

# ELECTRIC & MAGNETIC FIELDS – WHAT WE KNOW

## ABOUT EMFS

ELECTRIC AND MAGNETIC FIELDS – OR EMFS – ARE FOUND EVERYWHERE THERE IS ELECTRICITY. THEY ARE INVISIBLE.

For many years, questions have been raised about whether EMFs affect people's health. It remains a controversial issue although research over more than 40 years has greatly increased our understanding. There have been thousands of studies – some suggesting a link, others not, and some raising further questions. As electricity is so widespread in our society, questions about electricity and health are important to people. The purpose of this brochure is to inform the public about the issue – what we know, and what we are doing about it.

## WHAT ARE ELECTRIC FIELDS?

An electric field is a region where electric charges experience an invisible force. The strength of this force is related to the voltage, or the pressure which forces electricity along wires. Electric fields can be present in any appliance plugged into a power point which is switched on. Even if the appliance itself is turned off, if the power point is on, an electric field will be present.

Electric fields are strongest close to their source, and their strength diminishes rapidly as we move away from the source, in much the same way as the warmth of a fire decreases as we move away from it. Many common materials such as brickwork or metal will block electric fields. As such, walls, tables and bench tops can act as a shield.

## WHAT ARE MAGNETIC FIELDS?

A magnetic field is a region where magnetic materials experience an invisible force produced by the flow of electricity, commonly known as current. Unlike electric fields, magnetic fields are only present when electric current is flowing. In other words, if an appliance is operating, a magnetic field is produced. For most appliances, once the appliance is switched off, the current stops flowing and there is no magnetic field. However, for an increasing number of appliances, particularly electronic equipment, some current flows even when they are switched off, but on standby. For these appliances, a magnetic field is present unless the appliance is switched off at the wall.

The strength of a magnetic field depends on the size of the current (measured in amps), and decreases rapidly once we move away from the source. While electric fields are blocked by many common materials (see illustration), this is not the case with magnetic fields. This is one reason why power lines may contribute to magnetic fields in the home and why burying power lines will not eliminate them.

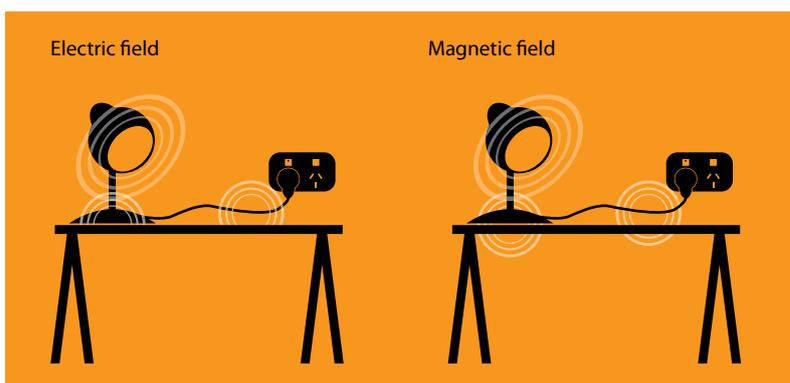
## DO EMFS CAUSE ADVERSE HEALTH EFFECTS?

Research on EMFs and possible health effects has been conducted for over 40 years. This includes over 2,900 studies at a cost of more than \$490 million internationally. Many questions have been answered but not all questions.

The research has generally focused on the magnetic field component as this has raised more issues than electric fields. There have been two main areas of research, *epidemiology* and *laboratory* studies. Both areas would need to provide links between EMFs and adverse health effects for causality to be accepted by health authorities.

Epidemiology is about people's health. This research looks at statistics to see if there are patterns of disease in large groups of people. The difficulty with large statistical studies is that they take several years to produce meaningful results, and even then, there are different opinions about how the results should be interpreted. There may be other factors in the study (such as how EMFs are measured or patient histories) which could complicate the interpretation of the results. Some studies have reported statistical links between EMFs and cancer while others have not. Scientists generally agree that the epidemiological studies aren't strong enough by themselves to establish that adverse health effects exist.

In the laboratory researchers have studied living cells as well as animals and human volunteers to see if EMFs have any effects.



There have been many hundreds of these studies reported, and scientists examine them for results which can be successfully repeated in different laboratories. In over 40 years of research there have been no such reproducible results. Hence the evidence from the laboratory is that low level EMFs of the type experienced by the public do not cause the health effects that some have claimed. Lack of consistency in the results of the laboratory studies is one reason why scientists treat the weak positive results from some epidemiological studies with scepticism.

## SCIENTIFIC REVIEWS

It is well accepted by scientists that no one study considered in isolation will provide a meaningful answer to the question of whether or not EMF can contribute to adverse health effects. In order to make an informed conclusion from all of the research, it is necessary to consider the science in its totality. All of the research is reviewed periodically by expert panels which are established by national or international bodies with the purpose of trying to determine whether or not human exposure to EMF is related to adverse health effects.

