

Policy

September 2016

Electromagnetic Fields Safety

Occupational Health & Safety Service

HSD072R (rev 1)



**UNIVERSITY OF
CAMBRIDGE**

1. Definitions and Scope

Non-optical electromagnetic fields include static electric, static magnetic and time-varying electric, magnetic and electromagnetic fields with frequencies up to 300 GHz.

There are well established and understood short term adverse effects at high levels of exposure to electromagnetic fields and the University has a duty to protect staff students and others affected by the work.

2. European legislation

In June 2013, the European Commission published a Directive¹ on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields). This Directive sets out the minimum health and safety requirements regarding the exposure of workers to the risks arising from electromagnetic fields. The Control of Electromagnetic Fields at Work Regulations 2016 came into force in the UK on 1 July 2016. The Management of Health and Safety at Work Regulations also apply. This policy sets out departments' duties under the legislation regarding significant or "non-trivial" sources of electromagnetic fields.

In the University, the most significant areas of work are likely to involve large magnets, e.g. Nuclear Magnetic Resonance (NMR), Magnetic Resonance Imaging (MRI) and similar equipment, and individuals at particular risk need to be considered (see section 4, below). Older NMR equipment may generate large stray static magnetic fields, but modern equipment is normally better shielded. Radiofrequency fields are easily shielded so are unlikely to result in significant exposures if the equipment is well-designed. There may be older equipment, modified equipment or equipment built "in-house" for which the risks need to be assessed, if this has not already been done. For more information on what sources are considered to be non-trivial, please refer to the University Safety Office electromagnetic fields web pages <http://www.admin.cam.ac.uk/cam-only/offices/safety/radiation/nonir/emf> .

3. Health effects of exposure to electromagnetic fields

3.1 Direct health effects

- **At low frequencies (300 kHz and below), effects on the nervous system and, below 1 Hz, the heart.** Up to 300kHz, overexposure can cause small induced electric currents to flow in the body which can interfere with the brain and nervous system. Magnetic phosphenes are a perception of faint flickering light thought to result from interaction of induced electric currents with cells in the retina. Fields at 0-1Hz can cause cardiovascular effects and even cardiac arrhythmia, and also vertigo and nausea.
- **At high frequencies (10 MHz and above), heating effects on the body and on specific tissues.** Induced currents can cause heating effects which must be limited in order to prevent whole-body heat stress and harmful localised heating of tissues in the body.
- **At intermediate frequencies (100 kHz – 10 MHz) both nervous system effects and heating effects.**
- **Risk of electric shock or burn** from touching objects in an electromagnetic field.

3.2 Indirect effects

- **Interference** with active implanted active medical devices such as cardiac pacemakers.
- **Projectile risk** from ferromagnetic objects in static magnetic fields.
- Initiation of electro-explosive devices (detonators).
- Fires and explosions resulting from ignition of flammable materials by sparks caused directly or indirectly by electromagnetic fields.

4. *Individuals at particular risk*

Individuals at particular risk **must** be considered as part of the risk assessment, including those wearing **medical devices and prostheses**, cardiac pacemakers and defibrillators, cochlear implants and other metallic implants or body-worn medical devices. Possible problems include electrical interference or physical movement or twisting of the implant which can give rise to safety or health effects, depending on the exposure and the implant. Disruption of cardio-pacemakers could result in serious injury or death to the individual. Other implanted ferromagnetic objects including pins, stents, shunts and also any embedded fragments such as metal splinters or shrapnel can also be adversely affected in magnetic fields.

The individual may have to check with their medical consultant as to the susceptibility of implanted material or implanted device. Access is normally restricted to magnetic flux densities of 0.5mT (5 Gauss) based on the most sensitive devices, so a further risk assessment will need to be done if the individual needs to access these areas. Please consult the Safety Office for further advice.

Pregnancy and exposure to electromagnetic fields: There is no evidence of detrimental effects to the embryo or foetus within exposure limit values, but in the event of pregnancy being declared, the risk assessment must be reviewed and any concerns discussed. The main issue is excessive heating to the mother and foetus when exposed to radiofrequency fields, but this is normally very unlikely, particularly if working well within exposure limit values.

5. *Exposure Limit Values and Action Levels*

Exposure limit values and action levels are set out in the Schedule of the Regulations and Annex 1 of the Directive¹.

Action levels are not limits but are practical in establishing compliance with the overall limits. In the regulations, action levels are given for direct effects (low action levels for sensory effects, and high action levels for health effects) and for indirect effects.

Note that workers at particular risk may not be adequately protected by action levels or exposure limits.

Before purchasing equipment, suppliers should be able to provide information on compliance with overall limits and information on how to work safely. Measurements or calculations may be needed, but these should normally be done by the manufacturer or supplier of the equipment.

The University RPO should be consulted regarding measurement or calculation of EMFs for comparison with action levels or exposure limits.

6. Organisational arrangements – Responsibilities and duties

The Head of Department is responsible for implementing effective safety management.

