

Sources and useful links

The following are links to more information and studies on EMF:

- EMF: Electric and Magnetic Fields Associated with the Use of Electric Power, Questions and Answers, June 2002, prepared by the National Institute of Environmental Health Services (NIEHS), National Institute of Health, www.niehs.nih.gov/emfrapid/booklet/emf2002.pdf. This booklet also includes an extensive list of references on a variety of EMF topics.
- “A White Paper on Electric and Magnetic Field Policy and Mitigation Options,” prepared by the Minnesota Interagency Working Group on EMF Issues. www.capx2020.com/documents.html
- Electric and Magnetic Fields: Facts, Western Area Power Administration, www.wapa.gov/newsroom/pdf/EMFbook.pdf.
- “Electromagnetic fields: Typical exposure levels at home and in the environment,” World Health Organization Fact Sheet, www.who.int/peh-emf/about/WhatisEMF/en/index.html. More general information on EMF can be found at www.who.int/emf.
- NIEHS/Department of Energy EMFRAPID program toll-free public information number to answer EMF-related questions: 800-363-2383.

ELECTRIC AND MAGNETIC FIELDS (EMF): THE BASICS

EMF exists wherever electricity is produced or used. Electric and magnetic fields are invisible lines of force that surround any electrical appliance or wire that is conducting electricity. You're exposed to these fields in your home when you turn on a lamp, e-mail a friend or cook your dinner. In all likelihood, you're surrounded by EMF from machines in your workplace, too.

The electric power we use daily is a 60-Hertz (Hz) alternating current, meaning that electric charges move back and forth 60 times a second. We use 'EMF' in this fact sheet in reference to these 60 Hz fields, called 'extremely low frequency' or 'power frequency' fields, which are distinct from the much higher frequency fields associated with radio and TV waves, X-rays and cell phone signals. As a matter of fact, currents from 60 Hz EMF are weaker than the natural currents found in the body, such as those from the electrical activity generated by your brain or your heart.

What are electric and magnetic fields?

Electric fields are created by voltage – the higher the voltage, the stronger the field. Anytime an electrical appliance is plugged in, even if it isn't on, an electric field is created. But these fields are easily blocked by walls, trees, and even your clothes and skin, and the farther away you move from the source of the electric field, the weaker it becomes. Moving even a few feet away from an appliance makes a big difference in the strength of the field that you're exposed to. Electric fields are measured in kilovolts (kV).

Magnetic fields, measured in milliGauss (mG), only exist when an electric appliance is turned on – the higher the current, the greater the magnetic field. As with electric fields, the strength of a magnetic field dissipates dramatically as you move away from its source. However, unlike electric fields that are easily blocked, magnetic fields can pass through walls and clothes and other barriers.

Studies on EMF and possible health effects focus on magnetic fields because they're more difficult to block and because most scientists have concluded that electric fields don't pose health threats.

Why are you calling them electric and magnetic fields instead of electromagnetic fields? Is there a difference?

These terms are often used interchangeably and both electric and magnetic fields and electromagnetic fields are usually abbreviated as EMF. However, technically there is a difference. The frequency fields produced by the generation, transmission and use of electricity – typical of most household and office appliances and power lines – are low and electric and magnetic fields exist separately. At higher frequencies, such as with radio or TV signals or X-rays, the fields are interrelated, and the term 'electromagnetic' more accurately describes these fields.

What are some of the things in my home and at work that produce EMF?

Anything that generates, distributes or uses electricity creates electric and magnetic fields. To the right is a list of some appliances and machines commonly found in homes or offices and the magnetic fields they emit.

Typical 60 Hz magnetic field levels from some common home appliances

	Magnetic field 6 inches from appliance (mG)	Magnetic field 2 feet away (mG)
Electric shaver	100	–
Vacuum cleaner	300	10
Electric oven	9	–
Dishwasher	20	4
Microwave oven	200	10
Hair dryer	300	–
Computers	14	2
Fluorescent lights	40	2
Faxogram machines	6	–
Copy machines	90	7
Garbage disposals	80	2

Source: National Institute of Environmental Health Services / National Institutes of Health: EMF Associated with the Use of Electric Power



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How can I find out what EMF levels I'm exposed to at home and at work?

You can find out your daily exposure to magnetic fields by wearing a personal exposure meter or by keeping one close to you. This is the most accurate way to measure your true exposure to magnetic fields during the course of your normal activities. Other meters, called gaussmeters, can be put in a location – like your kitchen or home office – to measure typical EMF levels in that spot. This type of measurement isn't an accurate measure of personal exposure, however, because it doesn't take into account your distance from the source of the fields or the amount of time you might spend in that place.

Contact your local electric service provider. Most utilities offer a free measurement service to customers for their homes or businesses.

What are 'typical' residential exposures to magnetic fields?

Exposure levels vary from individual to individual and from home to home, but a study by the Electric Power Research Institute (EPRI) puts the background levels of magnetic fields in the

typical U.S. home at between 0.5 mG and 4 mG with an average of 0.9 mG. Levels rise the closer you get to the source of the field. Most people are exposed to greater magnetic fields at work than in their homes.

[See the table of magnetic field levels given off by household and office appliances under What are some of the things in my home and at work that produce EMF?]

What EMF levels are found near transmission lines?

All transmission lines produce EMF. The fields are the strongest directly under the lines and drop dramatically the farther away you move. Contact your local utility to find out EMF information about a particular transmission line near you.

