

GE Healthcare

Optima* 1.5T MR430s Pre-Installation Manual



DOC0797563

Rev 4

2013, General Electric Company,
All Rights Reserved.

Revision History

Revision	Date	Changes
1	October, 2010	Initial conversion to GE format
2	May, 2011	EU Rep correction
3	August, 2012	Updated to indicate either solid glass with a sliding window or a solid glass pane with an intercom must be installed. Modified information in appendices and combined 50hz and 60 hz drawings. Corrected conversion of inches to mm for the penetration panel on pages 4-1 and 9-1. Removed mobile information.
4	August, 2013	Added 3 new symbols to the Electrical Safety Symbols section.

European Authorized Representative

GE Medical Systems S.C.S.
Quality Assurance Manager
283, rue de la Minière
78530 BUC France
TEL +33 (0)1 30 70 40 40



Table of Contents

Chapter: 1 Introduction	1-1
Electrical Safety Symbols	1-2
Overview	1-3
Safety Considerations	1-5
Limiting Access and General Site Considerations.....	1-5
 Chapter: 2 Space Requirements	2-1
Typical Imaging Suite Layout	2-1
Floor Space and Clearance Requirements	2-1
Extremity Equipment Legend	2-2
CODE.....	2-2
Description (Comments).....	2-2
Width.....	2-2
Depth.....	2-2
Height.....	2-2
Cabling Considerations	2-3
Floor Loading.....	2-4
Magnet Anchoring	2-4
 Chapter: 3 Magnetic Field Considerations	3-7
Effects on the MRI Equipment	3-7
Exclusion Limits	3-7
Two or More Magnet Site Layout	3-11
 Chapter: 4 Exam Room Physical & Electrical Requirements	4-1
RF Shielding and Exam Room Finishing	4-1
Sprinklers	4-5
Electrical	4-6
Lighting.....	4-6
RF Shield Grounding Technique	4-6
 Chapter: 5 Helium Venting	5-1
Introduction.....	5-1
Responsibilities	5-1
Vent Tube Wave Guide Penetration through the RF Room	5-3
Force on Vent Tube Penetration through the RF Room	5-4
Specific Requirements for the Building’s Helium Vent System	5-5
Maximum Pressure Drop	5-5
Vent Tube Materials	5-5
Joints	5-5
Vent Supports.....	5-7
Fire Breaks	5-7
Exhaust Vent.....	5-7

Vent Pipe Sizing	5-7
Chapter: 6 Electrical Requirements	6-1
Power Supply	6-1
Exam Room Electrical Raceway	6-2
Other Conduit or Raceway.....	6-2
Chapter: 7 Environmental Requirements	7-1
Temperature and Humidity Specifications	7-1
Heat Output and Cooling Requirements	7-1
Moving Metal and Ambient Magnetic Fields	7-1
50/60 Hz Stray Magnetic Fields	7-2
Vibration	7-2
Altitude Specification	7-2
Audible Noise	7-3
Reducing Air Pollution Effects	7-3
Chapter: 8 Shipping and Delivery Information	8-1
Transportation & Storage Requirements	8-2
Chapter: 9 Pre-Installation Checklist	9-1
Index	1
Appendix A Typical Layouts International/50 Hz and USA/60 Hz.....	<u>1</u>

Table of Figures

Figure 1-1. Typical Suite layout of system components (N.T.S.) 1-3

Figure 2-1. Magnet Stand base plate mounting anchor pattern and positioning of surface mount cable raceway and vent tube relative to magnet and exam room walls. See Figure 2-3 for section A-A. 2-5

Figure 2-2. Typical Floor Prep Detail for Hilti Anchor 2-6

Figure 2-3. Section A-A of Figure 2-1 showing detail of magnet base plate mounting anchors and floor preparation for “Grout & Copper” RF Floor. 2-6

Figure 3-1. Magnet Near Fringe Field Top View (not to scale). 3-8

Figure 3-2. Magnet Near Fringe Field Side View (not to scale). 3-9

Figure 3-3. Magnet Fringe Field Top View (not to scale). 3-10

Figure 3-4. Magnet Fringe Field Side View (not to scale). 3-11

Figure 4-1a. Exam room elevation showing penetration panel horizontal opening & helium vent waveguide penetration. 4-2

Figure 4-2b. Exam room elevation showing penetration vertical panel opening & helium vent waveguide penetration. 4-3

Figure 4-3a. Pen Panel wall section. Typical shown. Shield wall/floor detail may vary with RF subcontractor. 4-4

Figure 5-1. Major Elements of a Cryogenic Venting System. 5-2

Figure 5-2. Vent Tube Penetration Location Behind Magnet. Note: GE site planning will provide specific location for vent pipe penetration. 5-3

Figure 5-3. Side View of Vent Tube Penetration through RF Room Wall. 5-4

Figure 5-4. Force on Vent Tube Penetration through RF Room 5-5

Figure 5-5. Photograph of insulating joint using a 3” DWV coupling. A coupling with metal shield and 4 clamps is required. Some RF room suppliers will provide a special insulating coupling for use outside of room. This item is supplied by your general contractor. 5-6

Figure 5-6. Photograph of KF-40 flange to 3” DWV pipe adapter provided by GE. The adapter is to be soldered to 3” copper DWV positioned as shown in Figure 5-1 and Figure 2-1. 5-6

Figure 7-1. Maximum Vibration Levels as a Function of Frequency. 7-2

List of Tables

Table 1-1. Major System Components	1-3
Table 2-1. Component Dimensions	2-2
Table 2-2. Minimum Finished Room Size Requirements	2-2
Table 2-3. System Cable Properties for Two Available Lengths	2-3
Table 2-4. Floor Loading	2-4
Table 3-1. Maximum Magnetic Field Strengths	3-7
Table 3-2. Field and Proximity Limits of Various Equipment	3-12
Table 4-1. Exam Room and Shielding Requirements and Tests	4-1
Table 5-1. Copper Tube Dimensions	5-3
Table 6-1. Electrical Power Requirements	6-1
Table 6-2. System Electrical Power Connections for USA and Canada (60Hz operation)	6-2
Table 7-1. System Environmental Requirements.....	7-1
Table 7-2. Maximum Equipment Audible Noise.....	7-3
Table 9-1. Shipping Data	8-1

1 Introduction

This guide outlines the various site requirements and special preparations for the proper installation of the MRI system. The customer and their designated contractors are responsible for satisfying the requirements in this document.

The following is a summary of the major topics covered in this document:

- Placement of the components.
- Electrical service power and outlets.
- Exam room physical and shielding requirements.
- Helium gas venting.
- Environmental Control Requirements.
- Phone and computer network interfaces.

In preparing the site for installation, a variety of contracting trades will be required. Installation is normally coordinated through a single individual responsible for the project; sometimes this person is the customer, but usually it is a contractor or building facility coordinator retained by the customer who provides expertise in facility modifications.

During the course of preparing the site a GE installation project manager is available to assist the customer's representatives in properly interpreting the contents of this document. The cost of this service is included in the purchase price of the equipment. GE will generally provide a standard summary of the requirements tailored to site specific installation needs. Appendix A shows examples of this information and the format to expect.

Safety Hazard Alerts

There are three hazard classifications used in this document:

Alert	Circumstance for Use
 DANGER	Danger indicates an imminently hazardous situation, and, if not avoided, will result in death or serious injury. Danger is limited to extreme situations.
 WARNING	Warning indicates a potentially hazardous situation, and, if not avoided, could result in death or serious injury.
 CAUTION	Caution indicates a potentially hazardous situation, and, if not avoided, may result in moderate to minor injury.
The following ANSI Z535.2 definition is applied to notify users of the potential for property damage only:	
 NOTICE	Indicates information or company policy that relates directly or indirectly to the safety of personnel or protection of property.

Electrical Safety Symbols



Type B Applied Part



Type BF Applied Part



Dangerous voltage (components, points of entry)



Attention: Consult accompanying documents



Mandatory: Refer to the Instruction Manual



Equipotentiality (terminals)



Three phase alternating current with neutral conductor

Overview

The OPTIMA MR430S SYSTEM is a Magnetic Resonance Imaging (MRI) system designed specifically for imaging human extremities. Its operating principle is similar to that of a whole-body system. With the exception of its smaller size and field-of-view, the resultant image quality and overall performance is similar to a conventional whole-body system. Figure 1-1 shows a typical suite layout of the system components.

The OPTIMA MR430S SYSTEM components provided by GE are summarized in Table 1-1 below. The codes are used on various site-planning layouts when referring to equipment. Page 4 of Appendix A contains a summary of the equipment dimensions.

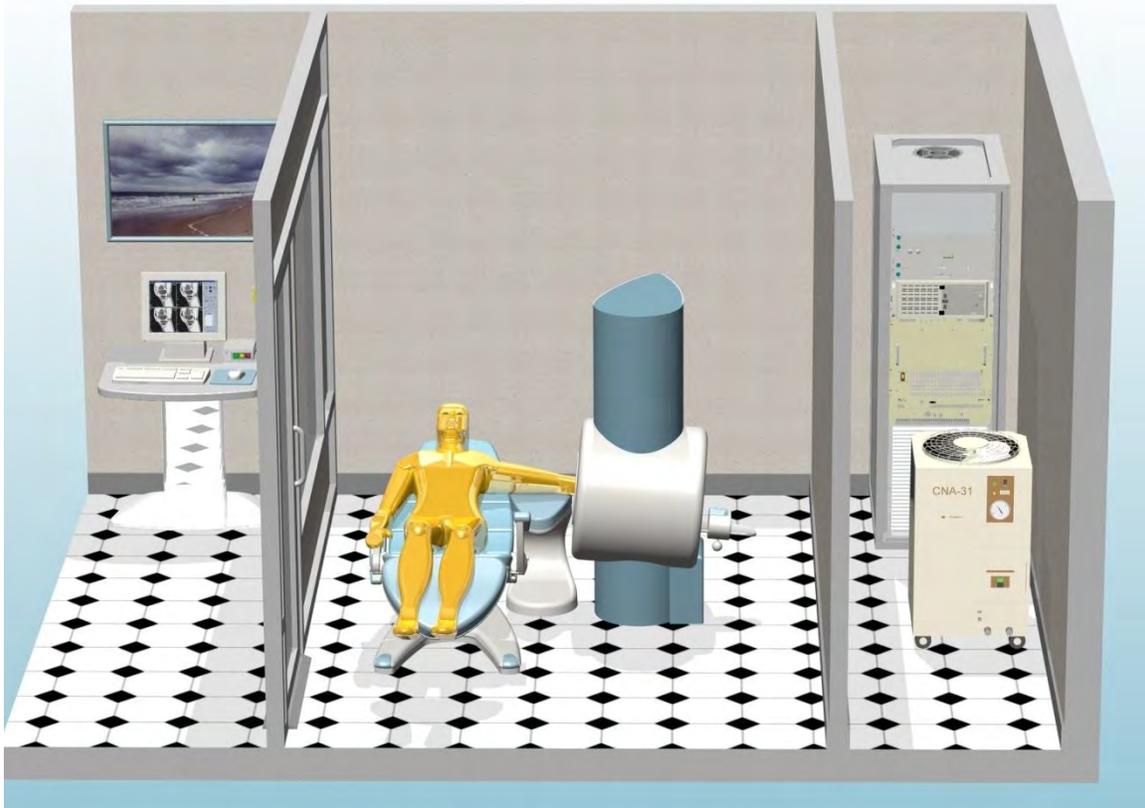


Figure 1-1. Typical Suite layout of system components (N.T.S.)

Please refer to Appendix A for typical layouts in plan view with dimensions.

Please note that the support stand for the console components shown in the rendering above is not provided or available from GE. The necessary support means for GE console equipment and all other casework or furnishings are the customer's responsibility.

Table 1-1. Major System Components

Code	Description	Rendition
OC	Operator's Console Equipment consisting of an LCD monitor, keyboard, mouse and power control unit.	
EQ	Emergency Quench Button.	
MA	1.5 Tesla Magnet Assembly.	
PP	Penetration Panel that mounts on the RF shield wall.	
LF	Service lifting fixture	
PC	Penetration Panel Cover	N/A

Code	Description	Rendition
PS	Patient Support Chair.	
HC	Air cooled Helium Compressor as part of the magnet refrigeration system.	
SE	System Electronics Cabinet.	
	Warning Signs. (QTY-2)	
	Cables	N/A

Safety Considerations

Limiting Access and General Site Considerations

The controlled access area is established to prevent potential harm to equipment and individuals due to implants or other ferrous objects interacting with the magnetic field. Concern is for anyone in the area (e.g. patient, operator, maintenance worker) defined by the three dimensional 5 Gauss (0.5 mT) fringe field contour around the magnet. This exclusion zone extends six feet (1.85 meters) in the axial direction (front and back), and four feet (1.15 meters) in the radial direction (side to side, up and down), from the centerline of the magnet. Refer to Figures 3-1 and 3-2 for the detailed locations of the 5 Gauss contour, and those of other fringe field levels relative to the magnet's center point.

WARNING Any ferrous object, e.g. paper clips, pocket knife, pen, keys, vacuum cleaner, oxygen bottles, tools, cordless drills, etc., brought within three feet (0.9 meter) of the magnet has the potential of becoming a projectile and causing harm to the system and anyone around the imaging system. With larger metal objects, the force can be very great and serious damage to equipment and serious personal injury can result, even death. Note: The Optima MR430s system ships with a reference manual for MRI safety which details further clinical screening needs and considerations that are beyond the scope of this pre-installation manual.

WARNING Pacemaker implants, neurostimulators, and other biostimulation devices may fail to operate properly in static magnetic fields greater than 5 Gauss. Therefore, individuals with these devices must not enter the controlled access area. All entries to the controlled access area are to be labeled by a warning sign of the type shown below.

CAUTION It is the responsibility of the user to follow local statutory requirements in regard to entering a controlled access area. Notification of maintenance personnel (especially those that might enter during off hours) and emergency personnel such as the fire departments is strongly recommended.



This page left blank intentionally.

2 Space Requirements

Use this section to plan the layout of the imaging suite. It provides information on overall space requirements for equipment, cabling and floor loading specifications.

Typical Imaging Suite Layout

Page 1 and page 2 of Appendix A shows two typical suite layouts. There are three main areas of the suite; the exam room, the control room, and the equipment room. Refer also to Table 1-1 for equipment references and Table 2-1 for component dimensions.

The operator's control room should have a work desk of sufficient area to place the Operators Console (OC) equipment, made up of the LCD monitor, keyboard, mouse and power control unit along with any desired additional work space. Minimum desk area recommended and provided by the customer or the contactor is 42"W x 24"D (1070 mm W x 610 mm D). The control room is also the location of the Emergency Quench (EQ) button, which is to be located within reach of the operator at the OC location.

The exam room, containing the Magnet Assembly (MA) and Patient Chair (PC), must be shielded from radio frequency interference and be large enough to allow adjustment of the patient chair into all necessary patient positions. Cabinets should be placed in the exam room to hold the RF coils, Daily Quality Assurance Phantom, and foam positioning pads. At least one non-ferrous wall hung cabinet provided by the contractor with minimum dimension of 30"W x 12"D x 36"H (760 mm W x 305 mm D x 915 mm H) is recommended. Steel cabinets cannot be used. The exam room shielded door should have a key lock for safety.

The equipment room contains the Helium Compressor (HC) and the System Electronics (SE) to operate the imaging system and should have enough space for a service person to access the equipment. The system also includes a system-electronics service lifting fixture that will need to be stored on site. The service lifting fixture is 24"W x 30"D x 72"H (610 mm W x 760 mm D x 1830 mm H).

Numerous alternative layouts are possible allowing flexibility to conform to specific limitations of the site. It is advised that a GE installation project manager be brought into the site planning process as early as possible so that tradeoffs can be fully explained and so that the space available is used in the most efficient and functional way.

