

Concern for Eye Protection

Physical Agents

Infrared Radiation [5,20,21,22]

All objects having temperatures above absolute zero emit IR as a function of temperature. In biological systems, IR exposure causes a rise in the temperature of the absorbing tissue. Physical factors which influence this temperature rise are the wavelength, heat conduction parameters, exposure time, and total amount of energy delivered to the exposed tissue. Since IR photons are low in energy, they would not be expected to enter into photochemical reactions with biological systems. Molecular interactions with radiation in the IR regions are characterized by various vibrational-rotational transitions resulting in an increase in thermal energy of the molecule. Since the primary effect of IR on biological tissues is thermal, the skin provides its own warning mechanism by having a pain threshold below that of the burn threshold. However, there is no such adequate warning mechanism in the eye. Traditionally, safety personnel consider IR to be a cataractogenic agent, but recent information has raised questions about whether IR cataracts can be produced in the workplace from non-coherent optical sources, such as glass furnace operations. IR radiation above 1400 nm can produce corneal and eyelid burns, as well as dry eyes and skin. The primary biological effect of IR on the retina and choroid is thermal in nature, with the amount of damage being proportional to the length and intensity of exposure. If the radiation intensity is low enough, normal retinal blood flow may be sufficient to dissipate any heat generated. Small amounts of IR, however, can produce a relatively intense point energy distribution on the retina, resulting in a burn.

Visible Radiation [5,23,24,25]

Visible radiation, from either the sun or artificial sources, is an important occupational health consideration because of its major role in our daily life. High light levels at certain wavelength regions are retinal hazards. These types of direct retinal effects from excessive light levels have been well known and documented for many years (i.e., staring at welding arcs or the sun). The ACGIH TLVs for visible radiation are intended to offer protection from retinal thermal injury and from photochemical injury that can occur from exposure to wavelengths in the region from 400-500 nm. While protective eyewear is essential under some conditions to protect the eye from ocular damage, often the luminous transmittance of the protective eyewear is so low that workers may not be able to see sufficiently well to perform a given task or job.

Ultraviolet Radiation [5,26,27,28]

UV radiation is an invisible radiant energy produced naturally by the sun and artificially by arcs operating at high temperatures. Examples of the latter include germicidal and blacklight lamps, carbon arcs, welding and cutting torches, electric arc furnaces, and various laboratory equipment.

Since the eyes and skin readily absorb UV radiation, they are particularly vulnerable to injury. The severity of radiation injury depends on exposure time, intensity of the radiation source, distance from the source, wavelength, sensitivity of the individual, and presence of sensitizing agents. Sunburn is a common example of the effect of UV radiation on the skin. Repeated UV exposure of lightly pigmented individuals may result in actinic skin: a dry, brown, inelastic, wrinkled skin. Actinic skin is not normally debilitating but is a warning that conditions such as actinic keratosis, squamous cell epithelioma, and basal cell epithelioma may develop. Since UV is not visible, the worker may not be aware of an exposure at the time it is occurring.

Absorption of UV radiation by the eye and eyelids can cause conjunctivitis. Lesions may also be formed on the cornea as a result of high exposure levels (photo keratitis). Such injuries usually manifest themselves 6 to 12 hours after exposure.

The injuries may be very painful and incapacitating, but impairment is usually temporary. Workers also need to be aware that some photosensitizing agents, page 6 Health Hazard Evaluation Report No. 98-0139-2769 including drugs such as hydrochlorothiazide, can produce exaggerated sunburn when exposed to UV.