

1. What is an Electromagnetic field (EMF)?

An EMF is produced whenever a piece of electrical or electronic equipment (i.e. TV, food mixer, computer, mobile phone etc) is used.

EMFs are static electric, static magnetic and time-varying electric, magnetic and electromagnetic (radio wave) fields with frequencies up to 300 GHz.

EMFs are present in virtually all workplaces.

2. Exposure to EMFs

If they are of high enough intensity, the employer may need to take action to make sure workers are protected from any adverse effects.

3. What are the effects of exposure?

Direct effects: EMFs at different frequencies affect the human body in different ways, causing **sensory** and **health** effects.

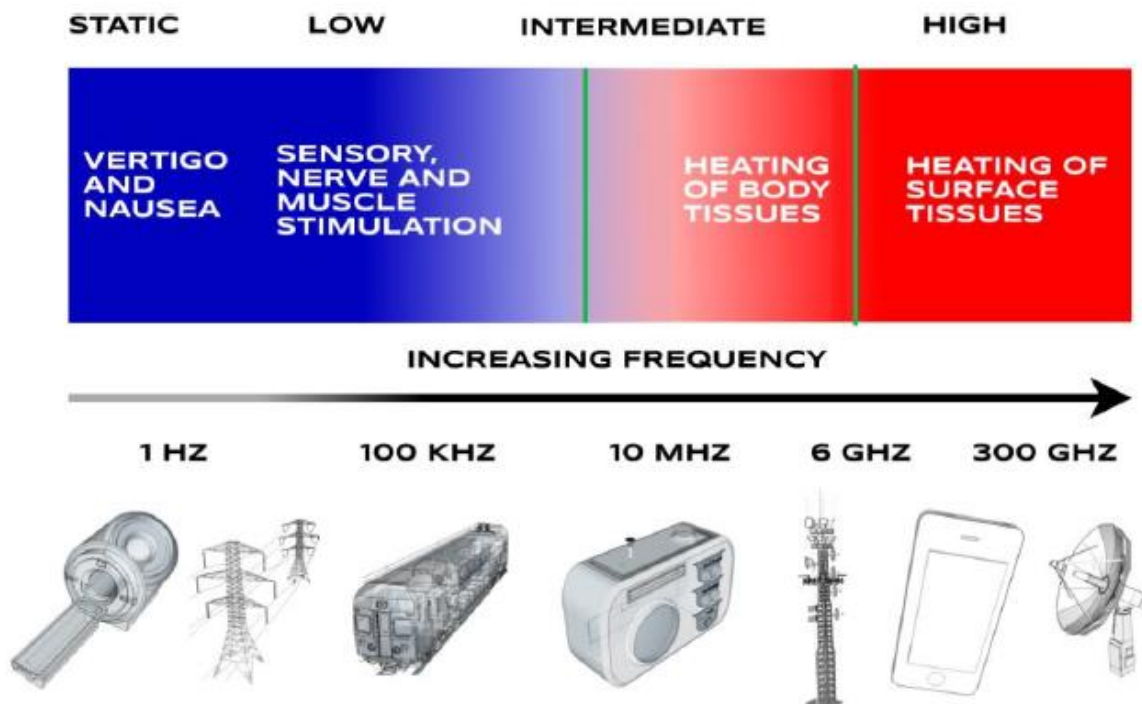


Figure 1 Adverse health effects of electromagnetic fields at various frequencies and related applications. The green line shows the power frequencies and radiofrequencies with which this report is primarily concerned.

Indirect effects can also happen; indirect effects are caused by the presence of an object in an EMF which may become the cause of a health and safety hazard.

An example would be the risk of injury from ferromagnetic objects in a large static magnetic field being attracted to the magnets and hitting anyone in the way.

Table 1 below indicates the field / frequency range and potential direct and indirect effects:

Field and frequency range	Effects	Examples of activities and equipment
Static electric and static magnetic fields 0–1 Hz	<p>Indirect effects: Uncontrolled attraction of ferromagnetic objects, ie the risk of injury from objects in a large static magnetic field being attracted to magnets in the workplace and hitting anyone in the way</p> <p>Sensory effects: Nausea, vertigo, metallic taste in the mouth, flickering sensations (magnetophosphenes) in peripheral vision</p> <p>Health effects: Micro shocks</p>	MRI scanners (main magnet) Electrochemical processes, eg industrial electrolysis, aluminium extraction Nuclear magnetic resonance spectrometers Electromagnetic lifting cranes Electric vehicles (cars, underground trains)