The most recent extensive review was carried out by the World Health Organisation (WHO) in 2007 which found:

*“Scientific evidence suggesting that everyday, chronic low-intensity (above 0.3–0.4  $\mu$ T) power-frequency magnetic field exposure poses a health risk is based on epidemiological studies demonstrating a consistent pattern of increased risk for childhood leukaemia. Uncertainties in the hazard assessment include the role that control selection bias and exposure misclassification might have on the observed relationship between magnetic fields and childhood leukaemia. In addition, virtually all of the laboratory evidence and the mechanistic evidence fail to support a relationship between low-level ELF magnetic fields and changes in biological function or disease status. Thus, on balance, the evidence is not strong enough to be considered causal, but sufficiently strong to remain a concern.”*

## WHAT DO HEALTH AUTHORITIES ADVISE?

In Australia, the relevant health authority is the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), an arm of the Commonwealth Department of Health and Aging. ARPANSA (in their Fact Sheet 19 Electricity and Health) advise that:

*“The scientific evidence does not firmly establish that exposure to 50 Hz electric and magnetic fields found around the home, the office or near power lines is a hazard to human health.”*

*“At the present time there is no proven evidence that exposure to low level electric fields is a health hazard (excluding of course electric shock).”*

The WHO advises that:

*“Despite the feeling of some people that more research needs to be done, scientific knowledge in this area is now more extensive than for most chemicals. Based on a recent in-depth review of the scientific literature, the WHO concluded that current evidence does not confirm the existence of any health consequences from exposure to low level electromagnetic fields.”*

## ARE THERE EMF GUIDELINES FOR ESTABLISHED HEALTH EFFECTS?

The Australian electricity industry follows the “Interim guidelines on limits of exposure to 50/60 Hz electric and magnetic fields” as developed by the National Health and Medical Research Council (NHMRC) in 1989. The NHMRC Guidelines suggest a magnetic field public exposure limit of 1,000mG. These Guidelines are currently recommended by ARPANSA pending finalisation of their new Guideline.

The two internationally recognised exposure limit guidelines originate from the

- » Institute of Electrical and Electronics Engineers (IEEE) of the USA, and
- » International Commission on Non-Ionizing Radiation Protection (ICNIRP), an expert advisory body to the WHO.

Under the IEEE Standard of 2002 the recommended magnetic field public exposure limit is 9,040 milligauss.

Under the ICNIRP guidelines of 2010 the recommended magnetic field public exposure limit is 2,000 milligauss.

## GUIDE TO COMMON EMFS

These days it is relatively easy to measure magnetic fields using a gaussmeter.

The fields are measured in a unit of milligauss (mG) or microtesla ( $\mu\text{T}$ ). 1 microtesla ( $\mu\text{T}$ ) equals 10 milligauss (mG).

To give you an idea of the relative strengths of EMFs, the following guide shows the typical magnetic fields close to appliances and under power lines.

Note that owing to variations in the design of electrical appliances and the loadings on power lines, the levels of magnetic fields can vary. The following table is based on a consistent set of measurements undertaken by power authorities in Australia using similar techniques and protocols to overseas measurements. Due to the difference in appliance design and voltages overseas, the field levels shown in overseas publications can often be different from those in the table.

Typical magnetic field measurements and ranges associated with various appliances and power lines are outlined below:

Localised EMFs may also be encountered in specific situations such as near substations, underground cables, specialised electrical equipment, or at elevated locations near lines. Note that the strengths of EMFs decrease rapidly with distance from the source.

**FIGURE 1: TYPICAL MAGNETIC FIELD MEASUREMENTS AND RANGES**

	Typical Measurement (mG)	Range of Measurement (mG)
Stove	6	2-30
PC	5	2-20
TV	1	0.2-2
Electric blanket	20	5-30
Hair dryer	25	1-70
Refrigerator	2	2-5
Toaster	3	2-10
Kettle	3	2-10
Fan	1	0.2-2
Overhead distribution line (under the line)	10	2-20
Overhead transmission line		
» under line	20	10-200
» edge of easement	10	2-50

Appliance Measurements taken at normal user distance

## WHAT IS THE BEST RESPONSE?

Electricity utilities continually review scientific developments related to EMFs and are guided by relevant health authorities. In Australia, ENA recommends that electricity utilities provide balanced and accurate information to the community and design and operate electrical power systems prudently within relevant health guidelines. This includes such actions as:

- » providing training to staff;
- » informing the community;
- » measuring field levels for the public and employees;
- » ensuring that fields are within established guidelines set by health authorities; and
- » practising “prudent avoidance” when building new electrical facilities.

Prudent avoidance involves reducing magnetic field exposure where this is practicable and can be done at modest cost. If utilities can easily keep people out of fields or in lower fields, then that, the industry believes, is a common sense thing to do.

So what can you as an individual do to reduce exposure to EMFs? There are some things you can do very easily. Since EMFs drop off rapidly as you move away from their source, you can modify your use of electrical appliances such as clock radios. You can locate beds away from a wall that has a switchboard outside and you can switch off your electric blanket before you get into bed. These actions will reduce exposure to EMFs but remember that no-one knows if doing any of these things will improve health outcomes at all.

Organisations which can provide further information about EMFs include:

- » your local electricity utility or the Energy Networks Association (ENA);
- » the Radiation Safety Unit of your state Health Department;
- » the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) - [www.arpansa.gov.au](http://www.arpansa.gov.au)
- » the World Health Organisation (WHO) – [www.who.int](http://www.who.int)

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