Floor Space and Clearance Requirements

Table 2-2 shows typical floor space and minimum clearances needed to install all components. The minimum dimensions of the exam room are necessary to open and manipulate the chair into all its necessary configurations for imaging the upper and lower extremities. All room sizes are highly dependent on the means of access and the arrangement of the MRI suite. Typical minimum square footage needed will vary between 222 sq. ft. (20.6 m²) and 250 sq. ft. (23.2 m²).

After renovation, there are minimum hallway and ceiling clearances required to allow servicing of the equipment. Helium dewar transport requires 36" (915 mm) wide doors from the receiving entrance, through the facility into the exam room.

NOTICE

32" (813 mm) or more may be sufficient in some cases. Check with the cryogen provider.)

Table 2-1. Component Dimensions

Extremity Equipment Legend				
CODE	Description (Comments)	Width Inch (mm)	Depth Inch (mm)	Height Inch (mm)
OC	Operator's Console equipment (requires counter space, incl. LCD monitor, keyboard, mouse, and power control unit)	32 (810)	24 (610)	20 (510)
EQ	Emergency Quench button (kills magnetic field, wall mount)	3 (80)	3 (80)	3 (80)
MA	Magnet Assembly	33 (840)	33 (840)	59 (1,500)
PS	Patient Support (maximum extensions shown)	30 (760)	65 (1,650)	53 (1,350)
HC	Helium Compressor (magnet cryo refrigeration)	22 (560)	25 (640)	35 (890)
SE	System Electronics	24 (610)	36 (914)	69 (1,750)
PP	Penetration Panel (mounts on RF shield wall)	25 (640)	4 (100)	13 (330)
PC	Penetration Cover (hides PP and Cryovent)	36 (910)	12 (310)	20 (510)
LF	Service Lifting Fixture	24 (610)	30 (760)	72 (1830)
* * * Customer and/or Contractor Supplied and Installed Items * * *				
RFS	Radio Frequency Shielded room (90dB or better, including door & window)	--	--	--
OWS	Operator's Work Surface (OC, phone, & writing surface)	42 (1,220)	24 (610)	32 (810)
CAB	Storage Cabinet-Non Magnetic (storage of accessories and so on)	30 (760)	12 (310)	36 (910)
AER	Aluminum Electrical Raceway (surface mount for MA wiring)	10 (250)	3-1/3 (90)	run length
SGW	RF screen window with sliding glass or solid glass (see INT below) on operator's side.	36 (910)	36 (910)	--
INT	Intercom mandatory if solid glass window installed.	--	--	--

Table 2-2. Minimum Finished Room Size Requirements

Room	Width	Depth	Height	Door
Control Room	24 to 30 Sq. Ft. (2.2 to 2.8 m ²)		Per code	36"x84" (915 x 2134 mm)
Exam Room ^{1,2}	11'-0" (3350 mm)	9'-6" (2896 mm)	7'-8" (2340 mm)	36"x84" (915 x 2134 mm)
Equipment Room	45 to 60 Sq. ft. (4.2 to 5.5 m ²)		Per code	32"x84" (915 x 2134 mm)

¹ Minimum finished floor to ceiling height required for helium fill

² Minimum door opening of 36"(915 mm) required to fit standard 250 liter helium dewar. A 32" (813 mm) door is required to fit a standard 100 liter dewar.

Cabling Considerations

There are numerous cables connecting the components located in the control room, the exam room, and the equipment room. All cables must be installed through conduits/raceways in a safe manner so as not to endanger foot traffic. A pull line must be left in all conduits. Table 2-3 summarizes the cabling requirements.

Table 2-3. System Cable Properties for Two Available Lengths

From	To	Cable Lengths ft(m)	Conduit/ Raceway ¹
System Electronics (SE)	Operators Console (OC)	24 (7.3)	2.5 in (63.5 mm) Min Diameter conduit or raceway
		49 (14.9)	
	74 (22.5)		
Emergency Quench ² (EQ)		24 (7.3)	
		49 (14.9)	
74 (22.5)			
RF Shield Penetration Panel (PP)		24 (7.3) 49 (14.9)	5 in (125 mm) conduit or raceway if required ⁴
Helium Compressor (HC)	RF Shield Penetration Panel (PP)	24 (7.3) 49 (14.9)	4 in (101 mm) conduit or raceway if required ⁴
Compressor Hoses ³	Magnet Assembly (MA)	32 (10) 65 (20)	
RF Shield Penetration Panel (PP)	Magnet Assembly (MA)	24 (7.3)	3.5 in. x 10 in. Aluminum surface mount raceway

¹ Conduit/Raceway run length will necessarily be less than the cable length by 10 ft (3050 mm) or more to allow cable to be attached to equipment. The precise length will depend on location of components relative to conduit/raceway inlet/outlet location. All conduit and raceway supplied & installed by the customer or their contractor.

² The Magnet Emergency Quench Unit must be located in the same suite as the operator's console and out of the controlled area so that emergency personnel have access to it.

³ The compressor Helium gas hoses form a single continuous connection that cannot be broken. As a result, the total length from the compressor to the magnet is a controlled length.

⁴ The equipment room does not normally require raised computer floor, conduit, or raceway. Cables are positioned out of the way of foot traffic in this room by GE's field engineer at installation.

Floor Loading

The flooring of the site must be adequate to handle the additional weight of the OPTIMA MR430S SYSTEM. Table 2-4 lists the gross weight of the larger components along with additional information regarding anchoring of the equipment. Page 3 of Appendix A also lists the weights of the components. It is the responsibility of the customer or their consultants to verify the adequacy of planned or existing floors for delivery and installation of the System

Table 2-4. Floor Loading

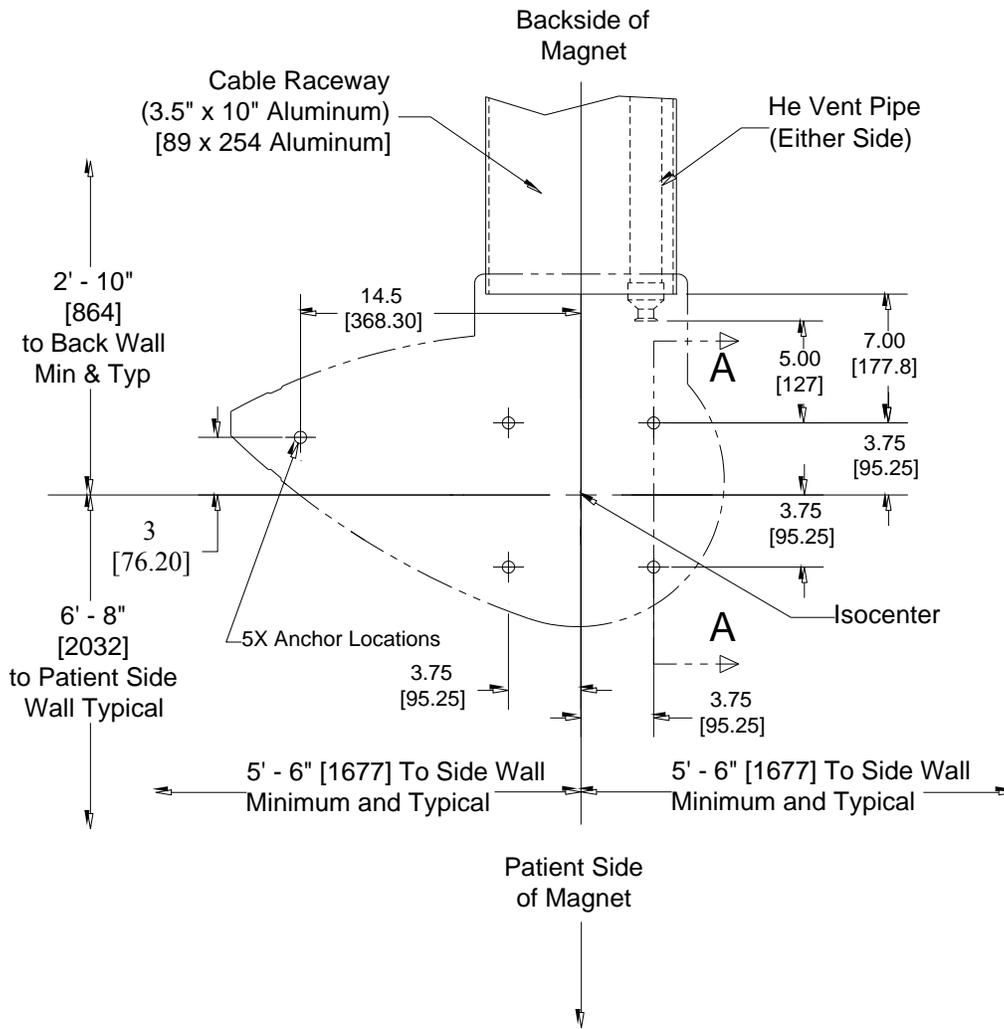
Component	Net Weight Lbs. (Kg)	Normal Mounting Methods
Magnet Assembly (MA)	1000 (454)	Bolted to the floor in a manner consistent with local earthquake and building codes. ¹
System Electronics (SE)	860 (391)	Free moving on casters, but could be attached to the floor if required by local earthquake requirements.
Patient Chair (PC)	120 (55)	Free moving on casters.
Helium Compressor (HC)	309 (140)	Free moving on casters, but could be attached to the floor if required by local earthquake requirements.

¹ The magnet assembly weight is distributed over an area of 1.0 square foot (92903 mm²) for a local floor loading of 6 psi (42 KPa).

Magnet Anchoring

The Magnet is to be anchored to the floor for safety and for proper operation. Figure 2-1 shows the location of 5 anchor points for the magnet along with the proper positioning of a surface mount raceway at the back of the magnet assembly. Also shown are the minimum distances to the wall required for adequate patient and operator space and for service of the magnet system. A full size anchor template can be requested from GE site planning.

Anchoring of the magnet must be done in such a way as to not compromise the integrity of the radio frequency shield. RF shielding manufacturers are familiar with the proper anchoring methods. Failure to properly mount the magnet could result in RFI artifacts in the images. Figure 2-2 and Figure 2-3 shows the typical details of how the magnet stand is to be anchored. Anchoring must be done in accordance to local earthquake requirements. If seismic compliance is a requirement, a structural engineer should review and approve anchoring details and weight distribution for the particular floor construction.



MOUNTING PATTERN

Figure 2-1. Magnet Stand base plate mounting anchor pattern and positioning of surface mount cable raceway and vent tube relative to magnet and exam room walls. See Figure 2-3 for section A-A.

NOTICE Helium vent pipe and cable raceway provided and installed by customer or their contractors.

NOTICE Distances to wall are typical only for those configurations where the magnet is oriented square to a four wall room. If the magnet is to be rotated out of square, or the room is a complex shape, contact GE site planning for assistance.

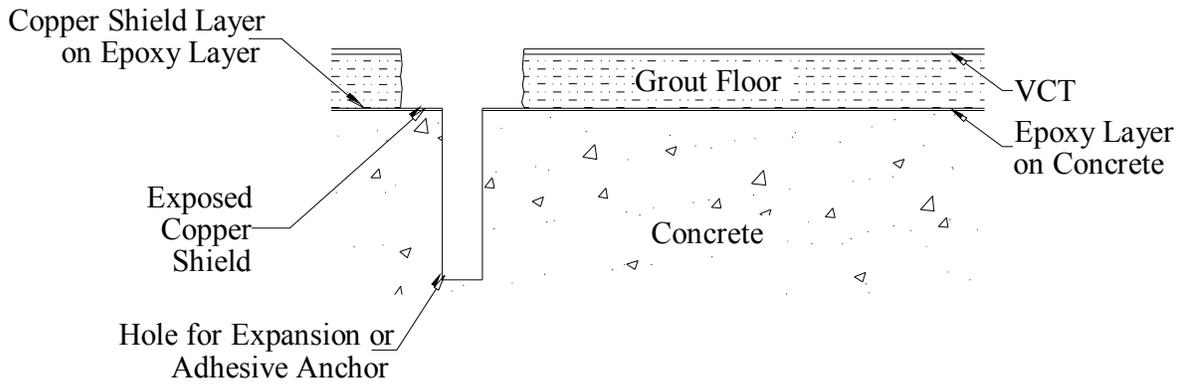
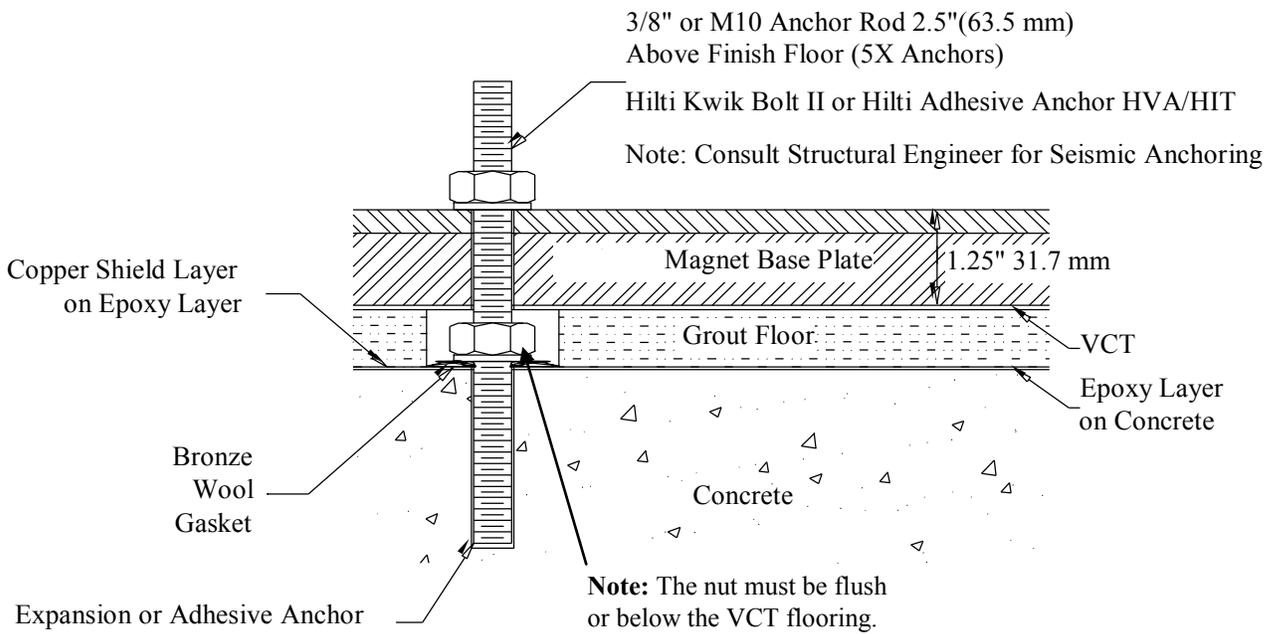


Figure 2-2. Typical Floor Prep Detail for Hilti Anchor



SECTION A-A

Figure 2-3. Section A-A of Figure 2-1 showing detail of magnet base plate mounting anchors and floor preparation for "Grout & Copper" RF Floor.

3 Magnetic Field Considerations

Effects on the MRI Equipment

The magnetic field can affect the operation of the components in the OPTIMA MR430S System. Consequently, the exact location of the components can be critical. Table 3-1 lists the maximum magnetic field strength that the system components (or group of components) can be subjected to without adverse effects. Figures 3-1, 3-2, 3-3 and 3-4 show the magnet near and far fringe field lines (shown in meters), respectively.

NOTICE

Ensure that components are placed in areas where magnetic fringe field strength does not pose a problem.

