

ACR Manual on MR Safety Updated March 2026

What's New?

The ACR Manual on MR Safety 2024 was updated in March 2026 and incorporates new content and recommendations, including a new MRI pre-appointment appendix and addresses the MRI industry changes as well as feedback from the MR imaging community.

Chapter	Section	Subsection	ACR Manual on MR Safety 2024	ACR Manual on MR Safety updated 2026
Chapter 3: MR Safety Zones	Zone IV		Periodic inspection and maintenance of the Zone IV door and associated locks, handles, articulating arms, etc., is recommended to minimize the likelihood of failures that may lead to entrapment or inability to reach the patient in a timely manner.	Periodic inspection and maintenance of the Zone IV door and associated locks, handles, articulating arms, etc., as well as any equipment in Zone IV (e.g., emergency call button, emergency switches, physiologic monitoring, power injector, etc.) is recommended to ensure their function is in accordance with site guidelines and manufacturer instructions.
	Zone III		Zone III primarily includes MR Controlled Access Areas where there is direct doorway access to Zone IV. A common Zone III could serve multiple scanners (Zone IVs). In addition, areas where the magnetic field (i.e., greater than 9 gauss) extends into spaces not connected directly by doorway to Zone IV and considered a B0 hazard risk area are also considered MR Controlled Access Areas and, as such, are included in the Zone III designation.	Zone III is an MR Controlled Access Area that serves as a safety interface between Zone II and MR -related fields that can be encountered within Zone IV or may extend peripherally from Zone IV. Zone III regions typically include the MR operator console and contain further strictly access - controlled doorways into Zone IV in which ferromagnetic objects can become dangerous projectiles. Zone III is also ascribed to areas in which there is egress of the MR Environment (delimited by the 9 gauss line) beyond the physical confines of Zone IV (e.g. MR equipment room in Figure 3), such that an unscreened individual with certain implanted devices could be at risk if they were exposed to these elevated magnetic fields. Free access into Zone III by unscreened Non-MR Personnel or ferromagnetic objects and equipment is not allowed. Access to and activity in Zone III is controlled by and entirely under the supervision of Level 2 MR Personnel (see also Chapter 4, Supervision and Independent Access).
Chapter 4: MR Personnel	Table 1		Unclear if elements of MR safety screening prior to entering Zone III and Zone IV, including the proper use of ferromagnetic detection systems, and understanding the factors that impact the safety of implants and devices is a Level 1 MR Personnel or Level 2 MR Personnel training element due to formatting of the table.	Table reformatted to clearly demonstrate elements of MR safety screening prior to entering Zone III and Zone IV, including the proper use of ferromagnetic detection systems, and understanding the factors that impact the safety of implants and devices is a Level 2 MR Personnel training element.
	Key Points		Level 2 MR Personnel: those who have been more extensively trained and educated in the broader aspects of MR safety issues, including but not limited to issues related to the potential for radiofrequency-related thermal loading or burns and direct neuromuscular excitation from rapidly changing gradients	Level 2 MR Personnel: those who have been more extensively trained and educated in the broader aspects of MR safety issues, including but not limited to issues related to the potential for radiofrequency-related thermal loading or burns and peripheral nerve stimulation (PNS) from rapidly changing gradients.

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Chapter 8: MRI Fields and Safety Concerns	Static Magnetic Field	Lenz effect	There are many scenarios in which these forces may pose concerns. For example, if a nonferromagnetic metallic device such as an MR Conditional oxygen tank is moved toward the bore of an MR scanner, as the scanner bore is approached, the force that arises from these Lenz effects can be sufficiently strong to virtually stop forward progress of the device.	There are many scenarios in which these forces may pose concerns. For example, if a nonferromagnetic metallic device such as an MR Conditional oxygen tank is moved toward the bore of an MR scanner, as the scanner bore is approached, the force that arises from these Lenz effects can be sufficiently strong to impede forward progress of the device.
			As Lenz effects are proportional to the rate of the object's motion through an SFG, and as these effects may be substantially higher at 7 T than 1.5 T or 3 T, these might bear special reconsideration for metal objects or devices used in or around 7-T MR scanners such as metallic aortic or mitral valve replacements [4].	As Lenz effects are proportional to the rate of the object's motion through an SFG, and as these effects may be substantially higher at 7 T than both 1.5 T or 3 T, these might bear special reconsideration for metal objects or devices used in or around 7 T MR scanners such as metallic aortic or mitral valve replacements [4].
	Time-Varying Radiofrequency Magnetic Field		FIGURE 12. 3-D depiction of the transmitted RF (B1) oscillating magnetic fields in a 1.5-T MR scanner. The right side of the scanner has been rendered transparent so that the energies/fields can be depicted as they are distributed 3-dimensionally throughout the MR scanner bore. (A) The spatial distribution of the transmitted RF (B1) oscillating magnetic fields with the body RF coil of this scanner being used as the RF transmitter hardware is depicted. (B) The spatial distribution of the transmitted RF (B1) oscillating magnetic fields with a transmit-receive head RF coil being used as the RF transmitter hardware is depicted. Note how the transmitted RF fields cover a smaller volume when a transmit-receive head RF coil is used for RF transmission in this same scanner. (Courtesy of Dr. Emanuel Kanal, created using MagnetVision, Advanced Magnetic Analytics, LLC)	FIGURE 12. 3-D depiction of the transmitted RF (B1) oscillating magnetic fields in a 1.5-T MR scanner for a brain MRI scan. The right side of the scanner has been rendered transparent so that the energies/fields can be depicted as they are distributed 3-dimensionally throughout the MR scanner bore. (A) The spatial distribution of the transmitted RF (B1) oscillating magnetic fields with the body RF coil of this scanner being used as the RF transmitter hardware is depicted. (B) The spatial distribution of the transmitted RF (B1) oscillating magnetic fields with a transmit-receive head RF coil being used as the RF transmitter hardware is depicted. Note how the transmitted RF fields cover a smaller volume when a transmit-receive head RF coil is used for RF transmission in this same scanner. Similarly, it is important to note that the region undergoing direct electromagnetic RF irradiation is often larger than the anatomic area of interest (i.e., head), particularly when using the body RF coil. Therefore, a device or foreign body outside the field of view may experience RF direct electromagnetic irradiation. (Courtesy of Dr. Emanuel Kanal)
		Specific absorption rate, B1+rms, specific energy dose, and specific absorption.		Entire section rewritten to clarify SAR estimation methods and added references.

