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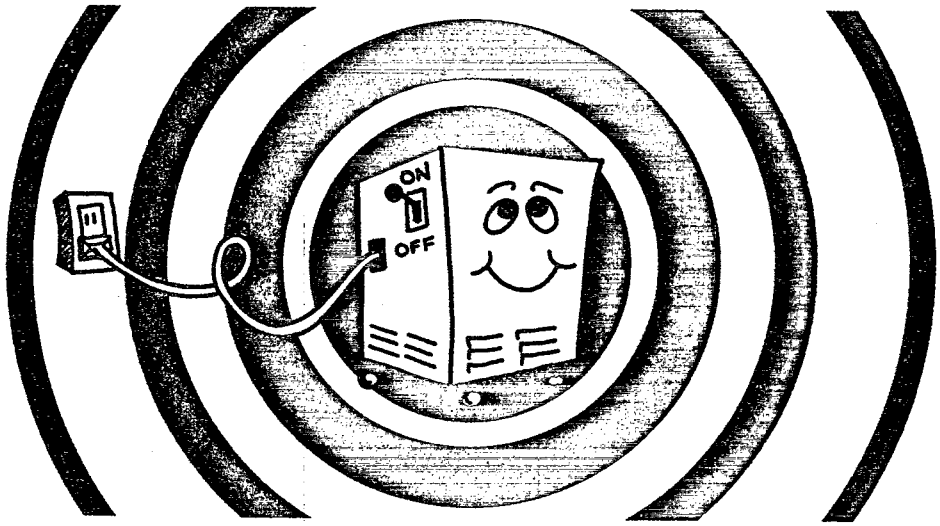
EMF In Your Environment

Magnetic Field Measurements Of Everyday Electrical Devices



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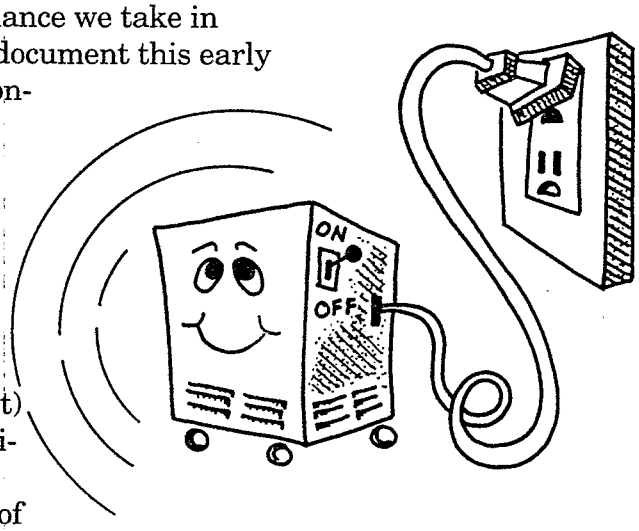
EMF IN YOUR ENVIRONMENT

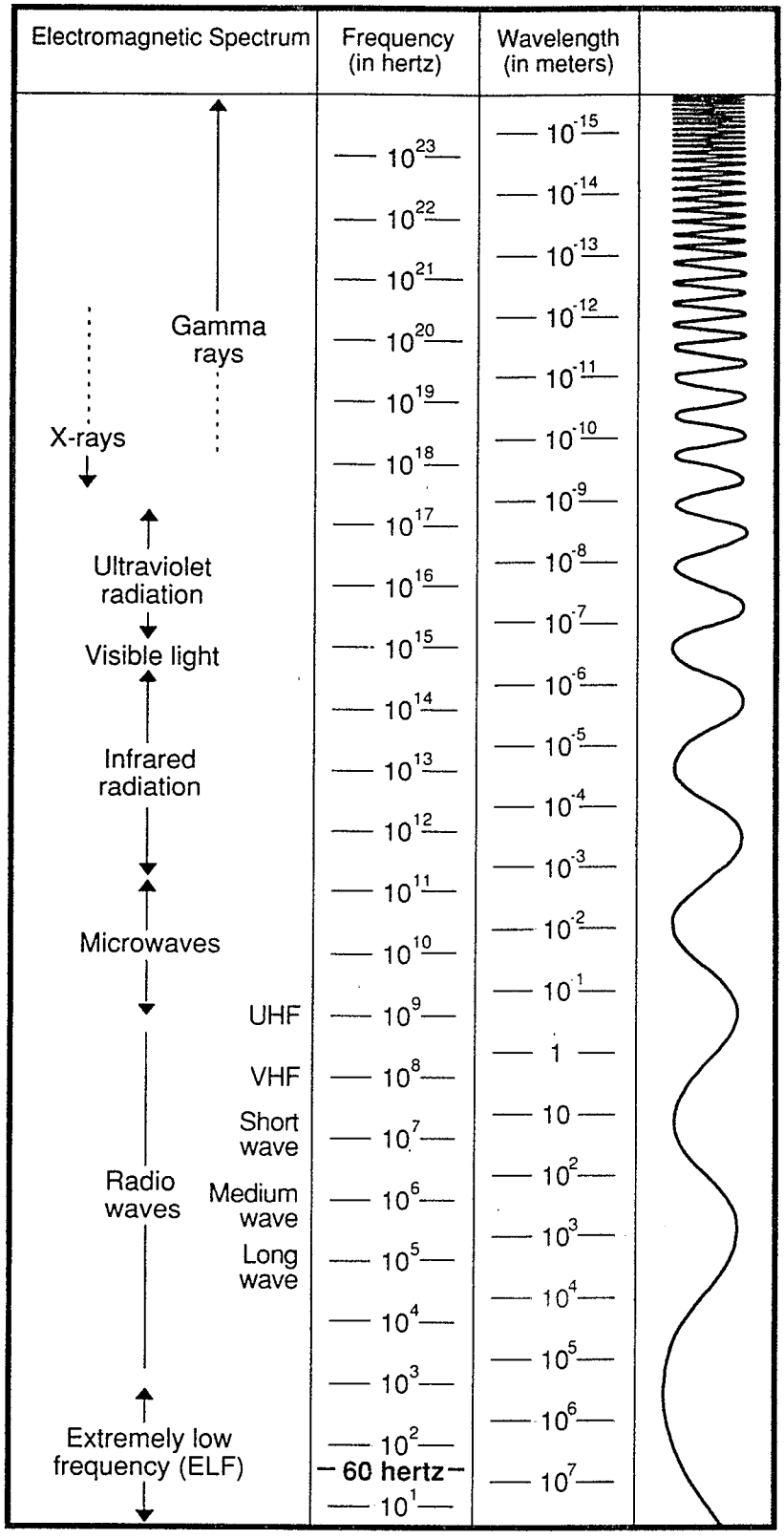
What are electric and magnetic fields (EMFs)? What common EMF sources do we encounter during a typical day? This publication compares the strength of 60 hertz magnetic fields produced by common electrical items and shows you how their strength diminishes as you move farther away from them.

