Ross Silverman

Jay Bell

Electrify Fruit Flies

Can electromagnetic fields (EMF) from power lines, home wiring, airport and military radar, substations, transformers, computers and appliances cause brain tumors, leukemia, birth defects, miscarriages, chronic fatigue, headaches, cataracts, heart problems, stress, nausea, chest pain, forgetfulness, cancer and other health problems?

**Reason For Choosing Topic**

The reason that I personally went for this topic and pulled Jay along was that I was almost affected by a power line that might have been installed underneath my feet. Pacific Gas & Electric Co. wanted to bury the 230,000 cable two to three feet under Benedict Court, Hearst Drive and Bernal Avenue to carry electric power from its Vallecitos Road overhead lines through Pleasanton to a PG&E Vineyard Avenue substation at Bernal and Stanley. The new cable would have been part of a multi-million-dollar Tri-Valley upgrade PG&E has said is necessary to meet growing electric demand in Pleasanton, Livermore, Dublin and San Ramon (Pleasanton Weekly). My family’s homeowner’s dues skyrocketed for the legal fees incurred while fighting this power line. I do not know if it was luck or not, but the power shortage occurred an PG&E had bigger issues to deal with other than a power line that would cost them millions of dollars that they did not have.

**Background on EMFs**

Electromagnetic fields are present everywhere in our environment but are invisible to the human eye. Electric fields are produced by the local build-up of electric charges in the atmosphere associated with thunderstorms. The earth's magnetic field causes a compass needle to orient in a North-South direction and is used by birds and fish for navigation. One of the main characteristics which defines an electromagnetic field (EMF) is its frequency or its corresponding wavelength. Fields of different frequencies interact with the body in different ways. One can imagine electromagnetic waves as series of very regular waves that travel at an enormous speed, the speed of light. The frequency simply describes the number of oscillations or cycles per second, while the term wavelength describes the distance between one wave and the next. Hence wavelength and frequency are inseparably intertwined: the higher the frequency the shorter the wavelength (EMR Alliance, *EMF Grassroots Handbook*).

**EMF Effects On Body**

Tiny electrical currents exist in the human body due to the chemical reactions that occur as part of the normal bodily functions, even in the absence of external electric fields. For example, nerves relay signals by transmitting electric impulses. Most biochemical reactions from digestion to brain activities go along with the rearrangement of charged particles. Low-frequency electric fields influence the human body just as they influence any other material made up of charged particles. When electric fields act on conductive materials, they influence the distribution of electric charges at their surface. They cause current to flow through the body to the ground. Low-frequency magnetic fields induce circulating currents within the human body (WHO). If sufficiently large, these currents could cause stimulation of nerves and muscles or affect other biological processes. Both electric and magnetic fields induce voltages and currents in the body. Heating is the main biological effect of the electromagnetic fields of radiofrequency fields. In microwave ovens this fact is employed to warm up food. The levels of radiofrequency fields to which people are normally exposed are very much lower than those needed to produce significant heating (Tarkin). The heating effect of radio waves forms the underlying basis for current guidelines. Scientists are investigating the effects of extremely low frequency (ELF, frequencies up to 300 Hz) fields, intermediate frequency (IF, 300 Hz to 10 MHz) fields, radiofrequency (RF, 10 MHz to 300 GHz) fields on the body.

**Studies On EMF**

Numerous studies have produced results going both ways. One side gives ample evidence that electromagnetic fields are attributed to a diffuse collection of symptoms. Reported symptoms include headaches, anxiety, suicide and depression, nausea, fatigue and loss of libido. General eye irritation and cataracts have sometimes been reported in workers exposed to high levels of radiofrequency and microwave radiation. A number of epidemiological studies suggest small increases in risk of childhood leukemia with exposure to low frequency magnetic fields in the home (Wertheimer & Leeper). At least some of these health problems may be caused by noise or other factors in the environment, or by anxiety related to the presence of new technologies. The other side shows that electromagnetic fields cause no harm at all with again reliable evidence. Some experts are convinced that the threat is real like Ross Silverman and Jay Bell (now experts). Dr. David Carpenter, Dean at the School of Public Health, State University of New York believes it is likely that up to 30% of all childhood cancers come from exposure to EMFs. The Environmental Protection Agency (EPA) warns "There is reason for concern" and advises prudent avoidance". Martin Halper, the EPA's Director of Analysis and Support says, "I have never seen a set of epidemiological studies that remotely approached the weight of evidence that we're seeing with EMFs. Clearly there is something here."

