

Text proposed by the Commission

Compromise T

Replacing amendments *190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226*

ANNEX II

EXPOSURE TO ELECTROMAGNETIC FIELDS IN THE FREQUENCY RANGE FROM 0 HZ TO 100 KHZ

A. EXPOSURE LIMITATION SYSTEM

The main principles underlying the protection system adopted for the range of frequencies up to 100 kHz (100 thousand cycles per second) are as follows:

- taking due account of the latest international recommendations published by the specialised organisations recognised worldwide
- introducing appropriate and ‘limited to purpose’ simplifications in order to facilitate the understanding and ‘in field’ implementation of the protection system
- introducing in practice a ‘zoning system’ in which each activity can be classified, whereby the location of an activity in a determined zone has a direct impact on the extent of the risk assessment to be carried out by the employer and on the recommended preventive measures
- limiting the number of cases where compliance with the actual exposure limits must be ensured because the measured exposure level is higher than the upper limit of the highest permitted zone (action level).

B. EXPOSURE LEVELS AND EXPOSURE LIMITS

In line with the most recent recommendations the following options have been taken:

- Action values and Orientation values correspond to estimated or measured field values at the workplace in absence of the worker.
- Exposure limit values for health effects and exposure limit values for safety effects are expressed as electric fields generated in nervous tissue *in the body* (in V/m)
- For a worker at particular risk, as defined in Article 4 (5c), an individual assessment must be made in accordance with Annex II point E.

Note 1: any situation where the measured value is higher than the action value, a thorough verification must be made according to Article 4(2).

Note 2: for any situation where the shape of the signal differs sufficiently from a sinusoid to affect the outcome, then peak values should be used as follows. For exposure limit values the peak value should be compared with the peak value of the induced electric field obtained by multiplying the values of table 2.1 by 1.41. For magnetic and electric field levels outside the body, peak values of their rate of change with time should be compared with the values of table 2.2 or 2.3 multiplied by $8.9f$ (which is $\sqrt{2} 2\pi f$).

For complex pulsed signals a thorough verification must be made according to Article 3(3).

Table 2.1 Exposure Limit Values (expressed in RMS values)

Frequency (Hz)	Exposure Limit Value (V/m)	
	For safety effects	For health effects
1 - 10	$0.5/f$	0.8
10 - 25	0.05	0.8
25 - 400	$0.002 f$	0.8
400 - 3000	0.8	0.8
3000 - 100000	$2.7 \times 10^{-4} f$	$2.7 \times 10^{-4} f$

f is the frequency expressed in Hertz (Hz)

The exposure limit value for safety effects is derived from the effect threshold for effects on the central nervous system in the head (CNS).

The exposure limit value for health effects is derived from the effect threshold for effects on the peripheral nervous system (PNS) and it also prevents stimulation of nerve fibres in the central nervous system.

Exposure limit values for static magnetic fields are given in table 2.3

Table 2.2 Orientation and action values for exposure to an **electric field** (RMS values)

Frequency (Hz)	Orientation value (V/m)	Action value (V/m)
1 – 25	20×10^3	20×10^3
25 – 90	$500 \times 10^3/f$	20×10^3
90 – 3000	$500 \times 10^3/f$	$1800 \times 10^3/f$
3000 - 100000	170	600

Note 1: The action value for electric fields for the frequency range 1-90 Hz is limited to 20 kV/m to limit the risk of indirect effects which are spark discharges which may occur when a worker comes into contact with a conducting object at a different electrical potential. Where the risk of spark discharges is managed using technical means and the training of workers, exposures in excess of action values can be accepted provided that the exposure limit values are not exceeded, in accordance with Article 4(2).

Table 2.3 Orientation and action values for exposure to a **magnetic field** (RMS)

Frequency (Hz)	Orientation value (μT)	Action value (μT)
0	2×10^6	8×10^6
>0 – 1	$(2-1.8 f) \times 10^6$	$(5.67 - 5f) \times 10^6$
1 – 8	$2 \times 10^5 / f^2$	$0.666 \times 10^6 / f$
8 – 25	$25000 / f$	$0.666 \times 10^6 / f$
25 – 300	1000	$0.666 \times 10^6 / f$
300 - 3000	$3 \times 10^5 / f$	$0.666 \times 10^6 / f$
3000 - 9000	100	222
9000 - 20000	100	$2 \times 10^6 / f$
20000 – 100000	$2 \times 10^6 / f$	$2 \times 10^6 / f$

Note 1: Values for 0 Hz in this table are exposure limit values. Above 8 T Article 3(6) shall apply.

Note 2: The action value above 9 kHz and the orientation value above 20 kHz result from the exposure limit values for whole-body average SAR as defined in Annex III. In addition to the values given in Tables 2.1, 2.2 and 2.3, steady-state contact currents resulting from a worker being in contact with conductive objects shall be limited to.

From 0 Hz up to 2.5 kHz: 1.0 mA;

From 2.5 kHz up to 100 kHz: $0.4 \times 10^{-3} f$ mA (frequency, f in Hz).

C. CATEGORIES OF WORK EQUIPMENT OR ACTIVITIES

1) The following work equipment or activities are, in normal conditions, considered to expose the worker under the *orientation value*.

