L.N. ??? of 2016

OCCUPATIONAL HEALTH AND SAFETY AUTHORITY ACT (CAP. 424)

Work Place (Minimum Health and Safety Requirements for the Protection of Workers from Risks resulting from Exposure to Electromagnetic Fields) Regulations, 2016

IN exercise of the powers conferred by article 12 of the Occupational Health and Safety Authority Act, the Minister for Social Dialogue, Consumer Affairs and Civil Liberties, after consultation with the Occupational Health and Safety Authority, has made the following regulations:

1. (1) The title of these regulations is the Work Place (Minimum Health and Safety Requirements for the Protection of Workers from Risks resulting from Exposure to Electromagnetic Fields) Regulations, 2016.

(2) The scope of these regulations is to lay down minimum requirements for the protection of workers from risks to their health and safety arising, or likely to arise, from exposure to electromagnetic fields during their work. These regulations shall implement Directive 2013/35/EC of the European Parliament and of the Council. These regulations cover all known direct biophysical effects and indirect effects caused by electromagnetic fields.

(3) The exposure limit values (ELVs) laid down in these regulations cover only scientifically well-established links between short-term direct biophysical effects and exposure to electromagnetic fields.

(4) These regulations do not cover suggested long-term effects.

(5) These regulations do not cover the risks resulting from contact with live conductors.

(6) These regulations shall apply fully to all workers without prejudice to more stringent and, or more specific provisions contained in any other law or regulation on the protection of workers from the risks related to exposure to electromagnetic fields.

(7) These regulations shall come into force on the 1st July 2016.

2. In these regulations, unless the context otherwise requires -

“Act” means the Occupational Health and Safety Authority Act;

“action levels (ALs)” means operational levels established for the purpose of simplifying the process of demonstrating the compliance with relevant ELVs or, where appropriate, to take relevant protection or prevention measures specified in these regulations.

The Action Level terminology used in Schedule II is as follows:

(i) for electric fields, ‘low ALs’ and ‘high ALs’ means levels which relate to the specific protection or prevention measures specified in these
regulations; and

(ii) for magnetic fields, ‘low ALs’ means levels which relate to the sensory effects ELVs and ‘high ALs’ to the health effects ELVs;

“Authority” means the Occupational Health and Safety Authority;

“Commission” means the Commission of the European Union;

“direct biophysical effects’ means effects in the human body directly caused by its presence in an electromagnetic field, including:

(i) thermal effects, such as tissue heating through energy absorption from electromagnetic fields in the tissue;

(ii) non-thermal effects, such as the stimulation of muscles, nerves or sensory organs. These effects might have a detrimental effect on the mental and physical health of exposed workers. Moreover, the stimulation of sensory organs may lead to transient symptoms, such as vertigo or phosphenes. These effects might create temporary annoyance or affect cognition or other brain or muscle functions, and may thereby affect the ability of a worker to work safely (i.e. safety risks); and

(iii) limb currents;

“electromagnetic fields” means static electric, static magnetic and time-varying electric, magnetic and electromagnetic fields with frequencies up to 300 GHz;

“exposure limit values (ELVs)” means values established on the basis of biophysical and biological considerations, in particular on the basis of scientifically well-established short-term and acute direct effects, i.e. thermal effects and electrical stimulation of tissues;

“health effects ELVs” means those ELVs above which workers might be subject to adverse health effects, such as thermal heating or stimulation of nerve and muscle tissue;

“indirect effects” means effects, caused by the presence of an object in an electromagnetic field, which may become the cause of a safety or health hazard, such as:

(i) interference with medical electronic equipment and devices, including cardiac pacemakers and other implants or medical devices worn on the body;

(ii) the projectile risk from ferromagnetic objects in static magnetic fields;

(iii) the initiation of electro-explosive devices (detonators);

(iv) fires and explosions resulting from the ignition of flammable materials by sparks caused by induced fields, contact currents or spark discharges; and

(v) contact currents;

“sensory effects ELVs” means those ELVs above which workers might be subject to transient disturbed sensory perceptions and minor changes in brain functions;
“Union” means the European Union.

3. (1) Physical quantities regarding exposure to electromagnetic fields are indicated in Schedule I. Health effects ELVs, sensory effects ELVs and ALs are set out in Schedules II and III.

(2) Employers shall ensure that the exposure of workers to electromagnetic fields is limited to the health effects ELVs and sensory effects ELVs set out in Schedule II, for non-thermal effects, and in Schedule III, for thermal effects. Compliance with health effects ELVs and sensory effects ELVs must be established by the use of relevant exposure assessment procedures referred to in regulation 4. Where the exposure of workers to electromagnetic fields exceeds the ELVs, the employer shall take immediate action in accordance with regulation 5(8).

(3) For the purpose of these regulations, where it is demonstrated that the relevant ALs set out in Schedules II and III are not exceeded, the employer shall be deemed to be in compliance with the health effects ELVs and sensory effects ELVs. Where the exposure exceeds the ALs, the employer shall act in accordance with regulation 5(2), unless the assessment carried out in accordance with regulations 4(1), (2) and (3) demonstrates that the relevant ELVs are not exceeded and that safety risks can be excluded.

