



SIGNA™ Pioneer 3.0T System

Preinstallation Manual

5680003-1EN
Revision 9

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DOC0371395 - Global Language Procedure

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1 Introduction

1.1 Preinstall Manual Introduction



(Applies to all subsections within this section)

1.1.1 Document Purpose

This preinstallation manual provides the necessary information to prepare a site for system installation. Specifically, this manual provides information:

1. To define system requirements and interactions.
2. For the effective arrangement and interconnection of system components.
3. The customer is responsible for:
 - a. Compliance with all local and national codes and regulations
 - b. Siting requirements for customer-specific site procedures (medical, MR, safety, and so on)
 - c. Any special architectural requirements (for example, seismic codes)

The implementation of all requirements and adherence to all specifications in this manual is the responsibility of the customer or its architect and engineers. Refer any questions to the GE HealthCare Project Manager of Installation (PMI).

1.1.2 Intended User

The primary users of this manual are the customer, the customer's architectural planner, and/or the customer's contractors.

1.1.3 Who Should Read This Manual

The following personnel must be aware of the content listed in the following sections:

Table 1-1 Personnel Index

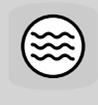
Section	Personnel						
							
	Architect	General Contractor	Customer	Electrician	Plumber	HVAC	RF Vendor
1.1 Preinstall Manual Introduction	X	X	X	X	X	X	X
2.1 System Level Requirements for Installing into Existing MR Suite	X	X					
2.2 System components	X	X					
2.3 MR Suite Minimum Room Size Requirements	X						
2.4 MR System Seismic Requirements	X	X					
2.5 Structure-borne Vibration Control Specifications	X						
2.6 MR Suite Magnetic Field Specifications	X		X				
2.7 Multiple MR System Requirements	X						
2.8 MR Suite Temperature and Humidity	X	X			X	X	
2.9 Facility Coolant Requirements	X	X			X	X	
2.10 MR Suite Electrical Requirements	X			X			
2.11 MR System Shipping and Receiving	X						
3.1 Magnet Room Introduction	X	X					
3.2 Magnet Room Structural Requirements	X						
3.2.1 Overview	X						
3.2.2 Environmental Steel Limits	X						
3.2.3 Vibration Requirements	X	X				X	
3.3 Magnetic Shielded Room Requirements	X						
3.4 ISC and ICC Wall Opening Requirements for Standard (On the Wall) Siting Configuration	X						

Table 1-1 Personnel Index (Table continued)

Section	Personnel						
							
	Architect	General Contractor	Customer	Electrician	Plumber	HVAC	RF Vendor
3.5 Penetration Panel Wall Opening Requirements for Remote (Off the Wall) Siting Configuration	X						
3.6.1 Ferrous Materials in the Magnet Room	X	X	X				
3.6.2 Walls	X						
3.6.3 Magnet Preinstallation Markings	X						
3.6.4 Penetration Wall Closet	X						
3.6.5 PEN Wall Closet Outline for Standard (On the Wall) Siting Configuration	X						
3.6.6 Penetration Panel Closet Specifications for Remote (Off the Wall) Siting Configuration	X						
3.6.7 Doors, Magnet Access Openings, and Patient Viewing Windows	X						
3.6.8 Finished Ceiling	X						
3.6.9 Magnet Room Floors	X	X					
3.6.10 Storage Cabinets	X	X					
3.7 Magnet Room Equipment Specifications	X	X					
3.8 Magnet Room Lighting Requirements	X			X			
4 Equipment Room chapter	X	X					
5 Control Room chapter	X	X					
6 Digital Service and Connectivity chapter	X			X			
7.1 MR System Interconnects Specifications	X	X		X			
7.2 MR System Interconnects Routing Requirements	X	X		X			
7.3 Facility-Supplied System Interconnects Specifications	X	X		X	X	X	
8.1 Glossary	X	X	X	X	X	X	X

Table 1-1 Personnel Index (Table continued)

Section	Personnel						
							
	Architect	General Contractor	Customer	Electrician	Plumber	HVAC	RF Vendor
8.2 MR Site Vibration Test Guidelines	x						
8.3 Sample Calculation AC Power Equipment Minimum Distance	x						
8.4 Selecting Anchor Size	x	x					
8.5 Sample control schematic for customer-supplied MDP	x			x			

1.1.4 Related Publications

The preinstallation requirements in the following publications are applicable to all systems. This document and all documents referenced herein shall be provided to the Responsible Organization or Operator as a supplement to the product instructions for use and/or technical description.

Table 1-2 Additional Preinstallation Requirements

Publication Number	Title	Personnel who must be aware of the content
5850262-1EN	<i>Acoustic Room Details</i>	
5850261-1EN	<i>International Electrotechnical Commission (IEC) Electromagnetic Compatibility (EMC)</i>	 
5850263-1EN	<i>Magnet Room Venting</i>	  
5850260-1EN	<i>RF Shielded Room</i>	 

1.1.5 Document Overview

This manual describes requirements and specifications for the following:

1. General system requirements that apply to the entire MR suite
2. Shipping and delivery
3. Magnet Room
4. Equipment Room
5. Control Room
6. Interconnects within and between the rooms listed above

1.2 Symbols Key

Table 1-3 Symbols Key

Symbol/Unit	Definition
	Center of gravity
	Magnet isocenter
	Service area
	Airflow
	Space for airflow and cables
	Valve

2 General System Level

2.1 System Level Requirements for Installing into Existing MR Suite



When planning for the installation of this system in an existing GE HealthCare MR suite or a non-GE HealthCare MR suite, all requirements in this manual must be met because these rooms are considered new installations.

When upgrading from a Signa OpenSpeed system, extensive building updates are required. The facility must remove any Magnet Room isolation system.

1. If the existing MR suite contains a GE system, the vibration environmental assessment must be done using the High Speed (magnetic field) Stability tool.

NOTE

The customer may have to hire a vibration consultant based on the results of the analysis.

2. Some GE HealthCare MR suites with overhead cabling may need to be modified to meet current cable tray requirements, such as minimum width and position. See [7.2 MR System Interconnects Routing Requirements on page 126](#).
3. Remove, cover, or fill in abandoned ducts or troughs from the Equipment and Magnet Rooms.
Access/computer room flooring in the Equipment Room can either be removed or assessed and reinforced to support heavier cabinets.
4. Structural vibration levels may be higher at some frequencies than other MR Systems, which may increase acoustic levels. Refer to [2.5 Structure-borne Vibration Control Specifications on page 24](#).
5. The VibroAcoustic damping kit must be surface mounted (if the floor is recessed, it must be filled in and level). For upgrades that reuse the existing magnet, recessed floors can be filled with magnet spacers (25 mm (1 in.) aluminum) that were included when the magnet shipped.
6. RF vendor responsibilities:
 - a. The old dock anchor cannot be reused. It must be removed and the hole filled in. The new anchor is reset after the magnet is installed. For upgrades that reuse the existing magnet, contact the PMI for further details about the potential reuse of the old dock anchor.
 - b. The RF shield ceiling must support the cable routing mechanism and cables. Reinforce RF shield ceiling (see [7.2 MR System Interconnects Routing Requirements on page 126](#)).
 - c. Two penetration panel openings are required for Standard (On the Wall) Siting and one penetration panel opening is required for Remote (Off the wall) Siting, which both must meet the requirements in: *RF Shielded Room Requirements*, 5850260-1EN.
 - d. RF shield attenuation must comply with: *RF Shielded Room Requirements*, 5850260-1EN

7. Cryogen vent may need to be relocated to align with the Magnet Cryogen Vent opening. The cryogen vent must meet all cryogen venting requirements (see *Magnet Room Venting Requirements*, 5850263-1EN).

2.2 System components



(Applies to all subsections within this section)

This system consists of the following components:

2.2.1 Magnet Room

1. 3.0T Magnet and Magnet Enclosure (MAG) and Vibroacoustic Damping Kit
2. Patient Table (PT)
3. Magnet Rundown Unit (MRU)

NOTE

An optional remote MRU may be located outside the Magnet Room.

2.2.2 Equipment Room

1. Main Disconnect Panel (MDP) (may be customer-supplied in some regions)
2. Integrated System Cabinet (ISC)
3. Integrated Cooling Cabinet (ICC)
4. Penetration Panel (PP) for Remote (Off the wall) Siting only
5. Magnet Monitor (MON)
6. Optional: Magnetic Resonance Elastography (MRE)

2.2.3 Control Room

1. Operator Workspace equipment (OW)
2. Pneumatic Patient Alert System (PA1)
3. Optional:
 - Oxygen Monitor (OXY)
 - Physiological Acquisition Transceiver (PAT) Charging Station

2.2.4 Accessories

1. Patient accessories, including RF coils, phantoms, cushions, sponges, straps, and wedges
2. Gating accessories, including patient cardiac leads, peripheral gating probe, and respiratory bellows

