

Skin effects are also included under these two entries – see below.

## Cataracts caused by heat radiation (502.01)

## Conjunctival ailments following exposure to ultraviolet radiation (502.02)

### Definition of causal agent

Heat and ultraviolet radiation are two forms of non-ionising radiation that can cause cataracts and conjunctival damage. Different ocular and skin effects can also occur from exposure to other forms of non-ionising radiation, and are described below.

The non-ionizing radiations which can cause typical disorders in man are those with wavelengths between 100 nm and 1m e.g.

- ultraviolet radiation (UV) (100 to 400 nm)
- visible light (400 to 760 nm)
- infrared radiation (IR) (760 nm to 3 µm)
- microwaves (1 µm to 1m)

Laser radiation within these wavelengths is also included under this heading.

Non-ionizing radiations with wavelengths > 1 m have no proven effect on health.

### *Main occupational uses and sources of exposure:*

- UV: bactericidal lamps, plasma arc and xenon welding, solar radiation especially at high altitudes, industrial lasers
- IR: solar radiation, sources of radiant heat, industrial lasers

## Adverse effects

### *1. Pathological effects of ultraviolet radiation*

The extent to which UV radiation penetrates the body, and its biological effects, vary according to the wavelength:

- UV(C) is absorbed through the skin, conjunctiva and cornea, but does not penetrate any further,
- UV(B) penetrates as far as the lens,
- UV(A) may reach the retina

### *Acute effects*

#### Keratoconjunctivitis

A painful disorder with conjunctival hyperaemia and photophobia. If the cause is a UV laser, the cornea may be severely affected with subsequent opacification.

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**Exposure criteria:**

*Minimum intensity of exposure:* Occupational exposure confirmed, if possible assessed, by:

- history and study of working conditions providing evidence of intense exposure (intensity greater than the limit values) to UV(C) or UV(B) or UV lasers.

*Minimum duration of exposure:* About one second.

*Maximum latent period:* 48 hours.

**☐ Photoretinitis**

Phototrauma of the retina.

Relatively painless disorder of the retina, with transient blindness, if the damage of the fovea is mild. If the damage is more severe, persistent distortion of visual image and scotoma may occur. Burns outside the foveal area may cause no subjective symptoms.

**Exposure criteria:**

*Minimum intensity of exposure:* Occupational exposure confirmed, if possible assessed, by:

- History and study of working conditions providing evidence of intense exposure to UV(A), particularly industrial lasers (A).

*Minimum duration of exposure:* Fraction of a second.

*Maximum latent period:* Immediate blindness

**Chronic effects****☐ Actinic cataract**

This is usually a disorder of the anterior capsule of the lens, extending to the sub-capsular epithelium.

**Exposure criteria:**

*Minimum intensity of exposure:* Occupational exposure assessed by:

- History and study of working conditions providing evidence of prolonged or repeated exposure to UV(B) and UV(A)

*Minimum duration of exposure:* One year.

*Maximum latent period:* 15 years.

**2. Pathological effects of visible light****Acute effects****☐ Photoretinitis**

Photochemical damage may be caused by blue light emitted at 400 to 550 nm or broad spectrum light emitted at high power (xenon projectors, arc lamps, flashguns). Documented pathological effects are those caused by class III and IV lasers used in visible light, which can cause acute lesions, ocular pain, transient blindness and persistence of visual image, chromatic deficiency.

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Photoretinitis can occur also asymptotically during exposure to continuous-wave lasers; a thorough examination may discover the presence of a scotoma.

***Exposure criteria:***

*Minimum intensity of exposure:* Occupational exposure assessed by:

- History and study of working conditions providing evidence of intense exposure to the above mentioned forms of radiation.

*Minimum duration of exposure:* A few seconds.

*Maximum latent period:* One year.

### 3. Pathological effects of infrared radiation

#### *Acute effects*

#### **□ Thermal effects on the anterior part of the eye and surrounding areas**

Burning sensation on the skin around the eyes, blepharitis and keratitis.

***Exposure criteria:***

*Minimum intensity of exposure:* Occupational exposure confirmed, if possible assessed, by: history and study of working conditions providing evidence of intense exposure to broad-spectrum (IR)B and IR(C) emitters (sun, incandescent light sources, special lamps) or to industrial lasers.

*Minimum duration of exposure:* A few minutes.

*Maximum latent period:* 24 hours.

#### **□ Heat-related retinal disorders**

Burns cause immediate oedematous lesions, which later show pigmentary changes. Often scars related to small burns and those after viral infections are identical in their morphology.

***Exposure criteria:***

*Minimum intensity of exposure:* Occupational exposure assessed by:

- History and examination of working conditions providing evidence of intense exposure industrial lasers.

*Minimum duration of exposure:* About one second

*Maximum latent period:* 24 hours.

#### *Chronic effects*

#### **□ Glass workers' cataract (Heat-induced cataract)**

This starts in the posterior cortex of the lens and forms a web, leading to irregularly shaped discoid posterior opacification.

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**Exposure criteria:**

*Minimum intensity of exposure:* Occupational exposure assessed by:

- History and study of working conditions providing evidence of prolonged or repeated exposure to IR radiation emitted by incandescent glass or metal (over 1 500°C).

*Minimum duration of exposure:* One year.

*Maximum latent period:* 15 years.

#### 4. Pathological effects of microwaves

##### □ Heat cataract

Cloudy opacities on the posterior cortex of the lens. Spot opacities spread over the lens cortex.

**Exposure criteria:**

*Minimum intensity of exposure:* Occupational exposure assessed by:

- History and study of working conditions providing evidence of exposure to microwaves (wavelength of the order of centimetres or even decimetres)

*Minimum duration of exposure:* Depends on intensity of the radiation. High-energy radiation (several hundred mW/cm<sup>2</sup>) can rapidly damage the lens.

*Maximum latent period:* 15 years.

#### 5. Cutaneous effects from exposure to non-ionising radiation

*Acute Effects:*

Erythema, skin burns. See also Annex I entry nr. 201 on *Skin diseases and skin cancers*.

**Exposure criteria:**

*Minimum intensity of exposure:* Occupational exposure assessed by:

- History and study of working conditions providing evidence of intense exposure to UV(C);
- and if the data is available:

Guide value: exposure of the uncovered parts to UV(C) with intensity of the dose received on skin > 0.03 J/cm<sup>2</sup>.

*Minimum duration of exposure:* A few minutes.

*Maximum latent period:* 24 hours.

*Chronic effects:*

##### □ Skin cancers

These appear on uncovered parts of the body (head, neck, hands and forearms) and are mainly associated with occupations exposed to solar radiation. They include basal cells and spinocellular epitheliomas and malignant melanomas.

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***Exposure criteria:***

*Minimum intensity of exposure:* Occupational exposure confirmed, if possible assessed, by:

- History and study of working conditions providing evidence of prolonged or repeated exposure to solar radiation.

*Minimum duration of exposure:* 20 years.

*Minimum induction period:* Epitheliomas: 20 years; Melanomas: five years.

See section on ***Occupational cancers*** in the **Preface**.