



Electricity and health

*Exposure limits * Electric and magnetic fields in daily life * Regulation and control * Research and recommendations*

Introduction

Electricity provides us with a lot of comfort in our daily life. But the transport and use of electricity also generates electric and magnetic fields. Does the exposure to these fields imply a health risk?

As soon as a device is connected to the electricity grid, i.e. when the plug is in the wall socket, an **electric field** is present around the cables. When current flows through the wires, i.e. when electricity is consumed (for instance when a bulb is on or a vacuum cleaner is running), a **magnetic field** is created around the cable and the device.

The current of the electricity grid is **alternating current**, with a frequency of 50 hertz in Europe (50 cycles per second, 50 Hz). The generated electric and magnetic fields are thus also **alternating fields** that alternate with the same frequency as the current: 50 Hz. As a result, they belong to the category of fields with extremely low frequencies (ELF), from 0 Hz to 300 Hz.

Exposure limits

Alternating fields with an extremely low frequency generate an electric current in the body. If the alternating fields are strong enough, this generated current can disrupt the functioning of nerves and muscles in the body and cause flashes of light in the field of vision. According to the recommendation of the Council 1999/519/EC, the following threshold values must not be exceeded by the fields so that these effects do not occur:

- for the electric field, the limit is 5 kilovolt per metre (5000 V/m or 5 kV/m);
- for the magnetic field, the limit is 100 microtesla (100 μ T).

The electric and magnetic fields, which surround us in daily life, are most of the time far below the limits. You can read more below about the exposure in daily life and how the recommendations of the Council were applied in the Belgian regulation.

The purpose of the exposure limits is to prevent immediate harmful effects at the level of the nervous system. There are still not enough scientific data to tell us if other (harmful) effects are possible in the long run.

Electric and magnetic fields in everyday life

Electric field

Live wiring and appliances are surrounded by an electrical field. The strength of an electric field depends on the voltage in a wire. The strongest electric fields are found under overhead transmission lines: just beneath the wires, this field can reach a few kilovolts per metre. Only under a 380 kV transmission line can the limit of 5 kV/m be exceeded. Electrical appliances and garden machinery can never cause an electrical field above the threshold value.

The electrical field decreases sharply with distance and is also resisted by barriers such as walls. As a result, the electrical field in homes is minimal, even in homes right next to a high voltage line.

Magnetic field

The strength of a magnetic field depends on the electric current in a wire. The strongest magnetic fields occur in magnetic resonance imaging machines (MRI), used for medical imaging (a few teslas).

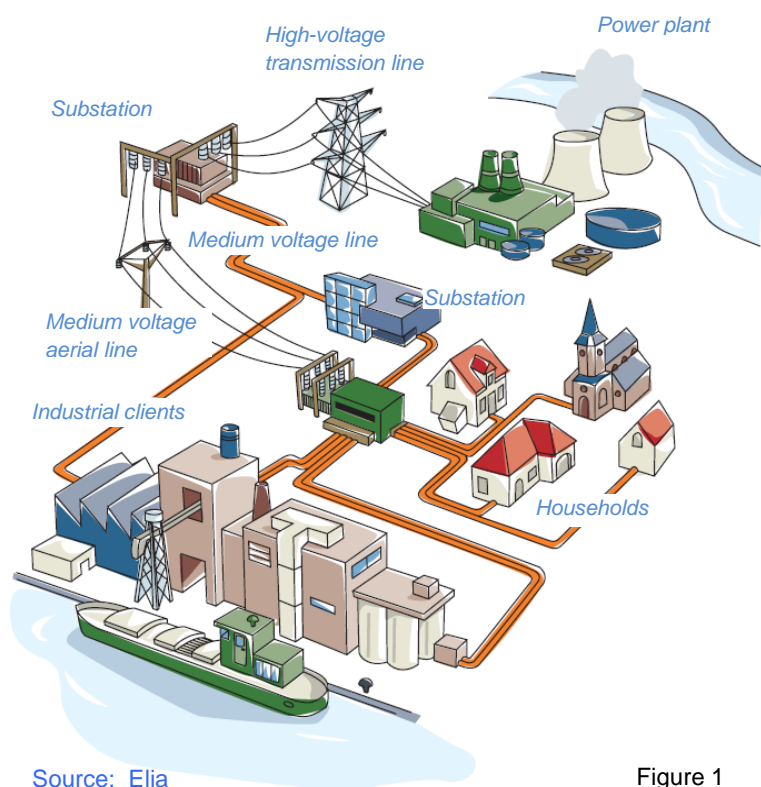
Fairly strong fields occur nearby motors and other electrical devices (between a few microteslas and several hundred microteslas). The electricity grid generates relatively weak magnetic fields (at most in the tens of microteslas).

The magnetic field also significantly decreases with distance, but is only slightly weakened by walls. There are magnetic fields around us originating from a whole range of sources both outside and inside.

The electricity grid

On the electricity network the strongest magnetic fields occur near high voltage cables because they carry the strongest electrical current.