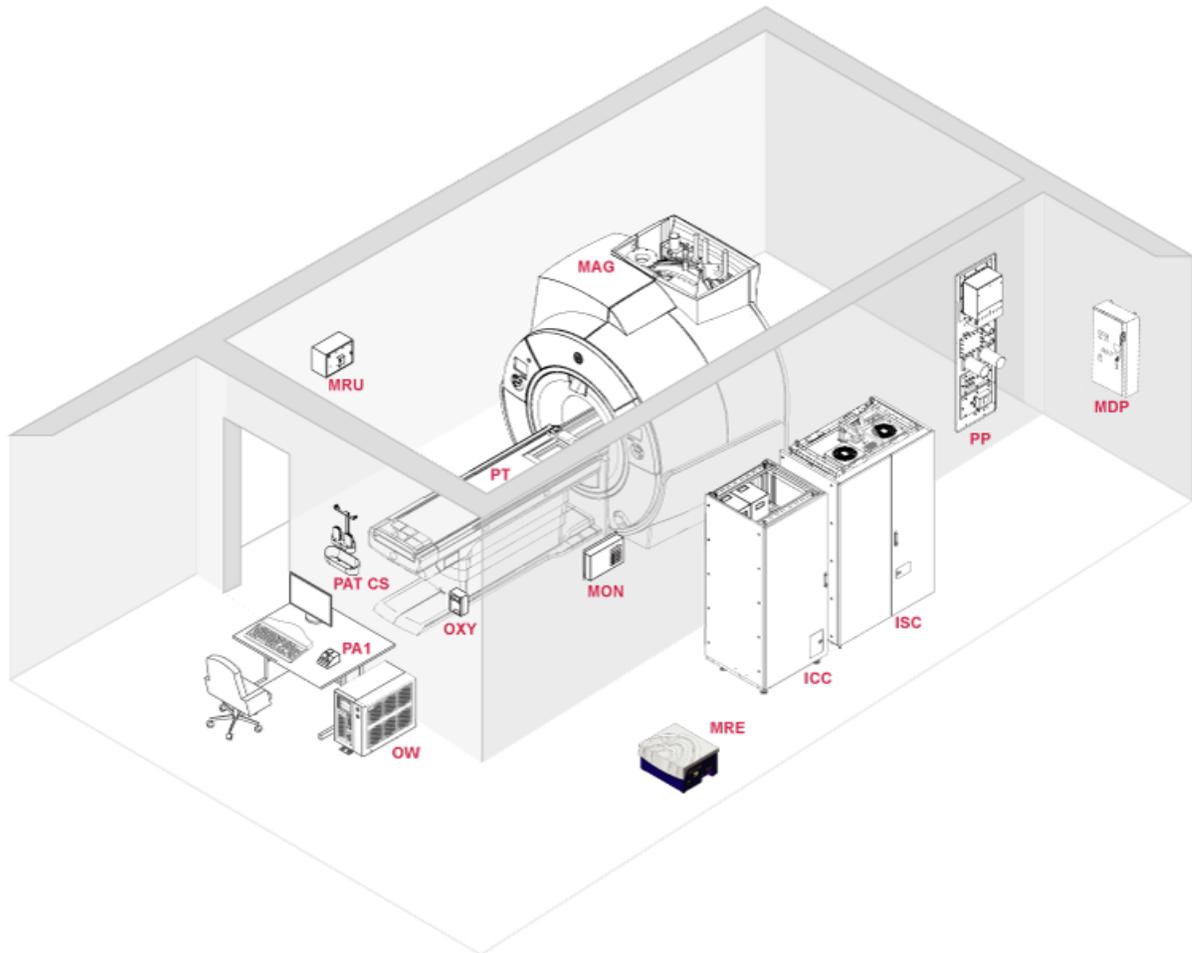
2.2.5 System Overview

Figure 2-1 System overview for Standard (On the Wall) Siting configuration (example)



NOTE

MRE, PAT Charging Station and OXY shown above are optional components of the system.

Figure 2-2 System overview for Remote (Off the wall) siting configuration (example)**NOTE**

The remote (Off the wall) siting configuration allows the ISC and ICC cabinets to be located away from the wall adjacent to the Magnet Room, either elsewhere in the equipment room, or in a separate room not adjacent to the Magnet Room.

NOTE

MRE, PAT Charging Station and OXY shown above are optional components of the system.

2.3 MR Suite Minimum Room Size Requirements



Room dimensions shown in the table below are the minimum finished room space requirements to safely install and service the MR System. Minimum dimensions are for service only. Room size may grow due to the items listed below, which are not included in the minimum area dimensions:

1. Building code requirements (for example, exit routes, door placement, seismic mounting requirements, local and national electrical codes, and so on).
2. Equipment and Magnet Room evacuation routes to comply with facility emergency procedures.
3. System requirements, including cable run locations, cryogen venting, patient observation requirements, and penetration panel placements.
4. Penetration panel closet and all associated areas.
5. GE optional equipment, such as MRE, MNS, accessories, and so on.
6. Non-GE HealthCare equipment options (such as additional AC or water cooling equipment in the Equipment Room).
7. Clinical workflow considerations.
8. Accessory storage. Refer to *Customer Site Storage Requirements*, 5182674 (available in the Customer Documentation Portal), or contact the GE HealthCare Project Manager of Installation (PMI) for any additional accessory storage requirements.
9. Magnetic field containment, for example, the 5 gauss line to the room. If fringe field containment is needed, see [2.6 MR Suite Magnetic Field Specifications on page 26](#).
10. The minimum service area shown must be kept clear of permanent or installed cabinetry, the MRU, the penetration closet, millwork, shelving, coil storage fixtures, furniture, and so on.

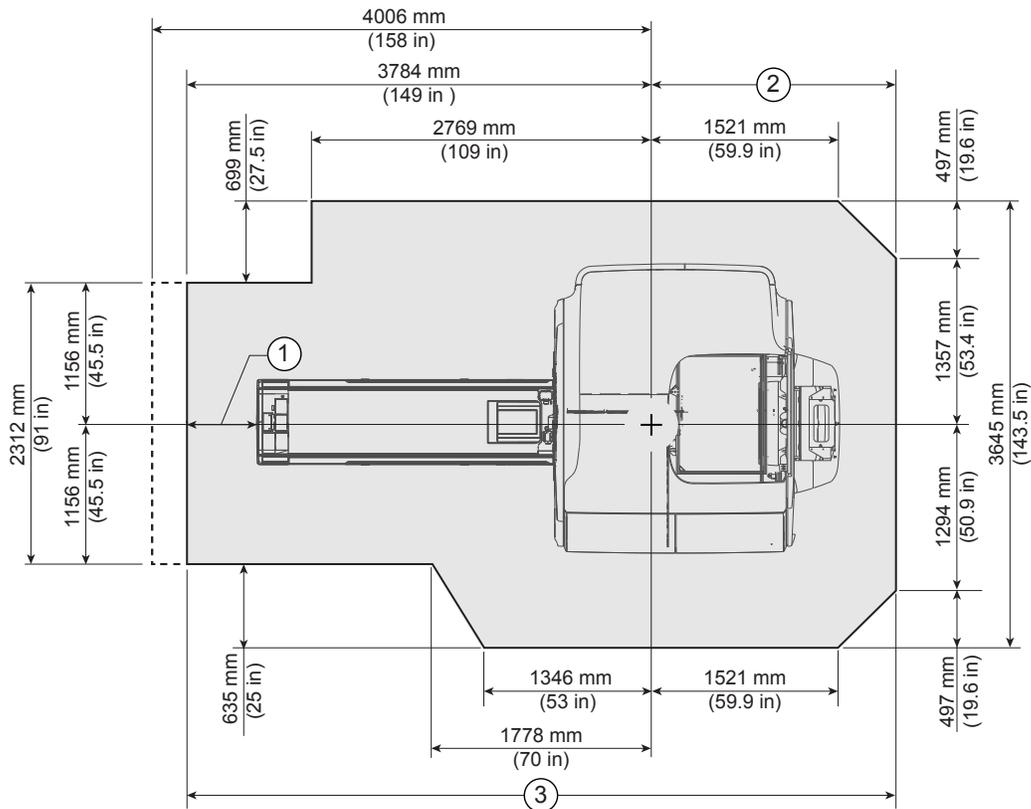
Table 2-1 Room Dimensions to Satisfy Minimum Service Area Requirements

Siting Configuration	Equipment Room ¹			Magnet Room ²			Control Room		Total System Area m ² (ft ²)
	W x D mm (in.)	Area m ² (ft ²)	Ceiling Height mm (in.)	W x D mm (in.)	Area m ² (ft ²)	Finished Ceiling Height mm (in.)	W x D mm (in.)	Area m ² (ft ²)	
Standard (On the Wall)	2510 x 2055 (98.8 x 80.9)	4.9 (53)	2400 (94.5)	3645 x 5727 (143.5 x 225.5)	18.5 (199.6)	2500 (98.5)	2130 x 1520 (83.9 x 59.8)	3.24 (34.9)	26.6 (287.6)
Remote (Off the wall)	2774 x 2614 (109.2 x 102.9)	6.6 (70.8)	2680 (105.5)	3645 x 5727 (143.5 x 225.5)	18.5 (199.6)	2500 (98.5)	2130 x 1520 (83.9 x 59.8)	3.24 (34.9)	28.3 (305.4)

Table 2-1 Room Dimensions to Satisfy Minimum Service Area Requirements (Table continued)

Siting Configuration	Equipment Room ¹			Magnet Room ²			Control Room		Total System Area m ² (ft ²)
	W x D mm (in.)	Area m ² (ft ²)	Ceiling Height mm (in.)	W x D mm (in.)	Area m ² (ft ²)	Finished Ceiling Height mm (in.)	W x D mm (in.)	Area m ² (ft ²)	
¹ See Figure 4-1 Typical Minimum Equipment Room with Service Clearances for Standard (On the Wall) Siting Configuration on page 90 or Figure 4-2 Typical Minimum Equipment Room with Service Clearances for Remote (Off the Wall) Siting Configuration on page 91 for specific dimensions ² See Figure 2-3 Minimum Magnet Service Area (Top View) on page 21 for specific dimensions									

Figure 2-3 Minimum Magnet Service Area (Top View)



Item	Description
1	374 mm (14.7 in)
2	1943 mm (76.5 in) GE recommends 2018 mm (79.4 in) to support future upgrades.
3	5727 mm (225.5 in) GE recommends 5802 mm (228.4 in) to support future upgrades.

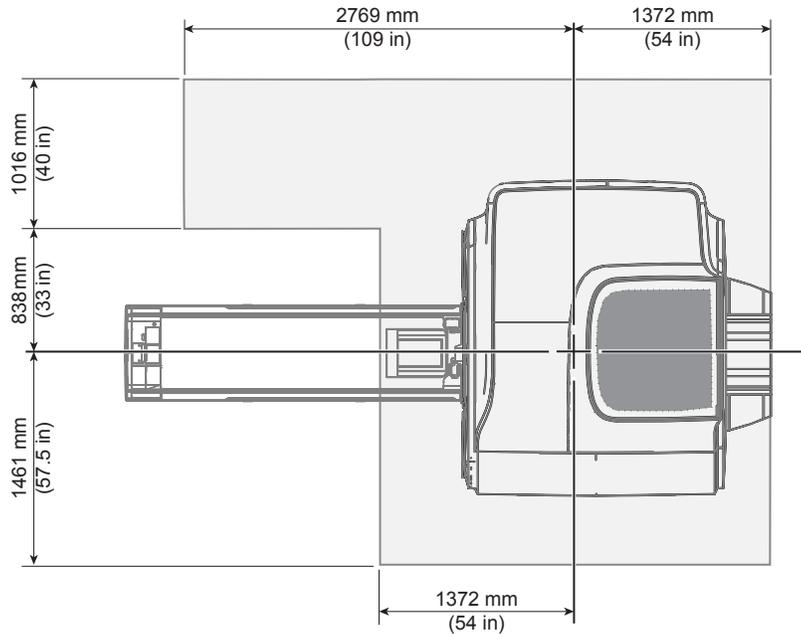
NOTE

The shaded area indicates minimum service area. The additional area identified by the dashed lines shows the recommended customer workflow area.

The following requirements apply to the Magnet Room finished ceiling:

1. Ideal Magnet Room suspended ceiling height is 2667 mm (105 in.). Minimum Magnet Room suspended ceiling height is 2500 mm (98.5 in). See [Figure 2-4 Area for Minimum Magnet Ceiling Height \(Top View\)](#) on page 22.
2. The ceiling service area should be kept clear of overhead items, including soffits, HVAC, plumbing components, and brackets. Permanent or installed objects in this area may prevent or delay magnet service or operation.