Notwithstanding sub-regulation (1), exposure may exceed:

(a) low ALs for electric fields (Schedule II, Table B1), where justified by the practice or process, provided that either the sensory effects ELVs (Schedule II, Table A3) are not exceeded; or

(i) the health effects ELVs (Schedule II, Table A2) are not exceeded;

(ii) the excessive spark discharges and contact currents (Schedule II, Table B3) are prevented by specific protection measures as set out in regulation 5(6); and

(iii) information on the situations referred to in paragraph (f) of regulation 6 has been given to workers;

(b) low ALs for magnetic fields (Schedule II, Table B2) where justified by the practice or process, including in the head and torso, during the shift, provided that either the sensory effects ELVs (Schedule II, Table A3) are not exceeded; or

(i) the sensory effects ELVs are exceeded only temporarily;

(ii) the health effects ELVs (Schedule II, Table A2) are not exceeded;

(iii) action is taken, in accordance with regulation 5(9), where there are transient symptoms under paragraph (a) of that regulation; and

(iv) information on the situations referred to in paragraph (f) of regulation 6 has been given to workers.

(4) Notwithstanding sub-regulations 2 and 3, exposure may exceed:

(a) the sensory effects ELVs (Schedule II, Table A1) during the shift, where justified by the practice or process, provided that:
(i) they are exceeded only temporarily;
(ii) the health effects ELVs (Schedule II, Table A1) are not exceeded;
(iii) specific protection measures have been taken in accordance with regulation 5(7);
(iv) action is taken in accordance with regulation 5(9), where there are transient symptoms under paragraph (b) of that regulation; and
(v) information on the situations referred to in paragraph (f) of regulation 6 has been given to workers;

(b) the sensory effects ELVs (Schedule II, Table A3 and Schedule III, Table A2) during the shift, where justified by the practice or process, provided that:

(i) they are exceeded only temporarily;
(ii) the health effects ELVs (Schedule II, Table A2 and Schedule III, Table A1 and Table A3) are not exceeded;
(iii) action is taken in accordance with regulation 5(9), where there are transient symptoms under paragraph (a) of that regulation; and
(iv) information on the situations referred to in paragraph (f) of regulation 6 has been given to workers.

4. (1) The employer shall assess all risks for workers arising from electromagnetic fields at the workplace and, if necessary, measure or calculate the levels of electromagnetic fields to which workers are exposed.

Without prejudice to regulation 12 of the General Provisions for Health and Safety at Work Places Regulations, 2003 (L.N. 36/2003) and regulation 6 of these regulations that assessment can be made public on request in accordance with relevant Union and national laws and practice. In particular, in the case of processing the personal data of employees in the course of such an assessment, any publication shall comply with the Data Protection Act on the protection of individuals with regard to the processing of personal data and on the free movement of such data. Unless there is an overriding public interest in disclosure, public authorities that are in possession of a copy of the assessment may refuse a request for access to it or a request to make it public, where disclosure would undermine the protection of commercial interests of the employer, including those relating to intellectual property. Employers may refuse to disclose or make public the assessment under the same conditions in accordance with the relevant Union and national laws and practice.

(2) For the purpose of the assessment provided for in sub-regulation 1 the employer shall identify and assess electromagnetic fields at the workplace, taking into account the relevant practical guides made available by the Commission and other relevant standards or guidelines, including exposure databases. Notwithstanding the employer's obligations under this regulation, the employer shall also be entitled, where relevant, to take into account the emission levels and other appropriate safety-related data provided, by the manufacturer or distributor, for the equipment, in accordance with relevant Union law, including an
assessment of risks, if applicable to the exposure conditions at the workplace or place of installation.

(3) If compliance with the ELVs cannot be reliably determined on the basis of readily accessible information, the assessment of the exposure shall be carried out on the basis of measurements or calculations. In such a case, the assessment shall take into account uncertainties concerning the measurements or calculations, such as numerical errors, source modelling, phantom geometry and the electrical properties of tissues and materials, determined in accordance with relevant good practice.

(4) The assessment, measurement and calculations referred to in sub-regulations 1, 2 and 3 shall be planned and carried out by competent services or persons at suitable intervals, taking into account the guidance given under these regulations and taking particular account of regulations 9 and 13 of the General Provisions for Health and Safety at Work Places Regulations, 2003 (L.N. 36/2003). The data obtained from the assessment, measurement or calculation of the level of exposure shall be preserved in a suitable traceable form so as to permit consultation at a later stage, in accordance with national law and practice.

(5) When carrying out the risk assessment, the employer shall give particular attention to the following:

(a) the health effects ELVs, the sensory effects ELVs and the ALs referred to in regulation 3 and Schedules II and III of these regulations;

(b) the frequency, the level, duration and type of exposure, including the distribution over the worker’s body and over the volume of the workplace;

(c) any direct biophysical effects;

(d) any effects on the health and safety of workers at particular risk, in particular workers who wear active or passive implanted medical devices, such as cardiac pacemakers, workers with medical devices worn on the body, such as insulin pumps, and pregnant workers;

(e) any indirect effects;

(f) the existence of replacement equipment designed to reduce the level of exposure to electromagnetic fields;

(g) appropriate information obtained from the health surveillance referred to in regulation 8;

(h) information provided by the manufacturer of equipment;

(i) other relevant health and safety related information;

(j) multiple sources of exposure;

(k) simultaneous exposure to multiple frequency fields.

