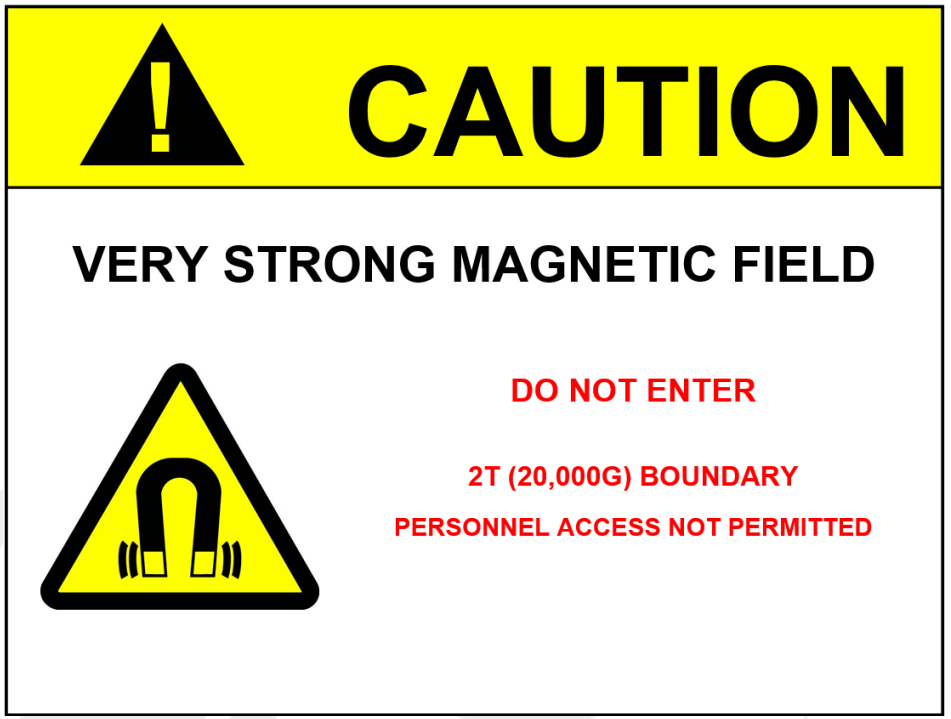
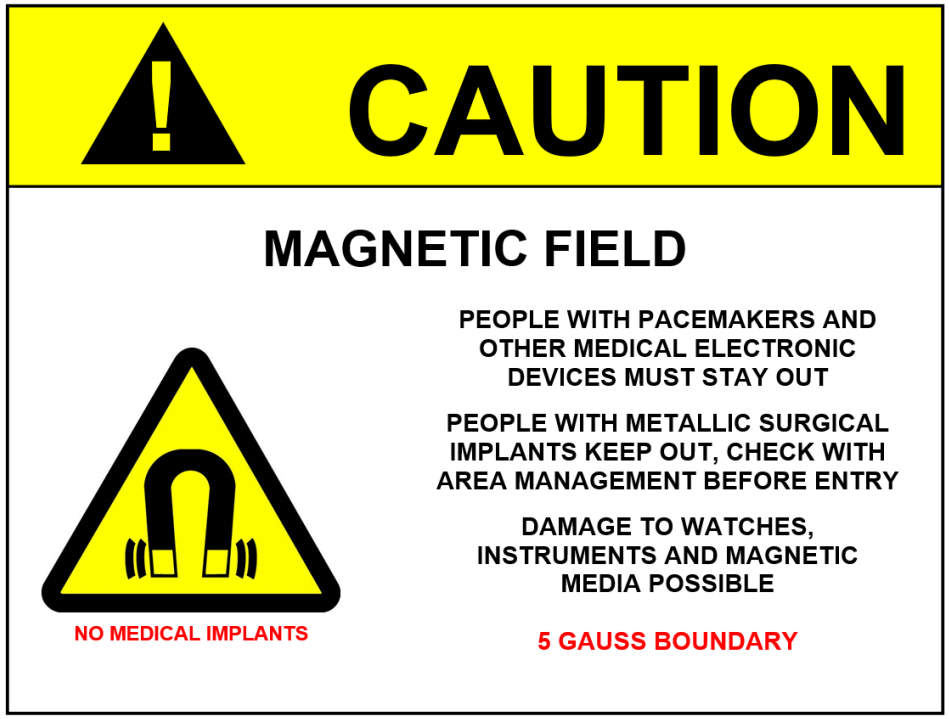
Jefferson Lab
MAGNET GROUP

