

Electrical Appliances

There are two primary sources of electromagnetic field (EMF) pollution in the home; house wiring (see "House Wiring and EMFs), and electrical appliances.

Here we list in alphabetical order some of the electrical appliances most commonly found in the home. Some give out powerfrequency EMFs and some radiofrequency or microwave EMFs. Some of the appliances have separate articles (e.g. Digital Cordless (DECT) Phones, wireless local area networks (wLANs)) as we believe they are particularly hazardous, and need a lot more information than can be included in this brief overview. Computers also are the subject of a separate article, because most may not be as hazardous as DECT phones, etc. but many people are particularly concerned about this source of EMF exposure.

Most of the research that has investigated the effects of EMFs on human health have looked at the level of EMFs rather than particular appliances, though there have been one or two exceptions. We discuss the appliances with respect to the level of EMFs, powerfrequency or radiofrequency, that they will expose the user to, in this context.

A doubling of childhood leukaemia (the most studied illness) has been associated with magnetic field levels above 0.4 microtesla (μT). Research in other countries put this level lower at 0.3 μT . Other forms of cancer, clinical depression, miscarriage, Alzheimer's and immune system problems, as well as prescribed drug interactions have been associated with low levels of magnetic field exposure. Magnetic field levels in the average UK house should be no higher than 0.04 to 0.05 microtesla.

Cancer, extreme lethargy, headaches, epilepsy, sleep disturbances, behavioural changes, irritability, concentration and memory problems are linked to microwave exposure.

Electric field exposure has not been studied as much, because it is harder to measure, and also is reduced by most building materials if it comes from a source outside the house. There is evidence that if it is experienced together with high magnetic fields it will greatly increase your risk of developing a serious illness. Ideally, electric fields in the house should be no higher than 15 volts per metre.

Generally, any appliance which only has a two wire mains lead (i.e. Neutral [blue] & Line [brown]) and no 'Earth' connection [green/yellow] will almost always give off high electric fields. This applies to many lamps. For instructions as to how to earth such an appliance, see the end of Section S-Z.

Most appliances which give you the option of running them from mains power or battery power only have two-wire connections, and also usually contain a cheap transformer which 'leaks' high levels of magnetic fields even when the appliance's own switch is off. *Such appliances need to be switched off at the wall, or unplugged, to remove the fields.*

The electromagnetic fields appliances give off vary greatly from one make and model to another. The *only* sure way of knowing is to obtain a meter, such as the EMFields [PRO](#) and measure them. In our opinion it is wise to minimise all exposure to EMFs.

The HPA-RPD (the Health Protection Agency – Radiation Protection Division), other advisory bodies, and some researchers have used what is called a "time-weighted average" (TWA) to assess the amount of radiation you are exposed to because of a particular piece of equipment. They obtain this by calculating the fields given off by the piece of equipment, and the amount of time you use it and then average this over 24 hours. Although this sounds like a reasonable idea in theory, in practice the body does not average out what it is exposed to over a certain period of time. It reacts to whatever level of exposure is *actually* there during critical periods.

The evidence does not make it clear whether long-term low-level chronic exposure is worse than short periods of high exposure. However, the evidence points towards the conclusion that you are more likely to experience adverse health effects if you are sitting or lying still in higher than normal fields for extended periods of time, or if the fields change rapidly in a short period of time.. Scientific evidence about the body's production of the hormone melatonin, with its protective effect on our health, suggests that it is unwise to have high exposure, even for short periods, in the evening.

We believe that electrical appliance use in the kitchen and elsewhere should be minimised - especially if you are standing closer than a metre away from the source. Night time exposure, when you are in bed, should be minimised as the top priority. We believe that this is the time when EMF effects are likely to be strongest when you are asleep and your body is repairing itself.

A survey reported in February 2010, showed that children are missing out on sleep because of televisions, mobile phones and computers in their bedrooms. It is recommended that 10-year-old children get at least 10 hours of sleep a night; half of children aged 9 to 11 are being kept awake by electric and electronic gadgetry. Health experts have linked a lack of sleep to problems with concentration, behaviour and schoolwork. Children who don't get enough sleep have less energy and can be irritable or behave badly. A study by Pesonen ([2010](#)) suggested a good night's sleep could reduce hyperactivity and bad behaviour among children.

