

LEVELS OF 50Hz MAGNETIC FIELDS IN THE HOME AND OFFICE ENVIRONMENT IN AUSTRALIA

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The subject of exposure to 50/60Hz magnetic fields and the possible adverse health effects amongst exposed groups has received an enormous amount of publicity recently. Although a number of studies have been published in the U.S.A. concerning magnetic field exposures in the home and environment^{1,2}, no such data has been published for Australian conditions.

The aim of this study was to quantify the 50Hz magnetic field levels in the home and office from domestic appliances, office equipment and electrical wiring.

SURVEY EQUIPMENT AND RESULTS

The three survey instruments used were commercial devices marketed under the tradename "Gauss Maus" and manufactured by the Arlunya Division of the Dindima Group, P.O. Box 106, Vermont, Victoria, 3133. These instruments are handheld portable devices comprising a measuring unit linked to a polarization sensitive sensor unit by a spring coil cable. The usual operation is to hold the measuring unit in one hand and the sensor unit in the other which can be moved around to measure magnitude and distribution of the magnetic flux density. They are designed to measure peak levels of extremely low frequency magnetic fields up to a maximum of 99mG (9.9 μ T). They operate in either a wideband mode (12Hz to 1.3kHz, 3dB points) or in a bandpass mode (50Hz \pm 6Hz, 3dB points). However, only the results taken in the bandpass mode are reported here. The calibration of one of the three instruments was checked by measuring the magnetic flux density at a known distance from a wire carrying a known current. The survey results are summarized in Tables 1, 2 and 3.

OBSERVATIONS AND DISCUSSION

The mean ambient levels of magnetic fields found in various rooms of the average suburban house varied between 0.5 and 1.3mG.

However, the maximum values quoted in Table 1 for the front door, lounge, master bedroom and bedrooms 1 and 2 were measured in the same house. This house was located close to a 22kV distribution line with bedrooms 1 and 2 approximately 5 metres from the power line. It was determined that the external wiring was the source of the fields in those bedrooms.

The magnetic fields associated with distribution lines depend on the current loading on the system and were found to vary by a factor of 2 to 3 over a 24 hour period. In addition, the magnetic fields within a house were found to vary by up to a factor of 2 depending on the usage of domestic appliances. The majority of levels presented in Table 1 were measured in the early evening when appliance usage and loading on the distribution system were close to maximum.

Another source of magnetic fields was found to arise from the unbalanced current flow between a house and the external distribution system resulting from multiple earth neutral (MEN) systems which are mandatory in Australia. With such a system not all the current that flows into the house returns back to the local transformer via the neutral line; an amount of current flows to ground because the neutral is also earthed at the house via an earth stake or through the plumbing as well as at the local transformer. The amount of current flowing in the earth was calculated from a measurement of the associated magnetic field and found to be 0.025 times the household current. It must be noted that this figure would be very dependent on soil conductivity.

Table 1. Levels of 50Hz magnetic fields (mG, rms) measured in houses.

Room	Minimum	Maximum	Mean(A)
Front door	0.2	3.7	1.2
Family room	0.4	2.3	1.0 (8)
Lounge room	0.3	3.2	1.0
Dining room	0.3	1.3	0.5 (11)
Hallway	0.4	1.1/5.3(B)	0.6 (6)
Master bedroom	0.1	4.5	1.0
Bedroom 1	0.1	7.0	1.2
Bedroom 2	0.1	7.1	1.3 (9)
Bedroom 3	0.4	0.5	0.5 (2)
Kitchen	0.4	3.5	0.9
Laundry	0.4	0.4	0.4 (6)

Notes: (A) The mean levels were based on measurements in 14 houses, except where the number of measurements appears in parenthesis.

(B) The level of 5.3mG was measured when the hot water storage unit located in the roof was heating. This measurement was not included in the calculation of the mean.

For a loop of unbalanced current as shown in Figure 1 the maximum magnetic flux density, B, at the distance indicated and in a direction perpendicular to the plane of the loop was calculated according to Weber³ and found to be 0.55mG for every Ampere of current flow in the MEN system.

Therefore, an ambient level of 0.55mG could be produced if a total household current of 40A were drawn and 1A (0.025x40)

flowed through the MEN system. Certainly this situation is not going to exist throughout the entire 24 hour period and it would thus appear that external wiring as well as appliance usage were the main sources of ambient levels in a house, particularly when that house is located close to power lines.