Note: not every cable hanging from a pylon is a high voltage line. High-voltage usually refers to a voltage of 30kV or higher. The voltage must be this high in order to efficiently transport large amounts of energy. This is what actually happens in high-voltage transmission lines: they transmit electricity over very large distances from the power plant to the users. In order to use the electric energy, the voltage must be reduced: this is done in substations. From there, the electricity is brought via the distribution grid (at medium voltage, up to 15 kV) to our homes (at low voltage, 230V) (see figure 1). The high-voltage transmission lines may be laid above ground or below ground.



Source: Elia

Figure 1

At ground level, the magnetic field is strongest a few metres from an **overhead transmission line**, and can reach a few tens of microteslas.

Along **underground transmission cables**, the field weakens much faster than along an overhead line with the same voltage: this is because the underground lines lie close to one another, three lines together. They carry the electricity in three different phases, allowing the alternating magnetic fields generated to partially cancel each other out.

Substations produce a negligible magnetic field outside of the safety zone. The largest fields in zones accessible to the public are caused by the power lines that run in and out of the substation.

The magnetic fields around [distribution lines and the wiring at home](#) are even weaker, a few microteslas in the immediate surroundings.

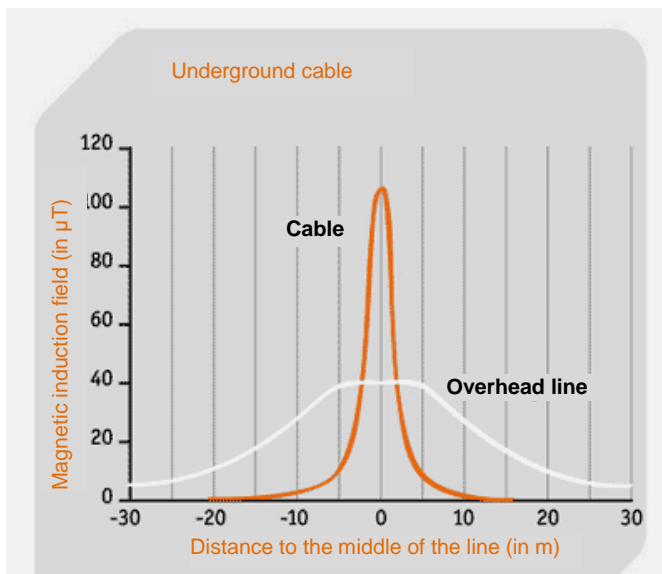


Figure 2: the magnetic field in relation to the distance to an overhead line and an underground high-voltage cable, source: Elia.

Household electrical devices

As soon as an electrical device is switched on, there is a magnetic field present. Sometimes the field is unintentional, it is just a by-product of the electric current. But sometimes a magnetic field must be specially created because this is necessary for the working of e.g. electrical motors or adapters. In these cases the manufacturer ensures that the field outside of the device remains at a minimum. Yet this is not always possible, particularly when a device should be light-weight and compact. An electric razor or a hair dryer, for example can generate a magnetic field in the range of 5 - 200 μT . In other devices, those that have no motor or adapter, the magnetic field is usually weak. The exceptions to this are devices in which the electricity runs in large loops (electric kettles, electric blankets, convection radiators). Generally the power of the device plays no role

The magnetic field decreases sharply as the distance from the source is increased. At a distance of 30 cm, the magnetic field around most household appliances is much lower than the current guideline of 100 μT at 50 Hz for the general public. At a distance of one metre, the magnetic field is already negligibly small.

A short exposure to a magnetic field larger than 100 μT does not necessarily constitute a risk. By setting the limit at 100 μT , a large safety margin has been included. Most devices are also not used close to the body. For occupational situations, the safety limit is set at 500 μT .

Normally, there is only a magnetic field present if a device is switched on. Devices that run on a lower voltage than the grid (halogen lamps and dimmers, for example) need an adapter (transformer). This adapter always uses electricity (and therefore also creates a magnetic field) whenever it is plugged in, regardless of whether the device is on or off.

Other devices and machines

There are also alternating magnetic fields present in the following situations:

- *Near machines that run on a light petrol engine, lawnmowers and chainsaws, for example*
A rotating magnetic field must ensure that the spark plugs are ignited.
- *Around the battery of a mobile phone*
This is because the battery of a mobile phone uses pulsed electricity, related to the radiation pattern of the mobile phone.
- *In a car*
These fields originate in the battery, the wiring and the magnetised steel belts of the tyres. When the tyres rotate, while driving, there is a rotating magnetic field. Car tyres can be demagnetised in a garage.
- *In a train*
Trains are driven by electricity.

Legislation and control

The electrical power network

The Belgian legislation (General Regulations for Electric Installations (RGIE/AREI)) limits the strength of the electric field that is generated by the 50 Hz electricity grid to:

- 5 kV/m in residential areas or residential expansion areas;
- 7 kV/m along roads;
- 10 kV/m in other places.

So far there is no federal Belgian legislation for the limitation of public exposure to magnetic fields of 50 Hz. Belgium has adopted the European recommendation of 100 μ T (recommendation of the Council 1999/519/EC). This is the limit for preventing strong currents in the body.