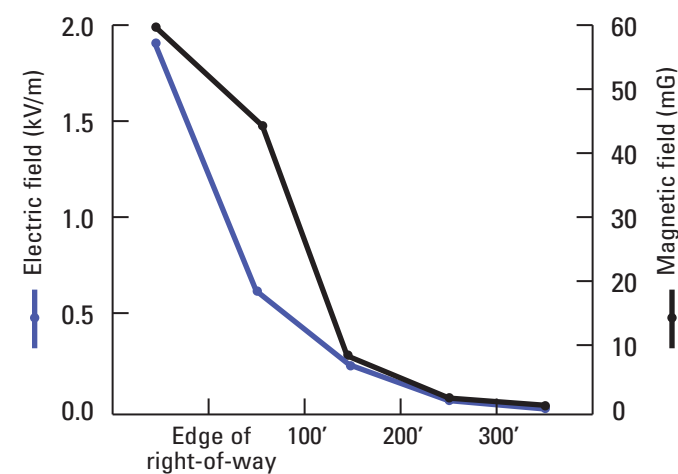
Typical 60 Hz electric and magnetic field levels from overhead power lines

Line voltage	Centerline	Approx. edge of right-of-way	100 feet	200 feet	300 feet
115 kV					
Electric field kV/m	1.0	0.5	0.07	0.01	0.003
Magnetic field mG	30	6.5	1.7	0.4	0.2
230 kV					
Electric field kV/m	2.0	1.5	0.3	0.05	0.01
Magnetic field mG	57.5	19.5	7.1	1.8	0.8
500kV					
Electric field kV/m	7.0	3.0	1.0	0.3	0.1
Magnetic field mG	86.7	29.4	12.6	3.2	1.4

Electric fields from power lines are relatively stable because voltage does not change. Magnetic fields fluctuate greatly as current changes in response to changing loads. The magnetic fields above are calculated for 321 power lines for 1990 mean loads.

Source: National Institute of Environmental Health Services / National Institutes of Health: EMF Associated with the Use of Electric Power

Typical EMF levels for a 230-kV transmission line



Source: Western Area Power Administration. Electric and Magnetic Fields: The Facts.

Do underground lines reduce EMF levels?

Because magnetic fields are hard to block, burying power lines won't keep the fields from passing through the ground. Additionally, underground lines can produce higher levels of magnetic fields directly above them at ground level because these lines are located closer to you than overhead lines, although the strength of the magnetic field from underground lines falls away more quickly than from overhead lines. Underground lines are significantly more expensive to install and more difficult to repair, and since current information provides no conclusive connection between EMF exposure and health effects, burying lines isn't a reasonable alternative.

Are there state or federal standards for EMF exposure?

There are no federal standards limiting residential or occupational EMF exposure. The EMF levels of appliances vary from manufacturer to manufacturer and model to model. The designs of many newer model appliances, in general, often produce lower fields than older models. There is no federal certification program on EMF levels so beware of advertisements on appliances making claims of federal government certification of low or no EMF levels.

Do EMF levels affect my health?

This issue has been studied for more than 30 years by government and scientific institutions all over the world. The balance of scientific evidence indicates that exposure to EMF does not cause disease. (See Sources and useful links section for more information on studies about EMF and health.)

In 2002 the Minnesota Department of Health released "A White Paper on Electric and Magnetic Field Policy and Mitigation Options." In regard to EMF levels and health effects, the report states:

"The Minnesota Department of Health concludes that the current body of evidence is insufficient to establish a cause and effect relationship between EMF and adverse health affects." (page 36)

* The entire 2002 report is available at <http://www.capx2020.com/documents.html>.

Does EMF interfere with pacemakers or other medical devices?

EMF can interfere with a pacemaker's ability to sense normal electrical activity in the heart. Most often, the electric circuitry in a pacemaker might detect the interference of an external field and direct the pacemaker to fire in a regular, life-preserving mode. This isn't considered hazardous and is actually a life-preserving default feature. There have been cases with dual-chamber pacemakers triggering inappropriate pacing before the life-preserving mode takes over.

The American Conference of Governmental Industrial Hygienists (ACGIH) issued guidelines for EMF exposure for workers with pacemakers or implantable defibrillators. Maximum safe exposure for workers with these medical devices at 60 Hz (the frequency of most transmission lines) is 1 G (1,000 mG) for magnetic fields and 1 kV/m for electric fields.

Nonelectronic metallic implants (artificial limbs, screws, pins, etc.) can be affected by high magnetic fields like those produced by magnetic resonance imaging (MRI) devices, but are generally unaffected by the lower magnetic fields produced by most sources.

How can I reduce my exposure to EMF?

Your exposure to EMF is determined by the strength of the magnetic fields given off by things around you, your distance from the source of the field and how much time you spend in the field.

Creating distance between yourself and the sources of EMF is the easiest way to reduce exposure. Standing back – even an arm's length away – from appliances that are in use is a simple first step. Remember: EMF reduces dramatically with distance. This is more feasible with some appliances than with others, but the following are some simple recommendations that will help you reduce your EMF exposure at home:

- Move motor-driven electric clocks or other electrical devices away from your bed.
- Stand away from an operating microwave or other appliances that use a lot of electricity.
- Sit a few feet away from the TV and at least arm's length away from the computer screen.
- Limit the time you're exposed to a magnetic field by turning appliances, like computer monitors, off when you're not using them.