



# ELECTROMAGNETIC FIELDS

## IO2 – EDUCATIONAL MATERIALS

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# Electromagnetic Fields

Electromagnetic fields (EMFs) arise whenever electrical energy is used.



**The exposure of people to high levels of EMFs can give rise to acute effects.**

EMFs means:

- Static electric;
- Static magnetic;
- Time varying electric;
- Magnetic;
- Electromagnetic;

fields with frequencies up to 300 GHz

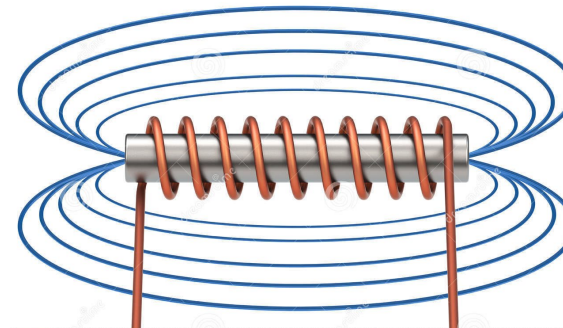


Figure 1 – E.g. Electromagnetic field  
Source: CharlesFockaert

# Electromagnetic Fields – Health effects

**Low Frequencies**



Effects on the central nervous system

**High Frequencies**



Rise in body temperature

**100kHz Frequencies**



Dielectric whole-body

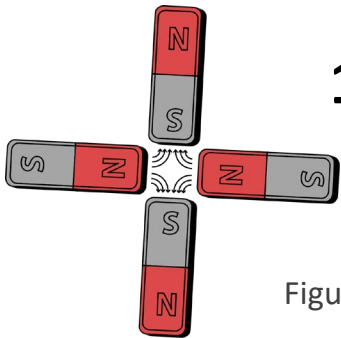


Figure 2 – Quadropole Magnetic Field  
Source: wikipedia.org

# Electromagnetic Fields – Health Effects

Workers with implants exposed to EMFs:

- The dominating effect on the human body due to static fields are resulting forces on ferromagnetic elements (e.g. metallic implants) or moving charges (e.g. blood ions).
- Passive and active medical implants like cardiac pacemakers might be susceptible to static and a.c. electromagnetic fields.

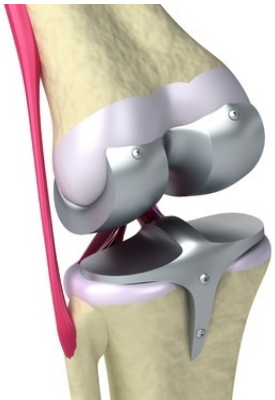


Figure 3 – e.g. metallic implant susceptible to electromagnetic fields

Source: farinia.com

# Electromagnetic Fields – Workplace risks

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Welding processes generally involve high currents and relatively low voltages. Thus, the magnetic field is of most importance.

## Main welding processes that produce considerable magnetic fields:

- |                       |   |  |
|-----------------------|---|--|
| ➤ Arc welding;        |   | <ul style="list-style-type: none"><li>• Electrodes</li><li>• Cable</li></ul> |
| ➤ Resistance welding; |  | <ul style="list-style-type: none"><li>• Electrodes</li></ul>                 |

the level of exposure of a welder will greatly depend on the proximity of the main emitters to the welder's body

# Electromagnetic Fields – Workplace risks

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With the main EMF hazardous effects on the human body previously explained, the following slides will focus on preventive measures for the working individual. These measures are listed below:

- Do not place your body between the welding electrode and work cables;
- Route cables on the same side of your body;
- Route the welding cables close together. Secure them together with tape or cable ties;
- Connect the work cable to the workpiece as close to the weld zone as practical;

# Electromagnetic Fields – Workplace risks

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- Do not use current settings higher than necessary;
- Keep the weld cables as close together as possible by twisting or taping them;
- Connect work clamp to workpiece as close to the weld as possible;
- Arrange cables to one side and away from the operator;
- Keep welding power source and cables as far away as practical;
- Do not weld with rapidly repeated short spurts—wait about 10 seconds between each weld;

# Electromagnetic Fields – Workplace risks

- If you feel sick, stop welding immediately and get medical attention;
- Do not work alone.

The electromagnetic spectrum comprises the entire range of frequencies of electromagnetic radiation and their respective photon energies and also wavelengths.