Table 3-1. Maximum Magnetic Field Strengths

Component	Magnetic Field Gauss(mT)
Helium Compressor (HC)	$G \leq 50$ (5)
System Electronics (SE)	$G \leq 10$ (1)

Exclusion Limits

When designing a floor plan, there are special considerations that must be taken into account in order to avoid interaction with or harm to certain medical implants (including cardiac pacemakers, neuro-stimulators, aneurysm clips, and bio-stimulation devices) due to the effect of the magnetic field. As a result, general public access must be limited to less than 5 gauss as discussed in the Safety Considerations section of Chapter 1.

In addition to concern about physical safety, the fringe field of the magnet has the potential to damage sensitive surrounding equipment. A further consideration is the need to minimize the environmental effects of motors, steel, etc., that can adversely affect the magnet field homogeneity and stability, possibly adversely affecting image quality. Table 3-2, is a guideline for the proximity limits of the various equipment considering all these factors.

Recommended limits provided in Table 3-2 are based on general MR site planning guidelines. Actual susceptibility of specific devices may vary significantly. Any equipment such as that shown in the table should be brought to the attention of GE site planning as early as possible in the process.

It is possible in some situations that large electrical equipment and moving metal is acceptable inside the exclusion zone. To make such a determination a site survey would normally be conducted at the expense of the customer. The survey would include a measurement of the background magnetic field changes due to moving metal, time varying DC magnetic fields caused by subways, trolleys, etc., and stray 50/60 Hz magnetic fields emanating from motors, transformers, power lines, & etc. Check with GE for further details.

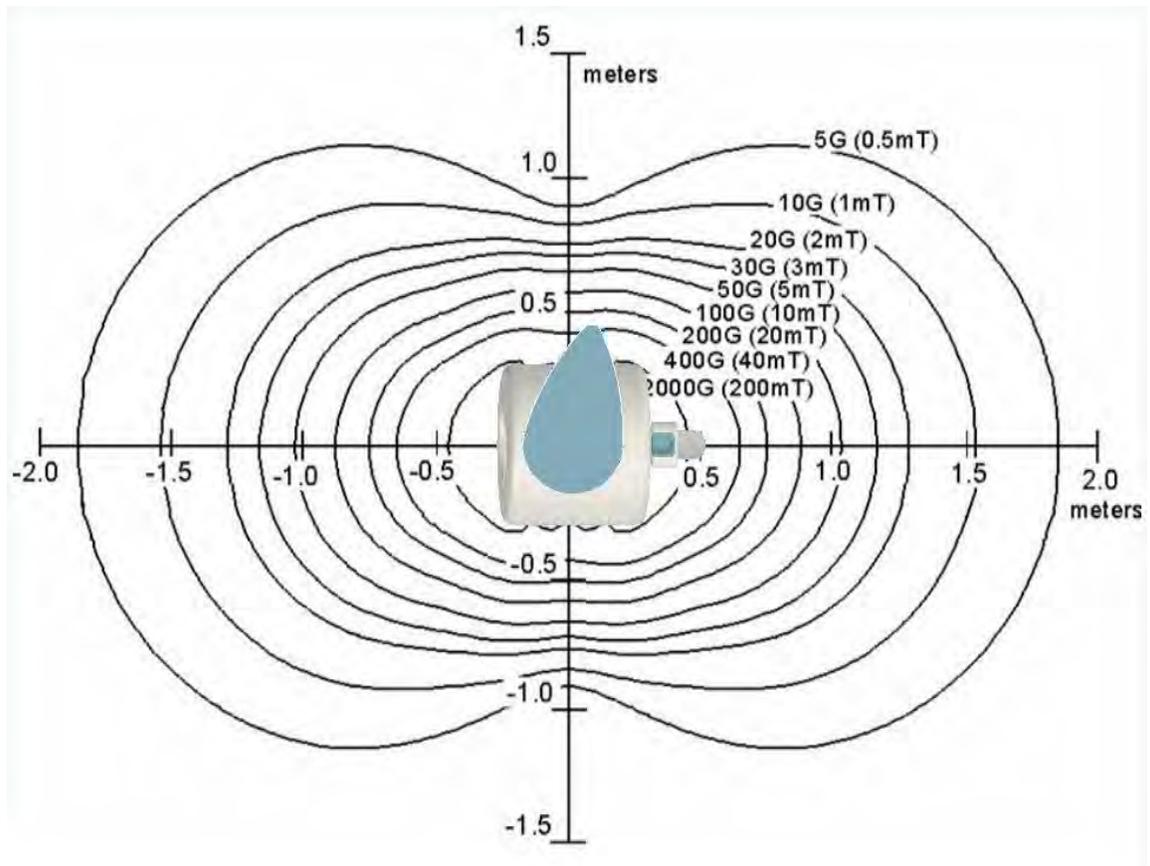


Figure 3-1. Magnet Near Fringe Field Top View (not to scale).

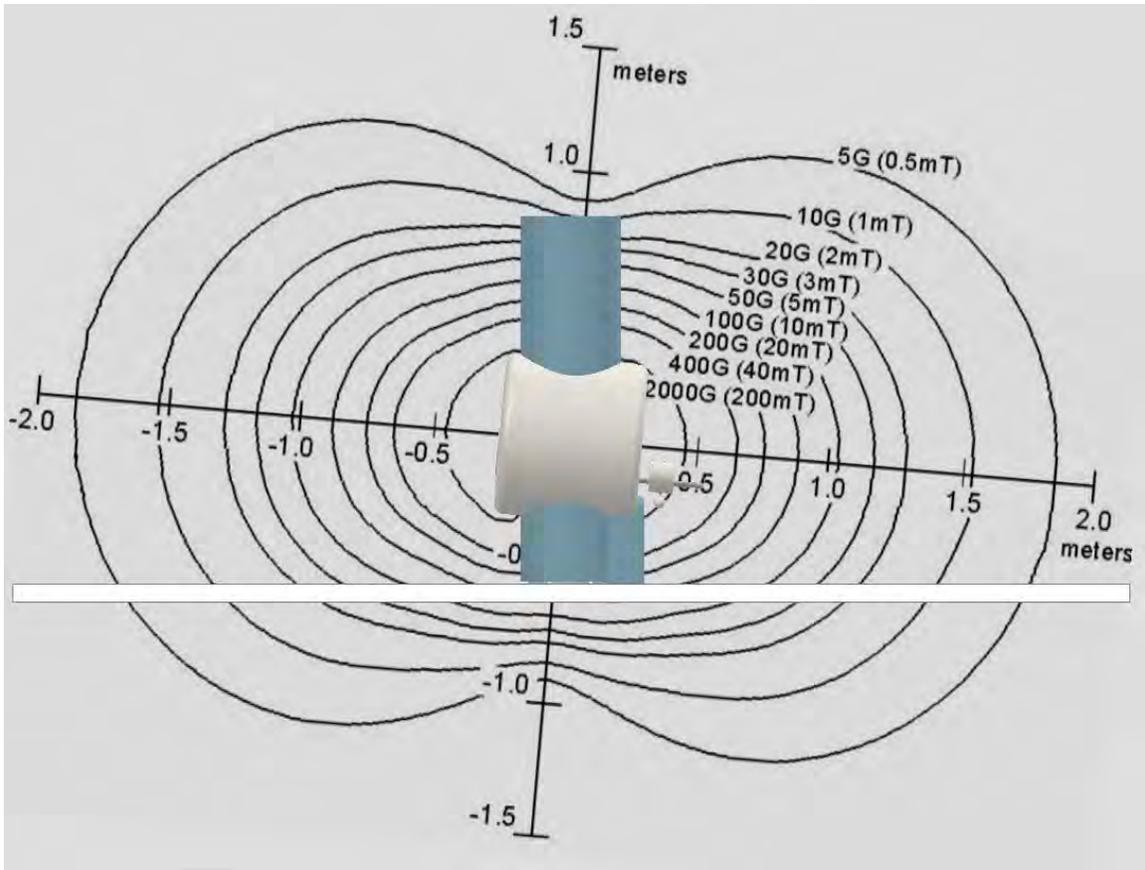


Figure 3-2. Magnet Near Fringe Field Side View (not to scale).

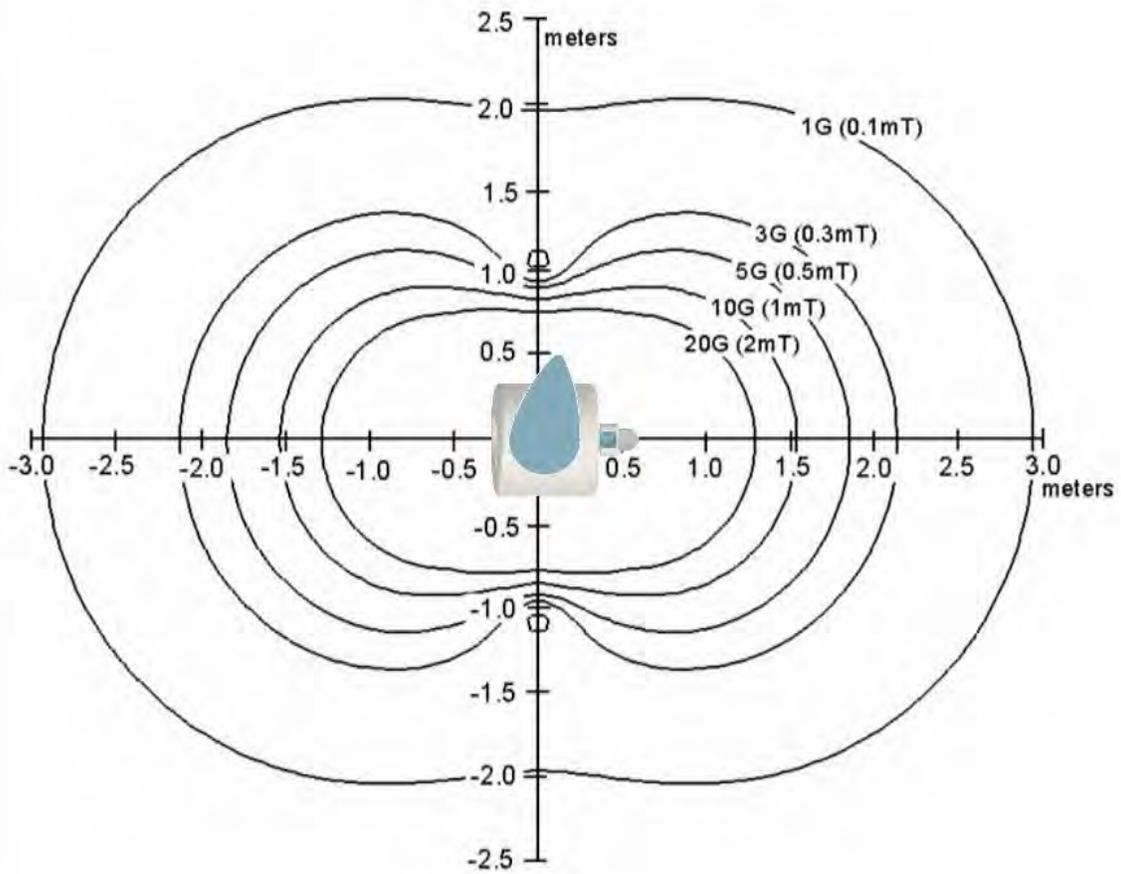


Figure 3-3. Magnet Fringe Field Top View (not to scale).

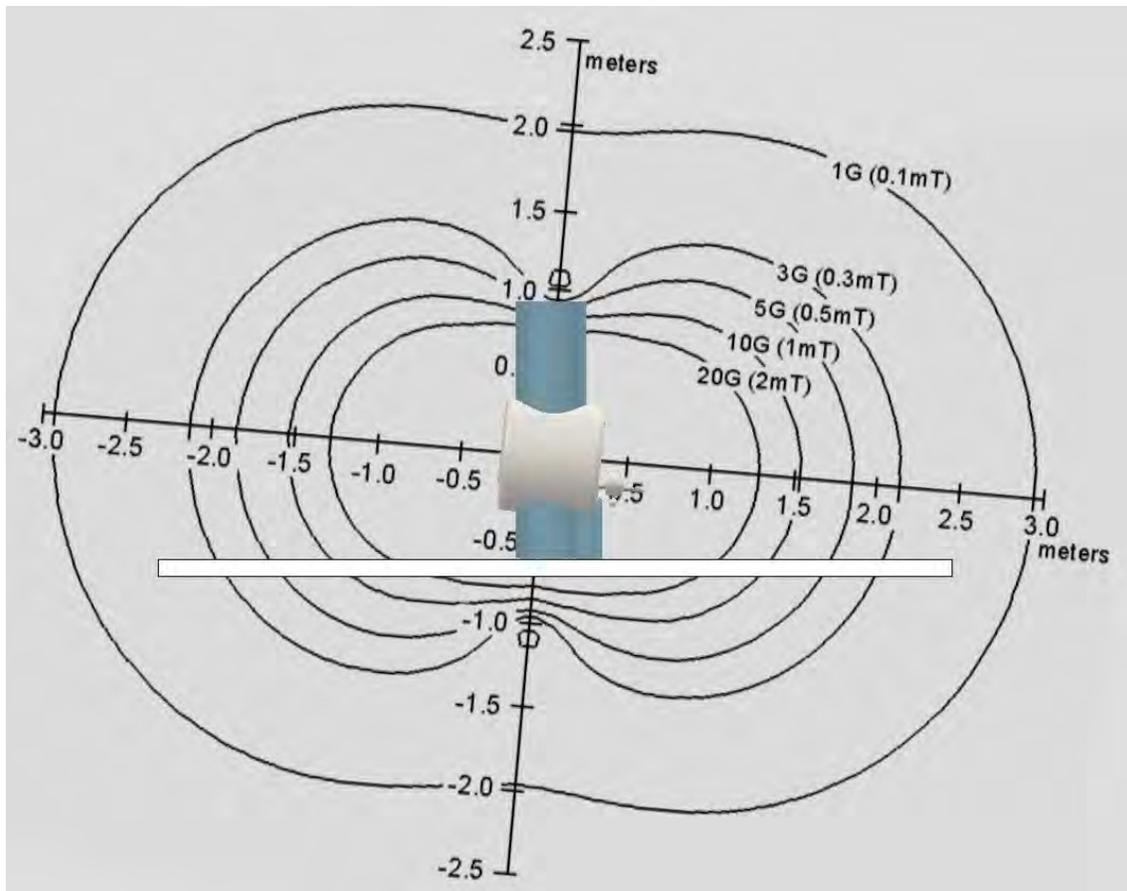


Figure 3-4. Magnet Fringe Field Side View (not to scale).

Two or More Magnet Site Layout

In some cases, there might be other magnets in close proximity to the OPTIMA MR430S System. Interaction will occur between the magnetic fields; therefore, a change in field strengths for either magnet may require re-shimming of both (or more) magnets. Accordingly, specific orientation of the two (or more) magnets may be necessary. It is recommended that the 5 Gauss contours of the two (or more) magnets do not overlap. Consult GE Customer Service if you encounter this situation.

Table 3-2. Field and Proximity Limits of Various Equipment

Field Limit ¹ (Gauss)	Minimum Distance from Iso-center of Magnet in any Direction ft (meters)	Equipment
Not Applicable	30 (9.2)	<ul style="list-style-type: none"> • Moving Steel Equipment such as: <ul style="list-style-type: none"> □ Vehicular Traffic. □ Fork Lift Trucks. □ Loading Dock (truck Traffic). □ Elevators. □ Movable Garbage Dumpsters • Building Electrical distribution Equipment • Electric Trains, Subways or Trolleys • Large Electrical Equipment with internal moving metal parts such as: <ul style="list-style-type: none"> □ Emergency Generators. □ Rooftop Air Conditioning Chiller.
1 or less	10 (3)	<ul style="list-style-type: none"> • Video Display (Color, B/W, Monochrome CRT based). • Power Transformers. • Main Electrical Distribution Panels and Transformers. • HVAC Blowers and Expansion Units.
5 or less	5.3(1.6)	<ul style="list-style-type: none"> • Cardio Pacemakers • Neuro-stimulators • Bio-stimulation Devices
10 or less	5 (1.5)	<ul style="list-style-type: none"> • Magnetic Tapes and Floppy Drives. • VCRs. • Credit Cards, Watches and Clocks. • Telephone Switching Station. • LCD based monitors.
200 or less	2 (0.6)	<ul style="list-style-type: none"> • Electrical Line Filters.