We still have a great deal to learn about electric and magnetic fields (EMFs). We really don't know if typical, everyday exposures to EMFs affect human health. Some studies indicate that they might – others suggest otherwise. Most of the recent research on possible biological effects of 60 hertz EMFs suggests that the magnetic, rather than the electric, fields are more likely to produce significant effects. Therefore, this publication focuses on them. The information presented here has to do with the **strength** of the magnetic field; however, we aren't certain that the strength of the field is the only important consideration. It may turn out that other factors are also important, such as how long the exposure lasts or whether particular characteristics of the field change rapidly. Future research is likely to reveal that the information given in this publication is only part of the story – that is the chance we take in providing a public information document this early in the study of a complex environmental health issue.



What Are Electric and Magnetic Fields ?

Electric charges create electric fields. Electric charges which move (i.e., electric current) create magnetic fields. An appliance that is plugged in, and therefore connected to a source of electricity, has an electric field



◀ This illustrates the point that the higher the frequency, the shorter the wavelength. The wavelengths are infinitely long at the bottom and infinitessimally short at the top of the spectrum so, obviously, the drawing cannot be done to scale.

even when the appliance is turned off. To produce a magnetic field, however, the appliance must be not only plugged in, but also operating, so that the current is flowing.

The electric current we use in our everyday life produces certain kinds of electric and magnetic fields. There are many other kinds of electric and magnetic fields as well, found throughout nature. The term "electromagnetic" field implies that the electric and magnetic fields are interrelated.

These fields can be characterized by either their **wavelength** or their **frequency**, which are related. The amount of energy an electric or magnetic field can carry depends on the frequency and wavelength of the field. The wavelength describes how far it is between one peak on the wave and the next peak. The frequency, measured in hertz, describes how many wave peaks pass by in one second of time.

The Electromagnetic Spectrum

If you take all the different kinds of electromagnetic fields we know about and place them on a chart, from the lowest frequency (i.e., lowest energy) to the highest, you have a chart of the electromagnetic spectrum. (See chart on the previous page.) The low end of the spectrum includes electric and magnetic fields produced by everyday electrical appliances. At the top of the spectrum are X-rays and gamma rays.

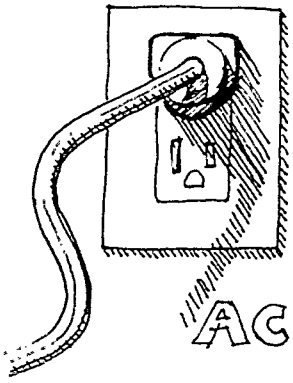
When you hear about "EMFs" in the news media, the term usually refers to electric and magnetic fields at the extremely low frequency (or ELF) end of the spectrum, such as those associated with our use of electric power. The term "EMF" can be used in a much broader sense as well, encompassing electromagnetic fields across the spectrum. When we use "EMF" in this brochure we mean extremely low frequency (ELF) electric and magnetic fields. We should note that in the ELF range, electric and magnetic fields are

not coupled or interrelated in the same way that they are at higher frequencies, so it is actually more accurate to refer to them as "electric and magnetic fields" rather than as "electromagnetic fields." In the popular press, however, you will see both terms used, abbreviated as "EMF."

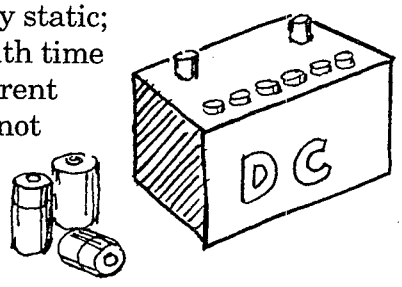
Electric fields from most appliances primarily create charges or current on or near the surface of the body and not in the internal organs. Magnetic fields, however, pass through the body and actually induce electric currents within the body. We don't know exactly what effect, if any, this has on the different internal organs, but many studies are now underway to try to find out.

60 Hertz Electric And Magnetic Fields

It is relatively easy to shield people from exposure to electric fields using commonly available materials. Magnetic fields, however, can pass through anything. Even though both are present around appliances and power lines, more recent interest and research have focused on potential health and biological effects of magnetic fields of various strengths.



This publication presents information regarding magnetic fields associated with 60 hertz alternating current (AC) electric power – that is, the kind of electric power we use in North America which flows back and forth or alternates at a rate of 60 times per second (60 hertz). We will not focus here on equipment that is powered by "direct current" (DC) such as battery-operated appliances. The magnetic fields created by direct current are primarily static; that is, they do not vary with time as do AC fields. Direct current (DC) magnetic fields have not raised as many questions about potential health



concerns as have the time-varying fields created by alternating current (AC). We should point out, however, that some DC-powered equipment can produce alternating magnetic fields, but these are usually not 60 hertz fields.

Other Electromagnetic Frequencies

Although the information presented here has to do with the low frequency magnetic fields associated with 60 hertz electrical current, we should note that some appliances, such as microwave ovens, baby monitors, and video display terminals, use 60 hertz electrical energy to create other electromagnetic frequencies.

The measurements we give for microwave ovens, for example, describe the magnetic field that results from the 60 hertz electrical current used to operate the oven. We are not describing the magnetic field associated with the approximately three billion hertz microwaves inside the oven which heat the food and from which people are protected when the door is secured properly.