Ref: **Pesonen AK** et al 2010 - *Sleep duration and Regularity are Associated with Behavioral Problems in 8-year-old children* Int J Behav Med 17(4):298-305 PMID: 19844792

The smart-home

Smart-home technology allows people to control household appliances via their mobile phone or other wireless gadgets. It uses a monitor to allow heating, air conditioning, lighting, and other things to be controlled. It requires all appliances in the home to be networked together, with the monitor between the appliances and the controller, such as a mobile phone.

This is hoped to be help people with special needs such as those with Alzheimer's disease, those who are blind or partially sighted, and young people with cognitive impairments.

Air Conditioners

Large air conditioning units are likely to be externally mounted, with pumps and motors giving off high levels of magnetic fields. They should be 1.5 metres from anything important. If you have double glazing without windows that open (especially in many places of work), your air-conditioning system may become clogged with dirt and pollutants, which then re-circulate, increasing the spread of airborne micro-organisms and bacteria, making you more vulnerable to sickness. It is important to keep the system clean and well maintained.

Amateur (Ham) radio transmitters

These can emit high levels of radiofrequency and microwave radiation and should not be in the house. Most of the radiation is associated with the aerials and can extend for a considerable distance, including affecting neighbours. Amateur UHF Moon-Bounce transmitters use a highly focused aerial array with extremely high power in the main beam. These arrays should be kept away from children's play areas and neighbouring houses.

Amplifiers, electric guitars and keyboards

The musical instruments are usually earthed systems and are not an EMF hazard. The amplifiers contain a transformer which gives off low levels of EMFs. Take care in its placement if used in the home.

Aquarium

The pumps that oxygenate most aquariums give off very high magnetic fields, between 0.3 and 0.4 microtesla at half a metre. Keep chairs about a metre away from the pumps. Aquarium heaters are not normally earthed and can leak electricity into the water causing the whole tank to give off surprisingly high electric fields.

Baby alarm

Alarms plugged into the mains should be at least 1 metre away from the baby's bedhead. Battery-operated, wire connected, alarms give off virtually zero fields. The walk-about 'freedom' alarms can radiate radio-frequency energy next to the child in order to communicate with the parents' listening unit and should be used with great caution. Sensor pads give off high levels of microwaves.

With 'talk back' digital baby monitors, where parents can talk back to the baby, both units continuously emit pulsing radiation (on 2 different frequency channels - one for each way), not just when the baby is making a noise or the parent is talking to them.

See also the separate article on "Digital Cordless Baby Monitors".

Barbecues

These are rarely electrical and, anyway, are only used for short periods and so will not pose a problem.

Bath Hoists

The motors give off high magnetic fields when in operation. Occasional exposure is unlikely to cause a problem. People operating a bath hoist on a regular basis, e.g. a care assistant in a day centre or residential home, will be exposed to high fields over a much longer period of time, and for women, there may be increased risk of breast cancer if the motor is at chest height.

Battery operated equipment

Batteries do not give off high EMFs. However, they are not energy-efficient: manufacturing them uses 50 times more energy than they will ever produce. They usually contain mercury, cadmium, lithium and other toxic, non-biodegradable metals that can affect water supplies from land-fill. Re-chargeable batteries should be used and then recycled if possible. It is better to consider your overall use of power-driven appliances, than just replace mains operated equipment with battery ones. Sweden, Finland & Denmark want to prohibit the use of cadmium in batteries, as workplace exposure to cadmium damages the lungs and can be fatal. Even if it is successfully banned, cadmium will still occur in waste for at least 10 years. Long term low level exposure to cadmium residues in air, water and food can cause kidney disease, lung damage and brittle bones. Improvements in battery technology now allow up to 75% of battery cadmium to be substituted.

Battery re-charging mats

Charging plates that can be embedded in walls, counter tops, or furniture are becoming available to re-charge, or power any item placed upon them. The system allows devices with very different voltages to be charged at the same time. Some use RFID tags to identify what is being laid down to charge. They are likely to vary as to the power- and radio-frequency levels that they will emit into the nearby environment.

Beds

Metal

Some mattresses contain individually coiled springs. These can resonate at RF/microwave frequencies and produce 'pools' of increased RF all over the bed.