# Working Safely in Magnetic Fields




**Ruben Fair - Magnet Group**

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*[Reviewed by J. Williams, JLab ESH – 02.21.2020)*

Jefferson Lab

U.S. DEPARTMENT OF ENERGY | Office of Science

JSA

# What are the present guidelines?

The DOE (under 10 CFR 851) requires the Lab to use the 2016 ACGIH Threshold Limit Values (TLVs) exposure limits for magnetic fields.

Generally speaking, the Lab does not deviate except where the guideline allows whole body exposures up to 8T. Since the Lab does not offer "special worker training" our upper limit is 2T whole body.

**TABLE 1. TLVs® for Static Magnetic Fields**

| Exposure | Ceiling Value |
|---|---|
| Whole body (general workplace) | 2 T |
| Whole body (special worker training and controlled work-place environment) | 8 T |
| Limbs | 20 T |
| Medical device wearers | 0.5 mT |

**Not allowed at JLab**

**5 Gauss**

***Source**: Jennifer Williams, JLAB ESH (Feb 2020)*
*[Note: ACGIH - The American Conference of Governmental Industrial Hygienists]*

# What are the known effects of working in a magnetic field

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***Source**: International Commission on Non-Ionizing Radiation Protection (ICNIRP) Guidelines on Limits of Exposure to Static Magnetic Fields; Published in Health Physics 96(4):504-514;2009*

There are three primary interaction mechanisms:

## 1. Biological Effects

- *Blood flow, cardiac and nerve function are unlikely to be affected up to 8 Tesla*
- *Normal movement within fields of greater than 2 to 3 Tesla may cause vertigo, nausea, activation of magneto-phosphenes (flashes of light) in the eyes and a metallic taste in the mouth*
- ***To date, there have been no reported adverse long term biological effects***

## 2. Attractive Forces

- *The potential hazard of the projectile effect of ferromagnetic material in a strong magnetic field is a serious concern. The force is proportional to the magnetic field strength (B), and the magnetic field gradient (dB/dx)*
- *Attractive forces increase exponentially as the object approaches the magnet*
- *The speed of the object can approach 40mph for a 1.5 T magnet*

## 3. Torque

- *Ferromagnetic objects will also experience a torque that will try to align that object along magnetic field lines. Torque is largely shape dependent and is proportional to the field strength, (B), and to the angle the object is away from alignment with the field*

# Objects being launched in a magnetic field

# Summary

- Never lean over any barriers to reach something on the other side - the barriers are there for a reason.
- Areas around a magnet should always be 'swept' for loose objects, ferromagnetic or otherwise, before the magnets are energized.
- Do not approach an energized magnet if you are wearing a watch with a mechanical movement or have credit cards on you. The movement could get disrupted permanently and cards can get wiped.
- Always stay outside the 5 Gauss boundary (all magnets should have the 5 G boundary either marked on the floor or with barriers), unless you have been authorized to work close to the magnet - i.e. on the inside of the barriers.

**IF IN DOUBT – ASK! – ALWAYS!**

- It is especially important to stay outside the 5 G boundary if you have a heart pacemaker or any metallic implant in your body - irrespective of whether that implant is magnetic or not. Simply walking in and out of a magnetic field can induce eddy currents (circulating currents) in the metallic implants and these currents can interact with the magnetic field to produce a force on the implant. The implant could then move and even a slight dislodging of this implant could cause internal bleeding which might only be noticeable sometime later.
- **Anyone with a medical implant who is assigned work in an area with magnets (halls, accelerator, some areas in the Test Lab and TED), should notify Occupational Medicine before starting work**