¹ Refer to magnetic fringe field plots in the prior section.

NOTICE Refer also to Chapter 7 for concerns related to environmental specifications related to time varying magnetic fields.

4 Exam Room Physical & Electrical Requirements

Ambient Radio Frequency Interference (RFI) can adversely affect the imaging performance of the MRI system. As a result RF shielding is required for all installations to prevent interaction of external RF radiation with MRI system operation (it also prevents MR system RF radiation from interfering with external RF systems, such as aircraft control). There are several well qualified RF shielding contractors. GE site planning can provide a contact list.

RF Shielding and Exam Room Finishing

Table 4-1 summarizes the RF shielding and exam room finishing requirements. These requirements are to be used by the customer and the customer’s contractors.

Table 4-1. Exam Room and Shielding Requirements and Tests

Parameters	Requirements
RF Shielding Effectiveness	90 dB of E field attenuation is required from 50 MHz to 80 MHz with a blank plate on the penetration panel opening.
Electrical Isolation	The RF shield must be electrically isolated from any point with a low impedance to ground, including non-GE electrical equipment, plumbing, and the quench vent. The isolation required is > 1000 ohms before magnet anchoring.
Size	The exam room must not interfere with the patient handling. Minimum finished exam room dimensions per Table 2-1 are 11’ wide x 9’6” (in direction of magnet axis) x 7’8” high (3.35 m x 2.9 m x 2.34 m).
Floor	The exam room floor must accommodate the floor loading from the GE equipment, see Table 2-3 for specific requirements. The floor must be smooth to allow the patient chair to move freely with the heavy patient load. Commercial grade Vinyl Composition Tile (VCT) or commercial grade sheet flooring capable of withstanding heavy casters or rollers is required. The maximum local floor pressure is estimated to be 1800 psi (12.4 MPa). Felt underlayment, textured or soft vinyl, or rugs are not acceptable. The floor level must be ≤ 0.078” (2mm) between depressions and high spots over a 5’ long(1524 mm) x 6’ wide(1829 mm) (centered in front of magnet bore opening) floor area. Figure 2-1, 2-2 and 2-3 specifies anchor bolt type and shows the bolt pattern for mounting the magnet to the floor. This pattern must be accommodated in the floor to enable the magnet stand base to be installed flat on the finished floor.
Door	The finished door opening must be a minimum of 36”w by 84” h (915 x 2134 mm). It should not interfere with the patient chair access area. Any threshold should be minimized with a ramp and no gaps in the flooring according to requirements of local codes. The door should be provided with a key lock for safety.
Window	A non-glazed or glazed RF screen window shall be provided to allow continuous visual and audible contact between the operator and the patient. This window should not degrade the effectiveness of the RF shield. Sliding glass on the operator side of the screen is recommended for privacy. If a single solid glass pane covers the RF screen window, the customer shall provide a 3 rd party MRI compatible intercom system. GE site planning should be consulted.
Penetration Panel (PP)	An 11”x23”(280 mm x 584 mm) opening must be reserved for the penetration panel (PP) and it should be approximately 6”(155 mm) off the exam room floor. Typically, the penetration panel opening is somewhere along the exam room wall that is common to the equipment room. For the penetration panel mounting pattern see Figure 4-1 and Figure 4-2. GE site planning will provide a drilling template/jig upon request.
Helium Venting	A helium vent pipe penetration is required. The shield contractor is to supply a 3” (76 mm) waveguide section of tube and mechanically and electrically secure the tube to the shield. Refer to Chapter 5 for more details on helium venting.
Safety Vent Panel	A minimum 12” x 12” (305 mm x 305 mm) EMI-shielded ventilation panel with honeycomb construction should be installed in the ceiling.

Parameters	Requirements
Air Ventilation	RF room supplier to supply heating/air conditioning feed and return penetrations.
Shielding Material	Any typical non-ferrous RF shielding material may be used. Moving parts, such as a door or removable parts, must be non-ferrous.
AC power line filter	RF room supplier to supply AC power line filters for lighting and power outlets in the exam room. Three 20 AMP filters are recommended.
Structural Material	All structural material should comply with all architectural and safety regulations. Parts that can't be removed from the exam screen room can be ferrous, e.g., steel wall studs. Check with GE for details.
Tests	The customer's RF shield vendor is responsible for conducting RF attenuation and ground isolation tests to verify that the shield meets GE specifications. A statement of test with test data sheets should be provided to the GE customer service representative before the installation commences.
Maintenance	Follow the RF shield vendor's recommended maintenance. Alert GE customer service representatives of any RF shield defects since they could affect image quality.
Finished Room	When planning the finished room, which includes wall coverings, ceiling tile, and other fixtures: <ul style="list-style-type: none"> 1. Do not use magnetic items (magnetic items could become projectiles when the magnet is installed). 2. Do not use items which may cause RF interference. 3. Meet all building codes (such as maintaining egress routes).

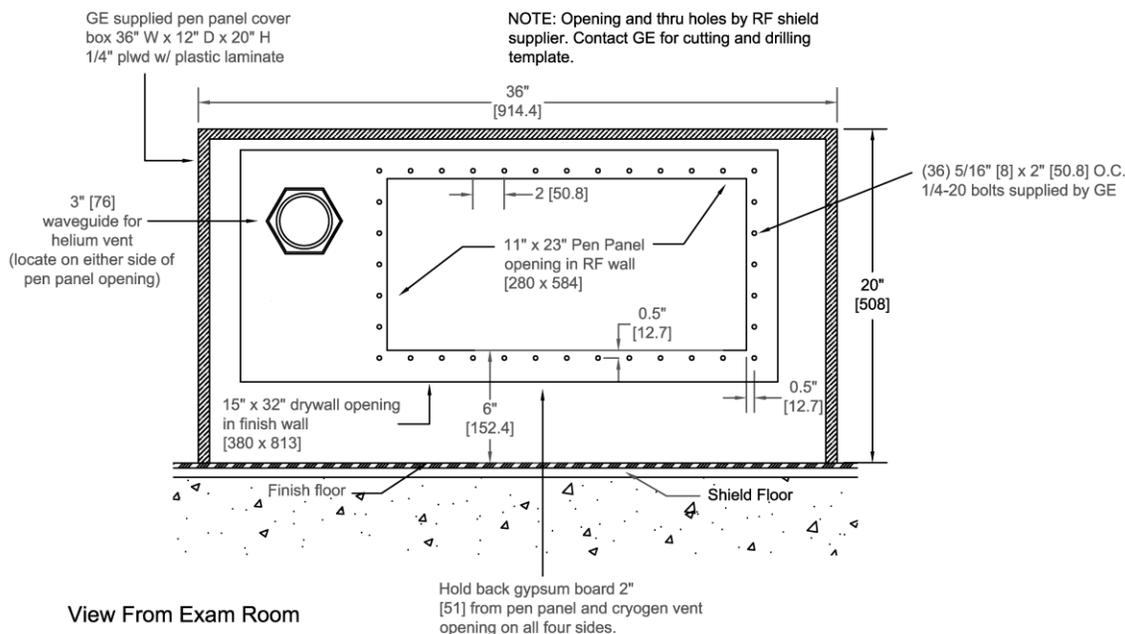


Figure 4-1a. Exam room elevation showing penetration panel horizontal opening & helium vent waveguide penetration.

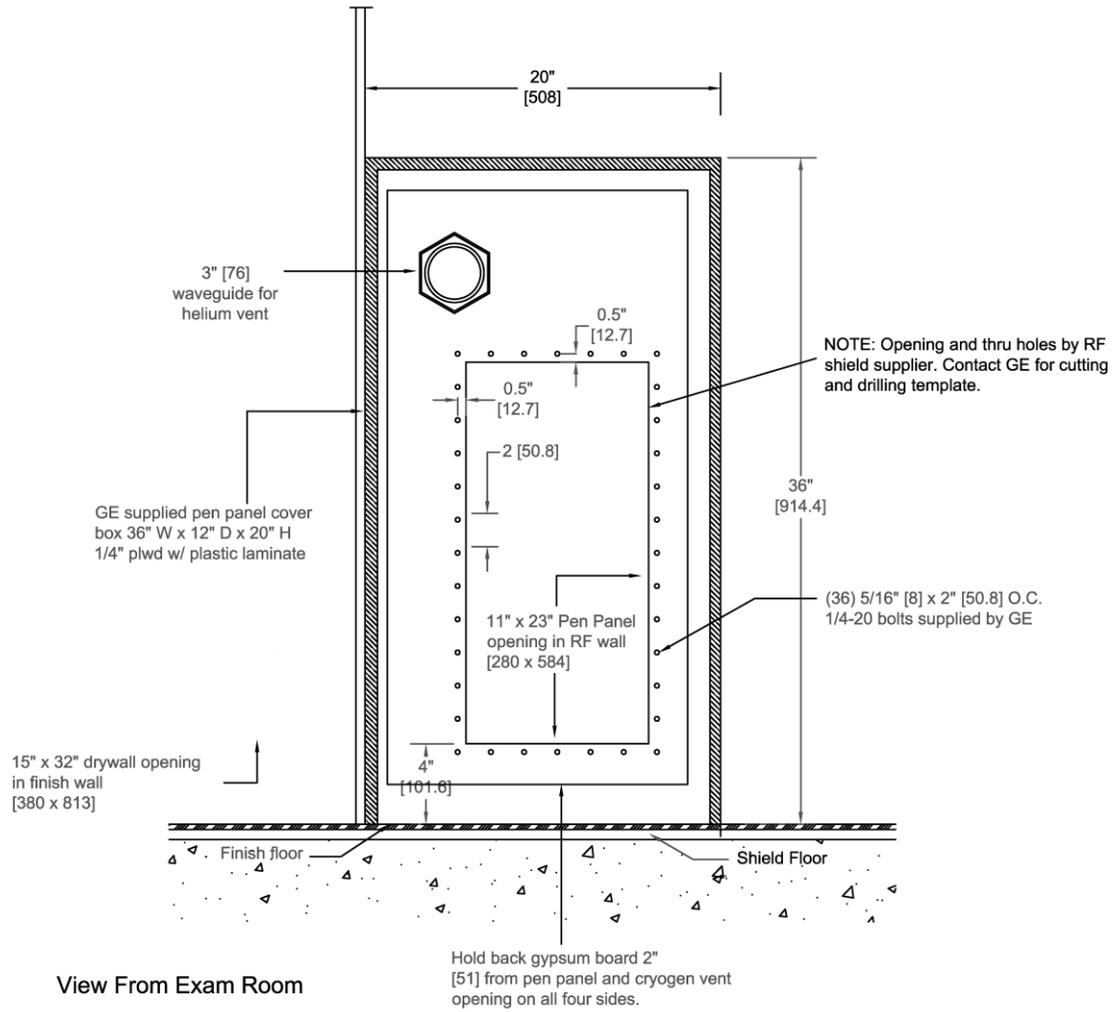


Figure 4-2b. Exam room elevation showing penetration vertical panel opening & helium vent waveguide penetration.

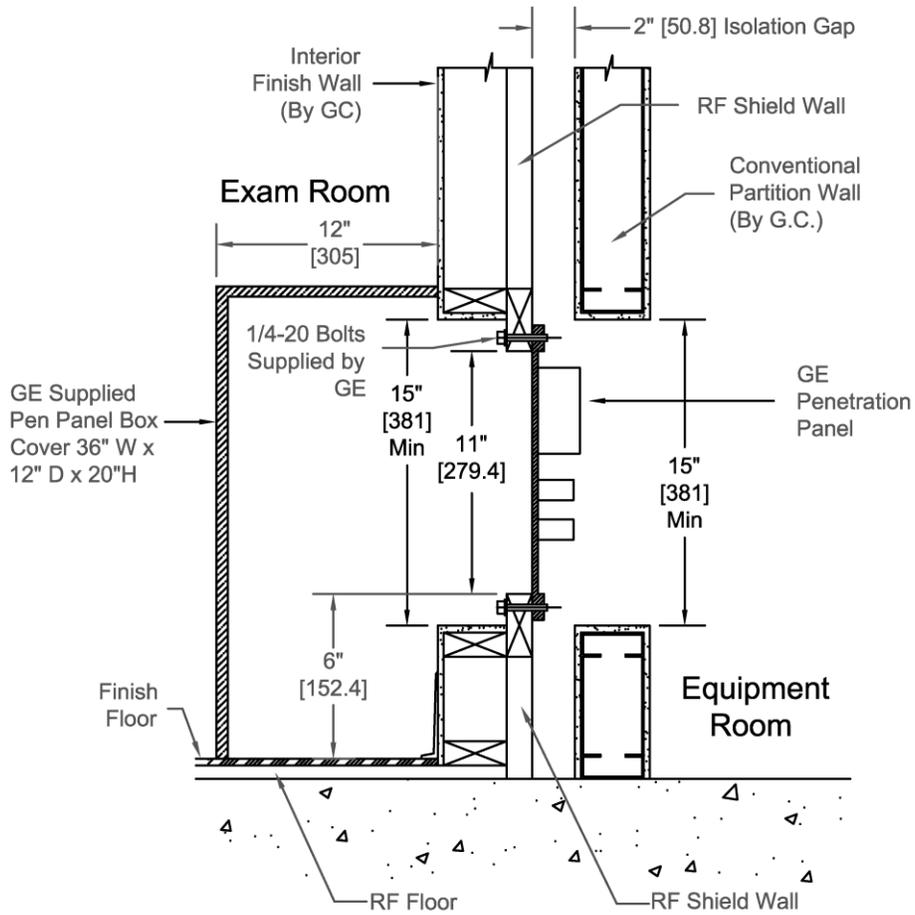


Figure 4-3a. Pen Panel wall section. Typical shown. Shield wall/floor detail may vary with RF subcontractor.