Field and frequency range	Effects	Examples of activities and equipment
Low frequency magnetic and electric fields: 1 Hz–10 MHz	<p>Indirect effects: Interference with active or passive implanted or body-worn medical devices (more information is provided later in this guidance), electric shocks, causing electro-explosive devices to initiate, ie when used in close proximity to explosives that have an electrical means of initiation</p> <p>Sparks caused by induced fields triggering fires or explosions where flammable fuels, vapours or gases are present</p> <p>Sensory effects: Nausea, vertigo, metallic taste in the mouth, flickering sensations (magnetophosphenes)</p> <p>Health effects: Nerve stimulation, effects on the central and peripheral nervous system of the body: tingling, muscle contraction, heart arrhythmia</p> <p>Contact currents caused by a person touching a conductive object in an EMF where one of them is grounded and the other is not, which can result in shocks or burns</p>	High voltage power lines Production and distribution of electricity Welding (arc and spot) Electrical arc furnaces Industrial induction heating (eg large coils used around the site of a weld) AM radio Electric hand-held tools Electric vehicles (cars, trains, trams, metros) Magnetic resonance imaging (MRI) (switched gradient fields)
Intermediate frequency fields: 100 kHz–10 MHz	<p>The health effects of both high and low frequencies can be experienced as detailed above and below (see also Annex 1)</p>	Surgical diathermy Broadcasting systems and devices (AM radio) Anti-theft devices Military and research radiofrequency systems

High frequency fields: 100 kHz–300 GHz	Indirect effects: Interference with active or passive implanted or body-worn medical devices (more information is provided later in this guidance), electric shocks, causing electro-explosive devices to initiate, ie when used in close proximity to explosives that have an electrical means of initiation Sparks caused by induced fields triggering fires or explosions where flammable fuels, vapours or gases are present	MRI (RF coils) Broadcasting and TV antennas Radar and radio transmitters Diathermy Dielectric heating (eg vulcanising, plastics welding or microwave drying) Anti-theft systems
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Field and frequency range	Effects	Examples of activities & equipment
100 kHz–300 GHz	Sensory effects: Auditory effects such as perception of clicks or buzzing caused by pulsed radar systems Health effects: Thermal stress, heating effects leading to a rise in core body temperature or localised limb heating (eg knees or ankles) Contact with charged conducting bodies can lead to RF shock or deep tissue burns (see also Annex 1)	Broadcasting and TV antennas Radar and radio transmitters Diathermy Dielectric heating (eg vulcanising, plastics welding or microwave drying) Anti-theft systems

4. What the law requires QMUL to do under the Control of Electromagnetic Fields at Work Regulations 2016 (the CEMFAW Regulations).

The CEMFAW Regulations require QMUL, as an employer, to:

- i. Assess the levels of EMFs to which employees may be exposed;
- ii. Ensure that exposure is below a set of ‘Exposure limit values’ (ELVs);
- iii. When appropriate, devise and implement an action plan to ensure compliance with the exposure limits
- iv. When appropriate, assess the risks of employees’ exposure and eliminate or minimise those risks.
- v. Make sure **employees at particular risk**, such as expectant mothers and workers with active or passive implanted or body-worn medical devices, into account.
- vi. Provide information and training on the particular risks (if any) posed to employees by EMFs in the workplace and details of any action QMUL is taking to remove or control them.
- vii. Take action if employees are exposed to EMFs in excess of the ELVs; provide health surveillance or medical examination, as appropriate.

5. Low-exposure work activities/equipment

Many sources of EMF at QMUL produce such low levels of EMFs that it is likely, other than assessing exposure to EMFs, the procedures QMUL already have in place to manage risks will be sufficient to make sure workers are protected and to meet the requirements of the CEMFAW Regulations.

Below is a non-exhaustive list of low-exposure equipment.

- All office locations, including Wi-Fi and Bluetooth equipment, computing equipment, etc.
- Use of mobile phones and two-way radios
- Alarm systems
- Broadcast and communication antennas, outside the relevant exclusion zone
- Metal detectors
- Tape or hard drive erasers (office, not industrial)
- Small battery chargers, wired or inductive
- Handheld machine tools
- Construction equipment (cranes, cement mixers etc.)

(Further information and lists on pages 9-10 of <http://www.hse.gov.uk/pubns/priced/hsg281.pdf>)

Where workplaces at QMUL only contain equipment on this list, the ELVs and indirect-effect ALs will not be exceeded and QMUL does not need to take any further action under the CEMFAW Regulations, except where:

QMUL has **employees at particular risk**

And/or

There is **no existing record of an assessment.**

6. Employees at particular risk (Table 2)

Workers at particular risk	Examples
Workers wearing active implanted medical devices (AIMD)	Cardiac pacemakers, cardiac defibrillators, cochlear implants, brainstem implants, inner ear prostheses, neurostimulators, retinal encoders, implanted drug infusion pumps
Workers wearing passive implanted medical devices (PIMDs)	Artificial joints, pins, plates, screws, surgical clips, aneurism clips, stents, heart valve prostheses, annuloplasty rings, metallic contraceptive implants, penile implants
Workers wearing body-worn medical devices	Insulin pumps, hormone infusion pumps, hearing aids, continuous glucose monitoring systems, metallised drug-delivery patches
Pregnant workers	-

Exposure limit values

ELVs are limits specified to protect employees from the health and sensory effects of EMFs.