Figure 2-4 Area for Minimum Magnet Ceiling Height (Top View)



NOTE

The shaded area within solid lines indicates floor to ceiling minimum height of 2500 mm (98.5 in).

NOTE

If the ceiling height is between **2500 mm (98.5 in.)** and **2667 mm (105 in.)**, the flexible main lead extension for low ceiling height (2.5M Low Ceiling Kit-Passive, M7000GM) is required for ramping the magnet. Contact the GE PMI and GE Service Field Engineer for further evaluation.

2.4 MR System Seismic Requirements



Contact the Project Manager of Installation with any questions.

1. The customer is responsible for seismic anchoring of GE components.
2. Center of gravity, weight, physical dimensions, and attachment points are provided for seismic calculations. Refer to the specifications or illustrations for each component (see [Magnet](#)

[Room Equipment Specifications on page 84](#), [Equipment Room on page 89](#), and [Control Room on page 109](#)).

2.5 Structure-borne Vibration Control Specifications



Structure-borne acoustic issues tend to occur at MR installations above the ground floor of the facility. Two options to mitigate structure-borne acoustic transmission are:

1. GE HealthCare provides a VibroAcoustic Damping kit (which must be surface mounted). Contact the GE HealthCare Project Manager of Installation for information.
2. The customer may design and implement a custom solution in addition to the VibroAcoustic Damping kit. See [Figure 2-5 Vibration Transmitted through VibroAcoustic Mat on page 24](#) for the plot of spectral vibration transmitted through the VibroAcoustic mat into the floor. If required, the customer should consult an acoustic engineer for a solution to further attenuate this transmitted vibration).

NOTE

The amount of vibration attenuation provided by the VibroAcoustic Damping kit will be site dependent.

Figure 2-5 Vibration Transmitted through VibroAcoustic Mat

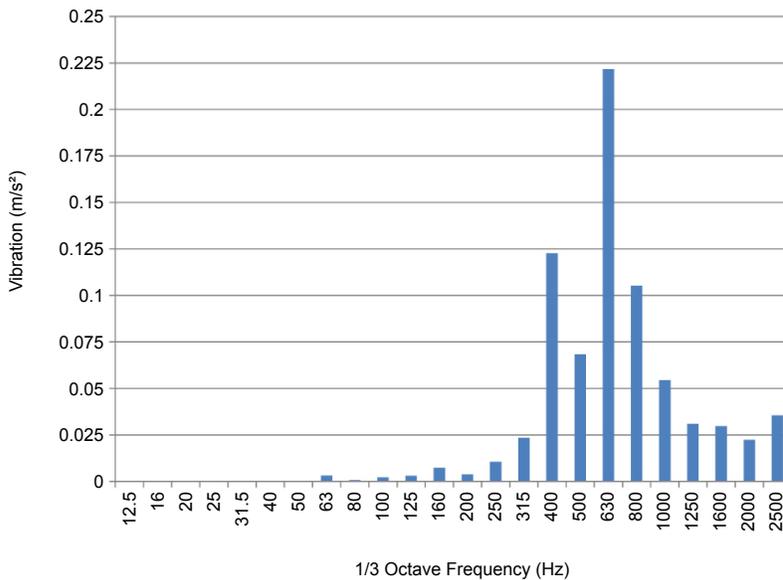
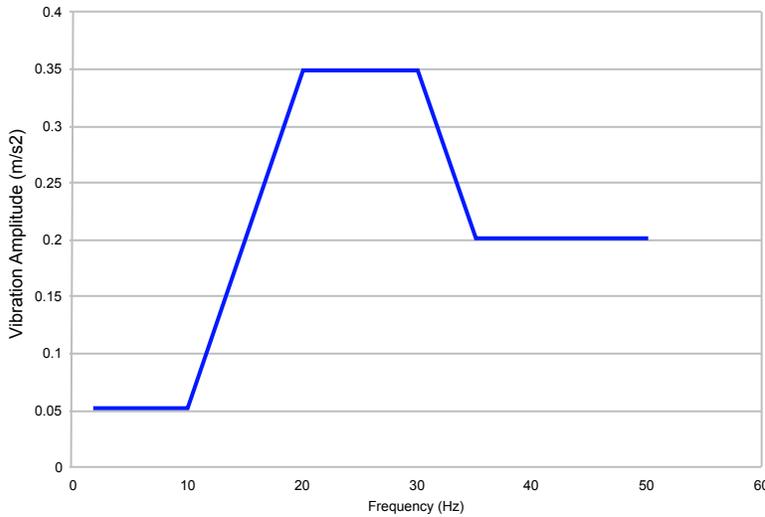


Figure 2-6 Low Frequency Magnet Floor Vibration (Vibration Amplitude at Each Foot)



Freq (Hz)	Amplitude (m/s ²)
2	0.05
10	0.05
20	0.35
30	0.35
35	0.20
50	0.20

Low Frequency Magnet Floor Vibration Notes:

NOTE

1. Illustrations above define the potential vibration level that may pass into the customer site. [Figure 2-5 Vibration Transmitted through VibroAcoustic Mat on page 24](#) is the high frequency audible vibration. [Figure 2-6 Low Frequency Magnet Floor Vibration \(Vibration Amplitude at Each Foot\) on page 25](#) is low frequency vibration that may dynamically displace the floor.
2. Vibration transfer may be the result of customer specific building construction as low levels of vibration transmit into the building through airborne and structure-borne paths. Customer MR clinicians recognize the vibration defined in the illustrations above is typically short bursts of vibration repeated multiple times as the scan progresses.
3. The customer should consider the impact of this vibration for the evaluation and design solution.

2.6 MR Suite Magnetic Field Specifications



(Applies to all subsections within this section)

2.6.1 Magnetic Fringe Field

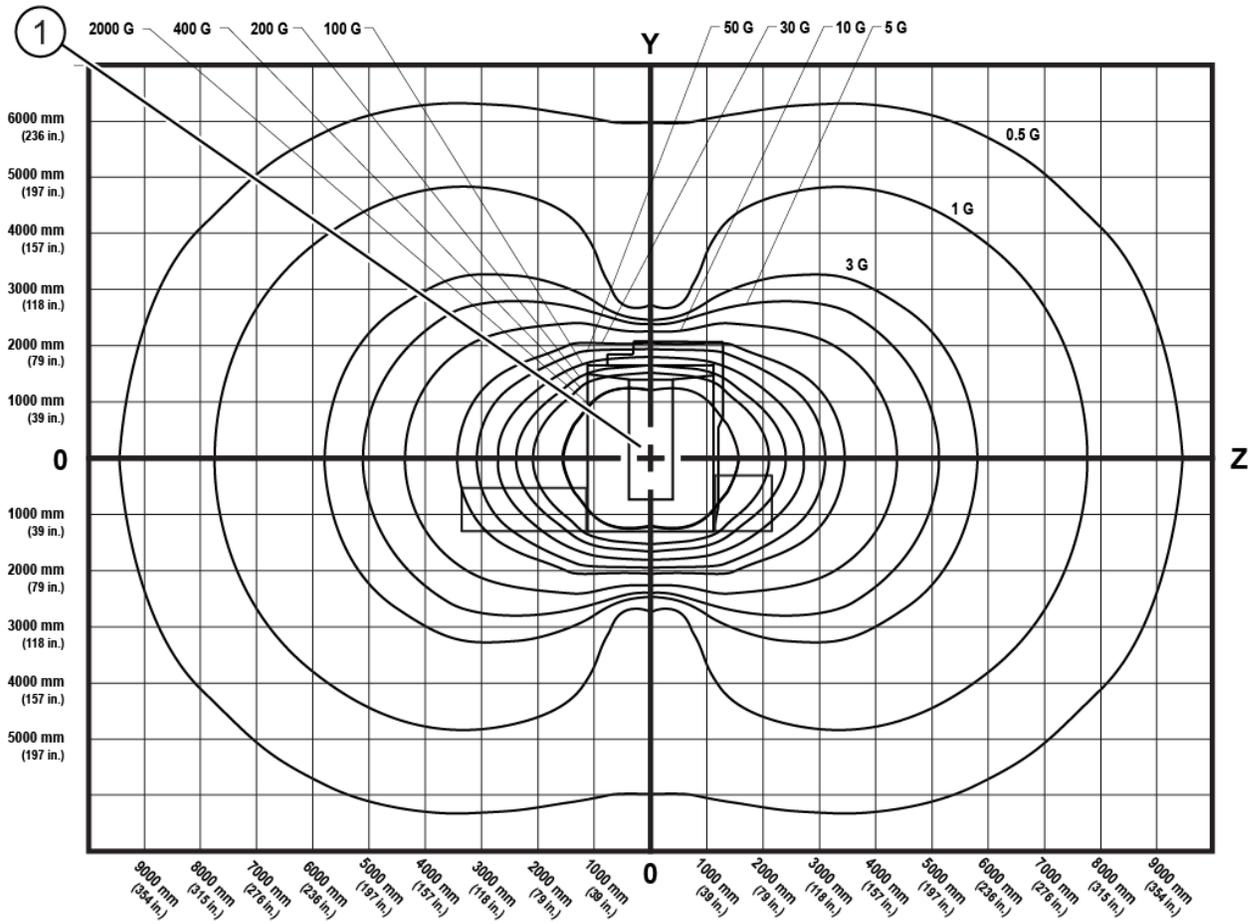
The following illustrations show the static magnet isogauss plot lines for the magnet. This information must be used to evaluate potential site interaction of GE HealthCare equipment with other non-GE HealthCare equipment, interaction with ferrous materials on the site, and to locate personnel and equipment within the site.

The 0.5 mT (5G) line can expand to 6.0 m (19.7 ft.) axially and 4.5 m (14.8 ft.) radially for up to 8 seconds in the rare event of a quench.