Springs usually end up magnetised in the manufacturing process. Beds with metal frames and bedsprings can become magnetised due to domestic wiring and electrical appliances in the bedroom. This means that the person lying on the bed is effectively lying on lots of magnets which can produce large field gradients over short distances – like very bad geomagnetic/geopathic stress. There is increasing concern about this. Metal (steel or iron) bed frames can also do this but to a smaller extent as the metal is further away from your body than the springs you lie on. On the mattress, the fields' distortions can be several times larger than the earth's magnetic field (which is about 50 microtesla static field in the UK.)

Bedframes can be de-gaussed, but places capable of doing this are scarce. If concerned, find an alternative bed-base and unsprung mattress, preferably made with natural materials.

Motor-adjustable reclining

They can give off high electric and ENORMOUS magnetic fields (several μT) even when stationary. The Tempur orthopaedic bed, tested in December 2004, measured $20\mu\text{T}$ Under the bed, and $0.88\mu\text{T}$ on top of the bed. You need to weigh up the advantages of this type of bed against the potential damaging affect on an already compromised immune system. It is quite easy to design such a bed with almost unmeasurable EMFs other than when actually using the motors to make the mechanical adjustments. If you have one of these beds then we suggest that you measure both the electric and magnetic fields. If they are high, the only easy thing to do is to turn off the supply at the wall when you are comfortable.

Water beds

These can give high magnetic fields from the water heaters and we suggest that you measure them. Waterbeds should ideally be warmed during the day, and unplugged before going to bed. A thick mattress pad or quilt will help you to stay warm on an unheated water bed.

Bedhead and bedside lights

See our article "Lighting and EMFs"

Bottle warmer

Electric bottle warmers for baby bottles give off low levels of EMFs. Some only have a two-wire connection and so give off electric fields. Only use this type when necessary, but not for everyday use.

Bra

Underwired (with metal wire) bras can act as 'antennas' re-radiating EMFs, including microwave radiation from mobile phones, into the body. Breast tissue is particularly susceptible to damage by microwaves.

Burglar Alarm

Main control units

These often contain 'cheap' transformers which give off quite high magnetic fields. Typical magnetic field at 50 cm. is around 0.16 microtesla, so ideally keep chairs, etc., at least 1 metre away.

They often have 'double insulated' or otherwise 'isolated' sensing circuit wires which are not referenced to 'earth' and which can therefore give off quite high levels of electric fields. If this is the case then all the wiring to the sensors and alarms will also be giving off high electric fields. If you do measure high fields coming from them you need to consult the manufacturer / supplier of the system and ask them to "reference the secondary circuits to earth". In some systems this only consists of connecting one of the wires to earth inside the alarm box, however some advanced 'tamper proof' sensing circuits will sound the alarm if this is done and then expert advice from the supplier is needed.

Burglar Alarm sensors

Most burglar alarms use simple switch or resistive sensors on doors and windows and passive infra-red sensors for rooms and corridors. These sense the heat given off by a moving body and their sensitivity can usually be adjusted so that cats and dogs do not set them off. Light-beam sensors are rarely used nowadays. None of these sensors give off significant EMFs.

Active microwave sensors are increasingly being used in both domestic and commercial buildings. These usually give out low level microwaves all the time and so we do not recommend their use. If you already have them in your system then you should contact your supplier and discover how to turn off the microwave transmitters in the sensors when you are moving about

in the building and garden area and the alarm is not required as they are otherwise often energised 24 hours a day, even when the alarm is apparently turned off.

One person who needed to replace their broken security alarm system was told that it would be impossible to retrofit a wired system.

Camcorder

The motor generates high fields, but is well shielded, so the person doing the filming is ok.

Carbon Monoxide detectors

The most common type are powered by a 9 volt battery and do not give off any EMFs; however they do use a very low level radioactive source and should only be installed on ceilings and disposed of carefully if you renew them.

CD Player

These can give off high magnetic fields, but the problem is usually high electric fields. Make sure the system has a decent electrical earth connection to the mains supply. This will remove most electric fields.