(6) In workplaces open to the public it is not necessary for the exposure assessment to be carried out if an evaluation has already been undertaken in accordance with the provisions on the limitation of exposure of the general public to electromagnetic fields, if the restrictions specified in those provisions are respected for workers and if the health and safety risks are excluded. Where equipment intended for the public use is used as intended and complies with
Union law on products that establishes stricter safety levels than those provided for by these regulations, and no other equipment is used, these conditions are deemed to be met.

(7) The employer shall be in possession of an assessment of the risks in accordance with regulation 10 of the General Provisions for Health and Safety at Work Places Regulations, 2003 (L.N. 36/2003) and shall identify which measures must be taken in accordance with regulation 5 of these regulations. The risk assessment may include the reasons why the employer considers that the nature and the extent of the risks related to electromagnetic fields make a further detailed risk assessment unnecessary. The risk assessment shall be updated on a regular basis, particularly if there have been significant changes which could render it out of date, or if the results of the health surveillance referred to in regulation 8 show this to be necessary.

5. (1) Taking account of technical progress and the availability of measures to control the production of electromagnetic fields at the source, the employer shall take the necessary actions to ensure that risks arising from electromagnetic fields at the workplace are eliminated or reduced to a minimum.

(2) On the basis of the risk assessment referred to in regulation 4, once the relevant ALs, referred to in regulation 3 and in Schedules II and III, are exceeded and unless the assessment carried out in accordance with regulations 4(1), (2) and (3) demonstrates that the relevant ELVs are not exceeded and that safety risks can be excluded, the employer shall devise and implement an action plan that shall include technical and, or organisational measures to prevent exposure exceeding the health effects ELVs and sensory effects ELVs, taking into account, in particular:

(a) other working methods that entail less exposure to electromagnetic fields;

(b) the choice of equipment emitting less intense electromagnetic fields, taking account of the work to be done;

(c) technical measures to reduce the emission of electromagnetic fields, including, where necessary, the use of inter- locks, shielding or similar health protection mechanisms;

(d) appropriate delimitation and access measures, such as signals, labels, floor markings, barriers, in order to limit or control access;

(e) in the case of exposure to electric fields, measures and procedures to manage spark discharges and contact currents through technical means and through the training of workers;

(f) appropriate maintenance programmes for work equipment, workplaces and workstation systems;

(g) the design and layout of workplaces and workstations;

(h) limitations of the duration and intensity of the exposure;

(i) the availability of adequate personal protection equipment.

(3) On the basis of the risk assessment referred to in regulation 4, the employer shall devise and implement an action plan that shall include technical and, or organisational measures to prevent any risks to workers at particular risk.
and any risks due to indirect effects, referred to in regulation 4.

(4) In addition to providing the information set out in regulation 6 of these regulations, the employer shall, adapt the measures referred to in this regulation to the requirements of workers at particular risk and, where applicable, to individual risks assessments, in particular in respect of workers who have declared the use of active or passive implanted medical devices, such as cardiac pacemakers, or the use of medical devices worn on the body, such as insulin pumps, or in respect of pregnant workers who have informed their employer of their condition.

(5) On the basis of the risk assessment referred to in regulation 4, workplaces where workers are likely to be exposed to electromagnetic fields that exceed the ALs shall be indicated by appropriate signs in accordance with Schedules II and III and with the Work Place (Provision of Health and, or Safety Signs) Regulations, 2002 (L.N. 45/2002). The areas in question shall be identified and access to them limited, as appropriate. Where access to these areas is suitably restricted for other reasons and workers are informed of the risks arising from electromagnetic fields, signs and access restrictions specific to electromagnetic fields shall not be required.

(6) Where sub-regulation 3(3)(a) applies, specific protection measures shall be taken, such as the training of workers in accordance with regulation 6 and the use of technical means and personal protection, for example the grounding of work objects, the bonding of workers with work objects (equipotential bonding) and, where appropriate and in accordance with Article 4(1)(a) of Council Directive 89/656/EEC of 30 November 1989 on the minimum health and safety requirements for the use by workers of personal protective equipment at the workplace, the use of insulating shoes, gloves and protective clothing.

(7) Where sub-regulation 3(4)(a) applies, specific protection measures, such as controlling movements, shall be taken.

(8) Workers shall not be exposed above the health effects ELVs and sensory effects ELVs, unless the conditions under either sub-regulations 9(1)(a) or (c) or regulations 3(3) or (4) are fulfilled. If, despite the measures taken by the employer, the health effects ELVs and sensory effects ELVs are exceeded, the employer shall take immediate action to reduce exposure below these ELVs. The employer shall identify and record the reasons why the health effects ELVs and sensory effects ELVs have been exceeded, and shall amend the protection and prevention measures accordingly in order to prevent them being exceeded again. The amended protection and prevention measures shall be preserved in a suitable traceable form so as to permit consultation at a later stage, in accordance with national law and practice.

(9) Where sub-regulations 3 and 4 of regulation 3 apply and where the worker reports transient symptoms, the employer shall, if necessary, update the risk assessment and the prevention measures. Transient symptoms may include:

(a) sensory perceptions and effects in the functioning of the central nervous system in the head evoked by time varying magnetic fields; and

(b) static magnetic field effects, such as vertigo and nausea.