Table 2. Levels of 50Hz magnetic fields (mG, rms) measured 30cm from domestic appliances.

Appliance	Individual Measurements		
Electric blanket	0.8	1.3	1.8
Hair dryer	2.1	3.5	7.8
Toaster	4.2	7.1	8.5
Electric kettle	1.4	1.8	2.6
Frypan	2.3	2.5	2.8
Electric Fan	0.4	0.7	0.7
Colour TV (screen)	3.5	6.0	7.1
Fluorescent fixtures	1.5	1.9	3.4
Electric ranges (front)	7.8	8.5	11
Ovens (front)	1.4	1.8	2.3
Refrigerators (front)	0.6	0.7	0.8
Irons	0.8	1.4	1.6
Vacuum cleaners	18	23	33
Washing Machines (front)	2.1	2.5	2.8
Drills and saws	7.1	11	13

Table 3. Levels of 50Hz magnetic fields (mG, rms) measured in offices and at various distances from office equipment.

Position/Equipment	Minimum	Maximum	Mean
Centre of office	0.1	0.5	0.3 (12)
Computer terminals (30cm)	0.8	3.6	2.0 (10)
Photocopiers (10cm)	0.7	20	7.9 (4)
Telex machine (30cm)			0.8 (1)
Letter punch (30cm)			8.5 (1)
Electric typewriter (30cm)	0.3	4.7	1.9 (4)

Note: The values in parentheses are the number of measurements.

Use of vacuum cleaners, electric ranges, drills and saws do expose persons to significantly higher levels of magnetic fields for periods of time approaching several hours per day. However, the fields close to electric blankets (<15cm) exceeded 99mG (peak) and of the appliances tested these provide the highest and most prolonged exposure for persons who use them.

It was not possible due to the limited dynamic range of the measuring instrument to determine with any confidence the fall off with distance of the magnetic fields from the appliances measured in this survey. However, from a detailed inspection of the work of Gauger² it can be concluded that, in general, for distances greater than 30cm, the fall off in magnetic field follows an inverse cube law with distance.

The levels of magnetic fields measured in offices appear to be lower than those found in the home. However, the levels from office equipment are comparable with those from domestic appliances.

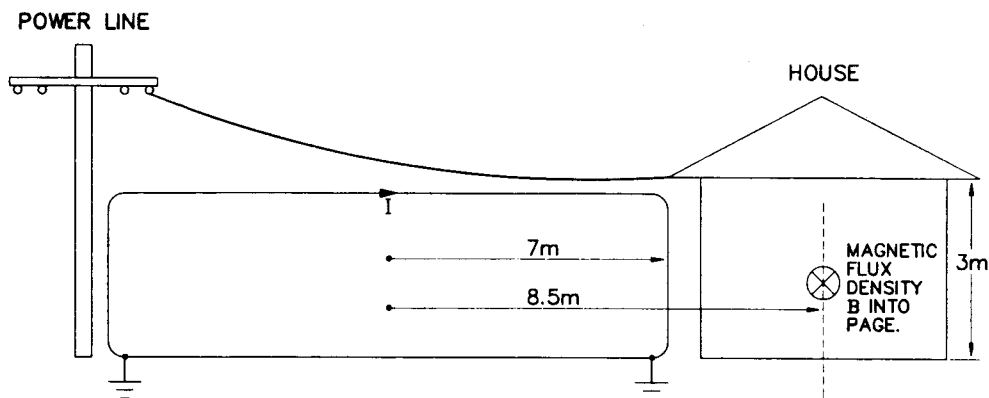


FIGURE 1. SCHEMATIC REPRESENTATION OF THE CURRENT LOOP FORMED FROM THE UNBALANCED CURRENT FLOWING IN THE MULTIPLE EARTH NEUTRAL SYSTEM.

ACKNOWLEDGEMENTS

The authors wish to thank Mr Peter Wallace, Mr Ron Owen and Mr Tanh Dovan of the Victorian State Electricity Commission and Mr Ian Macfarlane of the Telecom Australia Research Laboratories for helpful discussions.

The permission of the Chief Health Officer, Victorian Health Department and the Director Research, Telecom Australia to publish this work is hereby acknowledged.

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