Central heating

Central heating **boilers** do not generally give off any EMFs apart from a short burst when the electronic ignition fires if the boiler doesn't have a pilot light (flame) which burns continuously. However, most plumbers now fit wireless thermostats to control boilers, as it is cheaper, there are no wires, and no electrician is necessary. This will increase RF exposure.

Central heating **pumps** give off high fields close by - over 20 microtesla - which typically fall to around 0.5 microtesla at 50 cm. We recommend that chairs and beds are located at least 1.2 metres away from these pumps.

If your central Heating **Timer** is electromechanical and rotates then it will give off a magnetic field at 50 cm of about 0.13 microtesla.

Hot air central heating systems have a fan which will usually be situated near the heat-source (whatever the type of fuel is). The electric motor to the fan will give off significant levels of EMFs nearby.

Some **hot water radiators** and pipes that are part of central heating systems give off EMFs. This occurs when the metal pipes are carrying '**net**' currents causing high magnetic fields of several microtesla. These 'net' currents are due to wiring faults which can be either inside or outside your property. External causes of 'net' currents are discussed in the article "Powerlines, substations, underground cables and net currents".

Underfloor heating

See the article entitled "Underfloor heating".

Chair, motor-adjustable reclining

Some **motor-adjustable reclining chairs** give off ENORMOUS magnetic fields (several μT) all the time. They can also have unexpectedly large electric fields. It is just bad design. A chair with almost unmeasurable EMFs, other than when actually using the motors to make the mechanical adjustments, is quite easy to design. If you have a motor-adjustable reclining chair then we suggest that you measure both the electric and magnetic fields. If they are high, switch off the supply at the wall or unplug it once you are comfortable.

Clock radio

Electrically powered clocks and clock-radios should be at least 1 metre from your head at night. Older clocks had a cheap and magnetically leaky transformer and the very early ones even had an a.c. motor to turn the numbers – that was when they got the reputation in the EMF literature for giving off very high EMFs.

Nowadays they emit much lower levels of EMFs, but most mains ones are two-wire and not earthed so they do give off significant a.c. electric fields within about half a metre or so. The LCD ones with extra information on a dot matrix screen give off more RF noise than ones with simple large digits.

Battery (only) driven clocks produce negligible fields, but LED ones flatten the batteries quite quickly.

Digital (DAB) clock radios give off low levels of RF noise. This is a very different quality of exposure, and whether you are affected will depend on your sensitivity to RF radiation. So although RF levels are at a very low level, we recommend a DAB radio is situated at least 6-8 feet away from the pillow, twice the distance of a non-DAB radio.

Clothes Dryer

Separate **clothes dryers** which have an ailer unit attached to a floor-based heater give off quite a high magnetic field, between 0.3 and 0.4 μT at half a metre away.

Coffee grinder

The motor will give off high EMFs of up to 0.3 μT at half a metre, which drop away quite rapidly. Short periods of use should be no problem. If pregnant, it will be worth limiting time using electric appliances giving off these levels of fields at work-top height.

Coffee maker

The heater will give off high EMFs which drop away quite rapidly. Short periods of use should be no problem. If pregnant, it will be worth limiting time near electric appliances giving off these levels of fields at work-top height.

Computer Games consoles

These usually have a mains **transformer** which plugs into a power socket. They give off very high levels of magnetic fields. Unplug them when not in use. It is **very** important not to leave

transformers plugged into the wall by children's beds as they leak quite high levels of magnetic fields all the time they are connected to the mains electricity supply. Often neither the TV nor the games controller is connected to mains 'earth' and so the hand controllers can give off electric fields of several hundred volts per metre, but it does not seem easy to predict this.

The latest-generation consoles (XBOX 360, Nintendo Wii, Sony Playstation 3) are all wirelessly enabled. These all have the capability to have wireless controllers, and have either integrated or add-on WiFi. Some modern handheld consoles (Nintendo DS, Sony PSP) also have WiFi built in. Xbox support services in November 2009 replied to a customer query "*We regret to inform you that it is not possible to prevent the Xbox from emitting microwave signals. We apologize for the inconvenience.*"

Wireless entertainment systems, wireless music systems, digital wireless streamers, wireless stereo headphones and WiFi radios use either WiFi or 'class 1' Bluetooth for a distance of up to 100 metres.