The Departmental Safety Officer (DSO) advises on and coordinates safety in the Department, and assists in ensuring compliance on all safety matters including electromagnetic fields safety (unless this is delegated to another member of staff in writing).

Duties of:

Heads of Departments

- Ensure that local policy is implemented with regard to local rules and operating procedures, and ensure that suitable and sufficient risk assessments have been carried out for work involving non-trivial sources of electromagnetic fields where necessary.
- Ensure that adequate resources are available for identifying, installing and maintaining engineering controls, and, where necessary, appropriate personal protective equipment.
- Ensure that adequate information, instruction and training and supervision is received by users and their supervisors and ensure records are kept.
- Take action, or delegate as appropriate the authority to take action, to suspend any work that is unsafe or not used in accordance with University or Departmental policy.

The Research Supervisor (or Line Manager who is a University employee)

- Cooperate with the University in ensuring that safe working practices are promoted and employed, with consideration to legal requirements, and that the safe use of equipment is accepted as an integral part of any project.
- Ensure that work is carried out safely on a practical basis, also ensuring the safety of anyone else who may be affected by the work (for example, students and colleagues).
- Ensure that users fully understand any instructions and training given.
- Ensure that equipment is maintained in a safe order.
- Ensure that risk assessments are carried out, and that practical, unambiguous local rules and procedures are prepared in agreement with the Departmental Safety Officer. These are local policy documents and, as such, the Research Supervisor must ensure that they are implemented at all times and that the information is circulated to all who may be affected. These documents must also be reviewed and updated when necessary if procedures or circumstances change that may affect safety.
- Report any accident or incident, even if no injury occurs, and liaise with the Departmental Safety Officer in improving preventative measures.

The User of non-trivial sources of electromagnetic fields

- Inform the Research Supervisor BEFORE commencing any new work involving non-trivial sources of electromagnetic fields.
- Undergo suitable training and ensure that they are aware of the hazards associated with the sources of electromagnetic fields.
- Carry out a risk assessment of the work if required by the Research Supervisor or Departmental Safety Officer, and confirm the findings with them.
- Familiarise themselves with local rules and procedures and implement these at all times. Notify the Research Supervisor of any changes to procedures or circumstances that may affect the documentation.
- Cooperate with the Research Supervisor, department and University in ensuring safe working practices are observed, and bringing to the attention of the Departmental Safety Officer any non-compliance with safe working procedures.

7. *Information and Training*

Departments must ensure that appropriate training is provided and what is included will depend on the outcome of the risk assessment. Training may include attendance at a formal course but practical training on specific equipment is almost always needed.

If the risk assessment indicates that an exposure could occur which could result in adverse health effects to staff, students or visitors, training must include specific information. Consult the Safety Office for further advice.

8. *Principles of protection*

Risks that cannot be avoided must be assessed. Risks are to be combated at source and collective protective measures are to be given priority over individual ones.

The hierarchy of control measures common to general risk management are

1. Substitution by less or non-dangerous process or equipment
2. Engineering and design measures
3. Administrative controls
4. Personal Protective Equipment

Control measures must be adapted to the individual and must adapt to technical progress.

9. *Risk assessment (writing and revising)*

There is a duty to carry out a specific risk assessment where there is a reasonably foreseeable risk of adverse health effects where those risks have not already been eliminated or controlled.

Departments have a duty to eliminate or reduce to as low a level as is reasonably practicable the risk of adverse effects to the eye or skin of staff, students, visitors and others who may be affected by the work.

10. Health Surveillance

If the event of a health effect being reported, or in the event of exposure above the exposure limits, appropriate medical examinations or individual health surveillance will be provided.

11. Procurement of equipment

Adequate information should be provided by manufacturers and suppliers to ensure that assessments required by the legislation can be carried out. If adequate information is not provided on request prior to purchase, the equipment should not be purchased and an alternative supplier should be sought.

12. Other relevant University Policy and Guidance

University safety web pages on electromagnetic fields <http://www.admin.cam.ac.uk/cam-only/offices/safety/radiation/nonir/emf>

13. References: Regulations, Relevant Standards and Guidance

1. The Control of Electromagnetic Fields at Work Regulations 2016 http://www.legislation.gov.uk/ukxi/2016/588/pdfs/ukxi_20160588_en.pdf and the European Directive: Physical Agents (electromagnetic fields) directive <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:179:0001:0021:EN:pdf>
2. Health Protection Agency: <http://www.hpa.org.uk/Topics/Radiation/>
3. Health and Safety Executive: <http://www.hse.gov.uk/radiation/nonionising/electro.htm>
4. Safety Guidelines for Magnetic Resonance Imaging Equipment in Clinical Use: <http://www.mhra.gov.uk/Publications/Safetyguidance/DeviceBulletins/CON2033018>
5. International Commission for Non-Ionising Radiation: <http://www.icnirp.de>
6. A list of MR "implants" (note the disclaimer): <http://www.mrisafety.com/list.asp>



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