6. Without prejudice to the provisions of regulations 12 and 14 of the General Provisions for Health and Safety at Work Places Regulations, 2003 (L.N. 36/2003), the employer shall ensure that workers who are likely to be exposed to risks from electromagnetic fields at work and, or their representatives receive any necessary information and training relating to the outcome of the risk assessment provided for in regulation 4 of these regulations, concerning in particular:
(a) measures taken in application of these regulations;

(b) the values and concepts of the ELVs and ALs, the associated possible risks and the preventive measures taken;

(c) the possible indirect effects of exposure;

(d) the results of the assessment, measurement or calculations of the levels of exposure to electromagnetic fields, carried out in accordance with regulation 4 of these regulations;

(e) how to detect adverse health effects of exposure and how to report them;

(f) the possibility of transient symptoms and sensations related to effects in the central or peripheral nervous system;

(g) the circumstances in which workers are entitled to health surveillance;

(h) safe working practices to minimise risks resulting from exposure;

(i) workers at particular risk, as referred to in sub-regulation 4(5)(d) and regulations 5(3) and (4) of these regulations.

7. Consultation and participation of workers and, or their representatives on the matters covered by these regulations and the schedules hereto, including the assessment, measurement and, or calculations of the levels of exposure to electromagnetic fields experienced at work, shall take place in accordance with the General Provisions for Health and Safety at Work places Regulations, 2003.

8. (1) With the objective of the prevention and the early diagnosis of any adverse health effects due to exposure to electromagnetic fields, an employer shall make arrangements for carrying out appropriate health surveillance of workers exposed to electromagnetic fields. Health records shall be made available to the Authority.

(2) An employer shall ensure that the results of health surveillance are preserved in a suitable form that allows them to be consulted at a later date, subject to compliance with confidentiality requirements. Individual workers shall, at their request, have access to their own personal health records.

If any undesired or unexpected health effect is reported by a worker, or in any event where exposure above the ELVs is detected, the employer shall ensure that appropriate medical examinations or individual health surveillance is provided to the worker(s).

Such examinations or surveillance shall be made available during hours chosen by the worker, and any costs arising shall be borne by the employer.
9. (1) By way of derogation from regulation 3 but without prejudice to regulation 5(1), the following shall apply:

(a) exposure may exceed the ELVs if the exposure is related to the installation, testing, use, development, maintenance of or research related to magnetic resonance imaging (MRI) equipment for patients in the health sector, provided that all the following conditions are met:

(i) the risk assessment carried out in accordance with regulation 4 has demonstrated that the ELVs are exceeded;

(ii) given the state of the art, all technical and, or organisational measures have been applied;

(iii) the circumstances duly justify exceeding the ELVs;

(iv) the characteristics of the workplace, work equipment, or work practices have been taken into account; and

(v) the employer demonstrates that workers are still protected against adverse health effects and against safety risks, including by ensuring that the instructions for safe use provided by the manufacturer in accordance with Council Directive 93/42/EEC of 14 June 1993 concerning medical devices are followed;

(b) Equivalent or more specific protection systems may be implemented for personnel working in operational military installations or involved in military activities, including in joint international military exercises, provided that adverse health effects and safety risks are prevented. In such cases the Authority shall be informed in writing by the Commander of the Armed Forces of Malta before the start of these activities;

(c) The Authority may allow, in duly justified circumstances and only for as long as they remain duly justified, for the ELVs to be temporarily exceeded in specific sectors or for specific activities outside the scope of paragraphs (a) and (b). For the purposes of this point, ‘duly justified circumstances’ shall mean circumstances in which the following conditions are met:

(i) the risk assessment carried out in accordance with regulation 4 has shown that the ELVs are exceeded;

(ii) given the state of the art, all technical and, or organisational measures have been applied;

(iii) the specific characteristics of the workplace, work equipment, or work practices have been taken into account; and

(iv) the employer demonstrates that workers are still protected against adverse health effects and safety risks, including using comparable, more specific and internationally recognised standards and guidelines.

In such cases the employer shall inform the Authority in writing before the start of these activities.
10. In any proceedings for an offence under these regulations consisting of failure to comply with a duty or requirement to do something, or to do something so far as is reasonably practicable, it shall be for the accused to prove, as the case may be, that it was not practicable or not reasonably practicable to do more than was in fact done to satisfy the duty or requirement, or there was no better practicable means than was in fact used to satisfy the duty or requirement.

11. (1) Any breach by any person of any provision of these regulations shall be deemed an offence.

(2) Any person who knowingly or recklessly interferes with the performance of a duty or obligation by a person under these regulations shall be guilty of an offence.
The following physical quantities are used to describe the exposure to electromagnetic fields:

Electric field strength (E) is a vector quantity that corresponds to the force exerted on a charged particle regardless of its motion in space. It is expressed in volt per metre (Vm⁻¹). A distinction has to be made between the environmental electric field and the electric field present in the body (in situ) as a result of exposure to the environmental electric field.

Limb current (Iₗ) is the current in the limbs of a person exposed to electromagnetic fields in the frequency range from 10 MHz to 110 MHz as a result of contact with an object in an electromagnetic field or the flow of capacitive currents induced in the exposed body. It is expressed in ampere (A).

Contact current (Iₐ) is a current that appears when a person comes into contact with an object in an electromagnetic field. It is expressed in ampere (A). A steady state contact current occurs when a person is in continuous contact with an object in an electromagnetic field. In the process of making such contact, a spark discharge may occur with associated transient currents.

Electric charge (Q) is an appropriate quantity used for spark discharge and is expressed in coulomb (C).

