Electromagnetic radiation of lamps

*Which lamps give which type of light? * Regulation and market surveillance concerning radiation emissions * Health effects and limit values * Precautionary measures*

Introduction

As a result of the ban on incandescent lamps on the European market, alternative types of lamps (with a better energy efficiency) become available on the market. Because energy saving lamps work differently, one questions their possible radiation hazard. In this section we elucidate which types of electromagnetic radiation lamps can produce, and when there is a health risk.

Lamps exist in all sorts and sizes, for lighting the work place or the home (general lighting) or for specific applications such as infrared lamps for saunas or UV lamps in nail studios. In this section we only discuss lamps for general lighting.

Although intended only for lighting purposes, lamps for general lighting do not only produce visible light. As a by-product they also generate other types of radiation. Incandescent lamps radiate a lot of heat (infrared radiation). Energy saving lamps such as compact fluorescent lamps, tubular fluorescent lamps or led lights produce UV light and blue light as a by-product – in different measures, as a result of the specific technology which is used. This may imply a risk, especially with persons with a particular sensitivity of the skin or with a certain eye disorder.

Which lamps give which type of light?

Incandescent lamps

An incandescent lamp produces light through heating a filament. Most energy is radiated in the infrared (IR) area (as heat instead of light), which results in a very low efficiency. The health risks are minimal. Because they waste so much energy, the European Union has decided to gradually withdraw incandescent lamps from the market.

Halogen lamps

A halogen lamp is an incandescent lamp, where the bulb is filled with an inert gas under high pressure. To this gas a small amount of halogen (bromine or iodine) is added, from which the lamp gets its name. A halogen lamp works at a very high temperature. This is why its optical spectrum has shifted to the blue part, resulting in more UV light and less infrared emitted. In order to stop the harmful UV light, halogen lamps are made of a special type of quartz (“doted” quarts) or provided with special casings/filters.

Fluorescent lamps

The tube of a fluorescent lamp is covered on the inside by a fluorescent layer and is filled with mercury gas under low pressure. An electric tension between electrodes at the end of the tube excites the mercury gas, producing ultraviolet light. In the fluorescent layer the UV light is converted into visible light. The fluorescent layer is not always perfectly homogeneous and lets pass a bit of UV light . This is why a fluorescent lamp gives a bit of ultraviolet and blue light. The most well-known examples are the fluorescent lamp tubes and the compact fluorescent lamps, CFL (also called energy saving lamps).

Compact fluorescent lamps also produce non-optical electromagnetic fields of intermediate frequencies (30-60 kilohertz, kHz). They do not transmit radio waves, reason why they cannot be compared with mobile phones (as is done sometimes). Even the most prominent type of radiation (of 30–60 kHz) lies under the exposure limit if one maintains some distance to the lamp (a few centimetres).

LED

LED lamps (LED, “Light Emitting Diode”) are not lamps in the traditional sense of the word. They do not have a glass bulb and do not contain a filament. The light arises in a crystal made of a semi-conductor, which illuminates if a current is sent through it. All this solidly wrapped in a transparent casing of epoxy resin.

LEDs give light in one specific colour (red, green, blue,…) and there are also infrared or UV LEDs. White light in LED lamps is obtained through illuminating a fluorescent layer by blue or UV light. Nowadays there are also variations which emit white light directly, as a result of the composition of the crystal (such as RGB LEDs). LED lighting does not give infrared or ultraviolet radiation, with the exception of LEDs where the white light is obtained by means of UV light. Blue and cold white LED lamps emit relatively large amounts of blue light, which may pose a health risk (“blue light hazard”).

Regulation and market surveillance concerning radiation emissions

Concerning health and safety, lamps fall under the scope of the low voltage directive 2006/95/EC. This directive requires that radiation emissions of electrical equipment do not involve any risk for the health and safety of the user and of other persons, and that radiation emissions do not cause any electromagnetic interference. The manufacturer must test his products so as to ensure that they comply with all criteria.

The market surveillance in respect to this regulation is carried out by the FPS Economy, S.M.E.s, Self-employed and Energy.

Non-optical radiation

The limit values and the evaluation procedures for the hazards of electromagnetic fields (non-optical radiation) have been described in the European standards EN 62479 and 62493, harmonised under the low voltage directive. The limit values correspond with the exposure limits recommended by the Council of the European Union. These exposure limits are based on the guidelines of the ICNIRP (International Commission on Non-Ionizing Radiation Protection).