Oddly enough, we can be easily shielded from the higher frequency microwaves' magnetic fields, but not from the 60 hertz magnetic fields. This is because even though the microwave's **frequency** is higher, its **length** is much, much shorter (about 1 cm) than the wavelength of a 60 hertz field (about 5000 kilometers). The shorter wave can be blocked by materials such as thin metal sheets, whereas the much longer wave cannot.

Potential Health Concerns Associated With Electric and Magnetic Fields

Electric and magnetic fields from 60 hertz electric power (as well as microwaves and radio waves) are sometimes called non-ionizing radiation. The term "radiation" simply means energy

transmitted by waves. "Ionizing" radiation has enough energy to strip electrons from atoms. (X-rays are a form of ionizing radiation.) Extremely low frequency EMF cannot do this. Higher frequency non-ionizing radiation, such as microwaves, can heat up biological tissue by vibrating molecules. The lower frequency 60 hertz EMFs cannot. Because of their relatively lower energy, 60 hertz EMFs were not, until recently, thought to be connected with any potential health problems.

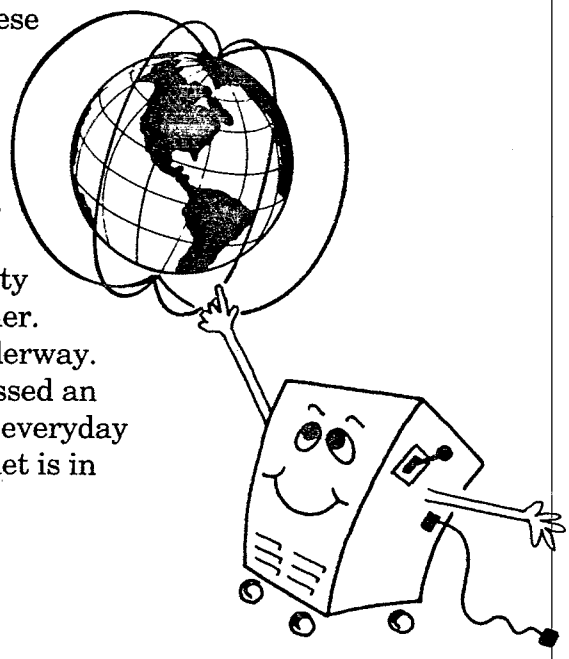
There are no national standards in the United States for exposure to 60 hertz electromagnetic fields. Several states have formally adopted standards to limit the permissible magnetic field strength along rights of way of electric transmission lines. Federal legislation has been enacted to establish and support national EMF research and public information programs, but no exposure standards have been proposed.

Some recent scientific studies have suggested a link – a statistical association – between exposure to 60 hertz EMFs and specific types of cancer, primarily leukemia and brain cancer. Other studies have found no such association (see Appendix B). In a sense, this can be compared to circumstantial evidence in a court of law. Laboratory studies have shown electromagnetic fields to affect cells in various ways, but whether these effects are important in terms of human health is still not clear. Almost everyone involved in EMF research agrees that much more needs to be learned before conclusions can be reached about the relative safety or harm of 60 hertz EMF exposure.

Some people doubt that the EMFs generated by 60 hertz electrical appliances and internal household wiring have any significant effect on human health, because they know that the earth's magnetic field, to which we are all constantly exposed, is stronger (sometimes over 100 times stronger) than the magnetic fields produced by

many of the appliances listed in this publication. However, the earth's magnetic field is primarily a DC field rather than a time-varying field. Our bodies seem to react differently to these different types of fields so comparing them can be misleading.

At this point, we are not at all sure that exposure to EMFs such as we find in our everyday environment has an adverse effect on our health. However, we cannot say with certainty that such exposure is safe for us, either. More research is needed – and is underway. Meanwhile, many people have expressed an interest in having information about everyday sources of EMF exposure. This booklet is in response to that interest.



MAGNETIC FIELD MEASUREMENTS OF EVERYDAY ELECTRICAL DEVICES

This publication gives information about the strength of the magnetic fields generated by everyday 60 hertz electrically powered equipment. It shows how the magnetic field strength diminishes with increased distance from the object.

Appliances and Magnetic Field Strengths

Magnetic fields from individual appliances can vary considerably, depending on the way they were designed and manufactured. One brand of toaster, for example, may generate a much stronger magnetic field than another. The strength of the magnetic field is measured in units of **gauss** (G) or **milligauss** (mG). A milligauss is 1/1000th of a gauss. (The international standard unit is microtesla which is the same as 10 milligauss.)

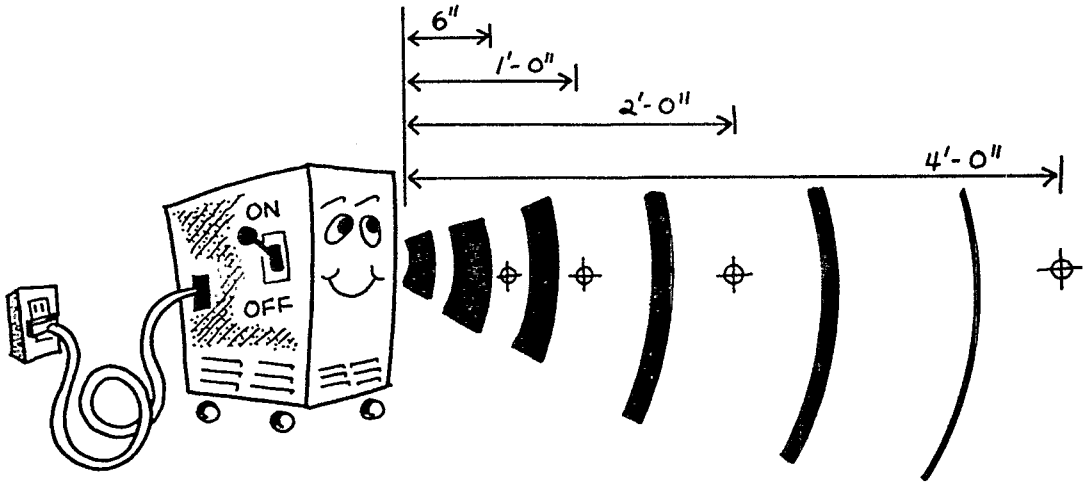
It is important to keep in mind that a typical

American home has a background magnetic field level (away from any appliances) ranging from 0.5 mG to 4 mG. The actual strength of the field at a given place in a room depends upon the number and kinds of sources, how far away they are, and how many are operating at one time. Walls generally do not block magnetic fields. An electrical appliance located near a wall extends its magnetic field into the room on the other side of the wall as well.