Magnetic field strength (H) is a vector quantity that, together with the magnetic flux density, specifies a magnetic field at any point in space. It is expressed in ampere per metre (Am⁻¹).

Magnetic flux density (B) is a vector quantity resulting in a force that acts on moving charges, expressed in tesla (T). In free space and in biological materials, magnetic flux density and magnetic field strength can be interchanged using the magnetic field strength of H = 1 Am⁻¹ equivalence to magnetic flux density of $B = 4\pi \times 10^{-7}$ T (approximately 1.25 microtesla).

Power density (S) is an appropriate quantity used for very high frequencies, where the depth of penetration in the body is low. It is the radiant power incident perpendicular to a surface, divided by the area of the surface. It is expressed in watt per square metre (Wm⁻²).

Specific energy absorption (SA) is an energy absorbed per unit mass of biological tissue, expressed in joule per kilogram (Jkg⁻¹). In these regulations, it is used for establishing limits for effects from pulsed microwave radiation.

Specific energy absorption rate (SAR), averaged over the whole body or over parts of the body, is the rate at which energy is absorbed per unit mass of body tissue and is expressed in watt per kilogram (Wkg⁻¹). Whole-body SAR is a widely accepted quantity for relating adverse thermal effects to radio frequency (RF) exposure. Besides the whole-body average SAR, local SAR values are necessary to evaluate and limit excessive energy deposition in small parts of the body resulting from special exposure conditions. Examples of such conditions include: an individual exposed to RF in the low MHz range (e.g. from dielectric heaters) and individuals exposed in the near field of an antenna.

Of these quantities, magnetic flux density (B), contact current (Iₐ), limb current (Iₗ), electric field strength (E), magnetic field strength (H), and power density (S) can be measured directly.
SCHEDULE II
NON-THERMAL EFFECTS
EXPOSURE LIMIT VALUES AND ACTION LEVELS IN THE
FREQUENCY RANGE FROM 0 Hz TO 10 MHz

PART A. EXPOSURE LIMIT VALUES (ELVs)

ELVs below 1 Hz (Table A1) are limits for static magnetic field which is not affected by the tissue of the body.

ELVs for frequencies from 1 Hz to 10 MHz (Table A2) are limits for electric fields induced in the body from exposure to time-varying electric and magnetic fields.

ELVs for external magnetic flux density from 0 to 1 Hz

The sensory effects ELV is the ELV for normal working conditions (Table A1) and is related to vertigo and other physiological effects related to disturbance of the human balance organ resulting mainly from moving in a static magnetic field.

The health effects ELV for controlled working conditions (Table A1) is applicable on a temporary basis during the shift when justified by the practice or process, provided that preventive measures, such as controlling movements and providing information to workers, have been adopted.

Table A1
ELVs for external magnetic flux density (B_0) from 0 to 1 Hz

| Normal working conditions | Sensory effects ELVs | 2 T |
| Localised limbs exposure | Health effects ELVs | 8 T |
| Controlled working conditions | | 8 T |

Health effects ELVs for internal electric field strength from 1 Hz to 10 MHz

Health effects ELVs (Table A2) are related to electric stimulation of all peripheral and central nervous system tissues in the body, including the head.

Table A2
Health effects ELVs for internal electric field strength from 1 Hz to 10 MHz

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>Health effects ELVs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Hz ≤ f &lt; 3 kHz</td>
<td>1.1 V m⁻¹ (peak)</td>
</tr>
<tr>
<td>3 kHz ≤ f ≤ 10 MHz</td>
<td>3.8 × 10⁻⁴ f V m⁻¹ (peak)</td>
</tr>
</tbody>
</table>
Note A2-1: \( f \) is the frequency expressed in hertz (Hz).

Note A2-2: The health effects ELVs for internal electric field are spatial peak values in the entire body of the exposed subject.

Note A2-3: The ELVs are peak values in time which are equal to the Root-Mean-Square (RMS) values multiplied by \( \sqrt{2} \) for sinusoidal fields. In the case of non-sinusoidal fields, exposure evaluation carried out in accordance with regulation 4 shall be based on the weighted peak method (filtering in time domain), explained in the practical guides made available by the Commission, but other scientifically proven and validated exposure evaluation procedures can be applied, provided that they lead to approximately equivalent and comparable results.

Sensory effects ELVs for internal electric field strength from 1 Hz to 400 Hz

The sensory effects ELVs (Table A3) are related to electric field effects on the central nervous system in the head, i.e. retinal phosphenes and minor transient changes in some brain functions.

Table A3

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>Sensory effects ELVs</th>
</tr>
</thead>
<tbody>
<tr>
<td>( 1 \leq f &lt; 10 \text{ Hz} )</td>
<td>( 0.7/f \text{ Vm}^{-1} ) (peak)</td>
</tr>
<tr>
<td>( 10 \leq f &lt; 25 \text{ Hz} )</td>
<td>( 0.07 \text{ Vm}^{-1} ) (peak)</td>
</tr>
<tr>
<td>( 25 \leq f \leq 400 \text{ Hz} )</td>
<td>( 0.0028 f \text{ Vm}^{-1} ) (peak)</td>
</tr>
</tbody>
</table>

Note A3-1: \( f \) is the frequency expressed in hertz (Hz).

Note A3-2: The sensory effects ELVs for internal electric field are spatial peak values in the head of the exposed subject.