The isogauss plots show an idealized magnetic field relative to magnet isocenter. The actual field strength can be affected by any of the following:

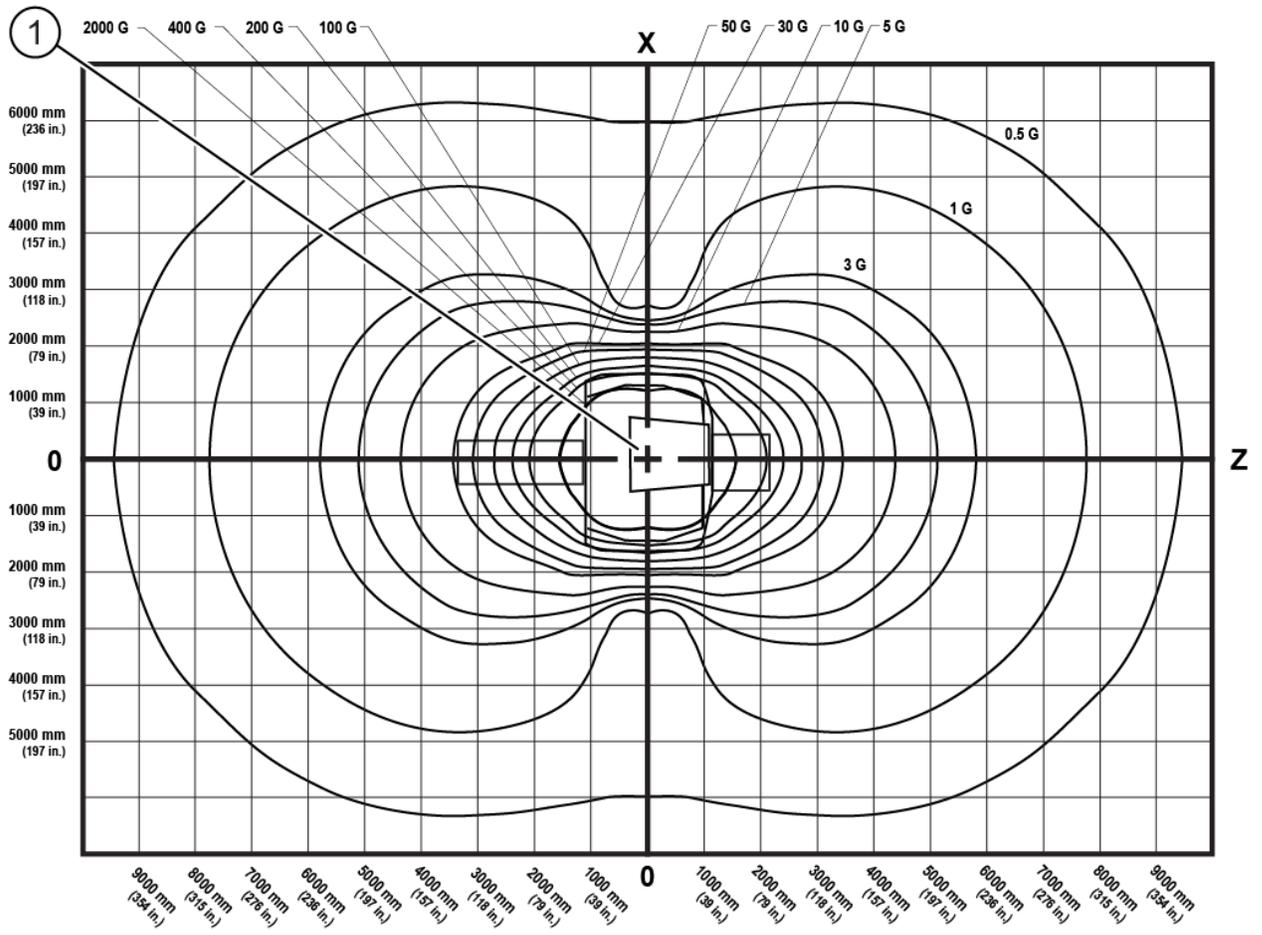
- Magnetic shielding
- Earth's magnetic field
- Other magnetic fields
- Stationary or moving metal

Figure 2-7 Magnetic Fringe Field Side View



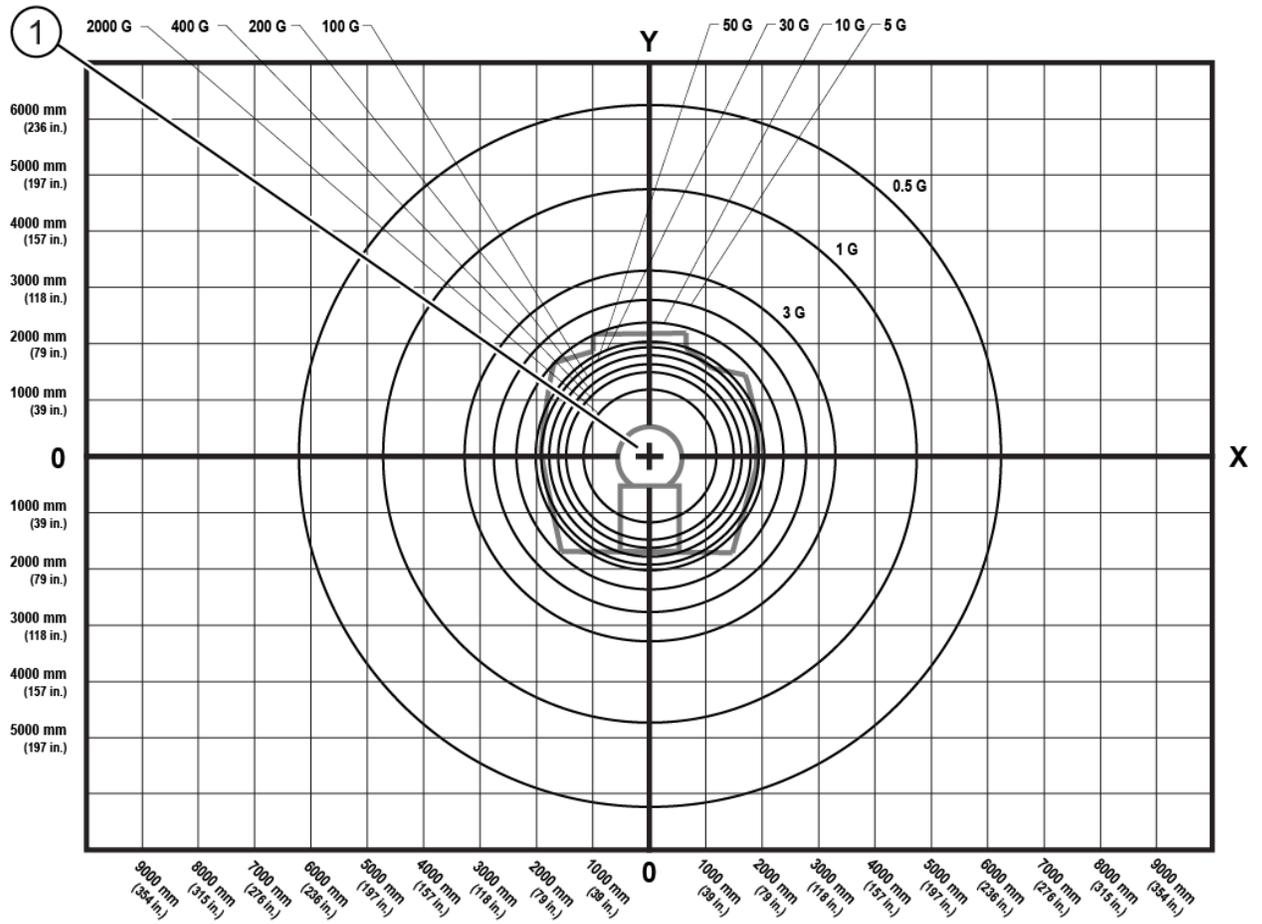
Item	Description
1	Magnet isocenter

Figure 2-8 Magnetic Fringe Field Top View



Item	Description
1	Magnet isocenter

Figure 2-9 Magnetic Fringe Field Front View

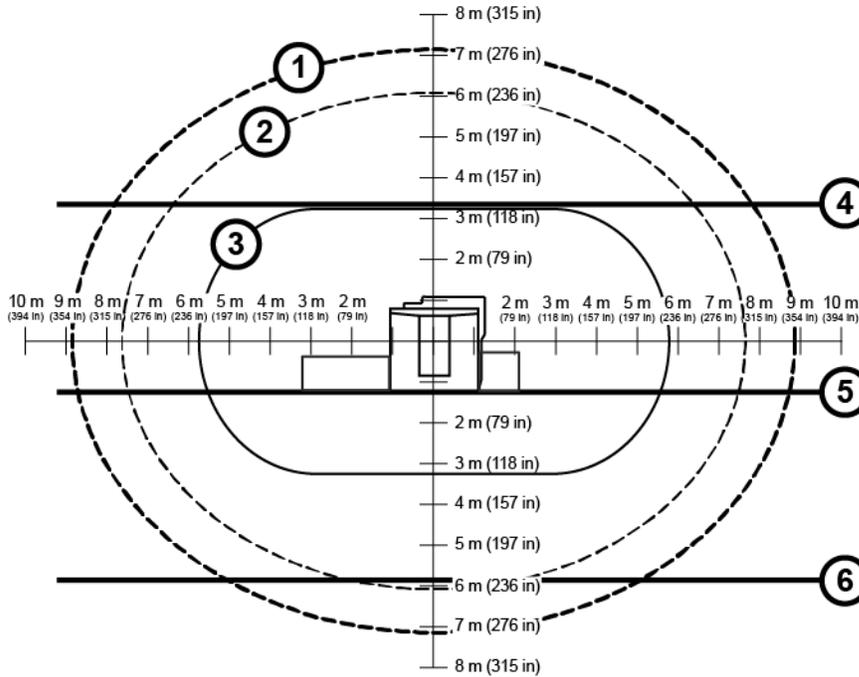


Item	Description
1	Magnet isocenter

2.6.2 Interference from Changing Magnetic Fields

Metal objects moving within the magnet sensitivity lines can produce a field disturbance during clinical imaging. If the metal object is moving it will produce a fluctuating dipole type of field which causes image artifacts. As an example, a car driven inside the moving metal line will act as a dipole and produce a time varying field which changes the magnet's main field during the scanning. The same vehicle may park within the moving metal line and remain parked during clinical scanning without impact to the main field.

Figure 2-10 Magnet Moving Metal Sensitivity Line Plot (Side View)

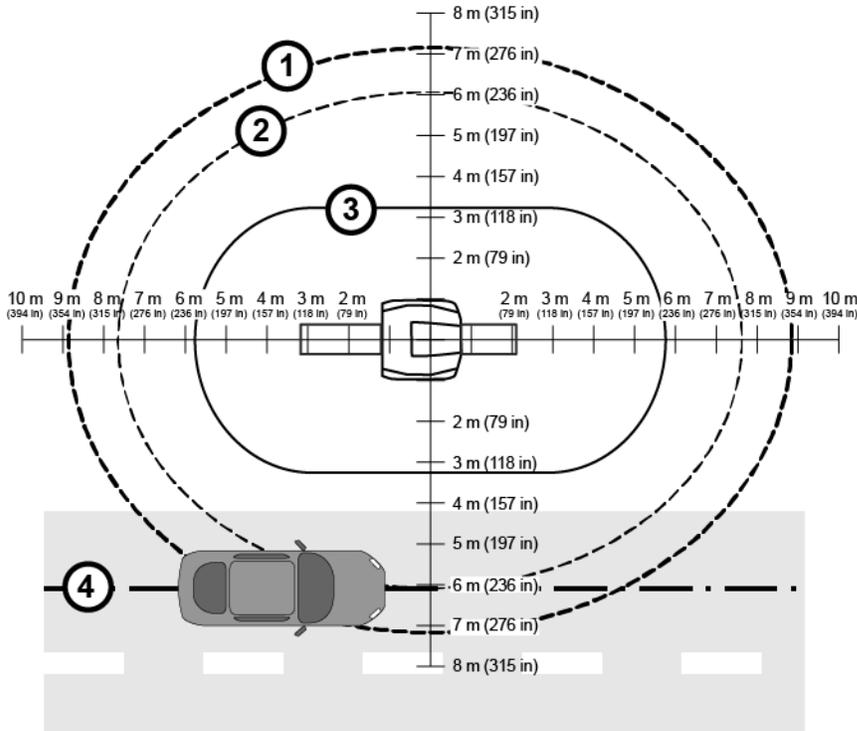


Item	Description	Item	Description
1	Trucks, Buses	4	Floor Above
2	Cars, Pickups, Vans, Ambulances	5	Magnet Room Floor
3	3 Gauss line	6	Floor Below

NOTE

The magnet isocenter, which is 1070 mm (42.1 in.) above the floor, is the origin of both the x-axis and the y-axis.