Health-effect ELVs are used to prevent possible harm from the heating of tissue and electrical stimulation of nerve and tissue caused by exposure to EMFs.

Sensory-effect ELVs are used to prevent effects such as magnetophosphenes (a flickering sensation), or a feeling of nausea, vertigo or a metallic taste caused by static magnetic fields.

These are often impossible or difficult and expensive to measure directly.

For this reason a separate set of values, known as (Action Levels) ALs, has been produced relating to quantities which can be measured more easily.

These are listed in the Annexes (Part 1-3) to the regulations http://www.legislation.gov.uk/ukxi/2016/588/pdfs/ukxi_20160588_en.pdf and explained in the accompanying guidance in Annex 1 of <http://www.hse.gov.uk/pubns/priced/hsg281.pdf>

7. Work activities/equipment where EMFs may exceed the ELVs

Some work activities will involve exposure to levels of EMFs which may exceed the ELVs and so potentially pose a risk to employees; a non-exhaustive list of such work activities/equipment is below, where further consideration is necessary.

Manufacturers and suppliers of new equipment, most of which will be subject to EU product safety regulations, have to ensure that the equipment is safe – and deal with the risks associated with (radiation) EMF; this information should be covered in the technical file and provided to the user as part of the user instructions etc.

For older equipment, which may have been supplied before regulations came into force, there is a general duty on the manufacturer/supplier to ensure that the equipment (articles for use at work) are safe and without risks. This would include providing the end user with relevant information about radiation/EMF. Where this is not immediately available, the responsible person for the equipment should contact the supplier to obtain the safety information.

Infrastructure (buildings and grounds)

Broadcast and telecoms base stations, inside operator's designated exclusion zone

Radio frequency or microwave energised lighting equipment

Electrical supply

Any electrical circuit or installation (including cables, busbars, switchgear and transformers), where the cables carrying the electrical currents are bundled together so that they are always touching or nearly so, but there are earthing arrangements that mean the cables **collectively** carry an unbalanced current of >100 A.

Or

Cables are separated, and the rating of the circuit or that part of it is >100 A.

Light industry

Dielectric heating and welding

Resistance welding: manual spot and seam welding

Induction heating
Induction soldering
Magnetic particle inspection (crack detection)
Industrial magnetiser and demagnetisers, eg tape erasers
Microwave heating and drying
RF plasma devices including vacuum deposition and sputtering

Heavy industry

Industrial electrolysis:
Furnaces, arc and induction melting

Medical

MRI equipment
Medical diagnostic and treatment equipment using EMFs, e.g. diathermy and transcranial magnetic stimulation

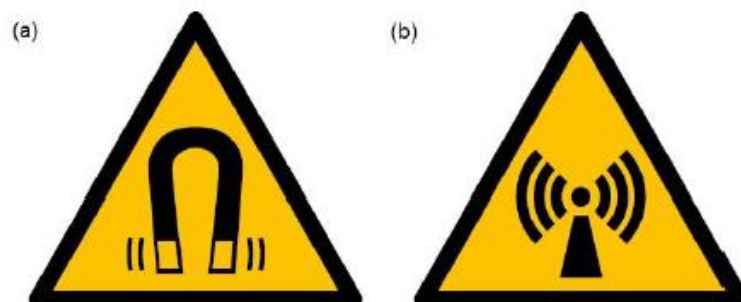
8. Certificate of Exemption

The HSE have provided a **certificate of exemption** for the listed activities below where electromagnetic field levels in excess of the ELVs may be exceeded **if** exposure is as low as is reasonably practicable and an action plan is therefore not required; all other requirements of the CEMFAW Regulations must be kept.

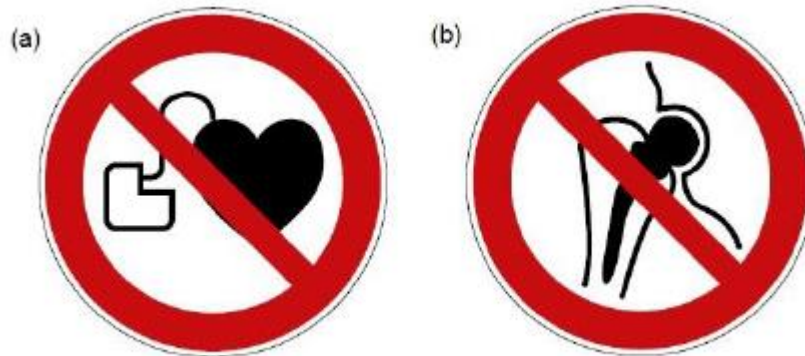
Electrolysis as part of a manufacturing process;
The use of dielectric heating equipment;
The use of induction heating equipment;
The use of manually-operated resistance welding equipment; and
The use of magnetic resonance imaging equipment (other than for patients in the health sector)