Note A3-3: The ELVs are peak values in time which are equal to the Root-Mean-Square (RMS) values multiplied by \( \sqrt{2} \) for sinusoidal fields. In the case of non-sinusoidal fields, the exposure evaluation carried out in accordance with regulation 4 shall be based on the weighted peak method (filtering in time domain), explained in the practical guides made available by the Commission, but other scientifically proven and validated exposure evaluation procedures can be applied, provided that they lead to approximately equivalent and comparable results.

PART B. ACTION LEVELS (ALs)

The following physical quantities and values are used to specify the action levels (ALs), the magnitude of which are established to ensure by simplified assessment the compliance with relevant ELVs or at which relevant protection or prevention measures specified in regulation 5 must be taken:

— Low ALs(E) and high ALs(E) for electric field strength \( E \) of time varying electric fields as specified in Table B1;
— Low ALs(B) and high ALs(B) for magnetic flux density \( B \) of time varying magnetic fields as specified in Table B2;
— ALs(Ic) for contact current as specified in Table B3;
— ALs(B0) for magnetic flux density of static magnetic fields as specified in Table B4.

ALs correspond to calculated or measured electric and magnetic field values at the workplace in the absence of the worker.

Action levels (ALs) for exposure to electric fields

Low ALs (Table B1) for external electric field are based on limiting the internal electric field below the ELVs (Tables A2 and A3) and limiting spark discharges in the working environment.

Below high ALs, the internal electric field does not exceed the ELVs (Tables A2 and A3) and annoying spark discharges are prevented, provided that the protection measures referred to in regulation 5(6) are taken.

Table B1
ALs for exposure to electric fields from 1 Hz to 10 MHz

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>Electric field strength Low ALs (E) [Vm⁻¹] (RMS)</th>
<th>Electric field strength High ALs (E) [Vm⁻¹] (RMS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ≤ f &lt; 25 Hz</td>
<td>2.0 × 10⁴</td>
<td>2.0 × 10⁴</td>
</tr>
<tr>
<td>25 ≤ f &lt; 50 Hz</td>
<td>5.0 × 10⁴ /f</td>
<td>2.0 × 10⁴</td>
</tr>
<tr>
<td>50 Hz ≤ f &lt; 1.64 kHz</td>
<td>5.0 × 10⁵ /f</td>
<td>1.0 × 10⁶ /f</td>
</tr>
<tr>
<td>1.64 ≤ f &lt; 3 kHz</td>
<td>5.0 × 10⁵ /f</td>
<td>6.1 × 10²</td>
</tr>
<tr>
<td>3 kHz ≤ f ≤ 10 MHz</td>
<td>1.7 × 10²</td>
<td>6.1 × 10²</td>
</tr>
</tbody>
</table>

Note B1-1: f is the frequency expressed in hertz (Hz).

Note B1-2: The low ALs (E) and high ALs (E) are the Root-Mean-Square (RMS) values of the electric field strength which are equal to the peak values divided by √2 for sinusoidal fields. In the case of non-sinusoidal fields, the exposure evaluation carried out in accordance with regulation 4 shall be based on the weighted peak method (filtering in time domain), explained in the practical guides made available by the Commission, but other scientifically proven and validated exposure evaluation procedures can be applied, provided that they lead to approximately equivalent and comparable results.

Note B1-3: ALs represent maximum calculated or measured values at the workers’ body position. This results in a conservative exposure assessment and automatic compliance with ELVs in all non-uniform exposure conditions. In order to simplify the assessment of compliance with ELVs, carried out in accordance with regulation 4, in specific non-uniform conditions, criteria for the spatial averaging of measured fields based on established dosimetry laid down in the practical guides made available by the Commission. In the case of a very localised source within a distance of a few centimetres from the body, the induced electric field shall be determined dosimetrically, case by case.
Action levels (ALs) for exposure to magnetic fields

Low ALs (Table B2) are, for frequencies below 400 Hz, derived from the sensory effects ELVs (Table A3) and, for frequencies above 400 Hz, from the health effects ELVs for internal electric field (Table A2).

High ALs (Table B2) are derived from the health effects ELVs for internal electric field related to electric stimulation of peripheral and autonomous nerve tissues in head and trunk (Table A2). Compliance with the high ALs ensures that health effects ELVs are not exceeded, but the effects related to retinal phosphenes and minor transient changes in brain activity are possible, if the exposure of the head exceeds the low ALs for exposures up to 400 Hz. In such a case, regulation 5(6) applies.

ALs for exposure of limbs are derived from the health effects ELVs for internal electric field related to electric stimulation of the tissues in limbs by taking into account that the magnetic field is coupled more weakly to the limbs than to the whole body.