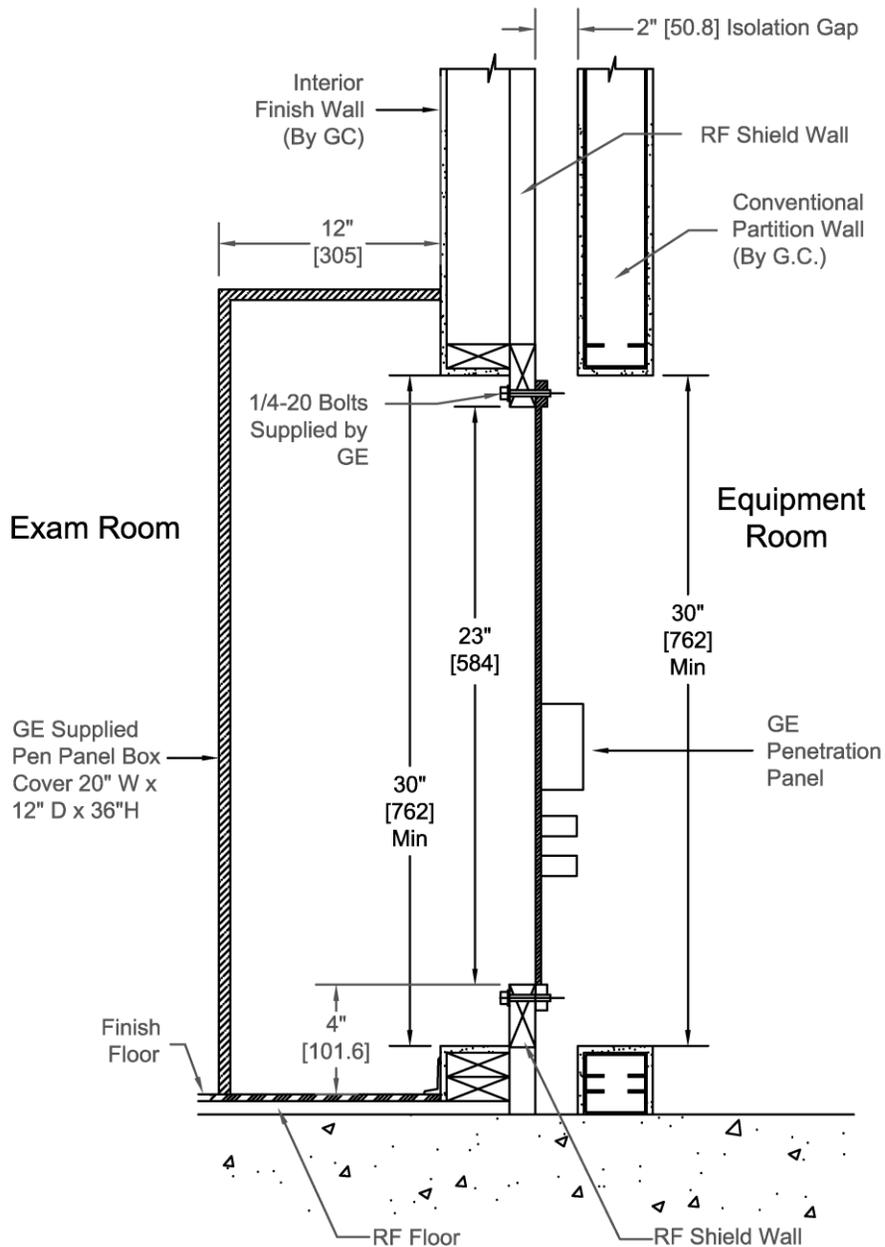


Figure 4-4b. Pen Panel wall section. Typical shown. Shield wall/floor detail may vary with RF subcontractor.

Sprinklers

If using sprinklers in the Exam Room, dry pipe systems have the advantage of reducing ground problems. However, all decisions regarding fire protection systems are the customer's responsibility.

Electrical

The entry of any electrical or non-electrical (water, oxygen, air, floor drains) lines into the RF shield must be filtered and/or dielectrically isolated to ensure that the RF shield meets the minimum attenuation levels. The RF shield vendor must supply filters for all penetrations of the RF shielding, excluding the lines entering through the GE-supplied RF penetration panel. All filters (for electrical lines) must be located outside the 200 Gauss line. The RF shield vendor should review with the electrical contractor the number of incoming power lines to the Exam Room in determining the number of filters needed for electrical requirements.

Lighting

All lighting in the Exam room must be *Incandescent, Fluorescent or Induction* lights are not permitted. *LED* lighting systems that are made to be compatible with MRI equipment are acceptable. Conventional dimmer switches must not be used; however, a selectable switch or special “inductive load” dimmers may be used to change the light intensity. Use of fluorescent or induction lights and conventional dimmer switches will create unacceptable RF interference in the image. Consult with your RF shielding supplier to determine the appropriate dimmer to use with their RF filters.

RF Shield Grounding Technique

The usual practice in shielding construction is to build the shield so that it is electrically isolated from earth and building ground by greater than 1000 ohms. The shield is then intentionally grounded at a single point to make the shield electrically safe and to minimize circulating currents in the shield's metallic structure. This point is called the "common ground". The common ground usually takes the form of a ground stud and bus bar to which the RF shield's electrical filter grounds and the MRI's equipment grounds are all tied. For the Optima MR430s system, there is no need for this type of common ground configuration. Instead, the single ground point will be the ground provided with the power wiring to the shield's electrical filters.

The electrical filters typically provided by the shield supplier are three 20 Amp units, two for lighting, the other for convenience outlets. They should be installed by the shield supplier immediately above the penetration panel (PP), either in the wall or the ceiling of the shield. If this is not possible, then they should be as close as is practical to this general area.

The electrical contractor must connect the branch circuit wiring directly to the filter assemblies *without* a dielectric break. That is, EMT conduit and fittings may be run directly to the metal filter units mounted on the shield. Although the bonded metallic conduit, fittings, and boxes used for this run may meet code requirements for electrical safety grounding, an insulated ground wire *must* be run along with the line and neutral wires from the bus bar of the distribution panel supplying the branch circuits. These ground wires must be fixed to the line-side ground terminals of the electrical filters.

NOTICE

The RF shielding ground isolation test must be done BEFORE the connection of power to the filters is done. RF attenuation tests should follow power connection.

5 Helium Venting

Introduction

The magnet system contains cryogenic helium necessary to maintain the magnet in a superconducting state. In case of a magnet quench, the helium boils and the resultant gas is expelled out of the magnet. This section describes the requirements necessary for safe venting of the cold helium gas.

During a quench, about 49 liters of liquid helium boils in approximately one minute. The resultant gas rapidly warms and expands as it travels out of the magnet and through the vent tube system. The 49 liters of liquid eventually expands to 800 times the original volume once the gas reaches room temperature. Thus, 49 liters turns into 39.2 cubic meters (1384 cubic feet) of gas once fully warmed. This is slightly larger than the typical exam room volume for the Optima MR430s.

The expanding gas from the magnet creates a number of potential hazards that proper venting avoids. The cold gas must be directed away from human contact to prevent possible injury in the form of cold-burns. Additionally, the expanding gas, if not vented externally, can potentially increase the room pressure to levels that would make it difficult to open a door. Finally, in very confined spaces, the gas can potentially displace air and reduce the oxygen to unsafe levels.

This gas must be vented to the outside, and must be done in a manner that prevents the cold gas from coming in direct contact with any person as well as electrical and plumbing devices while not reducing the oxygen to unsafe levels in occupied areas.

A warning sign should be placed at the outside vent with text similar to the following: “Warning. Freezing gasses and small objects may be discharged without notice. Stay at least two feet (60 cm) away from the opening.”

Figure 5-1 shows a pictorial representation of a typical vent system extending from the magnet through the wall of the Exam room and RF shield, to the outside of the building. The vent system consists of:

- Interior vent tubes between the magnet and the exam room wall.
- A tube penetrating through the RF shield wall.
- A building vent consisting of a set of tubes connecting the shield penetration to an exhaust external to the building.

Responsibilities

It is the responsibility of the customer’s mechanical/HVAC contractor to provide the vent tube between the base of the magnet and the RF shield penetration. The mechanical/HVAC contractor must coordinate the means of connection and routing of the tube with GE and the shielding supplier. GE will provide specific location information for magnet and helium vent penetration.

It is the responsibility of the customer’s RF shielding contractor to provide a tube that penetrates the RF room in accordance with the specifications described in this document and to coordinate the location of the tube with the customer’s HVAC contractor.

It is the responsibility of the customer’s HVAC contractor to route the vent tube external to the RF shield and to make the connection between the RF shield and the external vent tubing in accordance with the requirements cited in this document.

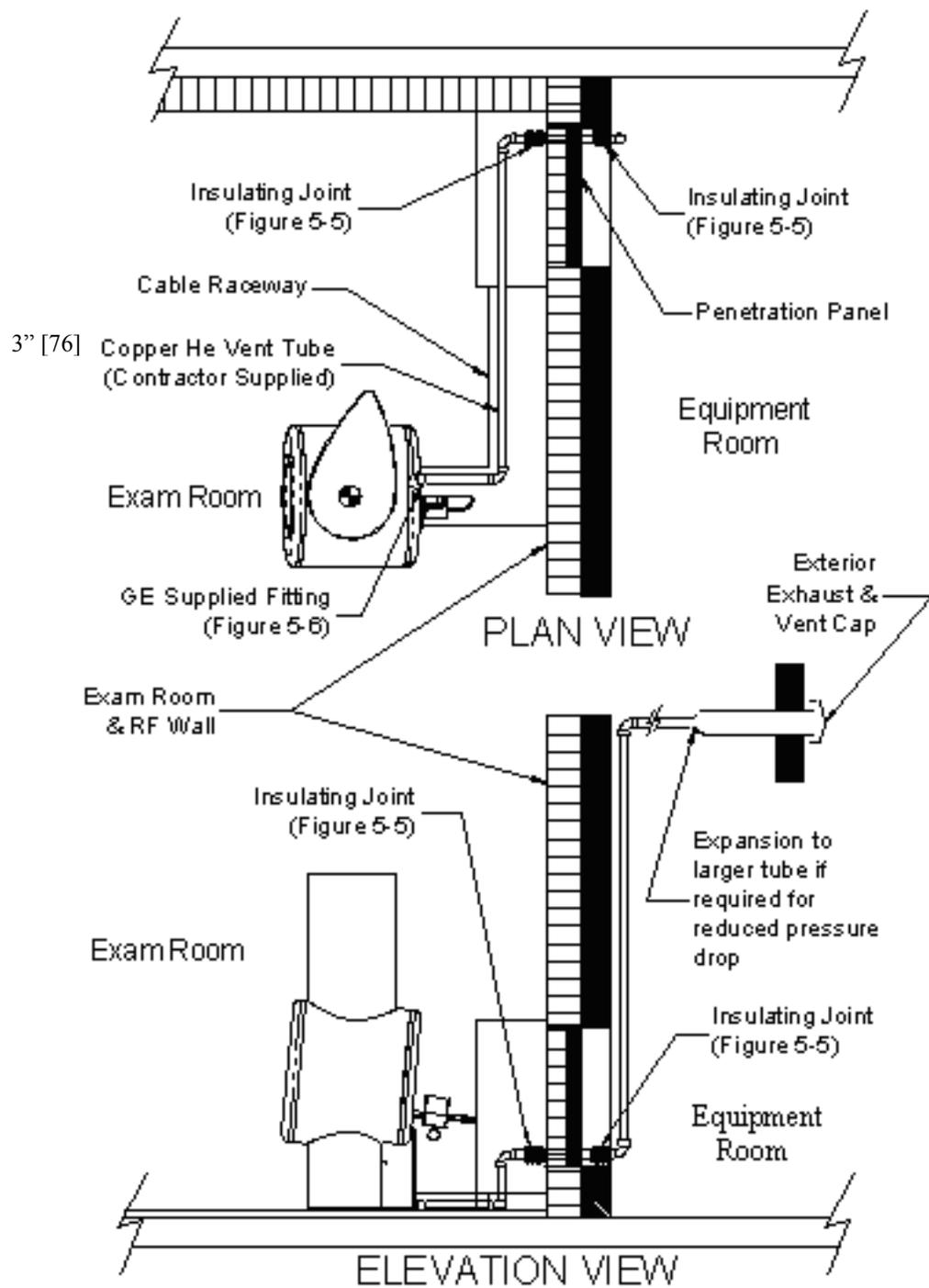


Figure 5-1. Major Elements of a Cryogenic Venting System.

Vent Tube Wave Guide Penetration through the RF Room

The vent tube wave guide penetration through the shield must be electrically-conducting to provide RF shielding. The shield contractor is to supply a 3”(76 mm) diameter waveguide section of tube and mechanically and electrically secure the tube to the shield. Adequate clearance and tube lengths must be maintained on both sides of the wall to permit electrical insulating connections.

The vent tube penetration is to be located on the lower portion of the wall on the rear side (non-patient side) of the magnet, typically adjacent to the penetration panel. Figure 5-2 shows the permitted locations for a wall vent tube. Figure 5-2a shows the top view of the permitted location of vent tube penetration, along the lower portion of the rear wall, and on the walls (near the corners). The maximum distance from the magnet center to the tube center is 8 feet (2438 mm). Maximum distance from the rear wall to the tube center is 6 inches (152 mm). Figure 5-2b shows the side view of the tube location relative to floor and wall. Floor and wall clearance is required to permit connection by the HVAC or plumbing contractor.

The outside and inside diameters of the copper tubes through the shielded room are shown in Table 5-1. These dimensional tolerances must be maintained so a proper seal can be made when making the electrical insulating connections.

Table 5-1. Copper Tube Dimensions

Copper Pipe Type	Standard size Inches (mm)	Outside Diameter	Inside Diameter	Wall Thickness
		Inches (mm)	Inches (mm)	Inches (mm)
K	3 (76)	3.125 (79)	2.907 (73.84)	0.109 (2.77)
L	3 (76)	3.125 (79)	2.945 (74.80)	0.090 (2.29)
M	3 (76)	3.125 (79)	2.981 (75.72)	0.072 (1.83)
DWV	3 (76)	3.125 (79)	3.030 (76.96)	0.045 (1.14)

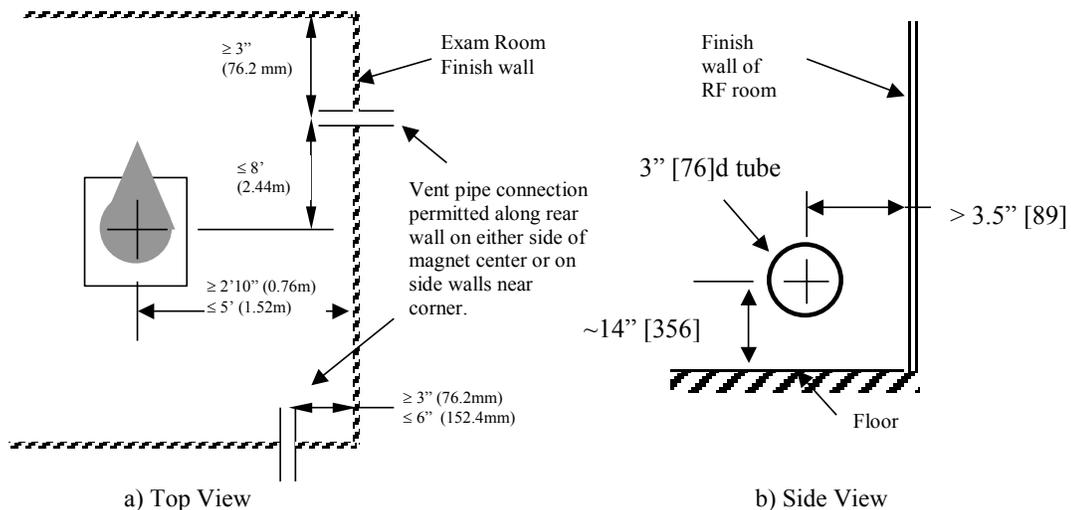


Figure 5-2. Vent Tube Penetration Location Behind Magnet. Note: GE site planning will provide specific location for vent pipe penetration.

Figure 5-3 shows the side view of the vent tube penetration through the wall, and the required length for adequate attachment of an insulating joint.

Figure 5-3a shows the required clearance for a wall configuration (straight through vent tube). Figure 5-3b shows a permitted variation of the wall configuration where a vent tube exit from the RF room is through a 90-degree bend. This configuration is useful where a wall vent is desired but the space outside the room for routing the vent tube is limited. Note that the pressure loss of the bend must be included when calculating the total pressure drop of the vent system (see Table 5-2).

