



Lighting for office and industry

Introduction

Adequate, well balanced levels of illumination are essential in establishing safe and productive working conditions, and for minimizing complaints due to sub-standard lighting.

Optimizing office and industrial lighting requires consideration of work tasks, environmental conditions and economic considerations.

The benefits of adequate lighting include greater productivity and accuracy, improved safety and security, and improved morale.

A complete lighting survey requires evaluating several factors; the task, the working environment, and the quantity and the quality of lighting.

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This publication provides practical loss control and safety information to assist you in making your workplace safer. It is not legal advice. SAIF Corporation has made every effort to bring significant Oregon Occupational Safety and Health Administration (OR-OSHA) regulations to your attention. Nonetheless, compliance with OR-OSHA remains your responsibility. You should read and understand all relevant OR-OSHA regulations that apply to your job site(s). You may want to consult with your own attorney regarding aspects of OR-OSHA that may affect you.

Note: The information in this publication is time sensitive. Do not rely upon this document if its publication date is more than three years old. Please check the Employer Guide "Safety" section of our web site at www.saif.com/employer for a more recent, printable copy. You'll also find a variety of other valuable safety information designed to help your business prevent injuries and control costs.

General Lighting

Adequate general and local lighting is needed for rooms, buildings and work areas during the time of use. Factors used to control the adequacy and effectiveness of illumination include the following:

■ Quantity of Light

The required quantity of light (illuminance) depends mostly on: the visible task, the time allotted to perform the task, the worker, and the importance of the various task parameters.

Examples of industrial and office tasks and recommended light levels are in the table below.

Recommended Lighting Levels*	
Type of Activity	Lighting** (Lux)
Public spaces with dark surroundings	30
Simple orientation for short temporary visits	50
Working spaces where visual tasks are only occasionally performed	100
Performance of visual tasks of high contrast or large scale	300
Performance of visual tasks of medium contrast or small size	500
Performance of visual tasks of low contrast or very small size	1000
Performance of visual tasks near threshold of person's ability to recognize an image	3000-10000

* Modified from: IESNA Lighting Handbook. 9th ed. Illuminating Engineering Society of North America, 2000. p. 10-13./Adapted with permission from the Canadian Centre for Occupational Health and Safety (2011).

** The recommended range is +/- 10% of these values.

OSHA recommends optimizing lighting and minimizing glare at computer workstations. They suggest lighting for computer work in a range between 20 and 50 footcandles (~2-5 Lux).

■ **Quality of Light (flicker and glare, contrast and shadows)**

While the quantity of light is commonly recognized as important, factors influencing the quality of light have a significant impact. These factors include flicker and glare.

Flicker

Light flicker refers to quick, repeated changes in light intensity - light that appears to flutter and be unsteady. Although lights flicker on and off due to alternating current, the flicker rate is normally too fast for us to detect.

Flicker is a more common problem in lighting with ballasts, like fluorescent lights, particularly for those lights that are older and have magnetic ballasts. For this reason, upgrades to fluorescent light fixtures commonly include replacing magnetic ballasts with electric ballasts, which have less detectable flicker potential. Electric ballasts are also less likely to produce a noticeable hum and are more energy efficient.

Although the human eye cannot see fluorescent light flicker, some individuals can somehow detect the flicker. This can result in complaints of headache, eye strain, and general eye discomfort. Studies have linked lower reporting of eye strain symptoms and headaches with use of electronic ballasts in fluorescent lights and to increased use of natural lighting.

Other steps to reduce flicker include:

- Replacing bulbs routinely as older bulbs are more likely to flicker and may emit less light.
- Ensuring that light fixtures, particularly ballast, are functioning properly.
- Upgrading fluorescent lighting to electronic ballasts when replacements are needed.

Glare

Glare is a common lighting problem, occurring when a bright light source or reflection interferes with the ability to see an object. In addition to decreasing the ability to see, glare can cause annoyance and discomfort.

There are two types of glare – direct or reflected.