Concern over EMFs exploded after Paul Brodeur wrote a series of articles in the New Yorker Magazine in June 1989 (Brodeur).

"Electromagnetic fields are associated with the development of leukemia, brain cancer and other serious diseases."

"Most unsettling of all, perhaps, is the fact that the pulsed VLF and ELF magnetic fields found routinely within a radius of about two feet from the average CRT computer terminal can be as strong as, or even stronger than, the sixty-hertz magnetic fields found inside the homes in which Wertheirner and Savitz discovered children to be dying unduly of cancer."

**Paul Brodeur**, writer, ***The New Yorker Magazine***, author of ***Currents of Death*** (Simon and Schuster), and ***The Great Power Line Coverup*** (Little, Brown).

Because of Paul Brodeur's reputation his articles had a catalytic effect on scientists, reporters and concerned people throughout the world. In November 1989, the Department of Energy reported, "It has now become generally accepted that there are, indeed, biological effects due to field exposure." The EMF issue gained more publicity in 1990 when alarming reports appeared in Time, the Wall Street Journal, Business Week and popular computer publications. ABC's Ted Koppel and CBS's Dan Rather both aired special segments on EMFs.

In addition to the long-term health concerns, buying a house with high fields will be an economic disaster. In a few years, when power line radiation is as well known as asbestos and radon, a house with high fields will be practically impossible to sell (Casper). Already there are hundreds of lawsuits regarding EMFs and property devaluation like the one that we just had in Kottinger Ranch.

By 1990, over one hundred studies had been conducted worldwide. Of these, at least two-dozen epidemiological studies on humans indicated a link between EMFs and serious health problems. In response to public pressure, the Environmental Protection Agency (EPA) began reviewing and evaluating the available literature. In a draft report issued in March 1990, the EPA recommended that EMFs be classified as a Class B carcinogen - a "probable human carcinogen and joined the ranks of formaldehyde, DDT, dioxins and PCBs. After the EPA draft report was released, utility, military and computer lobbyists came down hard on the EPA. The EPA's final revision did not classify EMFs as a Class B carcinogen Rather; the following explanation was added:

"At this time such a characterization regarding the link between cancer and exposure to EMFs is not appropriate because the basic nature of the interaction between EMFs and biological processes leading to cancer is not understood."

This unusual logic appears on the same page as the following:

"In conclusion, several studies showing leukemia, lymphoma and cancer of the nervous system in children exposed to supported by similar findings in adults in several occupational studies also involving electrical power frequency exposures, show a consistent pattern of response that suggest a causal link. "

When questioned about the contradictory nature of these statements, the EPA responded that it was "not appropriate" to use the probable carcinogen label until it could demonstrate how EMFs caused cancer and exactly how much EMF is harmful. This explanation did not satisfy many critics who claim that the EPA's upper management was influenced by political and economic considerations exerted by utility, computer and military lobbyists (Sugarman). A draft report prepared for the Environmental Protection Agency (EPA) generally endorses a 2 mG exposure limit. It would take effect immediately for new day care centers, schools and playgrounds, as well as for new transmission lines near existing housing. The EPA funded the report. Dr. Joe Elder, EPA's program officer for the NCRP study in Research Triangle Park, NC, called the committee's report "the first comprehensive review of the world's literature on EMF health effects.”