Table B2
ALs for exposure to magnetic fields from 1 Hz to 10 MHz

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>Magnetic flux density Low ALs(B) [μT] (RMS)</th>
<th>Magnetic flux density High ALs(B) [μT] (RMS)</th>
<th>Magnetic flux density ALs for exposure of limbs to a localised magnetic field [μT] (RMS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ≤ f &lt; 8 Hz</td>
<td>2.0 × 10^5 f^-2</td>
<td>3.0 × 10^5 f^-1</td>
<td>9.0 × 10^2 f^-1</td>
</tr>
<tr>
<td>8 ≤ f &lt; 25 Hz</td>
<td>2.5 × 10^4 f</td>
<td>3.0 × 10^5 f^-1</td>
<td>9.0 × 10^2 f^-1</td>
</tr>
<tr>
<td>25 ≤ f &lt; 300 Hz</td>
<td>1.0 × 10^3 f</td>
<td>3.0 × 10^5 f^-1</td>
<td>9.0 × 10^2 f^-1</td>
</tr>
<tr>
<td>300 Hz ≤ f &lt; 3 kHz</td>
<td>3.0 × 10^5 f</td>
<td>3.0 × 10^5 f^-1</td>
<td>9.0 × 10^2 f^-1</td>
</tr>
<tr>
<td>3 kHz ≤ f ≤ 10 MHz</td>
<td>1.0 × 10^2 f</td>
<td>1.0 × 10^2 f</td>
<td>3.0 × 10^2</td>
</tr>
</tbody>
</table>

Note B2-1: f is the frequency expressed in hertz (Hz).

Note B2-2: The low ALs and the high ALs are the Root-Mean-Square (RMS) values which are equal to the peak values divided by √2 for sinusoidal fields. In the case of non-sinusoidal fields the exposure evaluation carried out in accordance with regulation 4 shall be based on the weighted peak method (filtering in time domain), explained in the practical guides made available by the Commission, but other scientifically proven and validated exposure evaluation procedures can be applied, provided that they lead to approximately equivalent and comparable results.

Note B2-3: ALs for exposure to magnetic fields represent maximum values at the workers’ body position. This results in a conservative exposure assessment and automatic compliance with ELVs in all non-uniform exposure conditions. In order to simplify the assessment of compliance with ELVs, carried out in accordance with regulation 4, in specific non-uniform conditions, criteria for the spatial averaging of measured fields based on established dosimetry laid down in the practical guides made available by the Commission. In the case of a very localised source within a distance of a few centimetres from the body, the induced electric field shall be determined dosimetrically, case by case.
Table B3
ALs for contact current $I_C$

<table>
<thead>
<tr>
<th>Frequency</th>
<th>ALs ($I_C$) steady state contact current [mA] (RMS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to 2.5 kHz</td>
<td>1.0</td>
</tr>
<tr>
<td>2.5 ≤ $f$ &lt; 100 kHz</td>
<td>0.4 $f$</td>
</tr>
<tr>
<td>100 ≤ $f$ ≤ 10 000 kHz</td>
<td>40</td>
</tr>
</tbody>
</table>

Note B3-1: $f$ is the frequency expressed in kilohertz (kHz).

Action levels (ALs) for magnetic flux density of static magnetic fields

Table B4
ALs for magnetic flux density of static magnetic fields

<table>
<thead>
<tr>
<th>Hazards</th>
<th>ALs($B_0$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interference with active implanted devices, e.g. cardiac pacemakers</td>
<td>0.5 mT</td>
</tr>
<tr>
<td>Attraction and projectile risk in the fringe field of high field strength sources (&gt; 100 mT)</td>
<td>3 mT</td>
</tr>
</tbody>
</table>

SCHEDULE III
THERMAL EFFECTS
EXPOSURE LIMIT VALUES AND ACTION LEVELS IN THE
FREQUENCY RANGE FROM 100 kHz TO 300 GHz

PART A. EXPOSURE LIMIT VALUES (ELVs)

Health effects ELVs for frequencies from 100 kHz to 6 GHz (Table A1) are limits for energy and power absorbed per unit mass of body tissue generated from exposure to electric and magnetic fields.

Sensory effects ELVs for frequencies from 0.3 to 6 GHz (Table A2) are limits on absorbed energy in a small mass of tissue in the head from exposure to electromagnetic fields.

Health effects ELVs for frequencies above 6 GHz (Table A3) are limits for power density of an electromagnetic wave incident on the body surface.

Table A1

<table>
<thead>
<tr>
<th>Health effects ELVs</th>
<th>SAR values averaged over any six-minute period</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELVs related to whole body heat stress expressed as averaged SAR in the body</td>
<td>0.4 Wkg$^{-1}$</td>
</tr>
<tr>
<td>ELVs related to localised heat stress in head and trunk expressed as localised SAR in the body</td>
<td>10 Wkg$^{-1}$</td>
</tr>
<tr>
<td>ELVs related to localised heat stress in the limbs expressed as localised SAR in the limbs</td>
<td>20 Wkg$^{-1}$</td>
</tr>
</tbody>
</table>

Note A1-1: Localised SAR averaging mass is any 10 g of contiguous tissue; the maximum SAR so obtained should be the value used for estimating exposure. This 10 g of tissue is intended to be a mass of contiguous tissue with roughly homogeneous electrical properties. In specifying a contiguous mass of tissue, it is recognised that this concept may be used in computational dosimetry but may present difficulties for direct physical measurements. A simple geometry, such as cubic or spheric tissue mass, can be used.

Sensory effects ELVs from 0.3 GHz to 6 GHz

This sensory effects ELVs (Table A2) is related to avoiding auditory effects caused by exposures of the head to pulsed microwave radiation.

Table A2

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>Localised specific energy absorption (SA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0.3 \leq f \leq 6$ GHz</td>
<td>$10$ mJkg$^{-1}$</td>
</tr>
</tbody>
</table>
Note A2-1: Localised SA averaging mass is 10 g of tissue.