How Magnetic Field Measurements Were Taken

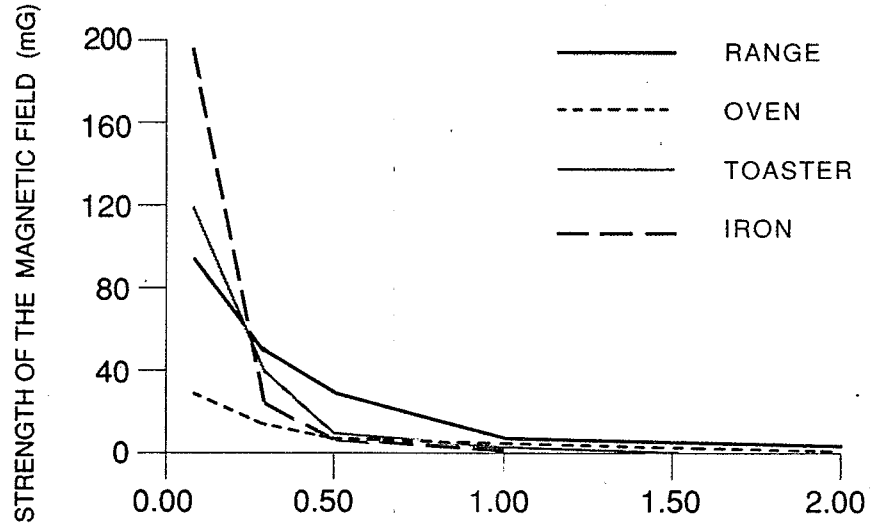
The data in the tables (beginning on page 13) came from three different organizations: the Electric Power Research Institute (EPRI), the Illinois Institute of Technology Research Institute (IITRI), and the U.S. Environmental Protection Agency (EPA). What we present here will give you an idea of the relative strength of magnetic fields produced by electrical items you are likely to use in your home or at work.

The strength of the magnetic fields has been measured at 6 inches from the item, and then at distances of 1, 2, and 4 feet. These distances do



not, in every case, correspond to the distance you would typically be from the appliance when you use it, but we kept the measurements consistent so that the magnetic field strength could be compared from appliance to appliance. It should also be mentioned 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 it is in use. An electric shaver when used, for example, may be three inches from the brain and two feet from the liver. Notice in the chart below how the strength of the magnetic field diminishes dramatically just a foot or two away from the appliance.

MEDIAN MAGNETIC FIELD STRENGTHS OF FOUR TYPICAL ELECTRIC APPLIANCES



TABLES

In the following tables, you will see three numbers listed for each appliance at each distance. First is the lowest measurement we have, followed by the median, and then the highest measurement taken. For some appliance categories, hundreds of individual items were measured. In other cases, the data gathering was less extensive. The median measurement is simply the middle number in a series of measurements.

The appliances are organized according to where you might encounter them during the day (in the kitchen, the office, the bedroom, etc). The magnetic field strength is measured in milligauss (mG).

For a detailed description of the methodology used by each of the three groups that conducted these measurements, please refer to Appendix A. Also in Appendix A is a reference chart showing the source of the data.

BATHROOM SOURCES

Distance from Source	6"	1'	2'	4'
HAIR DRYERS				
Lowest	1	-	-	-
Median	300	1	-	-
Highest	700	70	10	1
ELECTRIC SHAVERS				
Lowest	4	-	-	-
Median	100	20	-	-
Highest	600	100	10	1

Magnetic field measurements in units of milligauss (mG)

The dash (–) in the above table means that the magnetic field measurement at this distance from the operating appliance could not be distinguished from background measurements taken before the appliance had been turned on.

KITCHEN SOURCES				
Distance from Source	**6"**	**1'**	**2'**	**4'**
BLENDERS				
Lowest	30	5	-	-
Median	70	10	2	-
Highest	100	20	3	-
CAN OPENERS				
Lowest	500	40	3	-
Median	600	150	20	2
Highest	1500	300	30	4
COFFEE MAKERS				
Lowest	4	-	-	-
Median	7	-	-	-
Highest	10	1	-	-
CROCK POTS				
Lowest	3	-	-	-
Median	6	1	-	-
Highest	9	1	-	-
DISHWASHERS				
Lowest	10	6	2	-
Median	20	10	4	-
Highest	100	30	7	1
FOOD PROCESSORS				
Lowest	20	5	-	-
Median	30	6	2	-
Highest	130	20	3	-

Magnetic field measurements in units of milligauss (mG)

The dash (–) in the above table means that the magnetic field measurement at this distance from the operating appliance could not be distinguished from background measurements taken before the appliance had been turned on.

KITCHEN SOURCES

Distance from Source	6"	1'	2'	4'
GARBAGE DISPOSALS				
Lowest	60	8	1	-
Median	80	10	2	-
Highest	100	20	3	-
MICROWAVE OVENS				
Lowest	100	1	1	-
Median	200	40	10	2
Highest	300	200	30	20
MIXERS				
Lowest	30	5	-	-
Median	100	10	1	-
Highest	600	100	10	-
ELECTRIC OVENS				
Lowest	4	1	-	-
Median	9	4	-	-
Highest	20	5	1	-
ELECTRIC RANGES				
Lowest	20	-	-	-
Median	30	8	2	-
Highest	200	30	9	6
REFRIGERATORS				
Lowest	-	-	-	-
Median	2	2	1	-
Highest	40	20	10	10
TOASTERS				
Lowest	5	-	-	-
Median	10	3	-	-
Highest	20	7	-	-

Magnetic field measurements in units of milligauss (mG)

LIVING/FAMILY ROOM SOURCES				
Distance from Source	**6"**	**1'**	**2'**	**4'**
CEILING FANS				
Lowest		-	-	-
Median		3	-	-
Highest		50	6	1
WINDOW AIR CONDITIONERS				
Lowest		-	-	-
Median		3	1	-
Highest		20	6	4
TUNERS/TAPE PLAYERS				
Lowest	-	-	-	-
Median	1	-	-	-
Highest	3	1	-	-
COLOR TVs				
Lowest		-	-	-
Median		7	2	-
Highest		20	8	4
BLACK AND WHITE TVs				
Lowest		1	-	-
Median		3	-	-
Highest		10	2	1

Magnetic field measurements in units of milligauss (mG)

The dash (–) in the above table means that the magnetic field measurement at this distance from the operating appliance could not be distinguished from background measurements taken before the appliance had been turned on.

