs.ca/oshanswers/ergonomics/lighting\\_general.html](http://www.ccohs.ca/oshanswers/ergonomics/lighting_general.html)
- ❑ **OSHA Computer Workstations**  
[http://www.osha.gov/SLTC/etools/computerworkstations/wkstation\\_enviro.html](http://www.osha.gov/SLTC/etools/computerworkstations/wkstation_enviro.html)
- ❑ **ANSI Standard ANSI/HFES 100-2007 Human Factors Engineering of Computer Workstations** (available through <http://webstore.ansi.org/RecordDetail.aspx?sku=ANSI%2FHFES+100-2007>)
- ❑ **ANSI/IES RP-1-04 American National Standard Practice for Office Lighting Illuminating Engineering Society** / 20-Feb-2004 / 71 pages (available through [http://www.techstreet.com/cgi-bin/detail?product\\_id=1154865](http://www.techstreet.com/cgi-bin/detail?product_id=1154865))
- ❑ **Sylvania - Lighting 101**  
<http://www.sylvania.com/LearnLighting/>
- ❑ **National Lighting Bureau** <http://www.nlb.org/>

For additional resources, see the NTSP Ergonomic Guidelines at

<http://www.telsafe.org/ntsp/Publications>