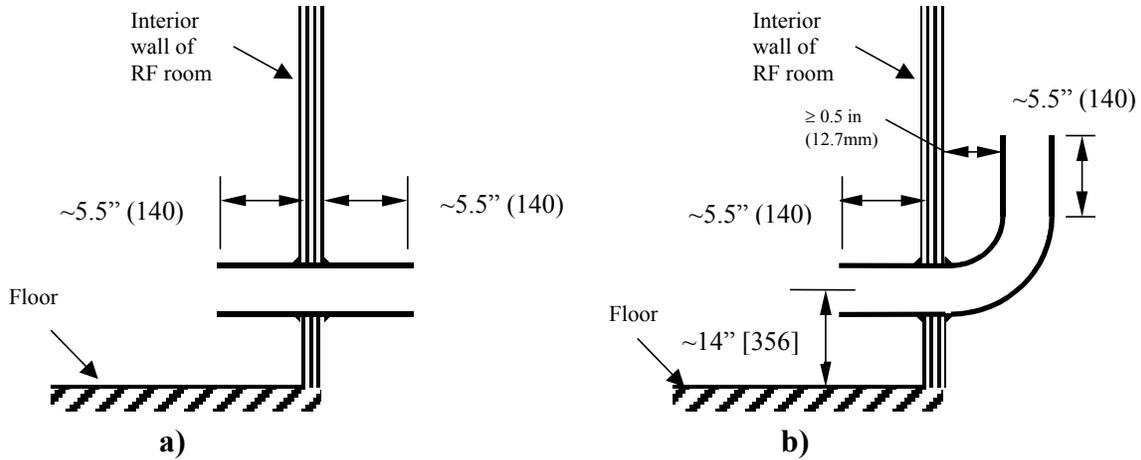


Figure 5-3. Side View of Vent Tube Penetration through RF Room Wall

Force on Vent Tube Penetration through the RF Room

Each of the two joints will experience a maximum separating force of 70 Lbs (311 N). (corresponds to the total force of 5 psi (34.5 KPa) on the cross-sectional area of a 3 in. diameter tube) during a quench. The force is parallel to the direction of the tube at the joint. The mechanical strength of the connection between the penetration tube and the shielded room must be sufficient to handle these forces, assuming the worst case that one or both of the joints cannot support the force directly.

Figure 5-4 shows the side view of vent tube penetration through RF room wall with 90-degree bend. During a quench, the penetration tube experiences a maximum force of 70 Lbs (311 N) in two directions (as shown) under the worst-case assumption that the electrical insulating joints provide no support in the direction parallel to the pipe.

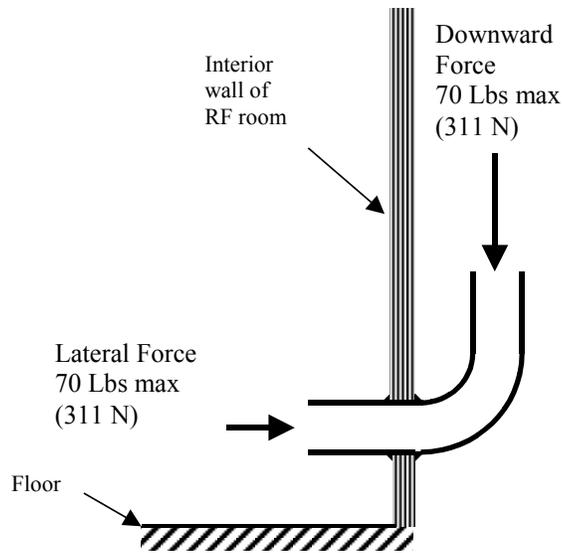


Figure 5-4. Force on Vent Tube Penetration through RF Room

Specific Requirements for the Building's Helium Vent System

This section describes permitted vent materials, types of connections, pressure drop requirements for the vent, and pressure drop tables for the vent system components.

Maximum Pressure Drop

The pressure drop of the entire venting system, including the RF penetration and internal room piping, must be less than 5 psi (34.5 KPa). When planning the route for the vent, the general rule is to identify the shortest distance to a safe exhaust location with as few bends as possible.

Vent Tube Materials

Permitted vent tube material inside the exam room is smooth-walled copper, aluminum, or stainless steel tubing. Outside the exam room conventional steel tubing can be used as well. The tubes must be continuous or have a smooth-welded seam. Drawn or annealed copper tubes are preferred; Drain Waist Vent (DWV), Type K, Type L, or Type M pressure ratings are acceptable because of availability and ease of soldering. PVC or ABS pipe are not permitted. Their interior surface is too rough – it creates too great a pressure drop. The integrity of the pipe (when exposed to cold gas) cannot be guaranteed.

Under quench conditions, the internal pressure is designed to be less than 5 psi over atmospheric pressure. The vent tube pressure rating must be greater than 10 psi to provide a safety factor of 2.

Joints

Joints must be soldered, braised, or welded, as appropriate for the vent material used. The only exception to this is the electrically-insulating connections between the RF shield and the vent tubing.

One method used to make the insulating joints between the RF shield and the vent tube is to wrap the tube with a thin sheet (1/32 inch, 1.3 mm or greater) of fiberglass to provide a primary barrier to the gas and to provide electrical insulation. This is followed by a wrap of thin stainless steel or aluminum (1/32 inch, 1.3 mm or greater) followed by 4 stainless steel clamps. In order to ensure

an adequate insulating joint, the gap between the two pipes must be maintained between 0.5 inch and 1 inch, as shown before wrapping. The wall thickness of the vent tube must be chosen such that the outside diameter of the vent tube matches the outside diameter of the RF room penetration to within $\pm 1/8$ inch (5 mm).

An alternative method to make the joint is to use an off-the-shelf DWV 3" to 3" connector. A coupler with a metal shield and 4 clamps is required. Figure 5-5 is a photograph of a permitted type to be used.

The connection of the OPTIMA MR430S SYSTEM to the vent tube is done via a special K-flange to 3" adapter as shown in Figure 5-6 (or similar). This adapter is provided by GE and is to be soldered to a 3" vent tube positioned at the base of the magnet as shown in Figure 5-1 and on the floor template in Figure 2-1.



Figure 5-5. Photograph of insulating joint using a 3" DWV coupling. A coupling with metal shield and 4 clamps is required. Some RF room suppliers will provide a special insulating coupling for use outside of room. This item is supplied by your general contractor.



Figure 5-6. Photograph of KF-40 flange to 3" DWV pipe adapter provided by GE. The adapter is to be soldered to 3" copper DWV positioned as shown in Figure 5-1 and Figure 2-1.

Vent Supports

The electrical insulating joint on the 3”(76 mm) tube at the exit of the shield experiences a maximum separating force of 70 Lbs(311 N) during a quench. The insulating joint must be sufficiently strong to prevent a separation of the joint during a quench. A support bracket can be placed on the pipe, near the insulating joint, to prevent a separation. The support bracket must not be attached to, or make contact with, the shielded room electrical surfaces. Other supports are required by the HVAC contractor to handle the weight of the vent system.

Fire Breaks

A Fire-Tite UL-approved fire damper may be required by local codes. It typically should have a replaceable fusible link with 165 °F(74 °C) standard.

Exhaust Vent

A low-pressure drop exhaust vent and cap must be used at the end of the vent pipe to prevent ingress of weather elements (such as rain, snow, hail, sand, and so on), and foreign material debris (such as leaves, bird’s nests, and so on). The pressure drop must be included in the calculation of the total vent system pressure drop. For purposes of choosing an appropriate vent, a maximum airflow rate of 750 Cubic Feet per Minute (CFM) or 0.35 m³/sec at atmospheric outlet pressure and room temperature can be assumed. This will result in a conservative estimate since the actual exhaust pressure drop for helium gas is lower than room temperature.

Choose the location of the exhaust vent so as not to cause possible injury to any person. If there is potential for human contact, warning signs must be placed near the exhaust, indicating a possible hazard due to cold gas for persons within 2 feet(610 mm) of the exhaust.

Aluminum, copper or other metal flashing material should be used to protect any nearby surfaces that have the potential of coming in direct contact with the exhaust gas stream. In addition, there should be no snow or ice blockage.

Vent Pipe Sizing

Inside the exam room, the vent pipe run must be 3” (76mm) diameter from the base of the magnet to the 3” (76mm) pipe penetration in the RF shield. Every effort must be made to minimize the number of bends (direction changes) in this pipe run, but no more than a total of 360 degrees (four 90 degree bends) of direction change are allowed in the exam room.

Outside the exam room, (exterior to the RF shield), the pipe diameter will be a function of the total run length from that point to the far end *and* the number of direction changes (bends) made along the way, *including any change of direction at the end of the run (vent cap, etc.)*.

1. For conditions where there are four (4) or fewer bends (<361 degrees of change), and the run length from the RF shield penetration to the end is 50’ (15m) or less, the total run should use 3” (76mm) diameter pipe.
2. For conditions where there are five (5) or more bends (450 degrees of change or more), irrespective of run length, the vent pipe must immediately transition to 4” (101mm) at the RF shield penetration. If the run length will exceed 100’ (30m), the pipe must expand to 5” (127mm) before the third bend or at the 75’ (23m) point, whichever comes first.

Please refer any necessary exceptions to these rules to GE’s Installation Project Manager for resolution.

This page left blank intentionally.

6 Electrical Requirements

Power Supply

Table 6-1 describes the electrical power requirements under normal conditions. Installation of a power conditioner may be required if the customer site is located in an area susceptible to brown outs, outages, surges, swells, and lightning storms. Such conditions could prove damaging and increase the downtime of the system. Power surges should be limited to a range 10% above and 10% below nominal operating voltages given in Table 6-1.

The location of electrical junction boxes and power outlets will be decided after GE and the customer agree on the equipment layout.

Supplying the Helium Compressor and the equipment room air conditioner with emergency back-up power is desirable if the extra capacity is available in an existing emergency power system.

Table 6-1. Electrical Power Requirements

Equipment Item	Power Feed	Frequency (Hz)	Voltage (volts)	Maximum Current Draw (amps)	Minimum Supply Capacity (kVA)	Steady Power Demand (kW)	Maximum Power Demand (kW)
Helium Compressor (HC)	Three-phase ² 3W+GND (PE) Dedicated Circuit. Permanently connected.	50	380, 400, 415 (±10%)	7.5	6.5	3.8	4.7 ¹
		50/60	200 (±10%)	16	6.5	4.8	5.6 ¹
System Electronics (SE)	Three-phase ² 3W + N +GND(PE) Dedicated Circuit.	50/60	200,208,400 (±10%)	20,19,10	6	1.3	5.5
RF Shielding (RFS)	Two single-phase branch circuits, one for lighting, one for receptacle, RF filtered.	50/60	Per local country requirements	Per local country requirements	--	--	--
Operator's Console (OC)	Single-Phase 2W+GND (PE). Dedicated Circuit not Required	50/60	100-240 (±10%)	0.7	--	--	41 W
Convenience Power Outlet	2-Wire Plus Ground	50/60	Per local country requirements	Per local country requirements	--	--	--

Notes: 1. At time of magnet cool-down, approximately 48 hours during installation.

2. See Appendix A (page 5) for circuit sizing data.

The power connections to the electronics cabinet and the compressor are to be as defined by IEC 60601-1-1 for permanently connected equipment and in accordance with local and national electrical code requirements. The customer and the customer's contractors must ensure that the connections meet these "permanently connected" requirements.

In the USA and Canada, the use of twist lock connections (as listed in Table 6-2 below) is the required equipment connection method. The twist lock connections defined in this table satisfy the requirements for permanently connected equipment.

Table 6-2. System Electrical Power Connections for USA and Canada (60Hz operation).

Equipment Item	Power Feed	Ground Wire	Connection Means
Helium Compressor (HC)	3 phase, 208 VAC, 30 Amp, 3W + GND (PE) Dedicated Circuit.	Ground wire size equal to phase wire size	NEMA L15-30R, 3 ϕ , Twist-Lock Receptacle on wall
System Electronics (SE)	3 phase, 208 VAC, 30 Amp, 3W + N +GND (PE) Dedicated Circuit.	Ground wire size equal to phase wire size	NEMA L21-30R, 3 ϕ , Twist-Lock Receptacle on wall
Operator's Console (OC)	1 Phase, 115 VAC, 15 Amp, 2W + GND (PE). Shared Circuit OK	Per local country requirements	NEMA 5-15R, 1 ϕ , Standard quad wall receptacle
Exam Room / RF Shielding (RFS)	Three 115VAC, 20 Amp branch circuits, two for lighting, one for receptacle, RF filtered.	Insulated Ground wire to be run along with line and neutral wire.	Hard wire to RF filters
Convenience Power Outlet	1 Phase, 115 VAC, 15 Amp, 2W + GND (PE). Shared Circuit OK	Per local country requirements	NEMA 5-15R, 1 ϕ , Standard duplex wall receptacle

Exam Room Electrical Raceway

The customer or their electrical contractor is required to supply a floor (surface) mounted lay-in type aluminum electrical raceway in the exam room. This raceway runs from the back of the magnet to the penetration panel as shown in Fig. 2-1, Fig. 5-1, and in the example drawings of sheets 2 and 3 of Appendices A and B. The size of the raceway is 3.5” (89mm) high by 10” (254mm) wide. See also Table 2-2.

NOTICE Wiremold’s ‘Walker Duct’ product (or equivalent) is suitable for this application. Check with GE Site Planning if additional information is required. GE engineers will lay-in cables and hoses. The mechanical contractor is responsible for installing the helium quench pipe in this raceway. There is a six to eight week lead time for delivery.

Other Conduit or Raceway

See Table 2-2 for sizes and run lengths for other possible conduit or raceway needs. Always check with GE Site Planning on the routing of conduits and raceways as run lengths are critical. GE engineers will require customer/contractor supplied assistance in pulling cables and hoses in situations where runs are lengthy.

7 Environmental Requirements

Optimum performance of the OPTIMA MR430S SYSTEM depends on abiding by the environmental conditions described in this section. Use this section to determine the required ambient environmental conditions.

Temperature and Humidity Specifications

Table 7-1 lists the specifications that the Heating Venting and Air Conditioning (HVAC) system must meet for the OPTIMA MR430S SYSTEM operation. Two separate HVAC zones for the suite are recommended: one dedicated zone for the exam room, and another for the equipment room. This table is duplicated on page 4 of Appendix A. Note that these specifications must be maintained 24 hours per day, seven days per week, 365 days per year. *NO energy conservation setbacks are allowed* in either the Exam Room or the Equipment room.

Table 7-1. System Environmental Requirements

Room	Temperature		Humidity	
	Range °F (°C)	Change °F/Hr (°C/Hr) ¹	Range %RH	Change %RH/Hr ²
Control Room	59-89.6 (15-32)	As required for Comfort 5.4 (3)	30-75 Non-Condensing	5
Exam Room	59-69.8 (15-21)		30-75 Non-Condensing	5
Equipment Room	59-89.6 (15-32)		30-75 Non-Condensing	5
Notes:				
¹ Operating temperature gradient limits shall be between -5.4° F/Hr (-3° C/Hr) and 5.4° F/Hr (3° C/Hr) when averaged over one hour.				
² Operating humidity gradient limits shall be between -5% RH/Hr and 5% RH/Hr when averaged over one hour.				

Heat Output and Cooling Requirements

The System components generate heat in their respective locations. Page 4 of Appendix A lists the maximum heat output in the room from the OPTIMA MR430S SYSTEM components *only*. At sea level, a 3 Ton (10.5 kW) dedicated air conditioning unit will generally be adequate for the equipment room if there are no other heat loads, including those cooling needs caused by outdoor temperature and/or direct sun.

The small rooms typically used for this equipment require adequate air flow and proper location and sizing of the supply and return ducts for cooling of the components. The thermostat for this room must be located so as to prevent the possibility of short cycling the air conditioning unit. It is suggested that the return duct be placed above the Helium Compressor (HC) and the supply duct at the opposite end or corner of the room.