**Types of Studies Possible Dealing With EMF**

Muckraking from authors like Paul Brodeur has caused a mix of studies in different research areas for the evaluation of a potential adverse health effect of electromagnetic fields. Different types of studies investigate distinct aspects of the problem. Laboratory studies on cells aim to elucidate the fundamental underlying mechanisms that link electromagnetic field exposure to biological effects. They try to identify mechanisms based on molecular or cellular changes that are brought about by the electromagnetic field; such a change would provide clues to how a physical force is converted into a biological action within the body. In these studies, single cells or tissues are removed from their normal living environment, which may inactivate possible compensation mechanisms (Milburn & Oelbermann). Another type of study, involving animals**,** is more closely related to real life situations. These studies provide evidence that is more directly relevant to establishing safe exposure levels in humans and often employ several different field levels to investigate dose-response relationships (Pinsky). Epidemiological studies or human health studies are another direct source of information on long-term effects of exposure. These studies investigate the cause and distribution of diseases in real life situations, in communities and occupational groups. Researchers try to establish if there is a statistical association between exposure to electromagnetic fields and the incidence of a specific disease or adverse health effect. However, epidemiological studies are costly. More importantly, they involve measurements on very complex human populations and are difficult to control sufficiently well to detect small effects. For these reasons, scientists evaluate all relevant evidence when deciding about potential health hazards, including epidemiology, animal, and cellular studies (Young).

Epidemiological studies alone typically cannot establish a clear cause and effect relationship, mainly because they detect only statistical associations between exposure and disease, which may or may not be caused by the exposure. Imagine a hypothetical study showing a link between electromagnetic field exposure in electrical workers of the company "X-Electricity" and an increased risk of cancer. Even if a statistical association is observed, it could also be due to incomplete data on other factors (lurking variables) in the workplace. For example, electrical workers may have been exposed to chemical solvents with the potential to cause cancer. Moreover, an observed statistical association may be due only to statistical effects, or the study itself may have suffered from some problem with its design. Therefore, finding an association between some agent and a specific disease does not necessarily mean that the agent caused the disease. Establishing causality requires that an investigator consider many factors. The case for a cause and effect link is strengthened if there is a consistent and strong association between exposure and effect, a clear dose-response relationship, a credible biological explanation, support provided by relevant animal studies, and above all consistency between studies (Tarkin). Research continues to try find that disguised cause and effect relationship. Human health studies are very good at identifying large effects, such as a connection between smoking and cancer. They are less able to distinguish a small effect from no effect at all. If electromagnetic fields at typical environmental levels were strong carcinogens, then it would have been easy to show that by now. By contrast, if low level electromagnetic fields are a weak carcinogen, or even a strong carcinogen to a small group of people in the larger population, that would be far more difficult to demonstrate. In fact, even if a large study shows no association we can never be entirely sure that there is no relationship. The absence of an effect could mean that there really is none. But just as well it could mean that the effect is simply undetectable with our method of measurement (WHO). Therefore, negative results are generally less convincing than strong positive ones.

**Background On Measurements And Gauss Meters**

A 2 milli-gauss reading is comparable to standing 4 feet away from a can opener or a microwave (EPA). Obviously, this limit that the EPA dictated is not even endorsed by even their own evidence. The Gauss is a common unit of measurement of magnetic field strength. To read the strength of an EMF, you must use a Gauss meter, which is an instrument that contains a coil of thin wire, typically with hundreds of turns. As a magnetic field radiates through the coil, it induces a current, which is amplified by the circuitry inside the Gauss meter. Gauss meters may vary in the strength of the magnetic field they are capable of measuring. A meter used for measuring EMFs from power lines, transformers, substations and appliances around the home, for example, should be able to measure as low as .1 mg. Meters have either a single axis coil or a triple axis coil. Single axis meters are much simpler than triple axis meters to manufacture and thus, are less expensive. To use a single axis meter you must point the meter's one sensor in three directions---the x, y and z-axis. Then, you combine the three readings in a mathematical equation to calculate the combined field strength. Triple axis Gauss meters are quite accurate, but they are also more expensive. Some Gauss meters do not even include the frequency of the EMF in its calculation. Most meters will read the same EMF strength no mater what the frequency. As the human body appears to be sensitive to both the field strength and the frequency, Gauss meters used for biological purposes should be "frequency weighted" (Levitt). While researching and looking at the means of research for a small number of studies, gauss meters that lacked frequency meters, therefore their results were swayed and bias occurred without the scientists knowing it. These studies had Gauss meters consider the frequency to be 60 Hz and used it in calculating and displaying the EMF's strength. This feature is why frequency weighted meters will show a higher EMF reading than those meters typically used by electricians and engineers, therefore these studies had probably shown no correlation between biological effects and EMF strength when there might have been one (Grant).