Independent research teams that are specialised in the measurement of transmission line magnetic fields include VITO (Vlaams Instituut voor Technologisch Onderzoek, Flemish Institute for Technological Research), the ISSeP (Institut Scientifique de Service Public) and the University of Liege (ULG, Transport and Distribution of Electrical Energy).

Elia, the operator of the Belgian transmission grid, is responsible for technical supervision. Elia measures the electric and magnetic field in homes free of charge.

Electrical household appliances

All these appliances such as washing machines, hair-dryers, electric blankets and microwave ovens may only be put on the market if they are safe and pose no danger to health. This also applies for electric and magnetic radiation that may be caused by these appliances. This requirement is established in the European low-voltage directive (2006/95/EC) and is specified further in the European product standards under this directive.

The compliance of this regulation is checked by the [FPS Economy, SMEs, Self-employed and Energy](#).

Research and recommendations

Electricity and childhood leukaemia

A short exposure to an electric or magnetic field under the recommended limits is not hazardous to your health. However, scientists have not yet come to a conclusion regarding the possible effects of long-term exposure to extremely low frequency magnetic fields.

There are indications from epidemiological research that long-term exposure may be associated with a mildly elevated risk of leukaemia in children. For that reason, the International Agency for Research on Cancer (IARC) has classified low-frequency magnetic fields (originating from the electric power grid) as 'possibly carcinogenic to humans'. 'Long-term exposure' refers to a long-term stay in places where the average magnetic field over 24 hours is higher than 0.3 – 0.4 μT , which could be the case near high-voltage power transmission lines.

The classification 'possibly carcinogenic to humans' is assigned to environmental factors and substances that show 'limited epidemiological evidence' in connection with cancer. As for 'limited indications', it is still possible that the connection is only apparent and that a coincidence or misrepresentation falsifies the results. The level of certainty when something is classified as 2B ('possibly carcinogenic in people') is lower than in the case of classification 2A ('probably carcinogenic') and 1 ('carcinogenic').

How great is the risk?

Childhood Leukaemia appears in 3 children in 100,000 each year. There are various risk factors that can increase the chance of developing childhood leukaemia, for example, ionising radiation (such as x-rays), genetic factors, household use of pesticides and certain solvents in paint, smoking and possibly alcohol use by the mother during the pregnancy.

If it should emerge from further investigation that ELF magnetic fields also belong on the list of risk factors, this factor would be responsible for less than 1% of the childhood leukaemia cases each year (in the Flemish region), according to the Superior Health Council.

Recommendation of the Superior Health Council

Although there is still much uncertainty regarding the precise role of magnetic fields in increasing the risk of childhood leukaemia, the Superior Health Council (advice no. 8081) recommends that children under the age of 15 not exceed the exposure limit of 0.4 μT (averaged over a long period).

This means that the home and in particular the bedroom should ideally be at a sufficient distance from electrical installations such as high-voltage power lines, distribution lines and substations. In addition, the bedroom and particularly the child's bed should be placed at a sufficient distance from the home's electrical installations (distribution board and wires, electric under-floor heating) and continuously operating devices (electric blankets, electric alarm clocks).

The table below provides an approximation of the distances to be maintained.

Installation	Type	Distance
1. Overhead high-voltage line	70 kV	30 m
	150 kV	45 m
	220 kV	60 m
	380 kV	100 m
2. Underground high-voltage cable	36 kV	4 m
	70 kV	5.5 m
	150 kV	7.5 m
3. Medium- and low-voltage line	< 15 kV	Immediate surrounding (0.5 m)
4. Transformers	from 30 kV towards 10 to 15 kV	8 m
	from 10 to 15 kV towards 220 to 400 V	5 m
5. Installations in the residence	<ul style="list-style-type: none"> • Distribution cables for different residences (e.g. apartment buildings) • Distributing board and meter for domestic use • Electrical floor heating 	Immediate surrounding (0.5 m)
6. Electrical devices, only:	<ul style="list-style-type: none"> • Radio alarm clock • Electric blankets 	0.5 m

Useful addresses

- **Elia**, Keizerslaan 20, 1000 Brussels. Tel.: 02 546 70 11, Fax: 02 546 70 10. www.elia.be
- **VITO** (Flemish Institute for Technological Research), Integrated Environmental Studies, Boeretang 200, B-2400 Mol. Tel.: 014 33 59 41, Fax: 014 32 11 85. www.vito.be
- **ISSeP** (Scientific Institute of Public Services), "electromagnetic fields" cell, Chronic Risks Division, Rue du Chéra 200, B 4000 Liege, Belgium. Tel.: 04 229 83 11. www.issep.be
- **Liege University**, Transport and Distribution of Electric Energy, 10 Grande Traverse, Sart Tilman (B28), B-4000 Liege, Belgium. Tel.: 04 366 26 33, Fax: 04 366 29 98. www.tdee.ulg.ac.be

Want to know more?

www.bbemg.ulg.ac.be (Belgian BioElectroMagnetic Group)

www.milieurapport.be (research reports about the high-voltage network)

www.who.int/peh-emf/en (World Health Organisation - electromagnetic fields)

www.health.fgov.be/CSS_HGR (advice and recommendations of the Superior Health Council)