## ELECTROMAGNETIC SPECTRUM

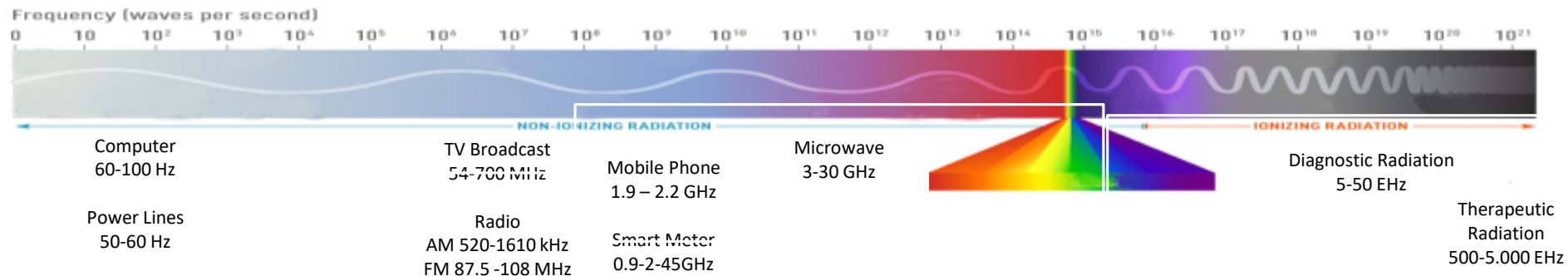


Figure 4 – Electromagnetic spectrum  
Source: quantifiedbob.com



# Electromagnetic Fields – Workplace Signalization

Some examples of the necessary signalization to have in a workshop where the workers might be subjected to EMFs with dicey intensities are shown below:

**NOTICE      CAUTION      WARNING**



Figure 5 - Colour code for RFR warning signs. & Typical warning sign of an area subjected to strong magnetic fields Source: <https://blink.ucsd.edu/safety/radiation/radfreq.html> & <https://www.safetysign.com/products/4991/danger-restricted-access-sign?s=st1ztfjkzsk15m9zppj7pzbp14x>

# Electromagnetic Fields – Workplace Signalization



Figure 6 – Standard prohibition signs often displayed in relation to EMF: No access for people with active implanted cardiac devices (left) and No access for people with metallic implants (right). Source: [https://en.wikipedia.org/wiki/ISO\\_7010](https://en.wikipedia.org/wiki/ISO_7010)

# Electromagnetic Fields – Checking the workplace

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**Action Level (AL)** - Have been produced relating to quantities which can be measured more easily.

**Exposure Limit Value (ELV)** - Legal limitations on the exposure of employees to EMFs and relate to the levels of exposure to EMFs within the body.

Some ALs are not tied to a particular ELV but serve as guidelines to indirect effects that may take place and harm the operator, i.e. interference with pacemakers or risking that metal objects become projectiles due to strong magnetic field.

# Electromagnetic Fields – Checking the workplace

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## High frequency electromagnetic waves



**Regular checks should also be performed considering equipment that generates x-rays or *γ-rays*.**

This type of radiation is commonly associated with long-term side effects such as the increased risk of cancer.

Considerations shall be taken regarding the exposure limit value (ELV), since there is a wide range of equipment that produces EMFs that are not hazardous for a person and a wide range of equipment that do so.

# Electromagnetic Fields – Use and maintenance of the equipment

An EMF meter is a scientific device for measuring EMFs.

Most meters measure the electromagnetic radiation flux density (DC fields) or the change in an electromagnetic field over time (AC fields). The latter is essentially the same as a radio antenna, but with quite different detection characteristics.

Figure 7 – EMF meter  
Source: Testmeter.co.uk



Every equipment tested should comply with the maximum permissible exposure (MPE) allowed by the European directive on this subject.

Other equipment and software are available to support this task.

# Electromagnetic Fields – Personal protective equipment

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**It is the supervisor's job to ensure:**

- Every worker exposed to EMF related risks have their correct PPEs;
  - This equipment should be free of damage;
  - It should be compliant with European and national safety standards;
- Provide the correct maintenance of the PPEs according to safety standards.

# Electromagnetic Fields – Personal protective equipment

Some of the protective actions concerning PPE which both the workshop **supervisor** and **worker** should be responsible for are listed below:

- Provide face shields, coveralls and gloves;
- Provide other protection devices such as screens/curtains/restricted access;
- Provide information and training;
- Display appropriate warning signs;
- Monitor and enforce use of control measures;
- If any workers are over-exposed, provide medical examination and consider whether follow-up health surveillance is appropriate;

# Electromagnetic Fields – European, national recommendations and regulations

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## European Recommendations

Directive 2013/35/EU