

UNIVERSITY OF TOLEDO

SUBJECT: SUPER CONDUCTING MAGNETS (MRI/NMR)

Procedure No: S-08-012

PROCEDURE STATEMENT

Precautions must be observed in the Magnetic Resonance Imaging (MRI) facility (and especially the scan room) and Nuclear Magnetic Resonance (NMR) labs with respect to the strong magnetic field and the presence of cryogenics (very low temperature liquids). These precautions apply 24 hours a day whether or not patients are being scanned and/or equipment is being used in the labs.

PURPOSE OF PROCEDURE

To ensure safety for patients and staff in the use of the MRI/NMR facilities.

PROCEDURE

I. Restricted Access

No one may enter the MRI facility without the permission of the technologist in charge. Fire response and cardiac arrest response teams should not enter the MRI scan room/NMR lab with any equipment. Emergency treatment of patients should be performed outside the scanner room.

MRI facilities are located in Radiology (1215C UTMC) and the UT Orthopaedic Center (1720H). NMR facilities are located in Bowman Oddy (Rooms 187 and 210B) and Health Education) 019J.

II. Strong Magnetic Field Precautions

A. Warning Signs

Warning signs will be posted on the scan room door and NMR labs. MRI signs are also posted in the outside hallway and outside the building.

B. Implantable Medical Devices

1. Implantable medical devices such as pacemakers, defibrillators, shunts, etc., may become mal- or dysfunctional in the scanner room. This field extends beyond the room and is present at all times.
2. Patients and staff with implantable medical devices will not be allowed into ZONE 4 of the MRI facility or into the NMR facility.
3. If a patient experiences problems within the 5 gauss zone (approximately 30 feet from the magnet), the patient should be taken outside the 30-foot zone as soon as possible and a physician notified immediately.
4. The 5 gauss line is indicated by stickers on the floor in the NMR lab.

C. Iron or Steel (Ferrous Metal) Objects

NOTE: Aluminum (silver) O₂ E cylinders must be used for patients needing O₂. These cylinders are available in the scanner area.

1. Iron or steel (ferrous metal) objects will be strongly attracted to the magnet. The larger the object, the greater will be the attraction force.

Unsecured objects may become "projectiles" or "bullets" that can cause serious injuries and/or damage to the equipment. (Examples: hand tools, pagers, jewelry, stethoscopes, pens, steel in shoes.)

2. Anyone entering the scan room and/or NMR facilities 5 gauss line (indicated by floor signage) should remove all objects such as watches, keys, pens, pencils, hearing aids, purses, magnetic credit cards, electronic pagers, brief cases, IUD's, hair pins, and ferrous jewelry.
3. Technologists should be notified of any patients with steel pins, artificial limbs, certain surgical clips, or other internal metal objects when MRI is required.
4. Mobile objects should never be wheeled in the hallways around the MRI exam room unless they have been determined to be 100% non-magnetic.
5. Many objects are stainless steel, but many have tops or wheels or other parts or accessories which are ferrous. If in doubt, a small magnet can be used to determine which parts are ferrous. This doesn't work on internal parts, so when in doubt, objects should be kept away. The technologist in charge or MRI physicist can help with questionable objects.
6. Facilities Maintenance, Environmental Services, and Food & Nutrition staff should be aware that much of their equipment is ferrous and should never be brought in to the hallways around the magnet or into the scanner room. Basic housekeeping duties such as sweeping and mopping the scanner room are performed by the Technologist in the MRI facilities.
7. If an object flies in to the magnet, it should not be reached for until it has stopped moving. An object entering the bore of the magnet can fly through the magnet and hit someone on the other side or even turn around and come back through the magnet like a boomerang.
8. If you are holding a large object and feel yourself being pulled toward the magnet, let go of the object immediately. You will not be able to stop it from pulling you with it. People have been trapped between large objects and the magnet and have been unable to free themselves. If there is an other person between you and the magnet, contain the object and back out of the room if possible.