Optical radiation

The limit values and the evaluation procedures for the hazards of optical radiation have been included in the European standard EN 62471, harmonised under the low voltage directive, and are also based on the directives of the ICNIRP. The aforementioned European standards can be consulted at the Belgian Institute for Normalisation.

Health effects and limit values

Optical radiation (visible light, UV and infrared light) is biologically active, that is to say that biological effects may occur. With too strong or protracted exposure, these may affect one’s health. Which are these effects and how are the limits taken into consideration?

Health effects

Ultraviolet light

UV light causes harmful chemical reactions in the skin and in the eyes. This is why it is said that it has a photochemical effect. UVB and UVC light are the most damaging.

This photochemical damage manifests itself in the skin as erythema (temporary redness of the skin) in case of intensive exposure. In the long run, chronic exposure can lead to skin cancer. It is especially UVB rays that are responsible for these effects, because UVC light (coming from the sun) is blocked by the atmosphere. The photochemical action of UVA light is less prominent, but it can penetrate deeper into the skin. Because UVA light reaches the deeper layers of the skin (the connective tissue), it causes premature ageing of the skin and wrinkles: under influence of UV rays, the connective tissue loses its elasticity.

Photochemical reactions in the eye cause inflammation of the cornea (photokeratitis, also known as “welder’s eye” or “arc eye”) or inflammation of the conjunctiva (photoconjunctivitis). In the eyes as well, UVA penetrates deeper than UVB. It can reach the eye lens and, in children, the retina. By contrast, the UVB and UVC light are stopped by the cornea and the conjunctiva, which are found on the outside of the eye (still in front of the eye lens). As the eye lens is not transparent for UVA light and absorbs its energy, cataract may develop there. Usually, with small children the eye lens is more transparent for the UVA light, so that it can penetrate still deeper into the eye, and this way reach the retina, where it causes the damaging photochemical reactions (see “blue light damage”).

Very intensive UVA light may also cause thermal damage (through heat) of the cornea and the conjunctiva in the eye. However, for this, the light intensity must be very high.

Visible light

- Blue light hazard

Visible light is necessary for seeing something. Yet, it can also prime harmful photochemical reactions in the eye, more particularly in the retina, where it is absorbed. This is called “blue light damage” because it is the blue light that contributes the most to this. The blue light can be found in the spectrum right next to the ultraviolet light, which is known for its photochemical working, and resembles this. The other colours – from deep blue to yellow – work in a similar way. With small children also UVA light can cause photochemical damage of the retina (see above, “UV light”).

Blue light damage of the retina can manifest itself in different ways.

- With intensive exposure, photoretinitis (inflammation of the retina) may develop, with as a result temporary or permanent blind spots. For example, this may happen by staring into the sun (looking at a solar eclipse without protective filter).
- Chronic exposure to blue light may accelerate some hereditary retina conditions (such as Stargardt macular dystrophy) and may contribute to a quicker ageing of the retina, with as a consequence loss of sharpness of vision.

- Thermal damage

When the light is very intensive, the retina in the eye may also get damaged by the conversion of visible light into heat. This results in a temporary or permanent blind spot.

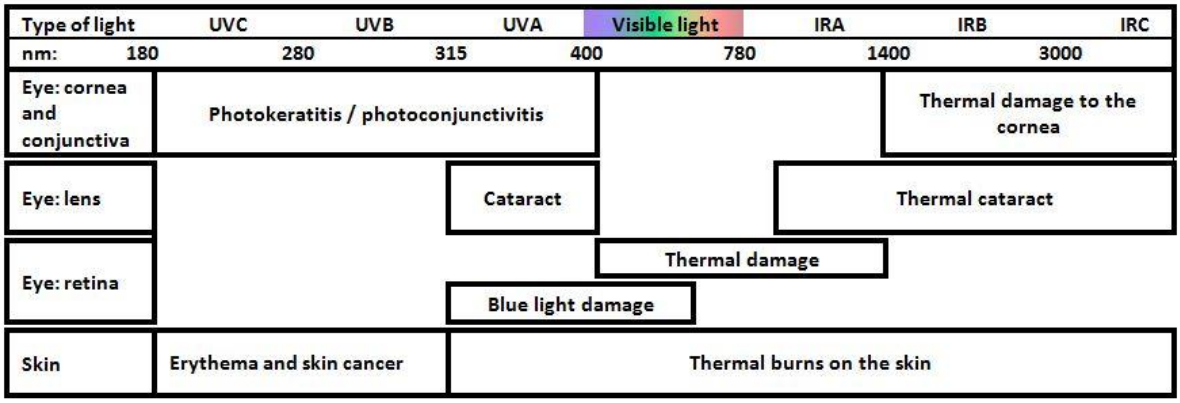
Infrared light (IR)

The energy of infrared light is converted into heat. Too intensive infrared light can damage the upper layers of the eye with inflammation of the cornea and cataract as a result, typical occupational diseases with glassblowers and metal founders. Moreover, the IRA rays can, just as

visible light, penetrate deeply into the eye and reach the retina, where the developed heat can cause damage.