**EMFs Concerning Power Lines**

An enormous amount of electricity is created at power generating stations and sent across the country through wires that carry high voltages. All power lines radiate electromagnetic fields. The amount of EMFs coming from a power line depends on its particular configuration. Power companies know which power line configurations are best for reducing EMFs but most don't feel the evidence supports costly changes in the way they deliver electricity. In relation to the power lines, one of the main cancer causing agents is a substation. A substation is an assemblage of circuit breakers, disconnecting switches and transformers designed to substations have been blamed for causing cancer clusters among nearby residents (Feychting & Ahlbom). Paul Brodeur wrote about several such cancer clusters in the July 9, 1990 issue of the New Yorker Magazine. Another part and a cancer-causing agent is a transformer. A key component of a utility's electrical distribution network depends upon numerous, small transformers mounted on power poles. A transformer looks like a small metal trash can, usually cylindrical. Even when the electrical service is underground, you will often see a metal box (usually square) located on the ground near the street. Many people don't realize that when they see a transformer, the power line feeding the transformer is 4000 to 13,800 volts. The transformer then reduces the voltage to the 120/240 volts needed by nearby homes. Since these transformers can be seen in almost every neighborhood, they are a source of concern. EMFs near a transformer can be quite high, but due to its small structure, the field strength diminishes rapidly with distance, as it does from any point source (Feychting & Ahlbom). For this reason, having a transformer located near your home is usually not a major source of concern, although just to make sure, everyone should measure the field strength around it (Prata).

**Inside And Outside Sources Of EMFs**

If your home has high EMF readings, it is important to determine the sources of the EMF so that remedial action can be taken, if possible. Many times a particular room will have a higher EMF reading. Check to see if the electricity is coming into the house on the wall outside that room. When this is the case, it is usually a good idea to block off that room and only use it for storage purposes. Sometimes, the source of a high magnetic field is incorrect wiring. If you suspect that your home is wired improperly, obtain the services of a licensed electrician (Coghill). Computers are another highly controversial subject concerning EMFs. Electromagnetic Fields radiate from all sides of the computer. Thus, you must not only be concerned with sitting in front of the monitor but also if you are sitting near a computer or if a computer is operating in a nearby room (Hughes). The Swedish safety standard, effective 711/90, specifies a maximum of 0.25 mG at 50 cm from the display (Feychting & Ahlbom). Many US manufactured computers have EMFs of 5 - 100 mG at this distance. The screens placed over monitors do not block EMFs. Not even a lead screen will block ELF and IF magnetic fields (Coghill).

Another source of EMFs are electric blankets create a magnetic field that penetrates about 6-7 inches into the body. Thus it is not surprising that an epidemiological study has linked electric blankets with miscarriages and childhood leukemia. Electric clocks have a very high magnetic field, as much as 5 to 10 mG up to three feet away. If you are using a bedside clock, you are probably sleeping in an EMF equivalent to that of a power line. Studies have linked high rates of brain tumors with chronic exposure to magnetic fields, so it is wise to place all clocks and other electrical devices (such as telephones and answering devices) at least 6 feet from your bed (Sugarman).