Figure 2-11 Magnet Moving Metal Sensitivity Line Plot (Top View)



Item	Description	Item	Description
1	Trucks, Buses	3	3 Gauss line
2	Cars, Pickups, Vans, Ambulances	4	Center of Driving Lane

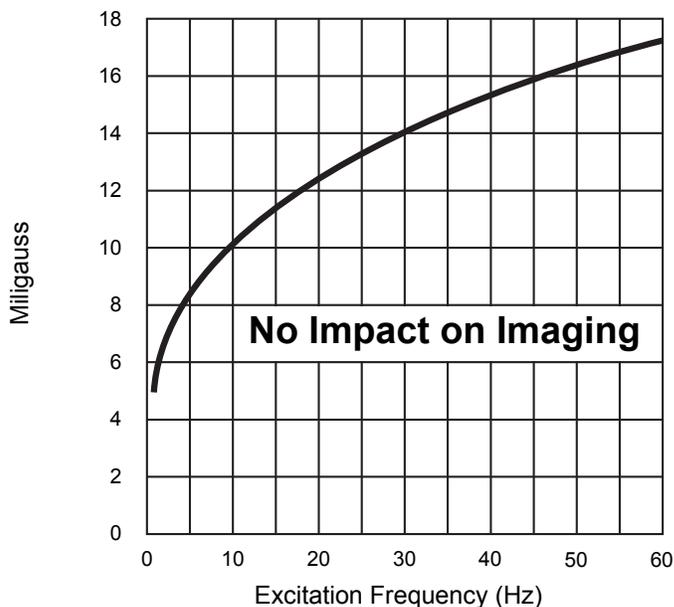
Table 2-2 Magnet Moving Metal Requirements

Metal Objects Category	Definition Of Distance Location	Magnet Minimum Distance Radial X Axial ¹ m (ft.)
Objects 45.36 - 181.44 kg (100 - 400 lb.)	Distance from isocenter radial x axial	0.3 mT (3 G) line
Cars, Minivans, Vans, Pickup Trucks, Ambulances	Distance from isocenter measured to center of driving or parking lane radial x axial	6.05 x 7.65 (20 x 25) (UA series magnet)
Bus, Trucks (Utility, Dump, Semi)	Distance from isocenter measured to center of driving or parking lane radial x axial	7.10 x 8.90 (23.3 x 29.2) (UA series magnet)
Objects > 181.44 kg (400 lb.), Elevators, Trains, Subways	Place a directional probe (for example, flux gate sensor) at isocenter of proposed magnet location aligned along the Z-axis. Measure peak-to-peak magnetic field change (DC).	Z-axis EMI disturbances must not exceed 560 nanotesla (5.6 milligauss) peak-to-peak. (UA series magnet)
Notes:		
1. Radial distances are magnet X and Y axis. Axial distances are magnet Z axis.		

2.6.3 Electrical Current

1. Electrical current in high voltage power lines, transformers, motors, or generators near the magnet may affect magnetic field homogeneity.
2. Magnetic field interference at 50 or 60 Hz must not exceed 1.622 μT (16.22 mG) or 1.710 μT (17.10 mG) RMS respectively at the magnet location (see [Figure 2-12 Magnet Allowable Milligauss vs. Line Frequency for AC Equipment on page 32](#)).
3. The following equation can be used as a general guide in determining allowable current in feeder lines at a given distance from the magnet isocenter:
 - a. For 3.0T Magnet: $I = (8.55X^2)/S$, where:
 - b. I = Maximum allowable RMS single phase current (in amps) or maximum allowable RMS line current (in amps) in three phase feeder lines
 - c. S = Separation (in meters) between single phase conductors or greatest separation between three phase conductors
 - d. X = Minimum distance (in meters) from the feeder lines to isocenter of the magnet

Figure 2-12 Magnet Allowable Milligauss vs. Line Frequency for AC Equipment



Refer to [Sample Calculation AC Power Equipment Minimum Distance on page 143](#) for additional examples.

2.6.4 Non-MR System Equipment Sensitivity to Magnetic Fields

Site plans must include consideration for magnetic field interaction with all customer equipment.

This section lists equipment known to be sensitive to high magnetic fields.

Use the table for reference only. The Tesla (Gauss) limits in the table are approximate for that type of equipment. Refer to OEM manuals for the equipment at your site to determine the actual Tesla (Gauss) limits.

Table 2-3 Magnetic Proximity Limits (For Reference Only)

mT (Gauss) Limit	Equipment	
0.05mT (0.5 G)	Nuclear camera	
0.1mT (1 G)	Positron Emission Tomography scanner	Video display (tube)
	Linear Accelerator	CT scanner
	Cyclotrons	Ultrasound
	Accurate measuring scale	Lithotripter
	Analog image intensifiers	Electron microscope
	Bone Densitometers	
0.3mT (3 G)	Power transformers	Main electrical distribution transformers
0.5mT (5 G)	Cardiac pacemakers	Biostimulation devices
	Neurostimulators	
1mT (10 G)	Magnetic computer media	Telephone switching stations
	Hard copy imagers	Water cooling equipment
	Line printers	HVAC equipment
	Video Cassette Recorder (VCR)	Major mechanical equipment room
	Film processor	Credit cards, watches, and clocks
	X-ray tubes	
	Large steel equipment, including:	
	Emergency generators	Air conditioning equipment
	Commercial laundry equipment	Fuel storage tanks
	Food preparation area	Motors greater than 5 horsepower
5mT (50 G)	Metal detector for screening	Telephones
	LCD panels	
No Limit	Digital Detectors	

2.7 Multiple MR System Requirements



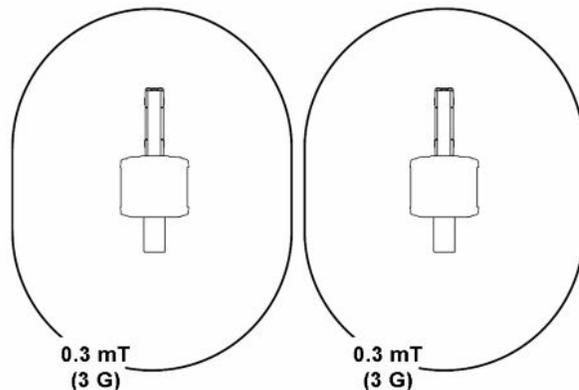
(Applies to all subsections within this section)

2.7.1 Multiple Magnets

When installing multiple magnets, the 0.3 mT (3 G) lines must not intersect or the magnets will be interactive. Contact the GE HealthCare Project Manager of Installation (PMI) for any questions regarding magnetic field interaction.

Magnet Rooms cannot share walls.

Figure 2-13 Two Magnet Installation (No Interaction)



2.7.2 Shared Equipment Rooms

When installing multiple MR Systems in a shared Equipment Room, of the same field strength, the following conditions must be met:

1. The RF cabinet of the existing installed system must be separated from the RF bay of the ISC by at least 2000 mm (79 in.).

This requirement does not apply if the existing system is one of the following: 1.5T SIGNA HDxt – SIGNA Works Edition (HD28), Brivo MR355/MR360, SIGNA Prime, SIGNA Creator/Explorer, SIGNA Star, SIGNA Star AIR, SIGNA Aviator, SIGNA Aviator AIR, SIGNA MR355/360, SIGNA MR380, SIGNA Victor, SIGNA Voyager, SIGNA Voyager AIR, Discovery MR450, Optima MR450w, SIGNA Artist, SIGNA Artist Evo, SIGNA Pioneer, SIGNA Hero, Discovery MR750, Discovery MR750w, SIGNA Architect, SIGNA Premier, SIGNA PET/MR, or SIGNA 7T.

2. The penetration panel of the other system must be separated from the penetration wall of the ISC by at least 3000 mm (118 in.).
3. Cables from different MR Systems must not be routed together.
4. Two systems cannot share common power or ground feeds.

NOTE

The distances shown in [Figure 2-14 Cabinet Separations in Shared Equipment Room \(Top View\)](#) on page 35 must be maintained between the RF cabinet of the new system and

existing RF cabinet of a non-GE HealthCare MR System. The distance is based on the location of the RF amplifier that is inside the ISC, not the location of the ISC.

* The 2000 mm (79 in.) requirement does not apply if the existing system is one of those listed in the requirements in item 1 above.

Figure 2-14 Cabinet Separations in Shared Equipment Room (Top View)

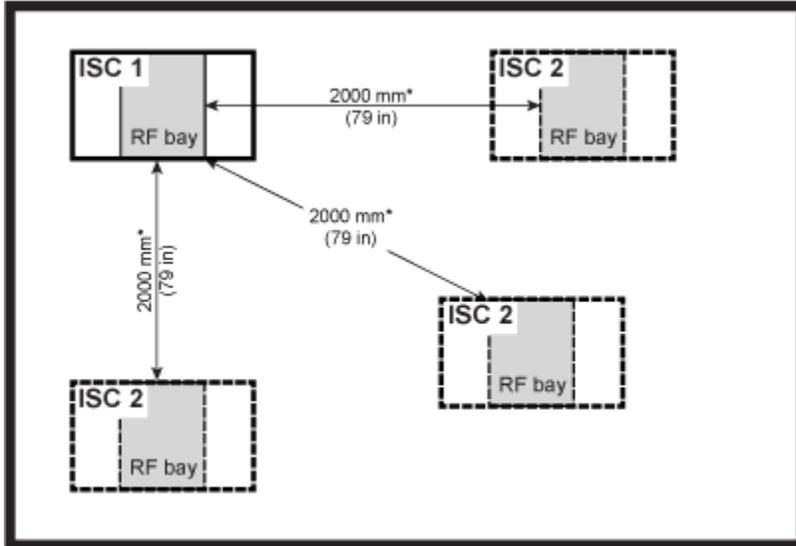
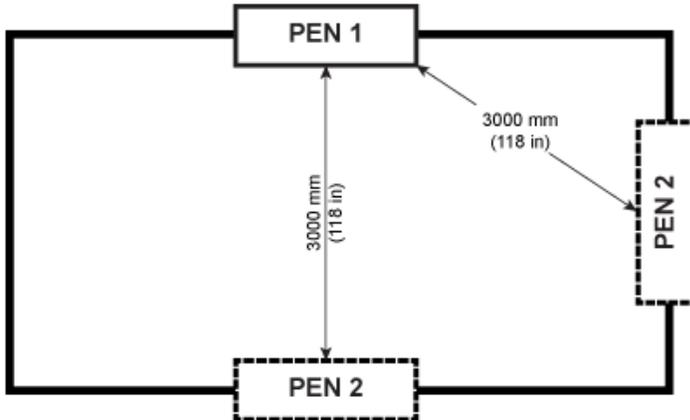


Figure 2-15 Panel Separations in Shared Equipment Room (Top View)



2.8 MR Suite Temperature and Humidity



(Applies to all subsections within this section)

This section provides temperature and humidity requirements for the MR suite.