Intensive infrared light also causes burns on the skin.

All these effects are shown on the diagram below.



Limit values

Limit values for optical radiation have been laid down in the standard EN 62471, harmonised under the low voltage directive. The standard prescribes that the producer evaluates the optical hazards of his product and subsequently assigns the product to one of the risk groups (from risk group 0: “exempt group” to risk group 3: “high risk”). With lamps which belong to risk group 1 and higher, guidelines for a safe usage are provided in the instructions for use (such as for some spotlights and pocket torches). Most lamps for general lighting belong to the risk group 0 (without risks).

Risks not covered by the limit values

The classification in the standard EN 62471 is particularly meant to protect against acute effects, in other words injuries. Such effects are most likely to occur in an industrial work environment. In the ordinary living environment this danger is virtually non-existent.

Long term effects (cataract, photochemical retina damage) may arise at a relatively low light intensity, because the dose plays a role. The protection against these effects is only partly foreseen in the standard. Pathological photosensitivities in some persons are neither taken into consideration.

Precautionary measures

Optical radiation (visible light, UV and infrared light) only implies a risk with very strong light sources (flash lights, lasers) and in the industrial work environment. Lamps for house, garden and desk lighting usually belong to the risk group 0 (no risk in normal circumstances). Some lamps belong to risk group 1-3 and may imply a risk. Mostly it is regarding a blue light damage to the retina. Therefore, read the instructions for use of a lamp carefully. Wrong installation or improper use of a lamp gives a higher exposure and may imply a risk.

Recently the SCENIHR (Scientific Committee on Emerging and Newly Identified Health Risks) has taken a close look at the health risks of current lighting sources. According to SCENIHR there are a few situations where one should pay attention.

In general

Do not stare into the bright light of led car headlights, led bike lights and led pocket torches. The light of cold white leds contain relatively much blue light, which may imply a health risk.

For desk lighting and for precise work (drawers, dentists, watchmakers, …) stronger lamps are used and/or they are placed somewhat closer by. As a result the skin is exposed for a long time to an increased amount of UV light (in case of tubular or compact fluorescence lamps). However, the total amount of exposure of the skin to the UV radiation by a lamp belonging to the risk group 0, is rather limited. The impact on a yearly basis is estimated by the SCENIHR to be equivalent to maximum 3-5 sunny vacation days at the Mediterranean Sea.

Night light (regardless the type of lamp) appears to be disadvantageous for sleep and the general state of mind. For example, when late in the evening one still looks for a long while at a screen (of a tv, computer, tablet or smartphone), this may disturb the biological clock of our body. If this becomes a habit, it can also increase the risk of cardiovascular diseases, gastro-intestinal disorders and even increase the risk of breast cancer.

Besides, remember that most damage to skin and eyes is caused by the sun. A good sun cream and sun glasses with UV filter in the summer are no luxury. You will find more information on www.soleilmalin.be or www.veiligindezon.be.

Persons with a photosensitive skin

Persons with a pathological sensitivity to light (photodermatosis) can experience a worsening of symptoms under the influence of lamps which give blue or UV light. For these persons the use of leds with a warm white light or CFL lamps with a double envelope is a better option. After all, a warm white lamp radiates a lot less blue light. A double envelope largely blocks the UV emissions.

Persons with certain eye conditions (retina dystrophy)

Persons with certain forms of hereditary retina degeneration (such as the Stargardt disease) should be aware of blue light hazard. Wearing glasses with special lenses which block the UV and blue light (coming from the sun or lamps), is recommended.

Photo sensitisation

Under the influence of certain medicines, people can become extra sensitive to the UV and blue light. Examples of these medicines are antibiotics from the tetracycline group, some antidepressants, contraception pills, medicine against diabetes and too high blood pressure (anti-hypertension medicines). This may also happen with cancer patients who undergo a photodynamic therapy (therapy based on light). With these persons the light of CFL or led lamps can cause a skin reaction (redness or even blisters).