

APPENDIX 1: INTERNATIONAL GUIDELINES ON EXPOSURE TO STATIC MAGNETIC FIELDS

International exposure guidelines are developed by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). This independent scientific body is officially recognized by WHO and its exposure guidelines advice is based upon the health risk assessments published by WHO and cancer reviews and classifications carried out by IARC. National authorities are advised to adopt international standards, where they exist.

Exposure guidelines serve five main functions:

- a general framework for the protection of people who may be exposed to static electric or magnetic fields whether at work, in public spaces or in the home;
- a tool for the practical safety assessment of exposures in relation to recommended exposure restrictions (compliance assessment);
- a basis for national standards and regulations on limiting exposure;
- a basis for the development of technical standards pertaining to equipment design, device emissions and measurement procedures;
- a basis for operational procedures at workplaces and facilities, especially if exposure to high field strengths are required for short periods of time in occupational settings.

The basis for exposure guidelines is the health risk assessment. From this, exposure restrictions are recommended below which acute adverse health effects will not occur. In specifying restrictions on exposure, it is important to note any uncertainties in the scientific evidence as presented in the health risk assessment. This may be particularly important in considering the evidence for adverse health effects due to long-term exposure at levels lower than those that cause acute adverse effects. It is also important that caution is exercised, to ensure the adequate protection of all members of the community. For the general public, those exposed include people who, for a variety of reasons, might be especially susceptible to adverse health effects. In this respect, it is important to consider the evidence, if any, of effects in children, neonates and the unborn child, older people and people taking prescribed medicines. In addition, possible effects of fields on medical implants should be addressed by competent technical bodies.

Exposure to static electric fields is addressed in the ICNIRP exposure guidelines (ICNIRP, 1998), although only in a general manner.

Only the indirect effects of electric discharge are considered. No quantitative restrictions on field strength are provided.

ICNIRP published its advice on limiting public and occupational exposure to static magnetic fields in 1994 (ICNIRP, 1994). This had the objective of protecting individuals from the direct effects of fields, from indirect effects on ferromagnetic objects, and on implanted devices such as pacemakers, aneurism clips etc. ICNIRP's guidelines followed after the development of a few national exposure guidelines including those developed in the former USSR in 1978 (see WHO, 1987 for a review), the American Conference of Governmental Industrial Hygienists (ACGIH, 2001) and by the National Radiological Protection Board in the UK (NRPB, 1993). Elsewhere, guidelines recommending limits on occupational exposure to static magnetic fields were developed for specific laboratories/facilities such as in the US Department of Energy (Alpen, 1979), the Stanford Linear Accelerator (1970) and the Lawrence Livermore National Laboratory (Miller, 1987).

ICNIRP (1994) noted that the scientific knowledge existing at that time did not suggest any detrimental effect on major developmental, behavioural and physiological parameters following transient exposure to static magnetic flux densities up to 2 T. In the absence of knowledge on possible adverse health effects from long-term exposure, ICNIRP recommended a restriction of 200 mT on time-weighted exposure. In addition, the movement of a person in a magnetic field of 200 mT was thought to result in a current density of between 10 and 100 mA m⁻², which was considered not to result in adverse effects on the function of the central nervous system at frequencies of less than 10 Hz. ICNIRP calculated the maximum electric current density induced in the aorta by the flow of blood in the magnetic field to be about 40 mA m⁻² and concluded that this would not be harmful. In addition, the magnetohydrodynamic effects at this flux density were also considered to be of negligible consequence.

Based on these considerations, ICNIRP (1994) recommended a time-weighted average exposure of 200 mT during the working day for occupational exposures, with a ceiling value of 2 T. A ceiling value of 5 T was considered acceptable for extremities, because they do not contain large blood vessels or critical organs.

A 'continuous exposure limit' of 40 mT was given for the general public. This is, in effect, a ceiling value, although "occasional access to special facilities where magnetic flux densities exceed 40 mT can be allowed under controlled conditions, provided that the appropriate occupational exposure limit is not exceeded."

ICNIRP suggested that wearers of cardiac pacemakers, ferromagnetic implants and implanted electronic devices might not be adequately protected by the exposure limits for direct effects. Therefore, ICNIRP recommended that people with cardiac pacemakers and implanted defibrillators should avoid locations where the magnetic flux density exceeds 0.5 mT. For other electronic devices, ICNIRP suggested that they 'may be susceptible' to magnetic flux densities exceeding a few mT. ICNIRP provided no specific quantitative restrictions on exposure levels to avoid such interference effects, but instead recommended that wearers of ferromagnetic implants, and specifically people with aneurism clips, should consult their physician for advice on whether environments with flux densities exceeding a few mT might pose a hazard. Finally, ICNIRP stated that precautions should be taken to prevent hazards from flying metallic objects if the magnetic flux density exceeded 3 mT.

Table 47. Limits of exposure to static magnetic fields (ICNIRP, 1994)

Exposure characteristics	Magnetic flux density
Occupational	
Whole work day (time-weighted average)	200 mT
Ceiling value	2 T
Limbs	5 T
General public	
Continuous exposure *	40 mT

*Occasional access for members of the public to special facilities where magnetic flux densities exceed 40 mT can be allowed under appropriately controlled conditions, provided that the appropriate occupational limit is not exceeded.

The ICNIRP exposure restrictions for the general public provided the basis for a Council of the European Union Recommendation on limiting public exposure to static magnetic fields throughout the European Community (CEU, 1999).