NOTE

Make sure the HVAC system has the correct capacity for the room size, equipment heat output, and environmental conditions to maintain correct temperature and humidity for the protection of the patient.

Specific construction requirements for each room can be found in the following chapters:

- Magnet Room
- Equipment Room
- Control Room

2.8.1 Temperature and Humidity Requirements

1. The customer is responsible for HVAC system design, purchase, and installation.
2. The temperature and humidity requirements must not be exceeded at any point during the day (both working or non-working hours).
3. A separate thermostat must be provided for the Magnet Room.

Table 2-4 Room Temperature and Humidity Requirements

Room	Temperature		Humidity	
	Range °C (°F)	Change °C/Hr (°F/Hr) ¹	Range %RH	Change %RH/Hr ²
Equipment Room (at Inlet to Equipment)	15-32 (59-89.6) ³	3 (5)	30-75	5
Magnet Room	15-21 (59-69.8)	3 (5)	30-60	5
Operator Room	15-32 (59-89.6)	3 (5)	30-75	5

Notes:

1. Operating temperature gradient limits shall be between -3°C/Hr (-5°F/Hr) and 3°C/Hr (5°F/Hr), when averaged over 1 hour.
2. Operating humidity gradient limits shall be between -5% RH/hour and 5% RH/hour, when averaged over 1 hour.
3. Maximum ambient temperature is derated by 1°C per 300 m above 2000 m (not to exceed 2600 m).

2.8.2 Equipment Heat Output Specifications

This section details the heat output for specific components. These heat outputs define the minimum, maximum and an assumed average condition over a 12-hour period. Actual heat output and room temperature may vary due to environmental factors, room insulation, clinical usage, and any non-GE HealthCare equipment used in the MR suite. Also, due to large variations in heat loads, the HVAC system may require unloaders, hot gas bypass, and reheat to maintain humidity levels.

Table 2-5 System Heat Output for Air Cooling

Component	Magnet Room W (BTU/hr)			Equipment Room W (BTU/hr)			Control Room W (BTU/hr)		
	Maximum	Average	Idle	Maximum	Average	Idle	Maximum	Average	Idle
Magnet (MAG) and Patient Transport Table (PT)	2400 (8189)	1200 (4095)	561 (1915)						
Main Disconnect Panel (MDP)				264 (901)	132 (450)	132 (450)			
Integrated System Cabinet (ISC)				7100 (24232)	2130* (7270*)	280* (955*)			
Integrated Cooling Cabinet (ICC)				1000 (3412)	500* (1706*)	0*			
Cryocooler Compressor (CRY)				500 (1706)	500 (1706)	500 (1706)			
Magnet Monitor (MON)				60 (205)	60 (205)	60 (205)			
Penetration Panel (PP) for remote (Off the Wall) siting configuration		0		0	0	0			
Operator Work-space equipment (OW)							1450 (4947)		

NOTE

For ISC and ICC, the Average value is calculated using Standby mode and the Idle value is calculated using Night Mode (Power Off Mode).

Table 2-6 System Options Heat Output for Air Cooling

Component	Magnet Room W (BTU/hr)			Equipment Room W (BTU/hr)			Control Room W (BTU/hr)		
	Maximum	Average	Idle	Maximum	Average	Idle	Maximum	Average	Idle
MR Elastography (MRE)					141 (480)				

2.9 Facility Coolant Requirements



(Applies to all subsections within this section)

Important

Equipment Failure. A continuous supply of facility liquid coolant to the Integrated Cooling Cabinet (ICC) is required at all times for correct system operation. Failure to provide liquid coolant with the requirements listed in this section may cause equipment failure.

2.9.1 Integrated Cooling Cabinet (ICC) Coolant Requirements

1. The facility must provide an uninterrupted supply of liquid coolant to the Integrated Cooling Cabinet (ICC) at magnet delivery. Coolant circuit must be operational at magnet delivery.
2. The facility must provide pipe/hose, filter, and connectors to the ICC.
3. The vertical distance between the coolant connection points of the ICC and the Gradient Coil must be less than ± 5 meters (± 196.8 in.).
4. The customer must provide and install an in-line flow meter on either the supply or return facility coolant hose. The flow meter must be capable of visually displaying volumetric flow between 40 and 100 L/min (10.5 and 26.4 GPM) and configured for the properties of the cooling fluid in use.
5. For sites without insite connectivity, the customer must provide and install an in-line thermometer on the supply facility coolant hose. The thermometer must be capable of visually displaying temperatures covering 5 to 15°C (41 to 59°F) and configured for the properties of the cooling fluid in use.

Table 2-7 Facility Liquid Coolant Requirements

Parameter	Requirements
Availability	Continuous
Antifreeze	0-40% propylene glycol or ethylene glycol
Minimum Flow	50 L/min (13.2 GPM)
Maximum Flow	80 L/min (21.1 GPM)
Nominal Flow	60 L/min (15.8 GPM)
Maximum Pressure Drop in ICC at Minimum Flow	1.8 bar (26.1 psi) with 40% propylene glycol-water or ethylene glycol-water; 1021 kg/m ³ density 1.3 bar (19.3 psi) with pure water; 994 kg/m ³ density
Maximum Pressure Drop in ICC at Maximum Flow	3.4 bar (49.3 psi) with 40% propylene glycol-water or ethylene glycol-water; 1021 kg/m ³ density 2.5 bar (36.5 psi) with pure water; 994 kg/m ³ density
Maximum Inlet Pressure to ICC	5.52 bar (80 psi)
Chiller Size	Minimum 36 kW
Condensation Protection	Facility Plumbing to the ICC must be properly routed and insulated to prevent equipment damage or safety hazards

Table 2-7 Facility Liquid Coolant Requirements (Table continued)

Parameter	Requirements
Minimum Continuous Heat Load	7.5 kW
Inlet Temperature	5 to 15°C (41 to 59°F) measured at the inlet to the ICC
Customer supplied feeder hose (from main water supply to ICC)	25.4 mm (1 in.) minimum hose inside diameter If the hose is longer than 10 m (32.8 ft.) and shorter than 30 m (98.4 ft.), a hose with a 31.75 mm (1.25 in.) minimum ID is recommended. If using 31.75 mm (1.25 in.) hose, an adaptor is required to reduce the inner diameter to 25.4 mm (1 in.) for the ICC connection.

Table 2-8 Facility Water Quality Requirements

Parameter	Requirement
pH Value	6.5 to 8.2 at 25 °C (77 °F)
Electrical Conductivity	< 0.8 mmho/cm
Chloride Ion	< 200 ppm
Sulfate Ion	< 200 ppm
M-Alkalinity	< 100 ppm
Total Hardness	< 200 ppm
Calcium Hardness	< 150 ppm
Ionic Silica	< 50 ppm
Iron	< 1.0 ppm
Copper	< 0.3 ppm
Sulfide Ion	None, not detectable
Ammonium Ion	< 1.0 ppm
Residual Chlorine	< 0.3 ppm
Free Carbon Dioxide	< 4.0 ppm
Stability Index	6.0 to 7.0
Suspended Matter	< 10 ppm
Particle Size	< 100 micron (with field changeable filter)

Figure 2-16 MR System Water Cooling Block Diagram for standard (On the Wall) siting configuration

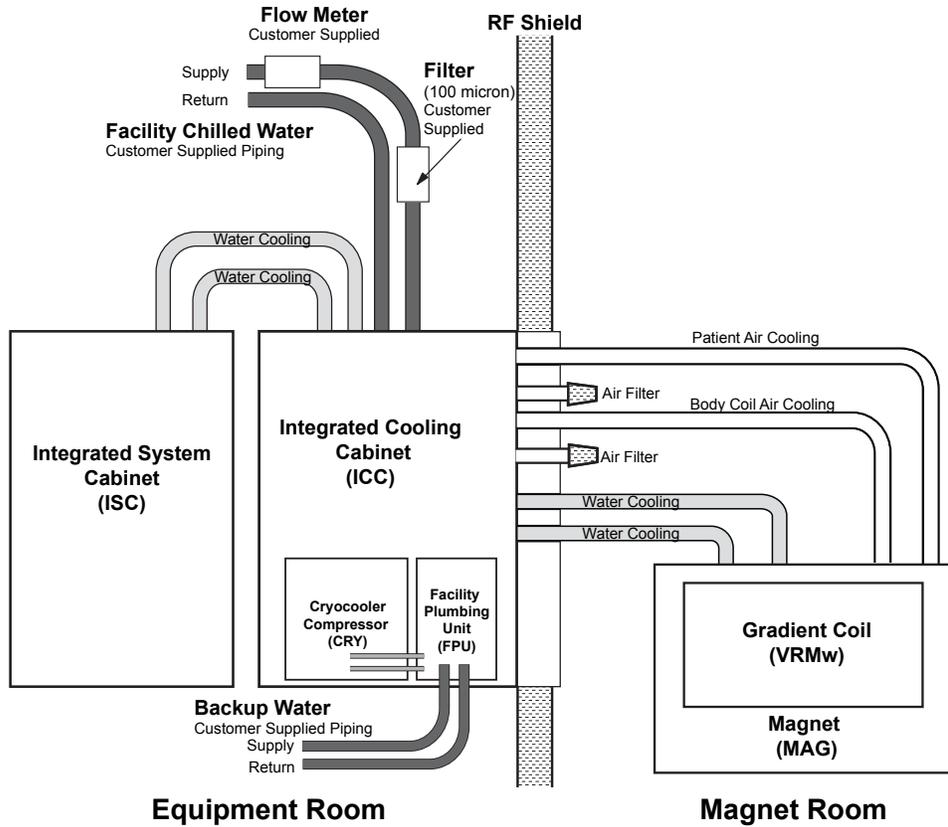
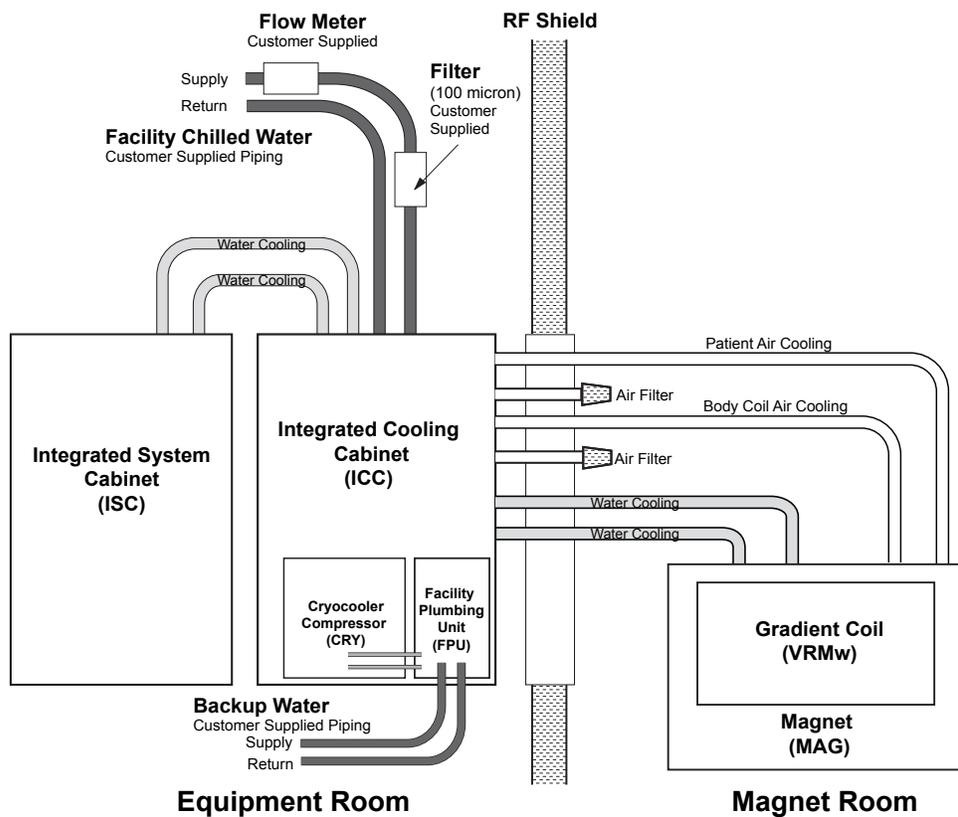