Table A3
Health effects ELVs for exposure to electromagnetic fields from 6 to 300 GHz

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>Health effects ELVs related to power density</th>
</tr>
</thead>
<tbody>
<tr>
<td>$6 \leq f \leq 300$ GHz</td>
<td>$50 \text{ Wm}^{-2}$</td>
</tr>
</tbody>
</table>

Note A3-1: The power density shall be averaged over any $20 \text{ cm}^2$ of exposed area. Spatial maximum power densities averaged over $1 \text{ cm}^2$ should not exceed 20 times the value of $50 \text{ Wm}^{-2}$. Power densities from 6 to 10 GHz are to be averaged over any six-minute period. Above 10 GHz, the power density shall be averaged over any $68f^{-0.05}$-minute period (where $f$ is the frequency in GHz) to compensate for progressively shorter penetration depth, as the frequency increases.

PART B. ACTION LEVELS (ALs)
The following physical quantities and values are used to specify the action levels (ALs), the magnitude of which are established to ensure by simplified assessment the compliance with the relevant ELVs or at which relevant protection or prevention measures specified in regulation 5 must be taken:

— ALs(E) for electric field strength $E$ of time varying electric field, as specified in Table B1;

— ALs(B) for magnetic flux density $B$ of time varying magnetic field, as specified in Table B1;

— ALs(S) for power density of electromagnetic waves, as specified in Table B1;

— ALs(Ic) for contact current, as specified in Table B2;

— ALs(Il) for limb current, as specified in Table B2;

ALs correspond to calculated or measured field values at the workplace in the absence of the worker, as maximum value at the position of the body or specified part of the body.

Action levels (ALs) for exposure to electric and magnetic fields

ALs(E) and ALs(B) are derived from the SAR or power density ELVs (Tables A1 and A3) based on the thresholds related to internal thermal effects caused by exposure to (external) electric and magnetic fields.

Table B1
ALs for exposure to electric and magnetic fields from 100 kHz to 300 GHz

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>Electric field strength ALs(E) [Vm$^{-1}$] (RMS)</th>
<th>Magnetic flux density ALs(B) [μT] (RMS)</th>
<th>Power density ALs(S) [Wm$^{-2}$]</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 kHz ≤ f &lt; 1 MHz</td>
<td>$6.1 \times 10^2$</td>
<td>$2.0 \times 10^0/f$</td>
<td>—</td>
</tr>
<tr>
<td>1 ≤ f &lt; 10 MHz</td>
<td>$6.1 \times 10^0/f$</td>
<td>$2.0 \times 10^0/f$</td>
<td>—</td>
</tr>
<tr>
<td>10 ≤ f &lt; 400 MHz</td>
<td>61</td>
<td>0.2</td>
<td>—</td>
</tr>
<tr>
<td>400 MHz ≤ f &lt; 2 GHz</td>
<td>$3 \times 10^{-3} f^{1/2}$</td>
<td>$1.0 \times 10^{-5} f^{1/2}$</td>
<td>—</td>
</tr>
<tr>
<td>2 ≤ f &lt; 6 GHz</td>
<td>$1.4 \times 10^2$</td>
<td>$4.5 \times 10^{-1}$</td>
<td>—</td>
</tr>
<tr>
<td>6 ≤ f ≤ 300 GHz</td>
<td>$1.4 \times 10^2$</td>
<td>$4.5 \times 10^{-1}$</td>
<td>50</td>
</tr>
</tbody>
</table>

Note B1-1: $f$ is the frequency expressed in hertz (Hz).

Note B1-2: $[\text{ALs(E)}]^2$ and $[\text{ALs(B)}]^2$ are to be averaged over a six-minute period. For RF pulses, the peak power density averaged over the pulse width shall not exceed 1000 times the respective ALs(S) value. For multi-frequency fields, the analysis shall be based on summation, as explained in the practical guides made available by the Commission.

Note B1-3: ALs(E) and ALs(B) represent maximum calculated or measured values at the workers’ body position. This results in a conservative exposure assessment and automatic compliance with ELVs in all non-uniform exposure conditions. In order to simplify the assessment of compliance with ELVs, carried out in accordance with regulation 4, in specific non-uniform conditions, criteria for the spatial averaging of measured fields based on established dosimetry laid down in the practical guides made available by the Commission. In the case of a very localised source within a distance of a few centimetres from the body, compliance with ELVs shall be determined dosimetrically, case by case.

Note B1-4: The power density shall be averaged over any 20 cm$^2$ of exposed area. Spatial maximum power densities averaged over 1 cm$^2$ should not exceed 20 times the value of 50Wm$^{-2}$. Power densities from 6 to 10 GHz are to be averaged over any six-minute period. Above 10 GHz, the power density shall be averaged over any $68/f^{1.05}$-minute period (where $f$ is the frequency in GHz) to compensate for progressively shorter penetration depth as the frequency increases.

Table B2

<table>
<thead>
<tr>
<th>Frequency range</th>
<th>Steady state contact current, ALs($I_C$) [mA] (RMS)</th>
<th>Induced limb current in any limb, ALs($I_L$) [mA] (RMS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 kHz ≤ f &lt; 10 MHz</td>
<td>40</td>
<td>—</td>
</tr>
<tr>
<td>10 ≤ f ≤ 110 MHz</td>
<td>40</td>
<td>100</td>
</tr>
</tbody>
</table>

Note B2-1: $[\text{ALs}(I_L)]^2$ is to be averaged over a six-minute period.