

Workers' exposure to electromagnetic fields from welding processes

Job Knowledge

In less than two years' time, new legislation will come into force in Europe requiring all employers to make an assessment of their workers' exposure to electromagnetic fields (EMF). The European Directive 2013/35/EU ⁽¹⁾, which was published last year, will be transposed into law in each European country and will come into force on 1 July 2016.

Although this legislation applies to all industrial processes, it is believed that it will have a significant impact on only a few industries which include welding, heating and inspection. High currents involved in welding create high levels of magnetic fields, to which the welder may be exposed. Furthermore, high frequency components of the field, as produced by inverters, AC and pulsed welding processes, produce magnetic fields that are more significant than those at power frequencies.

The aim of the legislation is to protect workers from the risks associated with electromagnetic fields, so it is mainly applicable to manual processes such as resistance welding using pedestal welders, portable spot welding guns and arc welding. Other processes such as induction heating and magnetic particle inspection may also be affected.

For welding processes producing low frequency fields the fields may have a detrimental effect on the mental and physical health of the exposed workers. The Directive lists the effects as stimulation of muscles, nerves or sensory organs and transitory symptoms such as vertigo or retinal phosphenes may be experienced. The concern is that these effects may affect the ability of the worker to work safely.

The EMF Directive requires employers to make an assessment relating to workers exposure to EMF, but unlike other Physical Agents Directives such as noise, this is not a simple task. The exposure limit values (ELVs) in the Directive are expressed as the electric field induced in the human body (V/m), Figure 1, but these fields cannot be measured directly.

[[Zoom](#)]

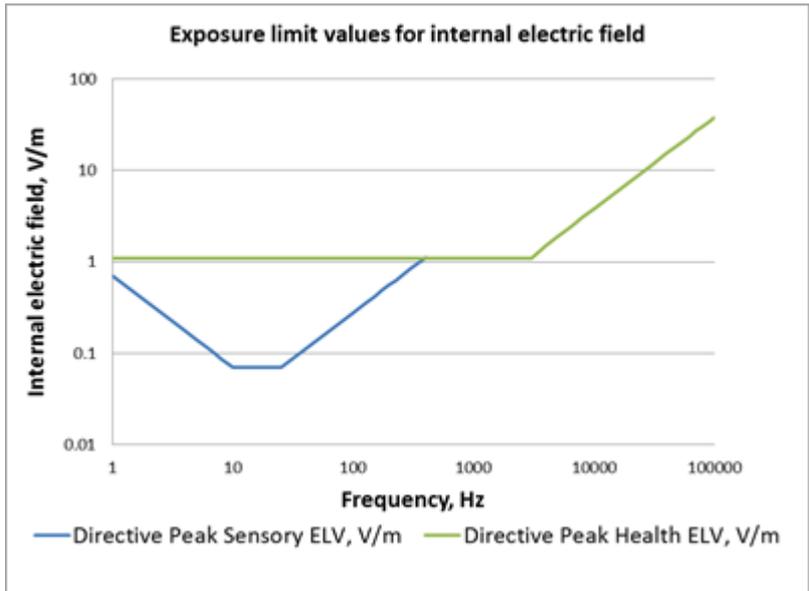


Figure 1. ELVs for the internal electric field strength from 1Hz to 10MHz
 Because of this, the Directive introduces action levels (ALs) for the field to which the welder/operator is exposed. Action levels can be measured directly using appropriate instruments, see Figure 2. Compliance with these ALs demonstrates compliance to the ELVs, but because the ALs are conservative, it is possible to be in compliance, even though the ALs have been exceeded.

Electromagnetic fields may be sub-divided into magnetic and electric fields and for most welding processes, it is the magnetic field which is significant.

[[Zoom](#)]



Figure 2. Equipment for measuring the magnetic field
 To make an assessment against the ALs, the magnetic field needs to be measured over a wide frequency range, as the ALs are frequency dependant, see Figure 3.

[[Zoom](#)]

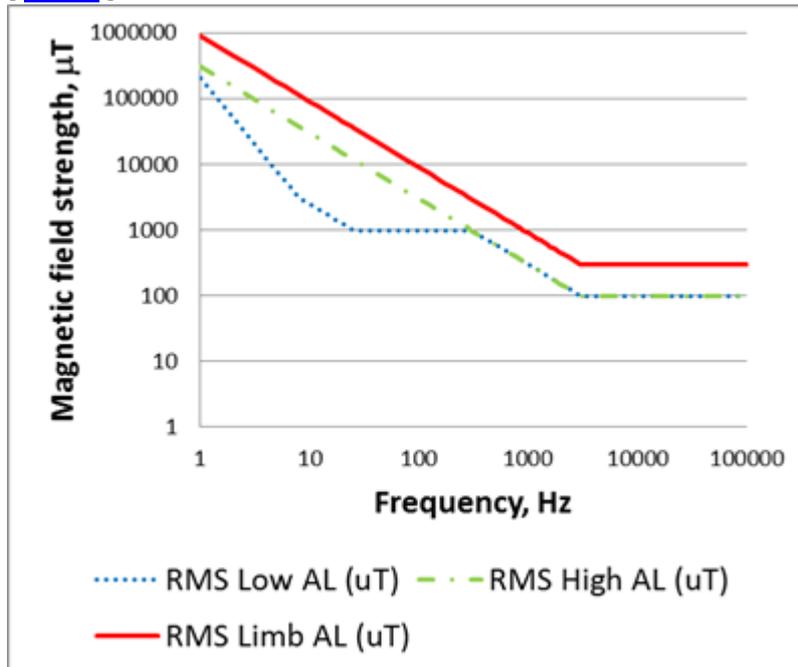


Figure 3 Action levels for the external magnetic field.

The Directive includes low and high ALs for the body and a separate AL for limbs which, although higher, could have serious implications for manual welding or when the work piece is being held, as is often the case in resistance welding. The magnetic field from most welding processes is non-sinusoidal, so the assessment needs to be made using the weighted-peak method as described by Hamnerius and Nilsson ⁽²⁾.

Measurements around resistance welding equipment have shown that the action levels can be exceeded even at relatively low currents. Figure 3 shows some typical values for a single phase resistance welding pedestal machine. Although at the front of the machine the low AL is not exceeded (less than 100%), to the side the low AL is exceeded and the hand exposure is very close to the limit.

[[Zoom](#)]



Figure 4 Assessment for resistance welding

Fortunately, the magnetic field falls off rapidly with distance, so moving just 200mm further away from the electrodes can make a significant difference to exposure.

However, even if the ALs are exceeded, the internal field may still be below the exposure limit values, but calculation is necessary to show this. This may require a specialist software modelling programme and one assessment can take many hours.

To assist companies in making an assessment of EMF exposure, the EMFWELD project ⁽³⁾ has produced a prototype of a web based software application. This software enables a company to make an assessment without having to take EMF measurements or carry out calculations.

A video describing the EMFWELD project is available here <http://youtu.be/oSPjV3PKXKk>

Once an assessment has been made, it may be necessary to reduce the workers exposure, which could be as simple as moving back slightly, but may require mechanisation of the process. Signs, floor markings and barriers may also be necessary. The Directive also requires that workers are given all necessary information about the assessment if they are likely to be exposed to risks from EMF and training should be provided as necessary. In some cases, health surveillance may be required. Further guidance on these aspects should be available by 2016 when the EU Practical Guide to the EMF Directive is published.

For further information on the EMF Directive and TWI assistance, please [contact us](#).