Syracuse University

Laboratory Guidance Document

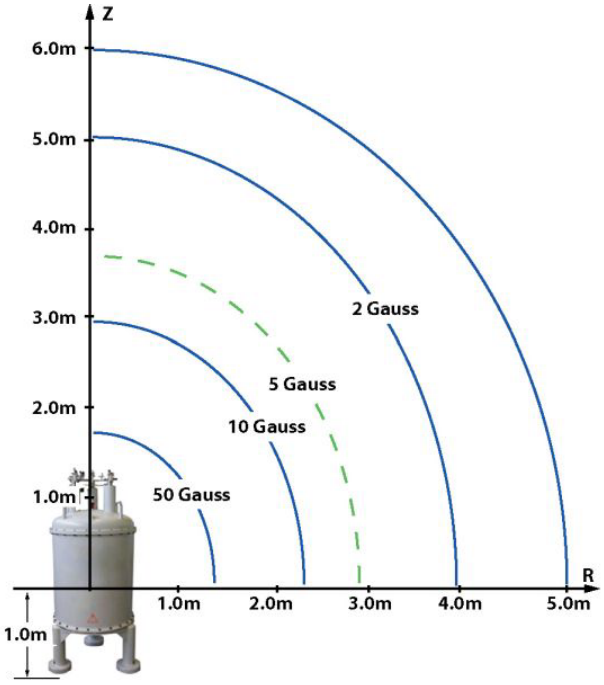
Strong Magnetic Fields

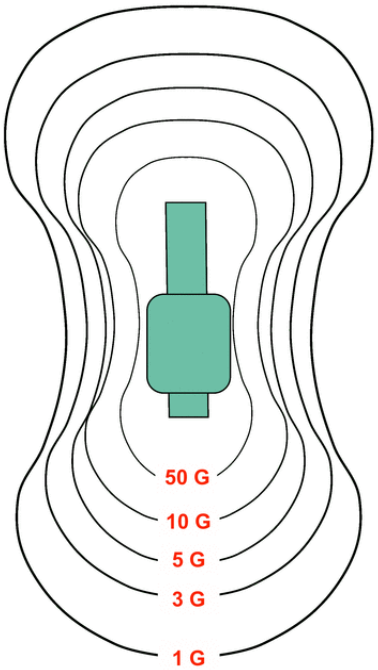
This Laboratory Guidance Document was created by Syracuse University Environmental Health & Safety Services (EHSS) to assist researchers in developing laboratory specific standard operating procedures for the operation of instruments that produce strong magnetic fields.

Properties:

Magnetic fields are generated by two sources: either1.) the magnetic component of electromagnetic radiation generating devices, or from 2.) magnetized metals. The most common laboratory examples are the superconducting magnets in nuclear magnetic resonance (NMR) machines, capable of producing fringe magnetic fields.

The fringe magnetic field is the peripheral field surrounding the magnet. The extent of the fringe field is dependent upon the static magnetic field strength, type of shielding (active, cladding, or whole room shielding) and whether the magnet has an open or closed design. Fringe magnetic field plots are available from each magnet manufacturer. Magnetic field intensity is typically expressed in units of measure known as a "Gauss" (G).





Based on the shape and orientation of the magnet, the resulting fringe field may not be circular; consult the manufacturer's specification sheet to determine the horizontal and vertical 5 G field line distances.

Potential Hazards:

The American Conference of Governmental Industrial Hygienists (ACGIH) publishes exposure guidelines for the magnetic field component of electromagnetic radiation.