LAUNDRY/UTILITY ROOM SOURCES

Distance from Source	6"	1'	2'	4'
ELECTRIC CLOTHES DRYERS				
Lowest	2	-	-	-
Median	3	2	-	-
Highest	10	3	-	-
WASHING MACHINES				
Lowest	4	1	-	-
Median	20	7	1	-
Highest	100	30	6	-
IRONS				
Lowest	6	1	-	-
Median	8	1	-	-
Highest	20	3	-	-
PORTABLE HEATERS				
Lowest	5	1	-	-
Median	100	20	4	-
Highest	150	40	8	1
VACUUM CLEANERS				
Lowest	100	20	4	-
Median	300	60	10	1
Highest	700	200	50	10

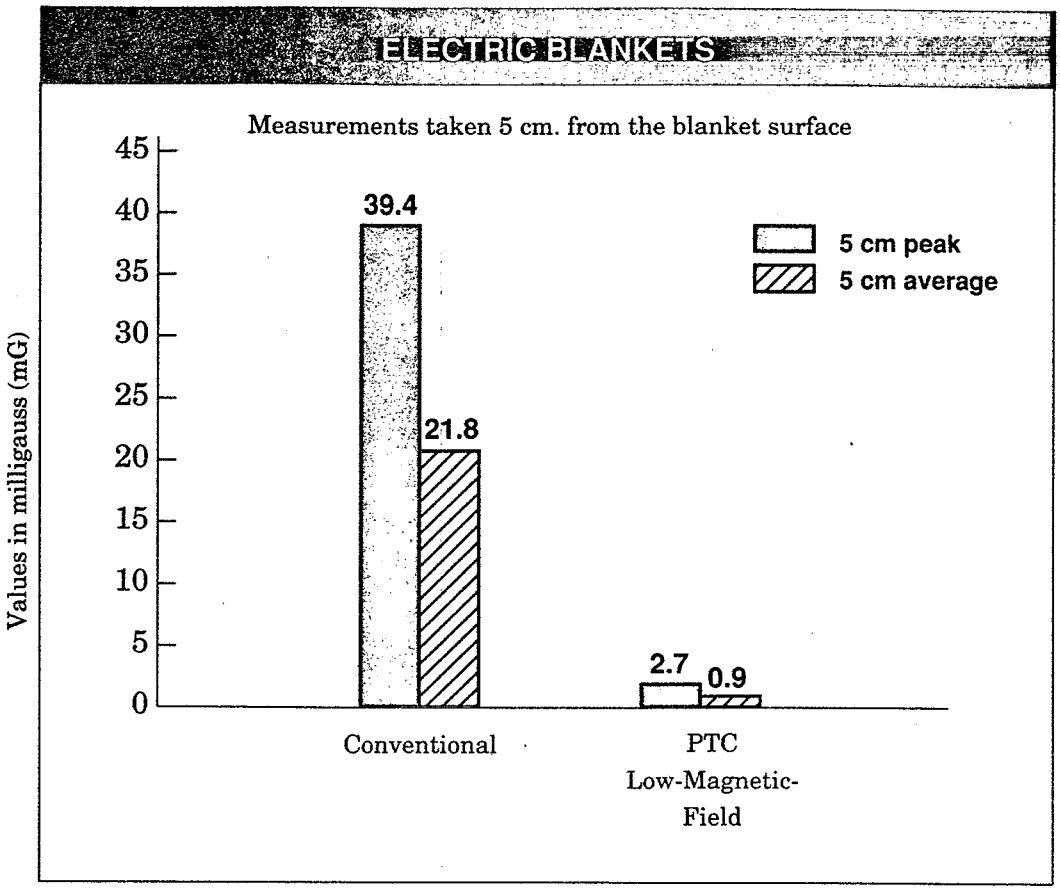
Magnetic field measurements in units of milligauss (mG)

BEDROOM SOURCES				
Distance from Source	**6"**	**1'**	**2'**	**4'**
DIGITAL CLOCKS				
Lowest		-	-	-
Median		1	-	-
Highest		8	2	1
ANALOG (CONVENTIONAL CLOCK-FACE) CLOCKS				
Lowest		1	-	-
Median		15	2	-
Highest		30	5	3
BABY MONITORS				
Lowest	4	-	-	-
Median	6	1	-	-
Highest	15	2	-	-

Magnetic field measurements in units of milligauss (mG)

The clocks described in the above table are electrically powered using alternating current (AC), as are all the appliances described in these tables. The measurements for baby monitors were taken for the unit nearest the child.

The dash (–) in the above table means that the magnetic field measurement at this distance from the operating appliance could not be distinguished from background measurements taken before the appliance had been turned on.



Information courtesy of the Center for Devices and Radiological Health, U.S. Food and Drug Administration

The above graph presents information regarding magnetic fields produced by electric blankets, including conventional 110 volt electric blankets as well as the newer model PTC (Positive Temperature Coefficient) Low Magnetic Field blankets. The fields were measured at a distance of five centimeters (a little less than 2 inches) from the surface of the blanket, roughly approximating the distance from the blanket to the users' internal organs. Because of the way blankets are wired, magnetic field strengths vary from point to point on the blanket. The graph reflects this and gives you both the peak as well as the average measurement.