Figure 2-17 MR System Water Cooling Block Diagram for remote (Off the Wall) siting configuration



2.9.2 Requirements for Emergency Backup Facility Coolant (Optional)

The customer must balance the cost of cryogenics and local controls with the cost of emergency backup facility coolant. There are two options for emergency backup, either total ICC backup or Cryocooler Compressor backup.

The facility may provide an optional emergency backup coolant supply in one of the following configurations:

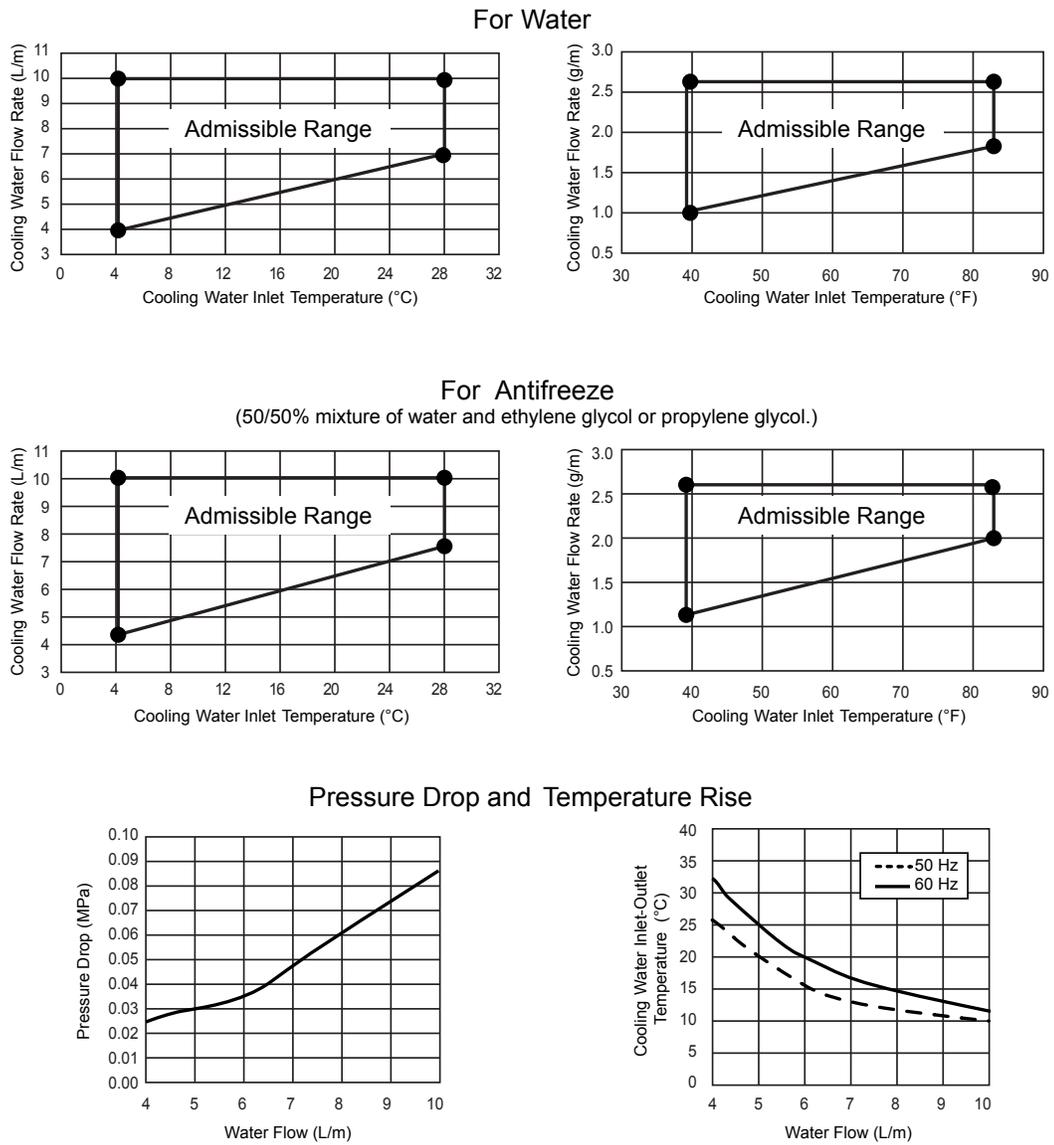
1. Total ICC backup:
 - a. The facility is responsible for the connection of all hoses of a backup system.
 - b. Coolant must meet all other ICC coolant requirements listed in [2.9.1 Integrated Cooling Cabinet \(ICC\) Coolant Requirements on page 38](#).

2. Cryocooler Compressor backup only:

Backup coolant may be routed to the ICC backup water port for the Cryocooler compressor at the location indicated in [Figure 2-16 MR System Water Cooling Block Diagram for standard \(On the Wall\) siting configuration on page 40](#) with the following requirements:

- a. The emergency coolant supply must be drained to the facility through customer supplied 12.5 mm (0.5 in.) hose and must not back-feed to the ICC.
- b. Coolant must meet all other ICC coolant requirements listed in [2.9.1 Integrated Cooling Cabinet \(ICC\) Coolant Requirements on page 38](#).
- c. The facility is responsible for coolant, 12.5 mm (0.5 in.) pipe/hose, filters, and connectors to supply the coolant to the ICC emergency facility coolant supply line (12.5 mm (0.5 in.) hose with a female threaded connector). The emergency coolant supply line is available from the Facility Plumbing Unit on the ICC. The hose comes out from the bottom rear of the ICC.
- d. The charts below show the coolant flow rate and temperature requirements for the Cryocooler Compressor:

Figure 2-18 Cryocooler Water Cooling Requirements



2.10 MR Suite Electrical Requirements



(Applies to all subsections within this section)

2.10.1 General Electrical Requirements

1. Customer is required to install a Main Disconnect Panel (MDP):
 - a. For GE HealthCare supplied MDP, M70022MB and M70022MC Design setup, see [2.10.2 GE Supplied Main Disconnect Panel \(MDP\) Specifications for M70022MB and M70022MC on page 46](#).
 - b. For Customer-supplied MDP:
 - i. Customer-supplied MDP may not be permissible in all regions. Contact your GE HealthCare Project Manager of Installation (PMI) to verify local requirements.
 - ii. MDP Design Requirements: [2.10.3 Customer-supplied Main Disconnect Panel \(MDP\) Requirements \(exempt countries only*\) on page 48](#).
 - iii. MDP Design Setup [Figure 2-20 Customer-supplied MDP MR System Main Disconnect Panel \(MDP\) Setup on page 50](#).
2. At least one remote Emergency Off push-button shall be installed in a location that is visible and accessible to the device operator (Control Room or Magnet Room). The push-button shall be normally closed and require operator action to release after activation (for example, twist and pull). GE HealthCare recommends installing two remote Emergency Off push buttons, installed in the Control Room and Magnet Room.
3. The facility must provide system power to the MDP.
4. All associated transformers and cables must be correctly sized for system power requirements.
5. The facility must connect the GE-supplied cabling from the MDP to the Cryocooler Compressor (F-50SH) in the Integrated Cooling Cabinet (ICC).
6. Runs E0009, E3030 and M3030 are GE-supplied. All other wiring shown in [Figure 2-19 GE-supplied Main Disconnect Panel \(MDP\) Setup for M70022MB and M70022MC on page 47](#) and [Figure 2-20 Customer-supplied MDP MR System Main Disconnect Panel \(MDP\) Setup on page 50](#) must be customer supplied and installed. A customer-supplied substitute for E0009 can be used if the supplied run is shorter than required.
7. All feeder circuits require dedicated ground wires.