<http://www.hse.gov.uk/radiation/nonionising/emf-exemption-certificate.pdf>

9. Hazard and Warning Signage



The standard warning signs relating to electromagnetic fields (a) Warning: magnetic field (b) Warning: non-ionising radiation.



The standard prohibition signs displayed in relation to electromagnetic fields (a) No access for people with active implanted cardiac devices (b) No access for people with passive metallic implants.

10. Key safety measures for EMF adopted at QMUL

QMUL has procured an expert consultant to assess EMF usage at QMUL and to identify which EMF generating equipment use / tasks exceed an ELV and / or AL and to identify employees at particular risk. An action plan (2018/19) has been provided for completion.

- i. Switch rooms and high-diameter cables - in the absence of a person-specific individual exposure assessment, a worker at particular risk should be excluded from these switch rooms. All worker's head should be kept at least 10 cm away from thick electrical cables within electrical switch rooms whilst in operation.
- ii. An individual person-specific risk assessment if a worker at particular risk is working within 30 cm of a large running motor.
- iii. An individual person-specific risk assessment if a worker at particular risk is working within 30 cm of a small centrifuge or mixer.
- iv. Workers at particular risk keep their medical devices at least 20 cm from small, desktop magnets.
- v. An exclusion zone around large diesel powered back-up generators for a worker at particular risk (this can be as high as 1.5 metres from the generator and conductors emerging from the generator).
- vi. No personnel work at height, or on scaffolding in front of roof top high powered antennas – without a task-specific EMF exposure assessment.
- vii. Antennas at ground level if high powered require task-specific EMF exposure assessment.
- viii. Magnetic Resonance Imaging (MRI) and X-ray Irradiators establish the required exclusion zones for workers at particular risk.

- ix. Transcranial magnetic stimulation devices - the head and torso of the operator should be kept at least 20 cm from the probe and supply cable.
- x. Nuclear Magnetic Resonance (NMR) and EPR Spectroscopy equipment and as applicable other magnetic equipment have defined exclusion zones during operation which are adhered to at all times.
- xi. Operator safety instructions, induction and tool box talks, training records.
- xii. Safety hazard and warning signage as noted in section 9 in place at appropriate points of equipment and access doors, exclusion zones clearly marked. Signs can be purchased from QMUL Health & Safety Directorate <http://www.hsd.qmul.ac.uk/az/safety-signage/> or from reputable suppliers.
- xiii. EMF awareness training to any identified workers at particular risk who have the potential to receive exposures exceeding reference levels.

11. Information and training for QMUL employees

Information to include:

- i. an explanation of ALs and ELVs;
- ii. details of possible health, sensory or indirect effects and what to do if these are experienced;
- iii. details of the safe working practices QMUL adopts to eliminate or reduce risks arising from exposure;
- iv. an explanation of any safety signage used;
- v. details of appropriate personal protective equipment;
- vi. information for employees at particular risk such as:
- vii. workers who have declared the use of AIMDs, PIMDs or BWMDs;
- viii. expectant mothers who have informed you of their condition;
- ix. employees who work in close proximity to electro-explosive devices, explosive materials or flammable atmospheres;
- x. The circumstances in which they may be entitled to an appropriate medical examination and/or health surveillance.

12. Health surveillance for QMUL employees

The CEMFAW Regulations only relate to short-term effects resulting from exposure to EMFs and while it is possible to incur health effects, there is no well-established scientific evidence of long-term effects. Therefore, health surveillance is only likely to be necessary in very limited circumstances.

Where an employee is exposed to EMFs in excess of any health-effect ELVs and reports experiencing a health effect, QMUL must make sure that health surveillance and medical examinations are provided as appropriate.

A suitable record must be kept by QMUL Occupational Health of any health surveillance and medical examinations undertaken.

13. References and further Information

- i. Control of Electromagnetic Fields at Work Regulations 2016
http://www.legislation.gov.uk/uksi/2016/588/pdfs/uksi_20160588_en.pdf
- ii. A guide to the Control of Electromagnetic Fields at Work Regulations 2016
<http://www.hse.gov.uk/pubns/priced/hsg281.pdf>
- iii. HSE Information Page on EMFs
<http://www.hse.gov.uk/radiation/nonionising/emf.htm>

14. Document Control

Initial Version

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1			
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