Moving Metal and Ambient Magnetic Fields

Large moving metal objects such as elevators, cars, fork lifts, trains, subways, dumpsters, etc. interact with the earth’s magnetic field and/or create a small time-varying magnetic field. Sufficiently large changes in the magnetic field can adversely impact image quality in the form of ghosting or artifacts. The field produced by moving objects should be maintained at less than 2 milli-Gauss (200 nano-Tesla) peak-to-peak for the Z-axis (down the magnet bore) and 20 milli-

Gauss (2000 nano-Tesla) for the X and Y axes (across the magnet bore) at the proposed location of the magnet to minimize the possibility of artifacts.

50/60 Hz Stray Magnetic Fields

Transformers, power conduits, motors and other 50/60 Hz electrical equipment can create stray magnetic fields. If too high, these fields can create ghosting or artifacts in the images. The 50/60 Hz stray magnetic fields should be less than 10 milli-Gauss (1000 nano-Tesla) RMS at the proposed location of the magnet to minimize the possibility of artifacts.

Vibration

Air conditioners, motors, pumps, cooling towers and other equipment can cause mechanical vibrations. These vibrations, if large enough at the proposed location of the magnet, can produce magnetic field instabilities that adversely affect image quality. Figure 7.1 is the recommended vibration limit for continuous vibrations at the proposed location of the magnet.

If there is any concern about vibration levels, a site vibration survey can be conducted to determine the levels of vibration present and the possible source. GE, or a qualified third party, should conduct the study. GE site planning can arrange for the survey to be conducted and to assist in the interpretation of any results.

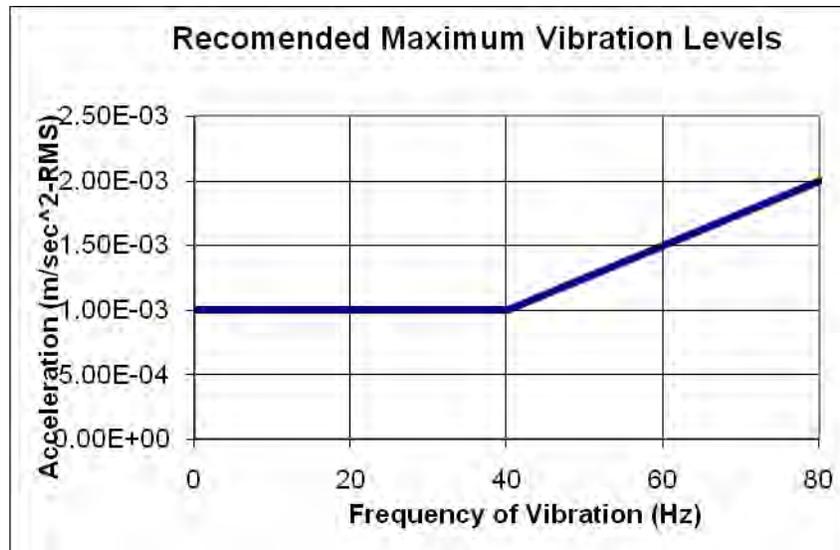


Figure 7-1. Maximum Vibration Levels as a Function of Frequency.

Altitude Specification

The OPTIMA MR430S SYSTEM will operate in the range of 100 feet (30.5m) below to 6500 feet (2000m) above sea level. Operating at altitudes greater than 6500 feet (2000 Mm) is possible with additional air conditioning in the equipment room or the use of a water cooled helium compressor. Contact GE's Installation Project Manager for more detail.

Audible Noise

Table 7-2, lists the typical noise level readings produced by the System components. OSHA and the FDA maintain safe operating guidelines for audible noise. Hearing protection is not required by the operator at the imaging suite operator’s console at this level of noise. However, hearing protection is required by the patient inside the exam room at this level of noise.

Table 7-2. Maximum Equipment Audible Noise

Room	Location	dB (A)
Imaging Suite	Operator’s Console	Less than 85
Exam Room	Patient Position	Less than 104

Measurement Notes:

1. “Patient Position” is at the center of the diameter of the bore at the face of the magnet. This position is as close as the patient’s ear can be during any exam. It is not possible for the patient’s ear to be in the bore. No measurement was found to be at or above 104dB(A).
2. “Operator’s Console” position was measured *inside the exam room* at a distance of 3.3’ (1.0m) from the face of the magnet, and in-line with the bore. As such, it represents the typical level of noise experienced by a patient during a lower extremity study. Note that the Operator’s Console is always outside the exam room at a distance greater than 6’ (1.8m), and on the other side of a double-layer RF screen window (unglazed). In the exam room, at the specified distance, no measurement was found to be at or above 85dB(A)
3. Measurement method: IEC 60601-2-33:2002-05 – Maximum amplitude bi-polar triangular gradient waveform.

Reducing Air Pollution Effects

All components of the OPTIMA MR430S SYSTEM that are air-cooled have their own filters; however, if the facility is located in a particularly dusty environment, then a more sophisticated air filtration system should be installed.

This page left blank intentionally.

8 Shipping and Delivery Information

The delivery route for magnet and other components should be planned within the facility. The width of all corridors and doorways should be at least 36 inches wide with no obstructions. Elevators should have sufficient capacity and size for the equipment. See table 9-1 for the size of the individual boxes/crates.

A staging area of a minimum of 150 square ft is required for storing and unpacking the equipment during installation.

Table 8-1. Shipping Data

Component	W x D x H in. (mm)	Shipping Weight lbs (Kg)
Magnet & Gradient Coil	30" x 36" x 60" (762 x 914 x 1520)	1000 lbs (455 Kg)
Compressor w/Helium Lines & Cold Head	27" x 28" x 63" (690 x 711 x 1600)	415 lbs (188.2 Kg)
Electronics Rack	33" x 48" x 76" (838 x 1219 x 1930)	1100 lbs (500 Kg)
Patient Chair Assembly	33" x 41" x 63" (838 x 1041 x 1600)	300 lbs (136 Kg)
Pen Panel Cover	13" x 39" x 22" (330 x 990 x 558)	21 lbs (9.52 Kg)
Magnet Front, Rear Covers & Foam wrap.	26" x 26" x 26" (660 x 660 x 660)	65 lbs (29.4Kg)
Magnet Cylindrical Cover, Heel Support Platform, Pad & Lock Knob, Extremity Support Bracket, Teardrop Cable Cover & Ottoman.	24" x 24" x 24" (609 x 609 x 609)	95 lbs (43.0 Kg)
LCD Monitor, Keyboard, Mouse & Host Computer Drive CDs, Power Control Unit, Pressure Control Module, Phantom Kit, Operators Guide, Viewer's Guide, Patient Log Books, SW Release Notes, MRI Exclusion Warning Signs & Health Effects Text, DVD & Power Cable.	26" x 26" x 26" (660 x 660 x 660)	65 lbs (29.4Kg)
Right & Left Enclosures	24" x 24" x 36" (609 x 609 x 914)	65 lbs (29.4Kg)
Upper Tear Drop Enclosure	24" x 24" x 48" (609 x 609 x 1219)	65 lbs (29.4Kg)
RF Coils	36" x 20" x 13" (914 x 508 x 330)	95 lbs (43.0 Kg)
Penetration Panel, RF Front End & Labeling Kit.	26" x 20" x 11" (660 x 508 x 279)	95 lbs (43.0 Kg)

Component	W x D x H in. (mm)	Shipping Weight lbs (Kg)
Spare Cables, RF Room Cable & Rack to Console Kits, Optional 50' Rack to Console & Rack to Pen Panel Kits.	26" x 20" x 11" (660 x 508 x 279)	95 lbs (43.0 Kg)
Magnet Saddle Stand, Cold Head Stand, Flexible tube, Cold Head Support Plate, Pressure Transducer, RF Coil Intf Plate, Laser Light Assy, Misc. parts for Enclosure Kit, Magnet & Hardware Kits.	60" x 32" x 16" (1524 x 812 x 406)	500 lbs (226.7 Kg)

Transportation & Storage Requirements

The system components can be transported and shipped in temperatures ranging from:

-40°F (-40°C) to 150°F (65°C) and altitudes of up to 35,000 feet (air cargo). Dry heated storage is required for any extended period of storage, more than a few days.

9 Pre-Installation Checklist

Use this section as a reminder of items that need to be coordinated. Some are frequently overlooked. A similar list will be used by a GE service or site planning coordinator to review the site readiness before shipment.

Suite Layout and Details - (Per GE provided site specific layout drawing)

Exam Room

- Dimensions, L x W x H, "finish to finish"
- Door location, size, and swing direction
- Pen panel location and accessibility
- Storage cabinet location and min size 30"W x 12"D x 36"H (760 mm W x 305 mm D x 914 mm H)

Equipment Room

- Dimensions, L x W x H, "finish to finish"
- Door location, size, and swing direction
- Pen panel location and accessibility

Control Room

- Dimensions, L x W x H, "finish to finish"
- Door location, size, and swing direction
- RF window size and location. Screen, bypass glass, or glazed. (Note, customer supplied intercom needed, if glazed.)
- Countertop and casework to support ops console equipment 42"W x 24"D (1070 mm W x 610 mm D)

RF Shielding Installation Details

Exam Room

- Copy of shield proof-of-performance test results
- Pen panel hole prepared for GE pen panel, 11" x 23" (280 mm x 584 mm) with perimeter holes drilled
- Floor anchors installed in the right locations (see anchor layout drawing, verify magnet orientation)
- Door complete with all "fingers" intact (if used)
- Lockable exam room door, with keys
- HVAC diffusers installed -- feed and return
- Helium vent penetration ready for connection to pipe from magnet
- Convenience outlets in room (check function -- may be wired to light circuit)

Equipment Room

- Electrical filters installed near (usually above) pen panel, including any needed for a thermostat.
- Helium vent penetration properly connected outside the shield

Electrical Requirements

Exam Room

- Incandescent AC lighting -- no fluorescent lamps, no conventional dimmers in room however a selectable switch or special "inductive load" dimmer may be used to change light intensity. Check with your RF shielding supplier for suitability of specific dimmers.

-
- ❑ Branch circuit receptacle (one OK) somewhere in room, 15 A, 115 VAC per local requirements (check function, may be wired to lighting circuit)
 - ❑ Aluminum lay-in raceway between pen-panel and back of magnet (may not be in place at time of inspection)

Equipment Room

- ❑ For compressor power verify three phase with ground, no neutral (four wires, verify phase line to line voltages, verify no voltage difference between receptacle ground and RF shield ground). In US/Canada verify NEMA L15-30R twist-lock receptacle, 30 A, 208 VAC. In other countries verify connection according to local or country voltage and code requirements. Phase rotation must be clockwise (L1, L2, L3).
- ❑ For electronics power, verify three phase with neutral and ground (5 wire, verify line to line and line to neutral), verify no voltage difference between receptacle ground and RF shield ground. In US/Canada verify NEMA L15-30R twist-lock receptacle, 30 A, 208 VAC. In other countries verify connection according to local or country voltage and code requirements.
- ❑ 110 VAC 20A convenience receptacle for Service Engineer's (SE) use per local codes.
- ❑ Adequate lighting

NOTICE

All electrical equipment must be installed prior to System installation.

Control Room

- ❑ Verify 115 VAC, 15 amp standard quad wall outlet 5-15R for console monitor if US/Canada or per local country standard outlet requirements.

NOTICE

This must be from the same panel and phase as the system electronics.

- ❑ Identify location for quench button mounting.

HVAC Requirements

NOTICE

All HVAC equipment must be installed prior to System delivery and installation.

Exam Room

- ❑ Verify thermostatic control of exam room temp. Note: thermostat control unit may be in control room with sensor in return air duct coming from Exam room. If mounted in-room, it should not be in a corner, or in sunlight, or other location where it will not be representative of average room conditions.
- ❑ Verify that room air feed and return is functional
- ❑ Confirm that there are NO energy conservation temp "set backs" -- must run 24 hours per day, 7days per week, 365 days per year at nominal temp.
- ❑ Helium vent penetration properly located and dielectric breaks in position on both sides of the waveguide.
- ❑ Helium vent piping outside the exam room properly routed to the exterior of the building. (Pipe to magnet will not be installed at this time.)
- ❑ Helium vent pipe termination safely located? Warning signs needed?

Equipment Room

- ❑ Perform functional check of A/C unit -- it should be able to get this room very cold without the equipment installed and running -- 65 F (18 C) should not be a challenge!

- In-room thermostatic control must be present, working, and in a logical location.
- Air feeds and returns in logical positions- return above HC, supply at opposite end of room or opposite corner from return.
- 24 hours per day, 7 days per week, 365 days per year operation required of A/C unit.
- Cable run lengths to other areas correct length for cable set on order.

Telecommunications Requirements

Equipment Room (Near location of Electronics Rack)

- RJ-45 socket for "Ethernet" connection, 10Base-T or 100Base-T network.
- RJ-11 socket for dedicated analog type telephone line for computer modem with long distance dial out privileges.

Miscellaneous Requirements

- All ceilings, walls, and floors completely finished and cleaned up (dust free).
- Delivery route for magnet and other components planned-out -- no obstructions or other problems (tiny elevators, steep ramps, no dock, street level delivery, curbs, etc.)?
- Staging area available at time of delivery for unpacking and sorting materials (150 sq ft)?
- Means of disposing of packing material, crates, boxes, etc., provided?
- Is it necessary to get permits for delivery? Parking problems (delivery truck size)? Restricted access in off hours?
- Have magnet safety and fringe field concerns been properly addressed?
- Have locations for warning signs (quantity-2) been identified?
- Has all required fencing been installed?
- Is a secure storage space available on site?
- Are first-aid kits and non-ferrous fire extinguishers available at the site?
- Have facility arrangements been made for refuse disposal during installation?

This page left blank intentionally.

Index

Access		Noise.....	7-3
Limiting.....	1-5	Phone connection.....	8-1
Air		Physical requirements.....	4-1
Reducing air pollution effects.....	7-3	Pre-Installation Checklist.....	10-1
Air filtration system.....	7-3	Pressure Drop	
Altitude specification.....	7-2	Maximum.....	5-5
Ambient EMI.....	4-1	Quench.....	5-1
Ambient RFI.....	4-1	Requirements	
Building		AC power.....	6-1
Vent system requirements.....	5-5	Altitude.....	7-2
Cabling.....	2-3	Building vent system.....	5-5
Checklist.....	10-1	Clearance.....	2-1
Clearance requirements.....	2-1	Cooling.....	7-1
Common Ground.....	4-6	Environmental.....	7-1
Cooling requirements.....	7-1	Exhaust.....	5-7, 6-2
Delivery information.....	9-1	Fire breaks.....	5-7
Electrical requirements.....	4-1	Floor space.....	2-1
Electrical system.....	4-6	Force on vent tube penetration.....	5-4
Environmental Requirements.....	7-1	Heating.....	7-1
Exclusion limits.....	3-7	Helium venting.....	5-1
Exhaust.....	5-7, 6-2	Joints.....	5-5
Field homogeneity		Responsibilities.....	5-1
Environmental effects.....	3-7	Space.....	2-1
Fire Breaks.....	5-7	Sprinklers.....	4-6
Floor loading.....	2-4	Temperature & humidity.....	7-1
Floor space requirements.....	2-1	Vent supports.....	5-7
Force		Vent tube materials.....	5-5
Vent tube penetration.....	5-4	Vent tube penetration.....	5-1
Hazards		Responsibilities.....	5-1
Fire breaks.....	5-7	RF Room	
Quench.....	5-1	Common Ground.....	4-6
Heat output.....	7-1	Electrical requirements.....	4-1
Helium Venting.....	5-1	Electrical system.....	4-6
Humidity.....	7-1	Force on vent tube penetration.....	5-4
Imaging suite		Lighting.....	4-6
Typical layouts.....	2-1	Physical requirements.....	4-1
Internal Venting.....	6-1	Specifications.....	4-1
Joints.....	5-5	Vent tube penetration.....	5-3
Lighting.....	4-6	RFI.....	4-1
Magnet		Shipping information.....	9-1
Others in proximity.....	3-11	Shipping List.....	9-1
Magnet Anchoring.....	2-4	Siting	
Magnetic field		50/60 Hz Stray Fields.....	7-2
Considerations.....	3-7	Cabling.....	2-3
Effects on equipment.....	3-7	Environmental requirements.....	7-1
Exclusion limits.....	3-7	Exclusion limits.....	3-7
Moving Metal.....	7-1	Floor loading.....	2-4
Network connection.....	8-1	General considerations.....	1-5

Magnet Anchoring	2-4	Temperature.....	7-1
Magnetic Field	3-7	Vent tube	
Moving Metal.....	7-1	External	5-5
Two or more magnets	3-11	Venting	
Vibration	7-2	Building system.....	5-5
Space requirements.....	2-1	Exhaust.....	5-7
Sprinklers.....	4-6	Helium.....	5-1
Stray Fields.....	7-2	Internal	6-1
Suite layouts	2-1	Pressure drop, maximum.....	5-5
System		Supports.....	5-7
Floor loading	2-4	Tube materials	5-5
Magnetic field effects.....	3-7	Vent tube penetration	5-3
Noise, audible.....	7-3	Vibration.....	7-2
Proximity of other magnets.....	3-11		

Appendix A.

