Measuring Magnetic Fields

Electric and magnetic fields

Everything electrical, from a toaster to a high-voltage power line, produces electric and magnetic fields. In Australia, the electric and magnetic fields associated with the use of electricity are generated at a frequency of 50 Hz (cycles per second).

Both the electric and magnetic fields are strong close to an operating source. The strength of the electric field depends on the voltage (typically 240 Volts for households) and is present in any live wire whether an electrical appliance is being used or not. Magnetic fields, on the other hand, are produced by electric currents and are only present when an appliance is operating i.e. there is no magnetic field when an electrical appliance is turned off.

Health Effects

Currently there is no evidence that exposure to electric fields is a health hazard (excluding electric shock). Whether exposure to magnetic fields is equally harmless remains an open question. A large number of scientific studies performed on animals and cells have not found a health risk. Some epidemiological studies, however, have suggested a weak association between prolonged exposure to magnetic fields at levels higher than what is normally encountered and childhood leukaemia.

For further information on electric and magnetic fields and the possibility of adverse health effects refer to the ARPANSA fact-sheet titled "Electricity and Health", which can be found on the ARPANSA website.

Magnetic field units

The strength of the magnetic field is expressed in units of Tesla (T) or microtesla (μT). Another unit, which is commonly used is the Gauss (G) or milligauss (mG), where 1 G is equivalent to 10^{-4} T (or 1 mG = 0.1 μT).

The Gauss meter

There is a range of different instruments that can measure the magnetic field strength. The gauss meter is a hand-held device that provides a simple way of performing such measurements. ARPANSA has three different gauss meter models available for hire, which are a Teslatronics Model 70, a Sypris Model 4080 and an EMDEX Snap. All three instruments operate in a similar manner and they are shown in the figure below.

The gauss meters available from ARPANSA measure alternating fields from 25 Hz (40 Hz for the EMDEX Snap) to 1000 Hz in units of mG. They do not measure and will give false readings from mobile phones. Readings taken very close (a few cm) to other electronic devices such as mobile phones (as distinct from electrical devices such as heaters, washing machines etc) may also give false readings. Shaking or vibrating any of the units may also give false readings. Since the meters only measure varying magnetic fields they will not measure the earth's magnetic field which is static and has a value of approximately 500 mG.

The power switch for all three meters is located on the side of the meters. For the Teslatronics and Sypris instruments, when either meter is turned on, it will perform an initial self-diagnostic test by showing all available readouts on its digital display. When the EMDEX instrument is turned on it will display the battery level. Following the initial stage, all three meters will display the magnetic field intensity at the location where the meter is held or placed and the intensity will change if moved accordingly. For the Teslatronics and Sypris instruments, if the negative sign is still showing after the initial test that indicates that the meter is running low on power and the battery needs to be replaced (if this occurs please ring ARPANSA for assistance). For the EMDEX instrument the battery should be replaced if the meter indicates a battery level of 25% or less.

Performing measurements

Measurements of the magnetic field in the home are generally taken in the middle of the room at about one metre from the ground or in locations where people spend a significant amount of time, for example, the bed. Measurements should also be performed several times over the course of a day. This is to allow for possible variations to electricity demand which presumably would peak during the evening at about 7.00 pm. Measurements can also be made at any other locations of interest.

It is important to remember, that as mentioned earlier, existing evidence relates any health effects to prolonged magnetic field exposure. Measurements taken with the gauss meter are instantaneous (i.e. measured at one point in time) and do not accurately reflect prolonged exposure levels. Details of the preferred measurement technique and instrumentation for making time-averaged measurements are available in a measurement protocol developed by ARPANSA and is available at: http://www.arpansa.gov.au/pubs/technicalreports/tr134.pdf.

Typical magnetic field strengths

Magnetic fields within homes can vary at different locations and also over time. The actual strength of the field at a given location depends upon the number and kinds of sources and their distance from the location of measurement. Typical values measured in areas away from electrical appliances are of the order of 2 mG.

Magnetic fields from individual appliances can vary considerably as well, depending on the way they were designed and manufactured. One brand of hair dryer, for example, may generate a stronger magnetic field than another. In general, appliances, which use a high current (such as those which have an electric motor) will lead to relatively high readings. It should also be noted that different body parts will be exposed to different magnetic field levels from the same appliance, depending on how far that part of the body is from the appliance when in use. Typical values of magnetic fields measured at normal user distance from some common domestic electrical appliances are listed in the table below.

Appliance	Range of measurements (mG)*
Electric stove	2 - 30
Refrigerator	2 - 5
Electric kettle	2 - 10
Toaster	2 - 10
Television	0.2 - 2
Personal computer	2 - 20
Electric blanket	5 - 30
Hair dryer	10 - 70
Pedestal fan	0.2 - 2

Homes near power lines

The power lines that are present in typical neighbourhoods are called "distribution" lines and they usually carry less voltage than "transmission" lines, which carry very high voltages. As stated earlier, however, it is the current and not the voltage that is associated with the strength of the magnetic field. Therefore, proximity to high voltage lines will not necessarily give a high reading unless those lines are also carrying a large current. Typical values of magnetic fields measured near power lines and substations are listed in the table below.

Source	Location of measurement	Range of measurements (mG)*
Distribution Line	directly underneath	2 - 30
Distribution Line	10m away	0.5 - 10
Substation	at substation fence	1 - 8
Transmission line	directly underneath	10 - 200
Transmission line	at edge of easement	2 - 50

* Note: Levels of magnetic fields may vary from the range of measurements shown

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