Causes of direct glare are typically caused by sun or lighting that is positioned to shine directly into someone's field of vision. A good test for direct glare is to stare off at an object in the distance, and cover up a light source between the source and the eye. If the object can now be seen more easily, the light source is probably a source of glare.

Indirect glare can be caused by light reflected off of polished, shiny or glossy surfaces, or from reflection off of glass surfaces (windows, picture glass), or computer monitors. To detect reflected glare, look at a task (for example, the desktop or computer monitor) from a normal working position. Block the light from the source to the potential source of reflection. If details are now more easily seen, reflected glare is a problem.

General measures to reduce glare are:

- Having multiple small lights rather than one big one.
- Keeping lighting at recommended levels.
- Positioning light fixtures, work surfaces or computer monitors to reduce light that reflects into eyes.
- Positioning work area so that windows and fluorescent lights are parallel to line of sight.
- Keeping surfaces as shine free as possible (matte finish paints, non-reflective surfaces, etc).
- Move shiny objects out of view of work areas.

Degree of Contrast and Shadows

There should be good contrast between objects of interest and background (i.e. print versus paper, characters on a computer monitor versus background).

Greater lighting in areas next to but outside the immediate work environment can make visibility difficult.

Configure work area set-up or lighting placement to avoid shadows within the work environment.

Factors Affecting Sight

In addition to the quality and quantity of lighting, other factors influence sight. These include:

1. Size of the object or print
2. Time available to see the object
3. Age factors: pupil size, vision ability and visual accommodation

Regulatory Requirements

■ **General Regulatory Requirements**

While no specific OSHA standard broadly addresses specific lighting levels, the requirement and expectation for adequate lighting in the workplace is encompassed in the 437-002-0144, *Additional Oregon Rules for General Environmental Controls*.

This rule states that "adequate general and local light shall be provided for rooms, building and work areas during the time of use." The American National Standard ANSI All.1-1965, "*American Standard Practice for Industrial Lighting*," is referenced for quantity of light. Requirements also include freedom from glare, shadows and extreme contrasts and that there be correct light direction, diffusion and distribution.

Further information from Oregon OSHA on compliance expectations regarding lighting can be found in the Oregon OSHA Lighting Program Directive A-66.

<http://www.osha.oregon.gov/pdf/pds/pd-066.pdf>

■ **Office Requirements**

Recommendations for office lighting can be found on the Federal OSHA website, in their etool for offices.

http://www.osha.gov/SLTC/etools/computerworkstations/wkstation_en_viro.html#lighting

■ Industrial Requirements

The regulation that addresses manlift use has some specific requirements on lighting, which includes a 5 foot-candle minimum during use (see Oregon Administrative Rules, Subdivision F, 1910.68).

Lighting standards for specific industries (EG foundries, dairies, bakeries, sheet metal works, etc.) can be found in "Annex A2 and A3" of the most recent version of the document ANSI/ IESNA RP-7. This document will outline ranges of illuminance for specific tasks or locations within each industry. Note: That these are standards not regulations.

Emergency, Safety and Security Lighting

■ Emergency

Emergency lighting requirements are often covered by codes or local ordinances that detail the light levels, the length of time the lighting must function under loss of power and the acceptable types of power supplies. Reference to these codes and ordinances is critical to ensure compliance with them.

■ Safety

Safety lighting is required at all times when the building or outdoor space is occupied. This amount of lighting is what will allow occupants to safely move through the space under normal conditions.

Recommendations for safety lighting from the ANSI/IESNA RP-7 standard are:

- Low Hazard Environment/ Low Activity – 5.4 Lux (0.5 Footcandles)
- Low Hazard Environment/High Activity – 11 Lux (1 Footcandles)
- High Hazard Environment/Low Activity – 22 Lux (2 Footcandles)
- High Hazard Environment/High Activity – 54 Lux (5 Footcandles)

- **Security**

The function of security lighting includes protection of property, discouraging trespassers and providing a means for indentifying employees. Considerations include working with local law enforcement and property owners. Principles using CPTED – Crime Prevention through Environmental Design – include lighting practices.

