

# Safety Considerations in the Design of Magnetic Resonance Imaging

Contributed by Robert Paul Junk, AIA, and Tobias Gilk

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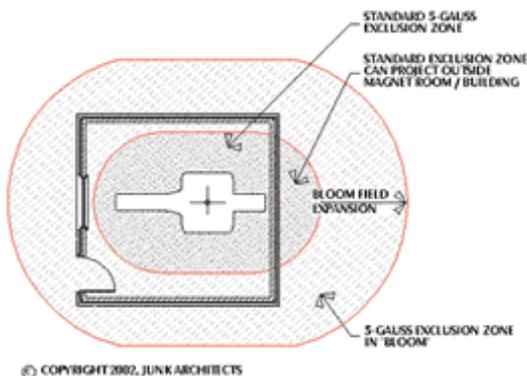
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## SUMMARY

Increased use of magnetic resonance imaging (MRI) scanners for medical diagnosis in hospitals, clinics, and freestanding facilities heightens the need to consider the structural and safety requirements for this equipment. This article summarizes a Special Report written by Robert Paul Junk, AIA, and Tobias Gilk for [www.diagnosticimaging.com](http://www.diagnosticimaging.com).

## THE EXCLUSION ZONE

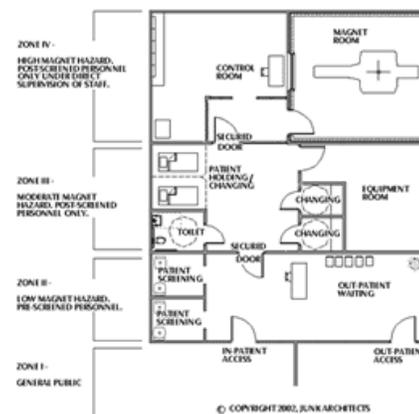
Patients and personnel must be protected from the strong magnetic field that surrounds MRI scanners. The magnet at the core of the MRI scanner can cause severe injury, massive property damage, and even death to persons who have pacemakers or ferrous implants or who are carrying loose objects containing iron. In planning an MRI suite, the magnet becomes a central design safety consideration.



The standard exclusion zone around the magnet includes all areas where the magnetic field is 5 gauss or more. ("Gauss" is the unit of density of a magnetic field.) This minimum exclusion zone extends in all directions around the magnet, including above and below, and may extend above ceilings and roofs, below floors, and outside the building. Magnetic shielding of this zone is achieved by the use of tons of steel plating, which increases the design structural load beyond the tremendous weight of the magnet itself.

## ADJACENCIES

The design of, and access to, adjacent spaces must also be considered in the design of MRI facilities. Adjacencies to cardiac facilities obviously require careful attention.



## OPERATIONAL CONSIDERATIONS

Operational considerations are of paramount importance. It is crucial for MRI staff to have direct visual supervision of all persons within the MRI suite at all times. At the same time, circulation routes through the suite for patients must be segregated from staff work areas, to protect the confidentiality of patient information. A circulation plan that allows controlled patient ingress and egress, waiting areas, screening areas, and changing/holding areas, as well as the MRI room itself, may require more space than the program would suggest. (See plan diagram, above.)

For patient comfort, adequate seating and bathrooms must be provided, a need that may be acute when this expensive equipment is being used at maximum capacity.

Computers and other sensitive equipment beyond the 5-gauss exclusion zone may need additional protection.

## PLAN FOR THE FUTURE

Because installation of MRI equipment and downtime of installed equipment is costly, it may be wise to take into account future expansion of an MRI suite when designing an initial installation, to allow uninterrupted operation of the existing suite and to minimize the cost of the infrastructure for additional units.

While design solutions alone cannot ensure operational safety, thoughtful solutions can have a significant impact on the implementation of safety protocols throughout the useful life of the facility.

## FOR MORE INFORMATION

Visit the Web site of the American College of Radiology at [www.acr.org](http://www.acr.org)

Or [www.diagnosticimaging.com](http://www.diagnosticimaging.com).

## INDUSTRY STANDARDS

The following standards address MRI safety and compatibility:

- ASTM F2052-00

*Standard Test Method for Measurement of Magnetically Induced Displacement Force on Passive Implants in the Magnetic Resonance Environment*

- ASTM F2119-01

*Standard Test Method for Evaluation of MR Image Artifacts From Passive Implants*

- IEC 601-2-33

*Medical Electrical Equipment - Part 2: Particular Requirements for the Safety of Magnetic Resonance Equipment for Medical Diagnosis*

Copies of the ASTM standards may be purchased from ASTM at <http://www.astm.org>

Copies of the IEC standard may be purchased from ANSI at <http://www.ansi.org>

## ABOUT THE CONTRIBUTORS

Robert Paul Junk, AIA, is a principal and Tobias Gilk is an associate architect of Junk Architects in Kansas City, Mo. The firm specializes in the design of health-care facilities. Junk or Gilk may be contacted at [www.junkarchitects.com](http://www.junkarchitects.com).

## RESOURCES

### Feedback

The AIA welcomes member feedback on Best Practice articles. To provide feedback on this article, please contact: [bestpractices@aia.org](mailto:bestpractices@aia.org).

### Key Terms

- Building performance
- Building components
- Building components by CSI Masterformat
- Educational and scientific equipment
- Healthcare equipment
- Examination equipment