OFFICE SOURCES				
Distance from Source	**6"**	**1'**	**2'**	**4'**
AIR CLEANERS				
Lowest	110	20	3	-
Median	180	35	5	1
Highest	250	50	8	2
COPY MACHINES				
Lowest	4	2	1	-
Median	90	20	7	1
Highest	200	40	13	4
FAX MACHINES				
Lowest	4	-	-	-
Median	6	-	-	-
Highest	9	2	-	-
FLUORESCENT LIGHTS				
Lowest	20	-	-	-
Median	40	6	2	-
Highest	100	30	8	4
ELECTRIC PENCIL SHARPENERS				
Lowest	20	8	5	-
Median	200	70	20	2
Highest	300	90	30	30
VIDEO DISPLAY TERMINALS (PCs WITH COLOR MONITORS) **(See note on following page)**				
Lowest	7	2	1	-
Median	14	5	2	-
Highest	20	6	3	-

Magnetic field measurements in units of milligauss (mG)

The dash (–) in the above table means that the magnetic field measurement at this distance from the operating appliance could not be distinguished from background measurements taken before the appliance had been turned on.

WORKSHOP SOURCES

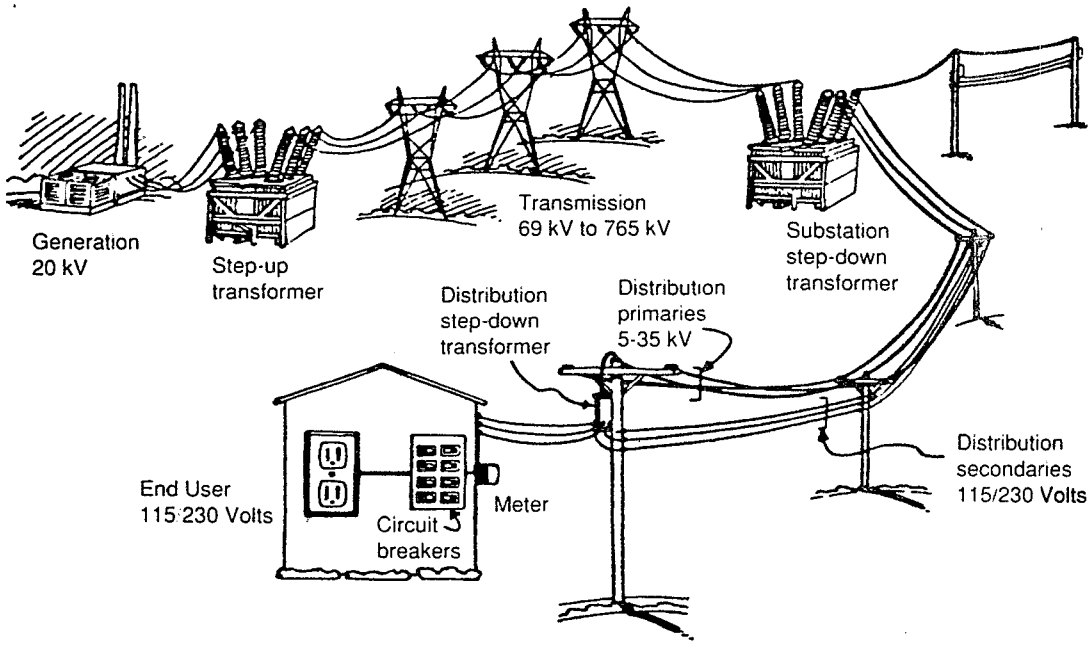
Distance from Source	6"	1'	2'	4'
BATTERY CHARGERS				
Lowest	3	2	-	-
Median	30	3	-	-
Highest	50	4	-	-
DRILLS				
Lowest	100	20	3	-
Median	150	30	4	-
Highest	200	40	6	-
POWER SAWS				
Lowest	50	9	1	-
Median	200	40	5	-
Highest	1000	300	40	4
ELECTRIC SCREWDRIVERS (while charging)				
Lowest	-	-	-	-
Median	-	-	-	-
Highest	-	-	-	-

Magnetic field measurements in units of milligauss (mG)

Although the U.S. has set no standards for magnetic fields from video display terminals (VDTs), the Swedish government has. Its standard of 2.5 milligauss (mG) at a distance of 50 centimeters (about 1'8") from the VDT has become a de facto standard in the VDT industry worldwide.

ELECTRIC POWER LINES

Another obvious source of everyday exposure to 60 hertz EMFs is from electric power lines.



From Carnegie Mellon brochure: Electric and Magnetic Fields from 60 Hertz Electric Power, 1989.

Substations: Some people are particularly concerned about the magnetic fields generated by electric substations. In fact, as with appliances, the fields produced by substation equipment quickly diminish in strength a short distance away and do not extend beyond the substation boundaries. However, magnetic fields near substations can be stronger than those in other parts of the neighborhood because the power lines drop down closer to the ground as they go in and out of the substation, bringing their accompanying magnetic fields closer to people on the ground.

The next table (see page 24) gives typical magnetic field measurements for several types of single circuit electric power lines at varying distances from the lines, both at times of average electricity usage and at peak usage times. A single circuit power line is actually a set of three lines. If you see more than three lines, it means that more than one circuit runs along the same right-of-way (ROW), in which case higher fields are possible. The first measurement on the table gives the maximum magnetic field strength measured within the power line ROW. The next four measurements are at distances of 50', 100', 200', and 300'. Power line ROW widths vary among utilities. All measurements were taken at a height of one meter above the ground.

The measurements shown here are from electric "transmission" lines, which use very high voltages and go long distances. The electrical lines you see in typical neighborhoods are "distribution" lines, which usually carry less voltage than transmission lines. Voltage is not, however, the critical issue with regard to magnetic field strength. Rather, magnetic field strength is directly proportional to current, which can be high in distribution lines as well as in transmission lines. Residential exposures to distribution lines are usually under 5 mG, but have been reported to be as high as 50 mG where the lines pass within a few feet of living space in densely populated areas.

It is interesting to note that the highest magnetic field strength measurement we have directly on the right of way of 500 kV transmission lines during peak usage is lower than the median measurement we have for magnetic field strength within 6 inches of many household appliances, such as hair dryers and vacuum cleaners. However, the duration of exposure to EMFs from power lines near a home is typically much longer than the duration of exposure to EMFs from most appliances. Is this an important distinction? We just don't know yet.