Microwave ovens and radar from military installations and airports emit two types of radiation: RFs and ELFs. Microwaves are measured in milliwatt per centimeter squared (mW/cm2). As of 1/1/93, the U.S. safety limit for microwave exposure is 1 mW/cm2, down from a previous 10 mW/cm2. The Russian safety limit is .01 mW/cm2. As all microwave ovens leak and exceed the Russian safety limit, microwave ovens have been outlawed in Russia. In addition, recent Russian studies have shown that normal microwave cooking coverts food protein molecules into carcinogenic substances. Telephones can emit surprisingly strong EMFs, especially from the handset (Grant). This is a problem because we hold the telephone so close to our head. Some brands emit no measurable fields and others emit strong fields that travel several inches right into your brain. Answering machines, particular those with adapter plugs (mini-transformers), give off high levels of EMFs (EPA). Electric razors and hair dryers emit EMFs as high as 200 to 400 mG. This seems alarming, but there is no evidence if this is worse (or better) than a chronic exposure to a 2-3 mG field. Some EMF consultants recommend that hair dryers not be used on children as the high fields are held close to their rapidly developing brain and nervous system (WHO).

**Mobile Phones and their EMFs**

Mobile phones allow people to be within reach at all times. These low-power radio wave devices transmit and receive signals from a network of fixed low power base stations. Each base station provides coverage to a given area. Depending on the number of calls being handled, base stations may be from only a few hundred meters apart in major cities to several kilometers apart in rural areas. Mobile phone base stations are usually mounted on the tops of buildings or on towers at heights of between 15 and 50 meters. The levels of transmissions from any particular base station are variable and depend on the number of calls and the callers' distance from the base station. Antennas emit a very narrow beam of radio waves, which spreads out almost parallel to the ground (Carlo). Therefore, radiofrequency fields at ground level and in regions normally accessible to the public are many times below hazard levels. Guidelines would only be exceeded if a person were to approach to within a couple feet or two directly in front of the antennas. Until mobile phones became widely used, members of the public were mainly exposed to radiofrequency emissions from radio and TV stations (Carlo). Even today, the phone towers themselves add little to our total exposure, as signal strengths in places of public access are normally similar to or lower than those from distant radio and TV stations. The user of a mobile phone is exposed to radiofrequency fields much higher than those found in the general environment. Mobile phones are operated very close to the head. Therefore, rather than looking at the heating effect across the whole body, the distribution of absorbed energy in the head of the user must be determined. Concerns about other so-called non-thermal effects arising from exposure to mobile phone frequencies have also been raised (Carlo). These include suggestions of subtle effects on cells that could have an effect on cancer development. Effects on electrically excitable tissues that may influence the function of the brain and nervous tissue have also been hypothesized (Bowman, Sobel, & Peters). However, the overall evidence available to date does not suggest that the use of mobile phones has any detrimental effect on human health (Levitt).

**Guidelines on EMF and Who Makes Them**

There's a heated debate as to what electromagnetic field (EMF) level is considered safe. Countries set their own national standards for exposure to electromagnetic fields. However, the majority of these national standards draw on the guidelines set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). This non-governmental organization, formally recognized by WHO, evaluates scientific results from all over the world. Based on an in-depth review of the literature, ICNIRP produces guidelines recommending limits on exposure. ICNIRP’s aim is

“Protection against the adverse health effects of non-ionizing radiation is a broad field demanding knowledge of many scientific disciplines.  Most important among these are epidemiology, medicine, biology and physics and engineering.  It is ICNIRP’s aim to harness such expertise by bringing together, within its membership, independent experts in these fields to provide sound advice on the health hazards of non-ionizing radiation exposure based on thorough professional evaluations of the published scientific literature.” (ICNIRP)

Their guidelines are reviewed periodically and updated if necessary. Many government and utility documents report the usual ambient level of 60-Hz magnetic field to be 0.5 mG (National Institute of Environmental Health Sciences and United States Department of Energy). Thus, any reading higher than 0.5 mG is above the "usual" ambient exposure. Many experts and public officials, as well as the few governments that have made an effort to offer public protection, have adopted the 3 mG cutoff point (National Health and Welfare Department (Canada)). The EPA has proposed a safety standard of 1 mG. Sweden has set a maximum safety limit of 1 mG. Dr. Robert Becker, an MD who has been studying the effects of EMFs for 20 years, states a 1 mG safety limit. When electricians try to solve a magnetic field problem they do their best to drop the level to 1 mG or below (National Electrical Manufacturers Association). Dr. Nancy Wertheimer, a Ph.D. epidemiologist who has been studying EMFs for 20 years, has been looking at the epidemiological data in a different way; she is trying to associate EMF levels with health rather than disease. The level she is coming up with is a cut off of 1 mG. Russian researchers claim that 1/1000ths of a mG should be the standard.