Xbox 360 users will be able to watch TV through their console following a deal between BT and Microsoft. The BT Vision service will be available to broadband customers who will have access to a range of TV shows, films and sporting events - including 'near live' FA Premier League football matches.

There is currently no research either way on WiFi at the moment, however WiFi enabled devices give off similar strength EMFs as an average Mobile Phone Mast would give at under 100m. There is strong scientific evidence for mobile phone masts causing a variety of serious health issues, so we consider it prudent to take a precautionary approach and avoid prolonged use of WiFi enabled devices.

In January 2009, there were about 5 million Nintendo Wiis in the UK, including consoles especially for toddlers. The Wii remote uses a mixture of Infra-Red and Bluetooth technologies. The emitted signals are in a much lower bandwidth than regular wireless waves. Infra-Red is used to provide a 'pointer' on screen which is used to select various on-screen buttons, in a similar way to a computer mouse, while Bluetooth is used to detect and supply information about movements that are made by the Wii Remote to the Wii console - for example, detecting a swing of the Wii Remote to represent a tennis racquet being swung.

The Wii emits constantly when switched on. The hand held device is also emitting. The wired controllers apparently work much better, but the console continues emitting. It is not possible to stop it transmitting without unplugging the mains lead or switching off at the mains socket. Using the Xbox 360 switch left the RF unit still emitting at full power.

Nintendo advises that the remote, or console, should not be operated within 9" (23 cm) of a pacemaker (Rajani [2008](#)).

Ref: **Rajani R** et al 2008 - *Wii seems safe with pacemakers* BMJ 337:a3103

Cookers (electric ovens & hobs)

The standard electric cooker, which has an oven, grill and top plates, gives off high magnetic fields when it is operating. These can be as high as several microtesla close to. Half a metre away the fields can still be as high as $0.2\mu\text{T}$. Pregnant women should keep their distance, as the highest field levels can be in the area of the growing child. Prepare uncooked food in advance and keep away, as far as possible, while it is cooking.

Children's normal playing area should be at least 1.5 metres away from the front of the cooker, while the cooker, especially the oven, is on.

Research at Bristol University suggests that the average time spent cooking is about one hour a day. If you spend longer than this it is worthwhile taking especial care.

Fan assisted ovens, double ovens, toaster ovens, grills, time switches, etc. give off significant magnetic fields. Bear in mind the distance away from the body, particular areas to watch (breasts in women with family susceptibility to breast cancer; genital area for men who are concerned about testicular or prostate cancer), and whether you are pregnant. Be aware of the height and distance of time switches. The different pieces of equipment vary as to the level of magnetic field. Keep a reasonable distance away whilst they are working. Caution is needed with regard to *all* electrical appliances.

A separate hob is used on average for about three-quarters of an hour. The fields are lower than those of a cooker, about $0.1\mu\text{T}$. Pregnant women are not advised to stand in front of it for longer than necessary.

Ceramic and **halogen hobs** generate similar levels of magnetic fields as conventional open-ring electric hobs.

Hobs with **magnetic induction plates** work on a different heating principle. High EMFs are generated by the cooker on purpose, and these EMFs induce currents to flow in the pans themselves, which cause them to heat up. The top of the cooker stays relatively cool and is heated by contact with the hot pan. As high EMFs are generated on purpose, we cannot recommend this way of cooking. Some magnetic induction hobs use mains frequency fields and some use low radio frequency signals which induce currents in the pan (and people standing nearby!) more easily. A study in [2009](#), by Sakurai found no detectable cellular genotoxicity as a result of exposure to magnetic fields for 2 hours from an induction heating cooktop.

Slow cookers usually use very low power and do not pose a significant EMF hazard.

The fields from a **cooker hood** motor are high, about $0.26\mu\text{T}$ half a metre away. The time spent in front of a hood is, on average, half an hour a day, so research would have us believe. Limit the time you spend in front of a cooker hood when it is dark, as high fields near head height inhibit the production of melatonin, necessary for good health, for the following night-time period.

There is a separate article on “Microwave Cooking”.

Sakurai T et al 2009 – *Intermediate frequency magnetic fields generated by an induction heating (IH) cooktop do not affect genotoxicities and expression of heat shock proteins* Int J Radiat Biol 85(10):883-90 PMID: 19863202