ELECTRIC POWER LINES					
Types of Transmission Lines	**Maximum on Right-of-Way**	**Distance from lines**			
		50'	**100'**	**200'**	**300'**
115 Kilovolts (kV)					
Average usage	30	7	2	0.4	0.2
Peak usage	63	14	4	0.9	0.4
230 Kilovolts (kV)					
Average usage	58	20	7	1.8	0.8
Peak usage	118	40	15	3.6	1.6
500 Kilovolts (kV)					
Average usage	87	29	13	3.2	1.4
Peak usage	183	62	27	6.7	3.0

Magnetic field measurements in units of milligauss (mG)

Information courtesy of Bonneville Power Administration.

Burying power lines underground often does reduce their magnetic fields. This is not because they are underground, however, since dirt does not act as a shield. Instead, the lower magnetic field is due to the way lines are arranged and encased when they are buried, which can have the effect of cancelling part of the field. Underground power lines are still capable of exposing you to magnetic fields if you are very close to them.

TRANSPORTATION SOURCES: CARS AND TRAINS

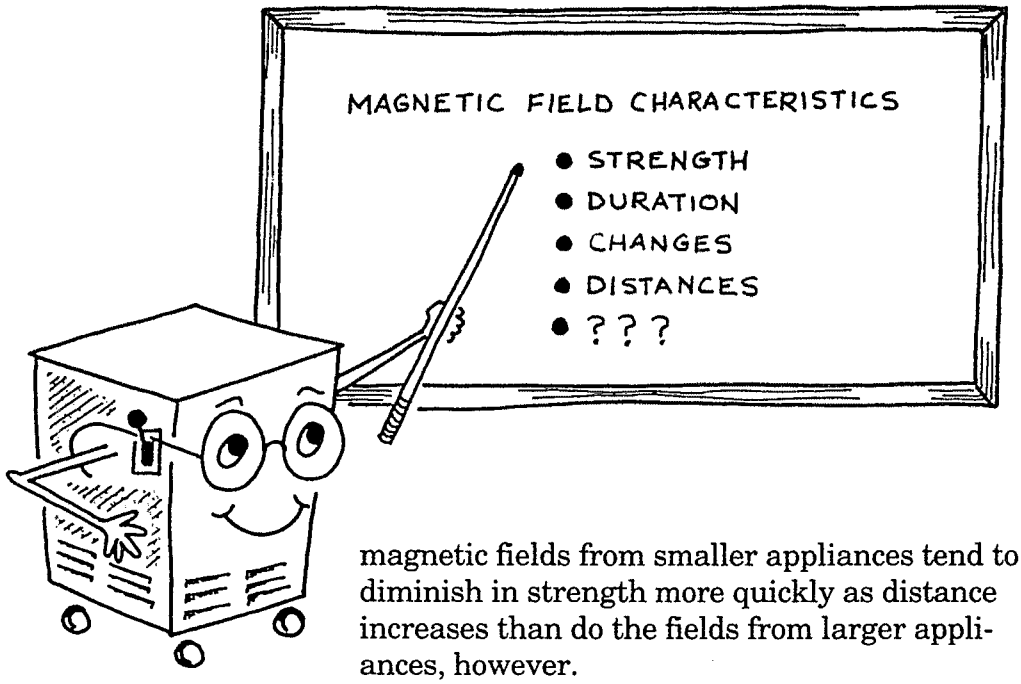
Inside a car, the dominant sources of 60 hertz magnetic field exposure are those you pass by (or under) as you drive, such as power lines. Car batteries involve direct current (DC), rather than alternating current (AC). Car phones are also battery-powered and are therefore not sources of 60 hertz magnetic fields, although they do transmit and receive fields in the radio frequency range. Some car components, such as alternators, can create alternating fields, but not necessarily in the 60 hertz frequency.

Trains present a more complicated picture. Some electrically powered trains operate on alternating current, such as the New York City subway and the Baltimore/Washington commuter train. Measurements taken on the Baltimore/Washington train in 1991* showed 25 hertz magnetic field strengths as high as 500 mG in the passenger areas at seat height. Other trains, such as the Washington D.C. Metro and the San Francisco Bay Area Rapid Transit (BART), run on direct current, but even these trains are not free of AC fields. Areas of strong AC magnetic fields have been measured on the Washington D.C. Metro, close to the floor, presumably near equipment located underneath some train cars. Train motors and other equipment create some very intense alternating fields at higher than 60 hertz frequencies. In addition to sources of magnetic field exposure from the train itself, train passengers are exposed to magnetic fields from sources the train passes on its route.

* *24-Hour Exposure Measurements to 60 Hertz Magnetic Fields: A Pilot Project,* presented by Lynne Gillette, U.S. EPA, at the Air and Waste Management Association Annual Meeting, June 1992.

HOW CAN I USE THIS INFORMATION?

Many people are surprised when they compare magnetic field measurement data from appliance to appliance and see that magnetic field strength does not depend on how large, complex, powerful or noisy the appliance is. In fact, the magnetic fields near large appliances are often weaker than those near smaller devices. There are many reasons why this can happen, all of them related to product design. The stronger



magnetic fields from smaller appliances tend to diminish in strength more quickly as distance increases than do the fields from larger appliances, however.

If you are trying to determine your potential exposure to a magnetic field from a particular appliance, it is important that you consider how close you are to the appliance and how long you use it. The electric alarm clock at the head of your bed may expose you to a magnetic field of 15 mG for 7 or 8 hours each night. The electric can opener in the kitchen is also capable of producing a magnetic field of 15-20 mG at a distance of one

foot away, but your potential exposure to that field is for a much shorter duration.

Does it matter how long we are exposed to a magnetic field? We don't know. Magnetic fields that are cycled on and off repeatedly, such as those from photocopiers, may have a different kind of effect on us than those from appliances that run constantly, such as alarm clocks.

Obviously, many remaining questions about EMF need to be answered before we can say what is safe or unsafe. The government and the private sector are currently working together to sponsor research that attempts to answer some of these questions.

This publication presents what we hope are some helpful pieces of the EMF puzzle – information about how magnetic field strengths of various everyday appliances compare with each other and how their strength diminishes the farther away you are from the appliances. In many instances, you can substantially reduce your exposure to magnetic fields by simply putting more distance between yourself and EMF sources.