**Disclaimer About Guidelines**

An important point to make is that a guideline limit is not a precise delineation between safety and hazard. There is no one level above which exposures become hazardous to health; instead, the potential risk to human health gradually increases with higher exposure levels (Sugarman). Guidelines indicate that, below a given threshold, electromagnetic field exposure is safe according to scientific knowledge. However, it does not automatically follow that, above the given limit, exposure is harmful. To be able to set limits on exposure, scientific studies need to identify the threshold level at which first health effects become apparent (Coghill). As humans cannot be used for experiments, guidelines critically rely on animal studies (WHO). Subtle behavioral changes in animals at low levels often precede more drastic changes in health at higher levels. Abnormal behavior is a very sensitive indicator of a biological response and has been selected as the lowest observable adverse health effect (EMR Alliance). Guidelines recommend the prevention of electromagnetic field exposure levels, at which behavioral changes become noticeable. This threshold level for behavior is not equal to the guideline limit. ICNIRP applies a safety factor of 10 to derive occupational exposure limits, and a factor of 50 to obtain the guideline value for the general public. Therefore, for example, in the radiofrequency and microwave frequency ranges, the maximum levels you might experience in the environment or in your home are at least 50 times lower than the threshold level at which first behavioral changes in animals become apparent (ICNIRP).

At present, speculations about potential long-term health effects cannot form the basis for the issuing of guidelines or standards. Adding up the results of all scientific studies, the overall weight of evidence does not indicate that electromagnetic fields cause long-term health effects such as cancer. National and international bodies set and update standards on the basis of the latest scientific knowledge to protect against known health effects. Guidelines are set for the average population and cannot directly address the requirements of a minority of potentially more sensitive people. Air pollution guidelines, for example, are not based on the special needs of asthmatics. Similarly, electromagnetic field guidelines are not designed to protect people from interference with implanted medical electronic devices such as heart pacemakers. Instead, advice about exposure situations to be avoided should be sought from the manufacturers and from the clinician implanting the device.

## **How Accurate Are the Guidelines?**

## The responsibility to investigate fields around power lines, mobile phone base stations or any other sources accessible to the general public lies with government agencies and local authorities. They must ensure that compliance with guidelines is maintained. With electronic devices, the manufacturer is responsible for complying with the standard limits. However, as we have seen above, the nature of most devices ensures that the emitted fields are well below the cut-off values (Sugarman). Furthermore, many consumer associations carry out tests on a regular basis. A regular question is “Are exposures above the guidelines harmful”? It is perfectly safe to eat food up to the expiration date, but if you consume the food any later the manufacturer cannot guarantee good food quality. Nevertheless, even a few weeks or months after the expiration date, it will usually be safe to eat the jam. Similarly, electromagnetic field guidelines ensure that, within the given exposure limit, no known adverse health effects will occur. A large safety factor is applied to the level known to cause a health consequence. Therefore, even if you experienced field strengths several times higher than the given limit value, your exposure would still be within this safety margin (Grant). In everyday situations, most people do not experience electromagnetic fields that exceed the guideline limits. Typical exposures are far below these values. However, there are occasions where a person's exposure may, for a short period, approach or even exceed the guidelines. According to ICNIRP, radiofrequency and microwave exposures should be averaged over time to address cumulative effects. The guidelines specify a time-averaging period of six minutes and short-term exposures above the limits are acceptable (ICNIRP). In contrast, exposure to low frequency electric and magnetic fields is not time-averaged in the guidelines. To make things even more complicated, another factor called coupling comes into play. Coupling refers to the interaction between the electric and magnetic fields and the exposed body (WHO). This depends on the size and shape of the body, the type of tissue and the orientation of the body relative to the field. Guidelines must be conservative: ICNIRP always assumes maximum coupling of the field to the exposed individual. Thus the guideline limits provide maximum protection. For example, even though the magnetic field values for hairdryers and electric shavers appear to exceed the recommended values, extremely weak coupling between the field and the head prevents the induction of electrical currents that could exceed guideline limits (WHO).