PRELIMINARY PLANNING ONLY

PROJECT TITLE:

TYPICAL

LAYOUT 1

APPENDIX

SCHEME NO.: 8-234

DRAWN BY: PMM

DATE: 14.JUN.12

THIS LAYOUT MUST BE APPROVED BEFORE FINAL DRAWINGS CAN BE STARTED. THANK YOU

CUSTOMER

GE Project Manager Installation

DATE:

DATE:

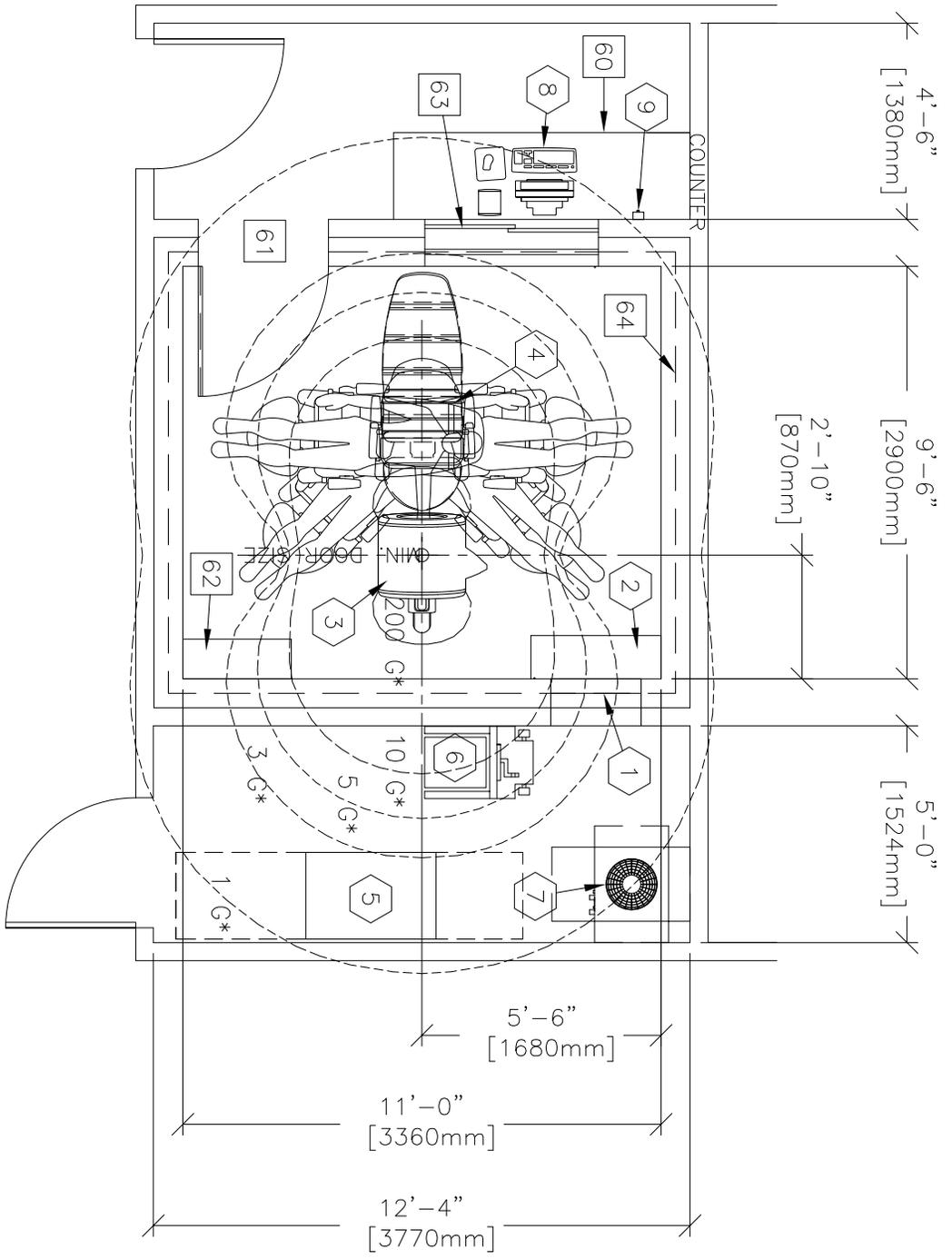


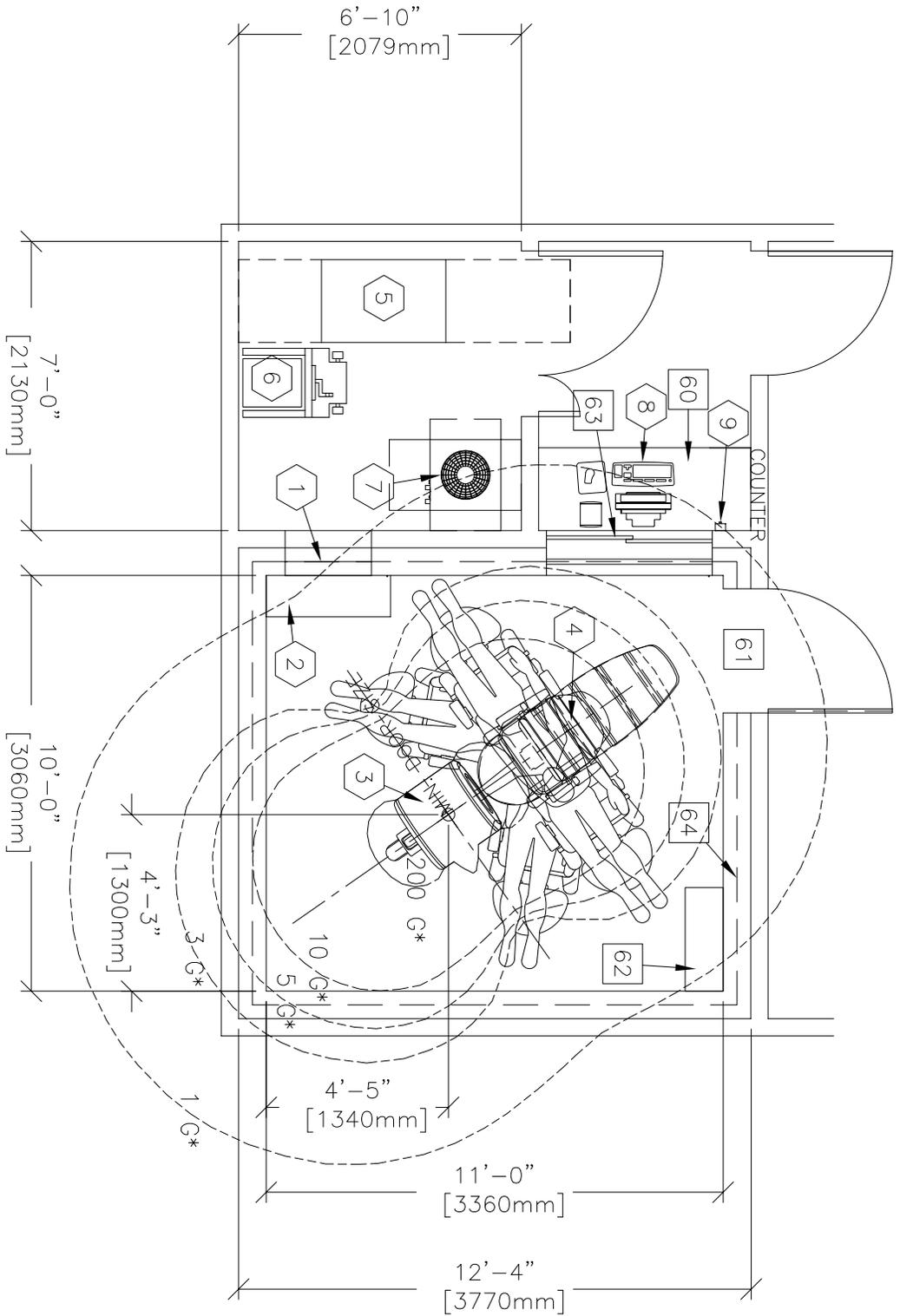
GE Healthcare

Installation Services

Wisconsin

This equipment layout indicates the placement and interconnection of the indicated equipment components. There may be federal, state and/or local requirements that could impact the placement of these components. It remains the Customer's responsibility for ensuring the site and final equipment placement complies with all applicable federal, state and/or local requirements.





PRELIMINARY PLANNING ONLY

PROJECT TITLE:

TYPICAL

LAYOUT 2

APPENDIX

SCHEME NO.: 8-234

DRAWN BY: PMM

DATE: 14.JUN.12

THIS LAYOUT MUST BE APPROVED BEFORE FINAL DRAWINGS CAN BE STARTED. THANK YOU

CUSTOMER

DATE:

GE Project Manager

DATE:

Installation



GE Healthcare

Installation Services

Milwaukee,

Wisconsin

This equipment layout indicates the placement and interconnection of the indicated equipment components. There may be federal, state and/or local requirements that could impact the placement of these components. It remains the Customer's responsibility for ensuring the site and final equipment placement complies with all applicable federal, state and/or local requirements.

GE EQUIPMENT LISTING

EQUIPMENT QUOTED FROM GE MEDICAL SYSTEMS
 PER QUOTE NO. N/A DATED N/A
 INSTALLED BY GEMS

ITEM NO.	QUANTITY ORDERED	ITEM DESCRIPTION (* = EXISTING/REINSTALL)	WEIGHT	HEAT OUTPUT
①	1	PENETRATION PANEL	26 lbs 12 kg	
②	1	PENETRATION COVER	11 lbs 5 kg	
③	1	MAGNET ASSEMBLY	1000 lbs 454 kg	331 btu 97 W
④	1	PATIENT SUPPORT	169 lbs 77 kg	
⑤	1	SYSTEM ELECTRONICS	842 lbs 382 kg	15003 btu 4396 W
⑥	1	LIFTING FIXTURE		
⑦	1	HELIUM COMPRESSOR	308 lbs 140 kg	16003 btu 4689 W
⑧	1	OPERATORS CONSOLE	26 lbs 12 kg	136 btu 40 W
⑨	1	EMERGENCY QUENCH BUTTON		

ANCILLARY ITEMS

CUSTOMER/CONTRACTOR SUPPLIED AND INSTALLED ITEMS

ITEM
NO.

ITEM DESCRIPTION
(* INDICATES EXISTING)

60

COUNTERTOP WITH DRAWERS FOR MISCELLANEOUS ITEMS.

61

DOOR OPENING MUST BE A MINIMUM OF 36 in. x 84 in. [915mm x 2134mm]. IT SHOULD NOT INTERFERE WITH THE PATIENT CHAIR ACCESS AREA ANY THRESHOLD SHOULD BE MINIMIZED WITH A RAMP AND NO GAPS IN THE FLOORING ACCORDING TO LOCAL CODES.

62

STORAGE CABINET

63

A SCREENED WINDOW SHALL BE PROVIDED TO ALLOW CONTINUOUS AUDIBLE AND VISUAL CONTACT WITH THE PATIENT. THE WINDOW SHOULD NOT DEGRADE THE EFFECTIVENESS OF THE RF SHIELD. SLIDING GLASS ON THE OPERATOR'S SIDE OF THE SCREEN IS RECOMMENDED FOR PRIVACY. AN INTERCOM IS MANDATORY IF A SOLID GLASS PANE IS INSTALLED.

64

THE RF SHIELD MUST BE ELECTRICALLY ISOLATED FROM ANY POINT WITH A LOW IMPEDANCE TO GROUND, INCLUDING NON-GE ELECTRICAL EQUIPMENT, PLUMBING, AND THE QUENCH VENT. THE ISOLATION REQUIRED IS > 1000 ohms BEFORE MAGNET ANCHORING.

THE FOLLOWING ITEMS ARE AVAILABLE FROM THE GE MEDICAL SYSTEMS SERVICE DEPARTMENT. CONTACT YOUR LOCAL GE MEDICAL SYSTEMS SERVICE REPRESENTATIVE FOR PRICING AND AVAILABILITY OR CALL 1-800-558-2040.

THE CUSTOMER MUST PROVIDE ONE INTERNET ACCESSIBLE (VPN) NETWORK CONNECTION UNLESS BASED UPON SYSTEM CONFIGURATION THAT A DEDICATED DATA TELEPHONE LINE IS ACCEPTABLE

POWER SPECIFICATIONS

MSK EXTREMITY

(REV. DATE 04/20/10)

VOLTAGE

PRIMARY SOURCE IS REQUIRED FOR ALL INSTALLATIONS.
 RANGE OF LINE VOLTAGES: NOMINAL LINE VOLTAGE OF 200 TO 415, 3 PHASE, 50 OR 60 Hz.

MAXIMUM DAILY VOLTAGE VARIATION MUST FALL WITHIN ONE OF THE RANGES IN TABLE A.

TABLE A ALLOWABLE INPUT VOLTAGES/ CURRENT DEMAND

NOMINAL VOLTAGE	ABSOLUTE RANGE	CURRENT (AMPS)	
		MOMENTARY	CONTINUOUS
200	180-220	32	18
208	187-229	31	17
380	342-418	17	9
400	360-440	16	9
415	374-456	15	8

PHASE-BALANCE.

PHASE-TO-PHASE VOLTAGES MUST BE WITHIN 2 PERCENT OF THE LOWEST PHASE-TO-PHASE VOLTAGE. MAXIMUM ALLOWABLE TRANSIENT VOLTAGE EXCURSIONS ARE 1.8 PERCENT OF RATED LINE VOLTAGE AT A MAXIMUM DURATION OF 75 MICROSECONDS AND FREQUENCY OF 10 TIMES PER HOUR.

VOLTAGE TRANSIENT OR IMPULSE ON THE INCOMING POWER MUST BE HELD TO A MINIMUM. TRANSIENTS CAUSED BY LIGHTNING, SURGES, LOAD SWITCHING, STATIC ELECTRICITY ETC. CAN CAUSE SCAN ABORTS OR, IN EXTREME INSTANCES, COMPONENT FAILURE IN THE COMPUTER SUBSYSTEM.

POWER DEMAND

MAXIMUM POWER DEMAND = 11.1 KVA. CONTINUOUS = 6.1 KVA

REFER TO DIRECTION LISTED ON C1 FOR ADDITIONAL INFORMATION.

© 2010-2013 General Electric Company
General Electric Company, doing business as GE Healthcare.
3200 N. Grandview Boulevard
Waukesha, Wisconsin 53188
USA * GE, and Optima are trademarks of General Electric Company.
www.gehealthcare.com