APPENDIX A

Technical Notes

The data in the tables came from three different organizations: the Electric Power Research Institute (EPRI), J.R. Gauger of the Illinois Institute of Technology Research Institute (IITRI), and the U.S. Environmental Protection Agency (EPA). Each set of data was collected in a different manner.

EPRI DATA

The EPRI data comes from the September 1992 Interim Report of EPRI's nationwide Survey of Residential Magnetic Field Sources. (EPRI TR-100194, Project 2942-06.) The survey involved 707 homes. Data was collected with Star magnetic field instruments at different distances from the appliances' front surfaces, at a height of 3 feet from the ground. The Star magnetic field meter measures only 60 hertz magnetic fields. EPRI did not measure magnetic field strengths at a distance of 6 inches from the appliance, as did IITRI and EPA. Therefore, the missing 6 inch measurements for appliances covered in the EPRI survey was provided either by ITTRI or by the EPA. It is important to note that although the tables in this publication give measurements at distances of 6 inches, 1 foot, 2 feet, and 4 feet from the source, the EPRI measurements were actually made at slightly closer distances from the appliances: approximately 10.5", 22.3", and 46". The number of appliances of each type measured by EPRI ranged from 60 to 400. EPRI researchers collected information on manufacturer and model of the appliances they measured, but they did not report that information.

IITRI DATA

The IITRI data set is from a 1984 report by J.R. Gauger of IITRI, prepared for the U.S. Naval Electronic Systems Command, entitled "Household Appliance Magnetic Field Survey" Technical Report E06549-3, Contract No. N00039-84-C-0070. IITRI used measurement equipment of their own design. They measured the maximum 60 hertz magnetic field for appliances in the location in which they were normally used, and turned off or otherwise minimized all other EMF sources in the vicinity of the appliance being measured. The IITRI data set is based on a smaller sample of appliances than EPRI used. About five appliances of each type were measured.

EPA DATA

EPA staff conducted measurements of commonly used electrical appliances for which data had not already been collected. At least five different types of a given appliance were measured. The measurement protocol used by the EPA in its data collection was the following:

1) Equipment consisted of a measuring tape and an Emdex II magnetic field meter measuring in the broadband magnetic field resultant mode every 1.5 seconds.

2) Sources being measured were left in their original positions in the environment. Other operating sources within 3 feet of the object source were turned off when the measurements were taken.

3) Measurement sites were at given distances from the center of the source surface closest to the most likely source user position. The measurement sites were on a line from the center of this surface, in the direction of the user position and parallel to the floor.

4) For each of the measurement sites, before turning on the source to be measured, an initial measurement of the background EMF was taken. This measurement was based on the average of ten consecutive Emdex II readings, rounded to the nearest tenth of a milligauss. With the source operating at its maximum output, the measurements were taken with the same averaging technique. Background measurements were taken again after the source was turned off.

5) In cases where the source field changed periodically (such as with some copy machines) the measurements were taken during the period of operation when the field was strongest.

The following chart shows, for each appliance listed in the publication, which organization provided the data.

DATA SOURCES			
	EPRI	IITRI	EPA
BATHROOM			
Hair Dryers		✔	
Electric Shavers		✔	
KITCHEN			
Blenders		✔	
Can Openers		✔	
Coffee Makers		✔	
Crock Pots		✔	
Dishwashers		✔	
Food Processors			✔
Garbage Disposals		✔	
Microwave Ovens	✔	*	
Mixers		✔	
Electric Ovens		✔	
Electric Ranges	✔	*	
Refrigerators	✔	*	
Toasters		✔	
LAUNDRY/UTILITY ROOM			
Clothes Dryers		✔	
Clothes Washers		✔	
Irons		✔	
Portable Heaters		✔	
Vacuum Cleaners		✔	

* Indicates Source of 6" Measurements

DATA SOURCES

	EPRI	IITRI	EPA
WORKSHOP			
Battery Chargers			✔
Drills		✔	
Power Saws		✔	
Screw Drivers			✔
LIVING/FAMILY ROOM			
Ceiling Fans	✔		
Window Air Conditioners	✔		
Stereo Tuners			✔
Color Televisions	✔		
Black & White Televisions	✔		
OFFICE SOURCES			
Air Cleaners			✔
Copy Machines			✔
Fax Machines			✔
Fluorescent Lights	✔	*	
Electric Pencil Sharpeners			✔
Video Display Terminals			✔
BEDROOM			
Digital Clocks	✔		
Analog Clocks	✔		
Baby Monitors			✔

* Indicates Source of 6" Measurements

APPENDIX B

Additional Reading and Information Sources

Public Information Brochures

Electric and Magnetic Fields from 60 Hertz Electric Power: What do we know about possible health risks?, Department of Engineering and Public Policy, Carnegie Mellon University, Pittsburgh, PA 15213, 1989. Available from Carnegie Mellon: (412) 268-2670. ($3.00)

Electric Magnetic Fields Brochures Series, Edison Electric Institute (EEI). A series of brochures targeted for various audiences (consumers, employees, realtors, teachers, physicians, etc.). Available from EEI: (202) 508-5424. ($1.25+)

Research Reviews

Biological Effects of Power Frequency Electric and Magnetic Fields-Background Paper, Office of Technology Assessment, May 1989. OTA-BP-E-53. Available from the U.S. Government Printing Office: (202) 783-3238. GPO# 052-003-01152-2. ($4.70+)

Electric and Biological Effects of Transmission Lines: A Review, Bonneville Power Administration, 1989. Available from BP: 1-800-622-4520. Publication number: DOE/BP-945. Free. 107 pages.

Basic Science

Electric and Magnetic Field Fundamentals: An EMF Health Effects Research Paper, Electric Power Research Institute (EPRI), January 1991. Available from EPRI: (510) 934-4212. Publication number: EN-7066. ($5.00)

Basic Electromagnetic Theory, by Demetrius T. Paris and F. Kenneth Hurd, McGraw Hill, 1969. Available in public libraries and bookstores.

For more information contact:

Office of Radiation and Indoor Air
Radiation Studies Division
U.S. Environmental Protection Agency
(6603J)
Washington, D.C. 20460