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		Electrically conductive wires/leads	To avoid potential thermal issues and injuries associated with RF fields, all unnecessary or unused electrically conductive materials external to the patient should be removed from the MR system before the onset of imaging [8]. It is insufficient to merely disconnect and leave unused, unnecessary electrically conductive devices, such as surface RF coils or ECG leads and electrodes, in the MR scanner with the patient during imaging. All electrical connections, such as those used for surface RF coils or patient interfaces used for physiological monitoring systems, must be visually checked by the scanning MR Technologist prior to each use to ensure the integrity of the thermal and/or electrical insulation.	To avoid potential thermal issues and injuries associated with RF fields, all unnecessary or unused electrically conductive materials external to the patient should be removed from the MR system before the onset of imaging [8]. Disconnected, unused, unnecessary electrically conductive devices external to the patient, such as unplugged surface RF coils or ECG leads and electrodes, should never be allowed in the MR scanner with the patient during imaging. This could lead to injury to the patient or damage to the surface coil. All electrical connections, such as those used for surface RF coils or patient interfaces used for physiological monitoring systems, must be visually checked by the scanning MR Technologist prior to each use to ensure the integrity of the thermal and/or electrical insulation.
		Internal	Very rapid and clinically significant internal lead heating can occur due to RF deposition. Especially at the uninsulated lead tips, this can occur in a matter of seconds with a magnitude sufficient to result in serious thermal injury [8]. Residual or abandoned implanted leads or wires that are not connected to any other device are also prone to substantial heating under certain conditions [25]. For example, while it has been demonstrated in vitro that the heating of certain implants or wires may be clinically insignificant at 1.5 T but quite significant at 3 T, the converse can also be true in some circumstances in which specific implants might demonstrate no significant heating at 3 T/128 MHz but may heat to clinically significant levels in seconds at 1.5 T/64 MHz [25]. Thus, it is important to follow established product MR Conditional labeling and safety guidelines carefully and precisely, applying them to the static magnetic field strengths and frequencies at which they have been tested. MR scanning at either stronger and/or weaker magnetic field strengths than those tested may result in significant heating in which no or insignificant heating had been observed at the tested field strength(s). For example, if MR Conditional labeling specifies 3 T, it cannot be assumed that similar scanning parameters at 1.5 T are safe for the patient.	Very rapid and clinically significant internal lead heating can occur due to RF deposition. Especially at the uninsulated lead tips, this can occur in a matter of seconds with a magnitude sufficient to result in serious thermal injury [8]. Residual or abandoned implanted leads or wires that are not connected to any other device are also prone to substantial heating under certain conditions [26]. For example, while it has been demonstrated in vitro that the heating of certain implants or wires may be clinically insignificant at 1.5 T but quite significant at 3 T, the converse can also be true in some circumstances in which specific implants might demonstrate no significant heating at 3 T /128 MHz but may heat to clinically significant levels in seconds at 1.5 T/64 MHz or 0.55 T/ 24 MHz [26, 27] . Thus, it is important to follow established product MR Conditional labeling and safety guidelines carefully and precisely, applying them to the static magnetic field strengths and frequencies at which they have been tested. MR scanning at either stronger and/or weaker magnetic field strengths than those tested may result in significant heating in which no or insignificant heating had been observed at the tested field strength(s). For example, if MR Conditional labeling specifies 3 T, it cannot be assumed that similar scanning parameters at 1.5 T are safe for the patient.
			There are devices available that can be used to shape the RF-field, such as RF-shielding blankets or RF shim pads. These can be potentially unsafe since electric fields are shifted to their edges where there could be interaction with adjacent tissue (heating). These devices should be used with caution and in accordance with their FDA approved instructions for use.	There are devices available that can be used to shape the RF -field, such as RF -shielding blankets or RF shim pads. These can be potentially unsafe since electric fields are shifted to their edges where there could be interaction with adjacent tissue (heating). These devices should be used with caution and in accordance with their FDA approved instructions for use. Indeed, many of these devices are no longer approved for use by the FDA, although they may be approved in other markets outside the U.S.