D. Fire Response (Code Red)

1. Fire extinguishers and hoses with metal nozzles must not be taken into the scan room. Extinguishers designed for use in these environments are in place.
2. If "smoke" comes out of the magnet, the area should be evacuated immediately.
3. Health Science Campus Security personnel will seal off the area and the Toledo Fire Department will handle any fire situation in the scan room. Toledo Fire Staff will be informed immediately upon arriving of the hazards of working around the MRI and NMR magnets with ferrous equipment.

E. Cardiac Arrest Response (Code Blue)

1. Call 911 for medical emergencies. Call Code Blue by dialing X77 for Code Blue response areas.
2. The patient should be removed from the scan room
3. Defibrillators and code carts must **not** be taken into the scan room.

III. Cryogenics (Low Temperature Liquids)

A. Burns and Frostbite

The magnet requires liquid helium and liquid nitrogen to stay in its operating condition. These liquids are several hundred degrees below zero and can cause frostbite.

Extensive tissue damage or burns can result from exposure to cryogenics or cryogen vapors. Affected areas should be flushed with large volumes of tepid water (105° - 115°F, 41° - 46°C) to reduce freezing. The affected area should be covered with sterile protective dressing or clean sheets if the area is large. The area should then be protected from further injury. A doctor should be notified immediately.

B. Oxygen Displacement (Asphyxiation)

1. These liquids can boil off and pose a danger of asphyxiation. Cryogens come in large containers called dewars. They must never be heated or tipped over. The valves on the dewars must not be tampered with.
2. If a release of gas occurs from the magnet, the MRI units are equipped with ventilation quench ducts which will remove the gas from the room.
3. O₂ monitors are installed in the NMR facility in Bowman Oddy to alert personnel to evacuate the lab. University of Toledo Police should contact the Toledo Fire Department who will give the "all clear" for occupying the space when oxygen levels have returned to normal.

IV. Alarms

A. Bowman Oddy NMR Alarms (transmitted to dispatch through fire panels)

1. Trouble – a "trouble" indicates a problem with the oxygen system equipment. Contact Yong Wah Kim at 419-530-2563 and Environmental Health and Radiation Safety via University of Toledo Police dispatch for equipment check (i.e., a power outage to the building may cause this condition).
2. Alarm – an "alarm" indicates low levels of oxygen. During this condition the strobes and horns (steady tone) will continue to sound until reset from inside the O₂ sensor control unit located in room 187. After the room is cleared by Toledo Fire Department, contact Yong Wah Kim and Environmental Health and Radiation Safety to reset alarm system.

B. Health Education NMR Alarms (local alarm only)

1. Alarm – an "alarm" indicates low levels of oxygen. During this condition the strobes and horns (steady tone) will continue to sound until reset from inside the O₂ sensor control unit located in room 019J. After the room is cleared by Toledo Fire Department, contact Jim Slama and Environmental Health and Radiation Safety to reset alarm system.

Magnetic Resonance Imaging (MRI) Facility

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For information or in an emergency regarding Magnetic Resonance Imaging (MRI):

During work hours: MRI Department.....419-383-3943, 419-383-6074
Amy Rettig, Radiology Manager, MRI.....419-383-3498
.....mobile 419-265-1547

After work hours: MRI Dept 419-383-3943, 419-383-6074 or Radiology Dept 419-383-3936
(Mon-Fri) Amy Rettig.....mobile 419-265-1547
Lindsay Katschke.....mobile 419-297-9168
Technology Support Technician..... 419-383-4899

Weekends: Contact technologist on-call (telephone number
available through Radiology Department at 419-383-3936).

For more information regarding Nuclear Magnetic Resonance (NMR):

During work hours: Bowman Oddy:..... Yong Wah Kim 419-530-2563
Health Education:..... Jim Slama 419-383-1925

After work hours and
Weekends University of Toledo Police 419-530-2600

Source: Safety & Health Committee

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