Resources and Information

■ Lighting Terminology

Foot-candles (fc)	=	common unit used in light measurement to indicate illuminance or light intensity, =10.7 Lux
Footlambert (fl)	=	brightness - (brightness contrast between work should not be over a 5 to 1 ratio) [illumination(fc) X percentage reflectance)]/100
Lumen (lm)	=	quantity of light
Luminance		light emitted from a surface
Lux	=	common unit used in light measurement, quantity of light per square meter that indicates illuminance or light intensity, =0.09 fc
Reflectance	=	amount of light a surface reflects relative to the amount that falls on the surface (typically in percent)

■ Light Measurement

A light meter (photometer) is used to measure foot-candles or lux. Follow the manufacturer's instructions of operation for the specific photometer being used for light measurement at the time of the survey.

■ Additional Information

- Color plus brightness can cause increased tension in the body.
- Eye comfort is important, affecting productivity and morale.
- Generally, someone at age 50 requires three times greater illuminance to see small size objects than someone who is age 20.
- Light diminishes by inverse square law: double the distance = 1/4 the light.

■ **Lighting Evaluation Checklist**

Use the checklist and answer yes or no to the following questions. Follow up any "no" answers with corrective action.

General	
Enough light for the task	<input type="checkbox"/>
No troublesome reflections	<input type="checkbox"/>
No glare along or near normal line of sight	<input type="checkbox"/>
No frequent transitions between extremes of light and dark or near and far	<input type="checkbox"/>
Lamps covered to diffuse light evenly	<input type="checkbox"/>
Adequate lighting of upper walls and ceilings	<input type="checkbox"/>
Shadows eliminated	<input type="checkbox"/>
Bright shiny objects out of view	<input type="checkbox"/>
Office	
Clear and readable images on VDT	<input type="checkbox"/>
Well-placed local lighting	<input type="checkbox"/>
VDTs positioned parallel to windows	<input type="checkbox"/>
VDTs positioned parallel to fluorescent light fixtures	<input type="checkbox"/>
Matte finishes on furniture and equipment	<input type="checkbox"/>
Blinds or curtains on windows	<input type="checkbox"/>
Brightness and contrast controls properly adjusted on VDTs	<input type="checkbox"/>
Appropriate size print, and good contrast on reading materials	<input type="checkbox"/>
Industry	
Very small objects magnified in addition to good lighting	<input type="checkbox"/>
Moving machinery parts painted a colour which contrasts with the background	<input type="checkbox"/>
Adequate lighting in storage rooms, stairways and hallways	<input type="checkbox"/>
Simple background behind tasks	<input type="checkbox"/>
Maintenance	
Regular replacement of bulbs	<input type="checkbox"/>
Regular cleaning of light fixtures	<input type="checkbox"/>
Upper walls and ceilings clean	<input type="checkbox"/>

Adapted with permission from the Canadian Centre for Occupational Health and Safety (2011).

Resources for Information about Lighting

illuminating Engineering Society	http://www.ies.org/education/index.cfm
Oregon Occupational Safety and Health Division (OR-OSHA) Program Directive (A-66) on lighting	http://www.osha.oregon.gov/pdf/pds/pd-066.pdf
American National Standard Practice for Office Lighting	ANSI/IESNA RP-1-04 For Purchase*: http://webstore.ansi.org/
Recommended Practice for Lighting Industrial Facilities	ANSI/IESNA RP-7-01 For Purchase*: http://webstore.ansi.org/
Canadian Centre for Occupational Health and Safety	http://www.ccohs.ca/ Search Word: Lighting
OSHA etool Computer Workstation Environment	http://www.osha.gov/SLTC/etools/computerworkstations/wkstation_enviro.html
Oregon OSHA Illumination Subject Page	http://www.orosha.org/subjects/illumination.html

*Note: These ANSI standards are available for in-library viewing at the Oregon OSHA library: Labor and Industries Building, 350 Winter St NE, Salem Oregon.