- Activities using equipment complying with Directives 1999/5/EC and 2006/95/EC when used as intended and notably:
 - household and similar electrical appliances (incl. mobile equipment fitted with heating elements; battery chargers; heaters; vacuum cleaners for dirt and water; cookers, ovens and cooking elements for industrial and commercial use; heating elements for waterbeds; microwave ovens for industrial and commercial use)

- offices (incl. computer equipment, cable networks, radio communication equipment; exc. tape erasers)
- operation of electrical installations:
 - low voltage network < 1000 V
 - low voltage components with power less than 200 kVA
 - workplaces at min. 60 cm distance from low voltage components with power not exceeding 1000 kVA
 - power transformers connected to low voltage networks (<1000 V between phases) with power up to 200 kVA
 - workplaces at min. 60 cm from power transformers connected to low voltage networks (< 1000 V between phases) with power not higher than 1000 kVA
- electric motors and electric pumps, subject to
 - the power being lower than 200 kVA
 - the workplace being at least 60 cm distance and the power not exceeding 1000 kVA
- detection of articles and people
 - RFID 1 Hz - 100 kHz
- tape erasers (if instructions of manufacturer available and followed).
- induction heating
 - automated systems (if instructions of manufacturer available and followed)
- detection of articles and people
 - EAS 0.01 - 20 kHz (magnetic)
 - EAS 20 - 100 kHz (resonant inductive)
 - metal detectors
- induction hobs in hotel & catering industry (food preparation)
- hand-held motor-operated electric tools
- transportable motor operated electric tools (incl. electrically operated garden appliances)
- testing instruments (exc. non-destructive magnetic testing)
- installation and maintenance
 - electrical hand-held tools (exc. welding equipment)
- electricity production and distribution
 - bus bars/conductor rails in substations
 - above ground high voltage cables

- electricity substations
- switch gear
- welding
 - automated systems (if instructions of manufacturer available and followed)
 - arc welding – cable (if instructions of manufacturer available and followed)
- medical applications
 - shallow hyperthermia (if instructions of manufacturer available and followed)
 - pain control, stimulation of bone growth etc.
 - incubators, lamps for phototherapy, wireless communication systems etc.
 - deep hyperthermia (if instructions of manufacturer available and followed)
 - electrosurgery (if instructions of manufacturer available and followed)
- transport and traction systems
 - rail transport powered by direct current
 - vehicles, ships, aircraft
 - (large) electric motors
- transport and haulage systems
 - rail transport powered by alternating current (50 Hz)
- electricity production and distribution
- electrochemical processes (except specific places)

2) The following activities may expose the worker above the *orientation value* but in normal conditions are considered to expose them under the *action value*.

- plastic sealers
- induction heating
- wood gluing equipment
- power stations
- air cooled coils in capacitor banks
- current supply systems (bus bars)
- electrolysis hall (parts of)
- larger furnaces
- arc welding – cable
- use of - ‘open magnetron’

– non-destructive magnetic testing

3) The following activities may exceed the action value and require special assessment to ensure that the exposure limit values for health effects are not exceeded:

- trouble shooting during installation and maintenance
- proximity of rectifiers in electrochemical processes
- non-automated induction heating (small melting furnaces)
- semi-automated spot and induction welding
- research activities.

D. PREVENTION MEASURES and other conditions

1) For persons at particular risk referred to in Article 4(5)(c), individual assessments must be made in accordance to point E.

2) Zone of exposures under the orientation value:

- Signage as appropriate

3) Zone of exposures above the orientation value but under the action value

- Signage as appropriate

- Delimitation measures (e.g. floor markings, fences) in order to limit or control access, as appropriate

- Information and specific training of relevant workers

- Verification of compliance with exposure limit values for safety effects or alternatively procedures to ensure adverse safety effects are managed.

4) Exposures above the action value:

- Signage as appropriate

- Delimitation measures (e.g. floor markings, fences) in order to limit or control access, as appropriate

- Verification of compliance with exposure limit values for health effects.

- Procedure to manage spark discharges through technical means and the training of workers. (Applies only where electric field exposures are in this zone.)

- Appropriate delimitation and access measures

- Information and specific training of relevant workers.

E. PERSONS AT PARTICULAR RISK

Workers having declared themselves as wearing an Active Implantable Medical Device (AIMD) and women having declared themselves to be pregnant are considered to be persons at particular risk, as stated in Article 4(5)(c).

Where a worker has declared to their employer that he or she wears an AIMD the employer shall carry out an assessment to determine what restriction on where they can work is needed to avoid interference to their implanted device. Advice on how to do this is provided by CENELEC (see EN 50527 and associate parts). It may be noted that principle underlying the CENELEC guidance is that interference will not occur when the fields is below the Reference Levels given in Council Recommendation 1999/519/EC on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz)¹.

Where a worker has declared to her employer that she is pregnant then the requirements of Council Directive 92/85/EEC on the introduction of measures to encourage improvements in the safety and health at work of pregnant workers and workers who have recently given birth or are breastfeeding² apply. The employer shall enable the worker to avoid having to enter areas where exposures exceeding the exposure limits for the general public given in Council Recommendation 1999/519/EC, or its subsequent revisions.

¹ OJ L 199, 30.7.1999, p. 59.

² OJ L 348, 28.11.1992, p. 1.

