

Compromise U

Replacing amendments 227, 228, 229, 230, 231, 232, 233

ANNEX III – THERMAL EFFECTS

EXPOSURE LIMIT VALUES AND ACTION LEVELS IN THE FREQUENCY RANGE FROM 100 KHZ TO 300 GHZ

A. EXPOSURE LIMIT VALUES (ELV)

Health effects ELV for frequencies from 100 kHz up 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 (EMF).

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

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

Health effects ELV for frequencies from 100 kHz up to 6 GHz

Table A1 Health effects ELV for exposure to electromagnetic fields from 100 kHz to 6 GHz

Health effects ELV	SAR values averaged over any 6 minutes
ELV related to whole body heat stress expressed as averaged SAR in the body	0.4 W/kg
ELV related to localised heat stress in head and trunk expressed as localised SAR in the body	10 W/kg
ELV related to localised heat stress in the limbs expressed as localised SAR in the limbs	20 W/kg

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. These 10 g of tissue are 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 ELV from 0.3 GHz to 6 GHz

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

Table A2 Sensory effects limit ELV for exposure to electromagnetic fields from 0.3 to 6 GHz

Frequency range	Localised Specific Absorption (SA)
$0.3 \leq f \leq 6$ GHz	10 mJ/kg

Note A2-1: Localised SA averaging mass is 10 g of tissue.

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

Frequency range	Health effects ELV related to power density
$6 \text{ GHz} \leq f \leq 300 \text{ GHz}$	50 W/m^2

Note A3-1: 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 50 W/m^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.

B. ACTION LEVELS (AL)

The following physical quantities and values are used to specify the Action Levels (AL), the magnitude of which are established to ensure by simplified assessment the compliance with the relevant exposure limit values or at which relevant protection or prevention measures specified in Article 5 of this Directive must be taken:

- AL(E) for electric field strength E of time varying electric field as specified in Table B1;
- AL(B) for magnetic flux density B of time varying magnetic field as specified in Table B1;
- AL(S) for power density of electromagnetic waves as specified in Table B1;
- AL(I_C) for contact current as specified in Table B2;
- AL(I_L) for limb current as specified in Table B2;

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

Action Levels (AL) for exposure to electric and magnetic fields

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

Table B1. Action Levels for exposure to electric and magnetic fields for exposure to electromagnetic fields from 100 kHz to 300 GHz.

Frequency range	Electric field strength AL(E) [V/m] (RMS)	Magnetic flux density AL(B) [μ T] (RMS)	Power density AL(S) [W/m ²]
100 kHz \leq f < 1 MHz	6.1×10^2	$2.0 \times 10^6 / f$	-
1 \leq f < 10 MHz	$6.1 \times 10^8 / f$	$2.0 \times 10^6 / f$	-
10 \leq f < 400 MHz	61	0.2	-
400 MHz \leq f < 2 GHz	$3 \times 10^{-3} f^{1/2}$	$1.0 \times 10^{-5} f^{1/2}$	-
2 \leq f < 6 GHz	1.4×10^2	4.5×10^{-1}	-
6 \leq f \leq 300 GHz	1.4×10^2	4.5×10^{-1}	50

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

Note B1-2: [AL(E)]² and [AL(B)]² are to be averaged over 6 min period. For RF pulses, the peak power density averaged over the pulse width shall not exceed 1000 times the respective AL(S) value. For multi-frequency fields the analysis shall be based on summation, as explained in the practical guide set out in Article 14.

Note B1-3: AL(E) and AL(B) represent maximum calculated or measured values at workers body position. This results in a conservative exposure assessment and automatic compliance with ELV in all non-uniform exposure conditions. In order to simplify the assessment of compliance with ELV, carried out in accordance with Article 4, in specific non-uniform conditions, criteria of spatial averaging of measured fields based on established dosimetry will be laid down in the practical guide referred to in Article 14. In the case of a very localized source with a distance of a few centimetres from the body, the induced electric field shall be determined dosimetrically, case by case.

Note B1-4: The power density shall be averaged over any 20 cm² of exposed area. Spatial maximum power densities averaged over 1 cm² should not exceed 20 times the value of 50 W/m². Power densities from 6 to 10 GHz are to be averaged over any

six-minutes 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. Action Levels for steady state time varying contact currents and induced limb currents

Frequency range	Steady state contact current, $AL(I_C)$ [mA] (RMS)	Induced limb current in any limb, $AL(I_L)$ [mA] (RMS)
$100 \text{ kHz} \leq f < 10 \text{ MHz}$	40	-
$10 \text{ MHz} \leq f \leq 110 \text{ MHz}$	40	100

Note B2-1: $[AL(I_L)]^2$ is to be averaged over 6 min period.
