Blue Light Hazard
Reference Sheet and Safety Tips

Visible light is defined as the portion of the electromagnetic spectrum between 380–400 nanometers (nm) and approximately 760 nm. Within the visible light spectrum, blue light (400–500 nm) is of particular importance. Blue light sometimes is further broken down into blue-violet light (roughly 380–450 nm) and blue-turquoise light (roughly 450–500 nm). Approximately one-third of all visible light is considered high-energy visible or "blue" light.

Sources of Blue Light

Sunlight is the main source of blue light, and exposure outdoors during daylight is the main source for most people. There are also many man-made, indoor sources of blue light, including fluorescent and LED lighting, and flat-screen televisions. The display screens of computers, electronic notebooks, smartphones, and other digital devices emit significant amounts of blue light, although it is only a fraction of the amount of blue light emitted by the sun. In a laboratory, sources of blue light are blue LED arrays and intense white light sources (projection lamps, floodlights, microscope lights, welding arcs, etc.).

Health Effects

Some blue light exposure is essential for good health. Research has shown that high-energy visible light boosts alertness, helps memory and cognitive function, and elevates mood. The term "blue light hazard" refers to the photochemical damage of the retina, in the range of 380–550 nm (and 300–550 nm for the aphakic eye).

Blue-light retinal injury can result from viewing either an extremely bright light for a short duration or a less bright light for a longer duration. Measurement of the spectral radiance of the sun has shown that the exposure limits for blue light can easily be exceeded when viewing the sun. Viewing the sun directly is very hazardous and should be avoided. Even typical or "normal" outdoor exposure to sunlight can result in damage to the retina over a period of many years.

Wearing amber- or red-tinted glasses is recommended to reduce blue light exposure.

Threshold Limit Values

The time-integrated radiance, weighted by the blue-light hazard function, should not exceed 100 J/(cm^2-sr) over a total viewing time of 167 minutes in a day. If the viewing duration is longer than 167 minutes, the radiance weighted by the blue-light hazard function should not exceed 10 mW/(cm^2-sr). If the light source subtends an angle less than 0.011 radians, the irradiance measured at the eye, weighted by the blue-light hazard function, should not exceed

100 µW/cm^2 for viewing times longer than 100 seconds, and should not exceed 10 mJ/cm^2 for viewing times shorter than 100 seconds.

Exposure Assessment

Blue-light radiance measurements should be performed with an optical meter with a detector that has a spectral response well matched to the ACGIH blue-light hazard function. If the results do not exceed the exposure limits, no further assessment is required. If the results exceed the threshold limit value, the maximum exposure time should be calculated. In such cases, the work task needs to be re-evaluated, and engineering and/or administrative controls need to be implemented.

Control Measures

Careful consideration should be given to whether exposure to the light hazard can be eliminated by altering the process used, or whether the light source can be replaced by one that is less harmful. If this is not possible, engineering controls should be considered.

Engineering controls help to prevent personnel from coming into contact with light hazards. Examples of engineering controls are filters, screens, dedicated rooms, and curtains. To the extent possible, enclose, provide a barrier, or orient intense short-wavelength light or infrared sources so they cannot be viewed. In addition, bear in mind that optical radiation such as visible light and infrared can be reflected off shiny surfaces. The walls of the enclosure should have a matte finish.

If viewing cannot be avoided, wearing amber-tinted eyeglasses or goggles is recommended.

Take-Away Safety Tips

- Do not look directly into intense light sources
- Enclose or orient intense short-wavelength light sources so they cannot be viewed
- Wear amber-tinted eyeglasses or goggles if viewing cannot be avoided