ACGIH threshold limit values for continuous exposure to static magnetic fields

Abbreviations used in this table: **G -** Gauss; a unit of magnetic field intensity, equal to 0.0001 Tesla **mT -** millitesla **T -** Tesla; magnetic field strength is measured in Tesla **TWA -** time weighted average **Note:** 1 Gauss (G) = 0.1 millitesla (mT)	
5 G (0.5mT)	Highest allowed field for implanted cardiac pacemakers
10G (1.0mT)	Damage to watches, credit cards, magnetic tape, and computer disks
30G (3.0mT)	Kinetic energy hazard from small ferrous objects
600 G (60mT)	Allowed TWA for routine exposure (whole body) (8-hour TWA*)
6000 G (600mT)	Allowed TWA for routine exposure (extremities) (8-hour TWA*)
20,000 G (2T)	Whole body ceiling limit (no exposure allowed above this limit)
50,000 G (5T)	Extremity ceiling limit (no exposure allowed above this limit)
1 2003 TLVS® and BEIs® based on the "Documentation of the Threshold Limit Values for Chemical Substances and Physical Agents & Biological Exposure Indices," ACGIH Worldwide, p. 142.	

Laboratory personnel and the unsuspecting public should be kept as far away from the magnet as possible, and not closer than the 5 G field line threshold.

- Strong magnetic fields can inhibit the operation of magnetically sensitive medical devices (e.g., cardiac pacemaker). Any persons with a magnetically sensitive medical device should never cross the 5 G field line.
- Strong magnetic fields present kinetic energy hazards: ferromagnetic objects (e.g., hand tools) can be pulled towards the magnet with sufficient force to become a projectile, posing a hazard to personnel and property in the path of travel..
- Superconducting magnets are typically cooled in a cryogen such as liquid helium. Contact with liquid or gaseous cryogens may cause frostbite to human skin or eye tissue.

General Precautions:

The operation of equipment producing strong magnetic fields requires extreme care; if not operated properly, these devices pose a serious threat to the health and safety of laboratory personnel.

1. **Training.**
   The Principal Investigator is responsible for ensuring all personnel under their supervision are aware of the hazards associated with strong magnetic fields, have received appropriate hands-on training, adhere to the laboratory standard operating procedures, and are provided with the appropriate personal protective equipment.
2. **Registration.**
   Any magnet requiring cryogenic support and electricity must be registered with EHSS. Please contact EHSS (315-443-4132 or ehss@syr.edu) prior to purchasing, relocating, and/or disposing of a magnet.
3. **Designate Areas.**
   Set up instruments in a dedicated room and clearly demarcate the 5 G field line. Ensure that all workspaces are outside the 5 G field line in all directions, including adjacent laboratories on the same level/floor, as well as the above and below floors. If necessary, use a stanchion or rope to ensure that laboratory personnel do not accidently cross beyond the 5 G field line.
4. **Hazard Communication.**
   Post signage to warn laboratory personnel and visitors of the associated hazards and the potential for damage to electronic and medical devices.

Personal Protective Equipment (PPE):

In general, standard laboratory attire (i.e., long pants and closed toe shoes), may be appropriate when working with magnetic fields. Do not rely on PPE to reduce exposure to magnetic fields.

Best Practices for the Operation of Strong Magnetic Fields:

1. Review the manufacturer's operating manual, laboratory standard operating procedure (SOP), and emergency procedures before operating devices the produce strong magnetic fields.
2. Restrict entry into the laboratory to only authorized personnel. Keep doors locked and posted with magnetic hazard warning signs to prevent unauthorized access to the magnet room.
3. Post a hazard warning label (available from EHSS) and emergency response procedure in use areas.
4. Post clearly visible warning signs in areas with strong magnetic fields.
5. Clearly mark the 5 G field line surrounding the magnet and restrict public access to areas of 5 G field lines and higher.
6. Ensure individuals with cardiac pacemakers or other implanted medical devices remain outside the 5 G threshold at all times.
7. Whenever practical, measure for stray magnetic fields with a gaussmeter.
8. Advise personnel in the area that strong magnetic fields can damage electronic equipment, watches, and credit cards.
9. Keep all tools, equipment, and personal items containing ferromagnetic material outside the 5 G field line.
10. Avoid skin contact with cryogens; don a lab coat, protective facemask, and thermal gloves when handling cryogens and/or frozen samples. Avoid positioning your body over the cryogen gas vent tubes.
11. Ensure that laboratory ventilation is sufficient to remove the cryogen gas exhausted by the instrument.

Incident Response:

All laboratory emergencies must be reported to the Department of Public Safety at 315-443-2224.