



INSTRUCTION DE SÉCURITÉ SAFETY INSTRUCTION

Mandatory as defined in SAPOCO/42

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Safety Rules for the Use of Static Magnetic Fields at CERN

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1 Scope

This Safety Instruction defines rules and exposure limits to reduce the hazards due to static magnetic fields.

2 Application

This Instruction applies to any equipment producing static magnetic fields, installed and operated on the CERN site.

3 Biological Effects of Static Magnetic Fields

Studies on workers exposed to static magnetic fields have indicated various subjective symptoms as well as functional disturbances like fatigue, disturbed electrocardiogram and changes in heart rhythm, loss of appetite, irritation or tingling sensation of the skin. No significant long term effects have been observed so far.

Persons wearing artificial metallic implants¹⁾ or even dental fillings may feel painful sensations.

Persons fitted with cardiac pacemakers or implantable defibrillators encounter a specific risk as static magnetic fields may affect the good working order of these devices. For these persons, the relevant exposure limits stipulated in paragraphs 5 and 6 must be strictly observed.

4 Technical Hazards

4.1 Collision hazards

A danger frequently encountered in a static magnetic field comes from loose ferromagnetic objects. The field may be strong enough to attract such objects and to cause them to fly along the field lines towards the magnet. Therefore ferromagnetic objects, particularly those with sharp edges, may become dangerous projectiles. Their use shall be excluded from any magnetic field area.

¹⁾ **Metallic implants:**

– Bone and articular prosthesis

– Surgical clips

– Any other type of metallic implant where the sensitivity is dependant on the alloy composition

4.2 Damage to electronic equipment and personal property

Various electronic equipment as well as magnetic data carriers may be affected by magnetic fields. For cathode ray devices and tubes this occurs already at 0.2 mT. Electronic implants such as cardiac pacemakers may be affected at fields above 0.5 mT. Computers, magnetic storage media, credit cards and analog watches may be affected in fields above 1 mT.

5 Exposure Limits

Exposure limits have been defined in the legislation of both CERN host countries^{2) 3)} or in other countries. In addition, various international authorities [World Health Organisation (WHO)⁴⁾, the International Committee for Non-Ionising Radiation Protection (ICNIRP)⁵⁾, European Union⁶⁾] have issued guidelines for limitations of occupational exposures to magnetic fields. Based on exposure limits and the various guidelines the following limitations for magnetic field exposures shall apply at CERN:

General Rule

Occupational exposure, as well as exposure of members of the public, shall be kept as low as reasonably practicable.

- **Occupational exposure limits**

Occupational exposure of any part of the body during the working day shall be limited to a magnetic flux density not greater than 200 mT.

- **Exposure limit for the general public**

Members of the general public shall not be exposed to magnetic flux densities exceeding 10 mT.

Cardiac pacemaker and implantable defibrillator bearers shall avoid locations where the magnetic flux density exceeds 0.5 mT. Specific recommendations may apply to various implants.

² **ORNI:** 'Ordonnance sur la protection contre les rayonnements non-ionisants du 23 décembre 1999'.

³ **French Decree 2002/775:** Décret relatif aux limites d'exposition du public aux champs électromagnétiques émis par les équipements utilisés dans les réseaux de télécommunication ou par les installations radioélectriques. The exposure values given are very similar to the values given in the Directive 2004/40/CE. Although issued as being valid only for the telecommunication sector values are given for extremely low frequencies and static magnetic fields. The general decree following the European Directive is not yet published.

⁴ **See references given in ICNIRP guidelines** (listed below)

⁵ **ICNIRP** (Secretariat at Bundesamt für Strahlenschutz, Institut für Strahlenhygiene, Inglostädter Landstraße 1, D-85764 Oberschleißheim): Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz), Health Physics Volume 74 Nr. 4 of April 1998

⁶ **European Directive 2004/40/CE:** 'On the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields)'.

Summary of exposure limits

A summary of the limits recommended for occupational and general public exposures to static magnetic fields is given below.

Limits of exposure to static magnetic fields

Exposure characteristics	Magnetic flux density
Occupational Full working day (up to 8 h/d)	200 mT
General public Any	10 mT

Occupational exposures to fields exceeding the limit need the authorisation of the Departmental Radiation Safety Officer (RSO) after prior consultation with the Medical Service.

It is the responsibility of the supervisor to inform persons concerned about the risks.

6 Safety Procedures for Operating Magnets

It is the responsibility of the Departmental Radiation Safety Officer (RSO) to make sure that the following safety rules are observed for the operation of equipment which produces static magnetic fields:

- The distribution of the magnetic flux density shall be determined. At the entrance of the area a field map shall be posted that clearly indicates regions above 0.5 mT and 10 mT, respectively. The field map shall be communicated to the SC Group concerned [General Safety (GS)].
- Accessible areas where the magnetic flux density exceeds 0.5 mT are clearly delimited and indicated by posting warning signs, as shown in the attached Figure.

The presence of the magnetic field is indicated by flashing warning light panels.



**CHAMP MAGNÉTIQUE
DANGER
MAGNETIC FIELD**

These flashing warning lights must be active only when the magnetic field is present.

- The operation of magnetic beam elements is indicated by warning lights mounted on these elements.

- A systematic check is made to free the field areas from ferromagnetic objects before switching on magnets.
- CERN staff and experimental teams are informed about the safety rules and hazards in static magnetic fields, especially in relation to persons fitted with pacemakers.
- The names of persons likely to be exposed to levels above 10 mT are communicated to the Medical Service.

Compliance with these safety rules will be verified in the regular SC safety inspections. Monitoring of the field strength to show conformity with the limits indicated will be carried out by the SC/GS Group.

7 Legal Basis

This Safety Instruction is published by the Safety Commission under the procedure set out in the CERN Safety Policy document SAPOCO/42 and in application of the CERN Staff Rules and Regulations.