## **The Future …**

The future rests in the hands of the WHO (World Health Organization), who conducts the most comprehensive research at this time. The main aim of WHO's International EMF Project is to initiate and coordinate research worldwide to produce a well-founded response to public concerns. This evaluation will integrate results from cellular, animal and human health studies to allow as comprehensive a health risk assessment as possible. A holistic assessment of a variety of relevant and reliable studies will provide the most reliable answer possible about the adverse health effects, if any exist, of exposure to electromagnetic fields.

#### ***Chart Showing Milligauss ratings of Common Household Items***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **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).  
*Source: EMF In Your Environment, EPA 1992*.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **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 | - | - |
| **Electric Slow Cookers** |  |  |  |  |
| 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 | - |
| **Garbage Disposals** |  |  |  |  |
| Lowest | 60 | 8 | 1 | - |
| Median | 80 | 10 | 2 | - |
| Highest | 100 | 20 | 3 | - |
| **Microwave Ovens** |  |  |  |  |
| Lowest | 100 | 1 | 1 | - |
| Median | 200 | 4 | 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).  
*Source: EMF In Your Environment, EPA 1992*.

“Some appliances produce both 60 Hz and higher frequency fields. For example, televisions and computer screens produce radio-frequency fields of 10,000-30,000 Hz (10-30 kHz) as well as 60 Hz fields. Microwave ovens produce 60 Hz fields of several hundred milligauss, but they also create microwave energy inside the appliance that is at a much higher frequency (about 2.45 billion hertz). We are shielded from the higher frequency fields but not from the 60 Hz fields.”

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **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 |
| **Turners/Tape Players** |  |  |  |  |
| Lowest | - | - | - | - |
| Median | 1 | - | - | - |
| Highest | 3 | 1 | - | - |
| **Color TV’s** |  |  |  |  |
| Lowest | - | - | - | - |
| Median | - | 7 | 2 | - |
| Highest | - | 20 | 8 | 4 |
| **Black and White TV’s** |  |  |  |  |
| Lowest | - | 1 | - | - |
| Median | - | 3 | - | - |
| Highest | - | 10 | 2 | 1 |

Magnetic field measurements in units of milligauss (mG).  
*Source: EMF In Your Environment, EPA 1992*.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **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).  
*Source: EMF In Your Environment, EPA 1992*.

“Sewing machines: Home sewing machines can produce magnetic fields of 12 mG at chest level and 5 mG at head level. Magnetic fields as high as 35 mG at chest level and 215 mG at knee level have been measured from industrial sewing machine models (Sobel 1994)”

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **BEDROOM SOURCES** | | | | |
| **Distance From Source** | **6"** | **1’** | **2’** | **4’** |
| **Digital Clock** |  |  |  |  |
| Lowest | - | - | - | - |
| Median | - | 1 | - | - |
| High | - | 8 | 2 | 1 |
| **Analog (Conventional Clock- Face) Clocks** |  |  |  |  |
| Lowest | - | 1 | - | - |
| Median | - | 15 | 2 | - |
| Highest | - | 30 | 5 | 3 |
| **Baby Monitor** |  |  |  |  |
| Lowest | 4 | - | - | - |
| Median | 6 | 1 | - | - |
| Highest | 15 | 2 | - | - |

Magnetic field measurements in units of milligauss (mG).  
*Source: EMF In Your Environment, EPA 1992*