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		Patients with tattoos within range of RF transmission	Extensive, dark, or loop-shaped tattoos or tattooed eyeliner may increase the potential for RF heating. Patients should be instructed to immediately report any discomfort during scanning. If appropriate, the placement of cold compresses or sealed ice packs should be considered. Parenthetically, although not an RF thermal concern, patients with tattoos that had been placed within 48 hours prior to the pending MR examination should be advised of the potential for a smearing or smudging of the edges of the freshly placed tattoo [32-36].	Extensive, dark, or loop-shaped tattoos or tattooed eyeliner may increase the potential for RF heating. Patients should be instructed to immediately report any discomfort during scanning. If appropriate, the placement of cold compresses or sealed ice packs should be considered. Parenthetically, although not an RF thermal concern, patients with tattoos that had been placed within 48 hours prior to the pending MR examination should be advised of the theoretical potential for a smearing or smudging of the edges of the freshly placed tattoo (Kanal et al AJR 2012). However, at this time, reports of smearing or smudging of tattoos or eyeliner are lacking. [34-38].
		Key Points		Added bullet: Never operate the MRI scanner with unconnected coils, open coil interfaces, or other electrically conductive devices.
	Time-Varying Gradient Magnetic Field	Auditory Considerations	Manufacturer instructions for use should provide at least the minimum appropriate level of hearing protection.	Manufacturer instructions for use should provide at least the minimum appropriate level of hearing protection. Be aware that the hearing protection muffs may be displaced during the exam offering inadequate protection. The use of both ear plugs and ear muffs is recommended whenever possible.
		Induced Voltage	Additionally, time-varying gradient magnetic field-induced voltages can potentially be induced in implanted devices, possibly causing implant vibration, active device damage/malfunction/incorrect sensing, or even device and tissue heating [39-41].	Additionally, time-varying gradient magnetic fields can potentially cause implant vibration, active device damage/malfunction/incorrect sensing, or even device and tissue heating [41-43]. These interactions are rare when performing MRI following the manufacturers' conditions for the device. However, these can present a higher risk if these conditions are not followed or when performing off-label imaging due to medical necessity.
Chapter 10: Classification of Objects and Medical Implants and Devices in the MR Environment	Key Points			Added a bullet: Ensure no change in attraction forces for MR conditional devices after repair or maintenance.

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Chapter 12: Managing Patients and Research Subjects with Medical Implants and Devices in the MR Environment	Figure 28		Incorrect image displayed for image labeled D. FIGURE 28. Examples of pronounced susceptibility artifact on 1.5-T localizer images associated with ferromagnetic intracranial aneurysm clip (A, B, C). The ferromagnetic clip is seen on the CT images (D). In this case, the patient was removed safely from the scanner using slow table speed, and the table was detached and wheeled out of the room slowly without the patient sitting up.	Updated image D. FIGURE 28. Examples of pronounced susceptibility artifact on 1.5 -T localizer images associated with an unsuspected ferromagnetic intracranial aneurysm clip (A, B, C). In this case, the patient was removed safely from the scanner using slow table speed, and the table was detached and wheeled out of the room slowly without the patient sitting up. The presence of a metallic clip was confirmed on CT (D).
Appendix 2: MR Facility Safety Design Guidelines	Zone IV	Cryogen Safety	Many MR manufacturers now require that magnet rooms for superconducting magnets also be provided with an additional form of passive pressure relief/pressure equalization to minimize the risks of positive-pressure entrapment. Designs for passive pressure relief mechanisms should follow design criteria similar to that of the cryogen vent pathway and active exhaust, including discharge to a protected area.	Many MR manufacturers now require that magnet rooms for superconducting magnets also be provided with an additional form of passive pressure relief/pressure equalization to minimize the risks of positive -pressure entrapment. Designs for passive pressure relief mechanisms should follow design criteria similar to that of the cryogen vent pathway and active exhaust, including discharge to a protected area. Importantly, it is recommended that these are appropriately marked with surface warnings/signage (see Chapter 3 -MR Safety Zones).
Appendix 6: MR Pre-Appointment Guide			Not available in previous version	New MR Pre-Appointment Guide Appendix