Ultraviolet radiation

This document describes the risks and precautions to be taken when using ultraviolet radiation.
Ultraviolet radiation lies between X-rays and visible light; have wavelengths (l) between 100 nm and 400 nm and are divided into 4 groups:

Group	*Wavelength*	*Action*
UVA, close	from 400 nm to 315 nm	induces fluorescence
UVB, mid	from 315 nm to 280 nm	spectrum of action for erythema
UVC, far	from 280 nm to 200 nm	germicidal lamps
UVV, vacuum	from 200 nm to 100 nm	radiations with a wavelength lower than 180 nm do not exhibit biological effects because they are absorbed by the air

Common UV sources

INCANDESCENT SOURCES: tungsten
GAS DISCHARGE SOURCES: mercury (low, medium, high pressure), germicidal, xenon, hydrogen and deuterium
FLUORESCENT SOURCES: fluorescent, solar and UVB, black light and UVA
Some of these sources are found more frequently in laboratories:
• Low pressure mercury (UVC) germicidal lamps, for disinfection of the air of confined spaces or liquids and for the sterilization of materials.
• Low, medium and high pressure fluorescent lamps used in photochemistry applications, induction of reactions and damage on materials, polymerization of molecules and induction of fluorescence in materials.
• Transilluminators (312 nm) for visualization of molecular structures, DNA.
In medicine, UV radiation is used both in the diagnosis and in the treatment of diseases, especially of the skin. In dentistry, the ability of some resins (methacrylates) to polymerize, and therefore harden, is exploited if subjected to UV irradiation; these resins are used for filling or reconstruction of teeth.
The effects on the operator given by the emission of UV radiation during welding should not be underestimated.

Damage

Damage from exposure to UV radiation can be divided into:
• damage that is not stochastic or directly related to exposure
• stochastic damage or that increases the risk of contracting a certain pathology
Given the limited penetrating power of UV radiation, the non-stochastic damage determined is limited to the skin, eyes and, in particular circumstances, to the oral cavity. Erythema occurs on the skin, while various forms of eye diseases such as photokeratitis, photoconjunctivitis, some forms of catarract and retinopathies are attributable to eye exposure. Variations in the immune response (UVB and UVC) have also been demonstrated.
The late effects of prolonged exposure to UV radiation result in:
• premature aging of the skin
• formation of precancerous epidermal cells
• appearance of some forms of cataracts
Stochastic effects result in skin and eye carcinomas and melanomas.

Protection standards

Protection against overexposure from UV electromagnetic radiation can be achieved by introducing technical standards, behavioral recommendations and by protecting personnel in the workplace.
Access limitations: access to areas containing equipment that emits UV radiation should be restricted to workers.
Risk information: all personnel using UV radiation must be informed about the risks associated with use; the rules relating to operating and behavioral methods must be displayed in the workplace;
Warning signs: the use of high intensity UV sources must be signaled by luminous signs installed on the access road. In any case, the signs must be affixed in a clearly visible and understandable way to anyone.
Limitation of exposure: the operator must keep as far away as possible from the operating source.
Construction techniques: the main safety construction measures, preferably to be introduced in the instrumentation design phase, consist of light-tight containers, closures, UV absorbing glasses and plastic screens. If observation of the UV source is required then closed housings and screened areas can be constructed so that all observation openings are of UV absorbing materials (eg PVC, special glass and acrylic materials).
To avoid the possibility of reflected UV radiation, all metal surfaces must be coated with anti-reflective material (eg zinc or titanium oxide).

Individual protection

If the technical measures have been adopted correctly it is not necessary to arrive at individual protection. However, on some occasions, the nature of the work determines an inevitable exposure of the areas most at risk, ie hands, arms and eyes. In these cases, protective measures require covering the exposed parts by the following means:
Face and eyes: glass glasses, blinders or plastic visor;
Hands and arms: gloves and muffs; for long exposures, plastic is preferable to rubber; materials that transmit little UV are also poplin and flannel;
Head and neck: cotton hood.
It should be noted that, although transparent to light, all glass (with the exception of special UV and quartz) and plastic substances such as perspex and polyvinyl acetate do not let UV radiation of short length pass through therefore ensure complete protection. .
In some cases, skin protection can also be ensured by lotions based on shielding substances (p-aminobenzoic acid or its esters in an alcoholic solution, b-carotene) or which inhibit the formation of tumor cells (retinoic acid).

Dangers associated with particular uses

In the emission of UV radiation with a wavelength shorter than 245 nm, ozone may be formed by the interaction of the radiation with atmospheric oxygen; its accumulation can be avoided by installing adequate ventilation systems.
High-pressure lamps can explode due to impact, so special care must be taken when removing these sources.
In welding operations, there is the possibility of damage to the retina due to the intense emission of visible light, therefore workers should be protected by helmets or masks with suitable absorption filters.