Table 2-9 Facility Power Requirements

Component	Parameter	Requirements	
At Main Disconnect Panel (MDP)	Voltage / Frequency	480 VAC	60 ±3 Hz
		415 VAC	50 ±3 Hz, 60 ±3 Hz
		400 VAC	50 ±3 Hz, 60 ±3 Hz
		380 VAC	50 ±3 Hz, 60 ±3 Hz

Table 2-9 Facility Power Requirements

Component	Parameter	Requirements	
	Daily Voltage Variation	Customer to provide +7.5% / -10% from nominal at MDP input under all line and load conditions. This includes variation of power source and transmission losses up to the MDP.	
	Phase	Input power to the MDP may use one of the following configurations: <ul style="list-style-type: none"> A 3 phase solidly grounded WYE with Ground (3 Wire + Ground) A neutral conductor is not required for MR System operation. If a neutral conductor is present, it can be terminated on the neutral bus provided in the GE-supplied MDP. A 3 phase floating DELTA with Ground (3 Wire + Ground). Do not connect a corner grounded DELTA source. Note: Some UPS options may require a neutral (refer to manufacturer documentation for requirements).	
	Phase Balance	Difference between the highest phase line-to-line voltage and the lowest phase line-to-line voltage must not exceed 2%	
	Power Quality	Recommended THD-V of less than 2.5%	
	Facility Zero Voltage Reference Ground	<ul style="list-style-type: none"> The facility ground for the MR System must originate at the system power source (that is, transformer or first access point of power into the facility) and be continuous to the MR System Main Disconnect Panel (MDP) in the room. Main facility ground conductor to Main Disconnect Panel (MDP) must be appropriately sized insulated copper wire. The main facility ground to the Main Disconnect Panel (MDP) must meet local codes. 	
	Power Availability	Continuous facility power is required at all times for operation of the Cryocooler (CRY) to minimize cryogen consumption.	
Service receptacle in Magnet Room	Voltage / Frequency	100-120 VAC 60 Hz (North America) 200-240 VAC 50/60 Hz (International)	Receptacle required for small power tools. Local voltage and portable transformers for voltage values.
	Phase	1	
	Maximum Current	20A (North America) 16A (International)	
Pneumatic Patient Alert	Voltage / Frequency	100-120 VAC 60 Hz (North America) 200-240 VAC 50/60 Hz (International)	The Control Box must be mounted within reach of the operator and within 1.5 m (5 ft.) of an electrical outlet.
	Phase	1	
	Maximum Current	20A (North America) 16A (International)	
Magnet Rundown Unit (MRU)	Voltage / Frequency	100-120 VAC 60 Hz (North America) 200-240 VAC 50/60 Hz (International)	Connection type: Hardwired or permanently wired directly to facility power, no plugs or connectors allowed. 25 mm (1 in.) PVC Schedule 40 Conduit recommended Availability: Continuous Circuit Breaker: Dedicated AC disconnect required for both live and neutral connections
	Phase	1	

Table 2-9 Facility Power Requirements (Table continued)

Component	Parameter	Requirements	
	Maximum Current	1A	
Magnet Monitor (MON)	Voltage / Frequency	100-120 VAC 60 Hz (North America) 200-240 VAC 50/60 Hz (International)	Power at the outlet must be continuously available.
	Phase	1	
	Maximum Current	3A	
Optional MRE Re-soundant Acoustic Driver	Voltage / Frequency	100-120 VAC 60 Hz (North America) 200-240 VAC 50/60 Hz (International)	
	Phase	1	
	Maximum Current	20A (North America) 16A (International)	
Oxygen Monitor (OXY) Option	Voltage / Frequency	100-120 VAC 60 Hz (North America) 200-240 VAC 50/60 Hz (International)	Connection type: Hardwired in unit
	Phase	1	
	Maximum Current	0.9A	
Optional Physiological Acquisition Transceiver (PAT) Charging Station	Voltage / Frequency	100-120 VAC 60 Hz (North America) 200-240 VAC 50/60 Hz (International)	The charging station must be mounted within 3000 mm (118 in.) of an electrical outlet.
	Phase	1	
	Maximum Current	1.5A	

Table 2-10 System Power Demand

Equipment	Power Draw (kVA)
ISC PDU Continuous Power	55
ISC PDU 50 Millisecond Power	77
Cryo Compressor Continuous Power consumption	9
	Note: The manufacturer recommends a connection capable of 12 kVA.
Total system Continuous Power	64
Total System 50 Millisecond Power	89

Table 2-11 Required Current per Input voltage setting

Input Voltage (V) +7.5%/-10%	Total Current (A)
480	100
415	113

Table 2-11 Required Current per Input voltage setting (Table continued)

Input Voltage (V) +7.5%/-10%	Total Current (A)
400	117
380	123

2.10.2 GE Supplied Main Disconnect Panel (MDP) Specifications for M70022MB and M70022MC

The customer is responsible for determining the suitability of the GE Supplied MDP with respect to governing electrical codes.

The GE HealthCare MDP consists of the following:

- A 3-pole 125A main circuit breaker rated for the total current of all the sub-breaker circuits.
- A 3-pole 110A circuit breaker rated for the current of the PDU circuit.
- A 3-pole 25A circuit breaker rated for the current of the Cryo-Compressor (CRY).
- All circuit breakers have a short circuit current interrupting rating of 25000 Amps.
- Auto restart on the Cryocooler circuit following loss and restoration of power.
- Two remote Emergency Off Buttons to be installed external to the MDP. Emergency Off removes power from all outputs when activated. MDP supports maximum E-off cable length of 100 meters when remote EPO push buttons are installed in the field.
- Manual restart push button to restore power after a power outage.
- Terminal blocks that can accept wire sizes for M70022MB are listed under [Table 2-13 GE Supplied MDP - Range of Standard stranded Conductors Accepted for M70022MB on page 48](#).
- Terminal blocks that can accept wire sizes for M70022MC are listed under [Table 2-14 GE Supplied MDP - Range of Standard stranded Conductors Accepted for M70022MC on page 48](#).
- Provision for terminating facility incoming neutral wire on the neutral terminal block.
- Multiple ground terminal blocks as required by panel design
- GE MDP M70022MC is listed and labeled by Nationally Recognized Testing Lab (NRTL) in accordance with UL 508A and bears UL and CE mark. These MDPs are certified as per “UL 508A and IEC 61439-2” standards.
- GE MDP M70022MB bears manufacturer’s CE mark and is certified as per “IEC 61439-2” standards.
- Power on indicators for ISC and CRYO COMPRESSOR outputs.
- Two isolated, normally open contact pairs that open when e-OFF is pressed or facility power is interrupted for use with optional accessories.
- Capability for single point lock-out/tag-out for the entire system (Mains Disconnect / Input Breaker) and a means to lock-out/tag-out each output breaker independently. All LOTO points support a standard sized hasp for lock-out.

Figure 2-19 GE-supplied Main Disconnect Panel (MDP) Setup for M7002MB and M7002MC

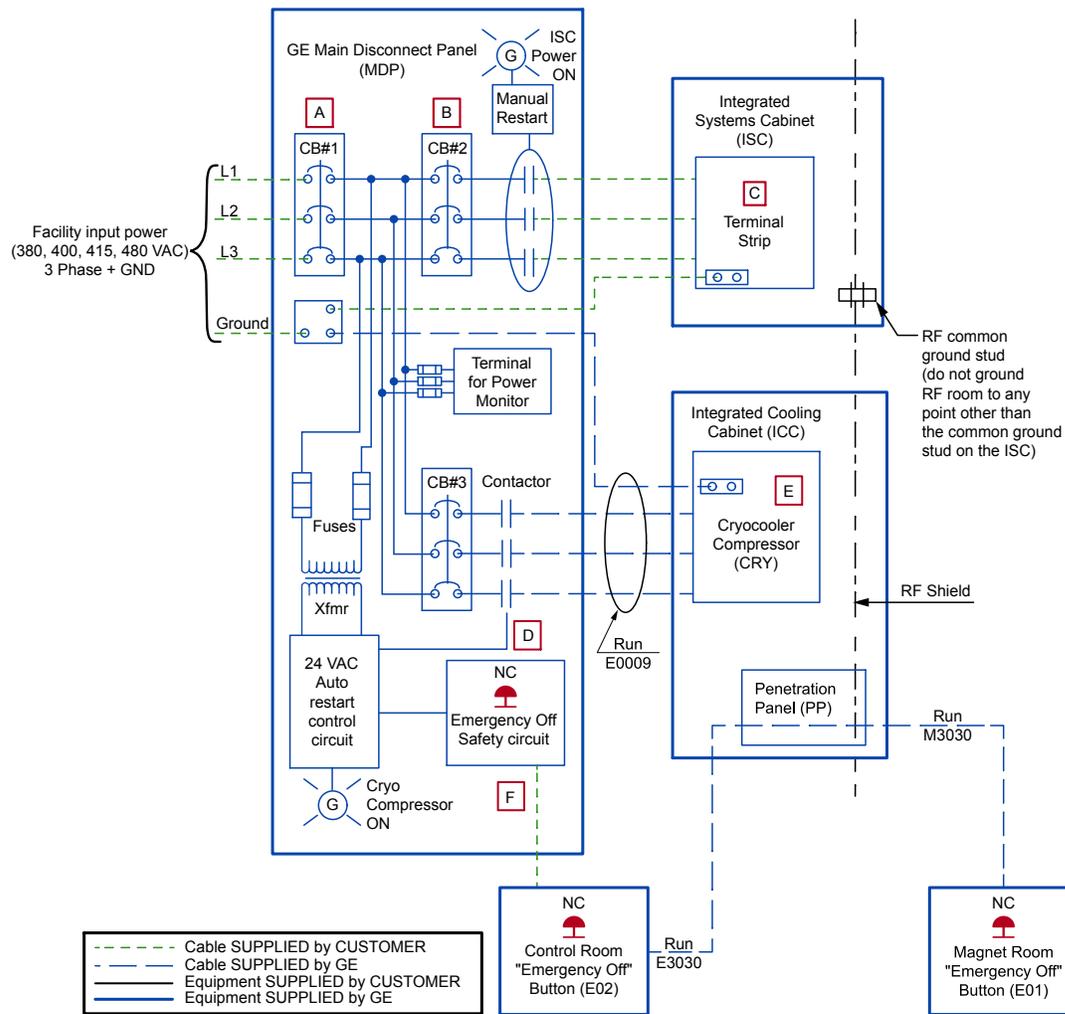


Table 2-12 GE-supplied MDP - Breaker Sizes for M7002MB and M7002MC

Catalog No.	M7002MB, 5815927-2	M7002MC, 5815927
Description	CE MDP 380V - 415V with RCD	MDP 380V-480V
Mains Input Breaker, CB1	125A	125A
ISC Breaker, CB2	110A	110A
Cryo-Compressor Breaker, CB3	25A	25A

The labeled connections shown in [Figure 2-19 GE-supplied Main Disconnect Panel \(MDP\) Setup for M7002MB and M7002MC on page 47](#) can accept the range of standard stranded conductors shown in the tables below. All wire types, color, and sizing are to be selected in accordance with governing electrical codes.

Table 2-13 GE Supplied MDP - Range of Standard stranded Conductors Accepted for M70022MB

Item	Phase		Ground	
	sq mm	AWG/kcmil	sq mm	AWG/kcmil
A	35-95	2-3/0	16-125	4-250
B	10-95	6-3/0	16-125	4-250
C	6-35	10-1	6-35	10-1
D	2.5-10	12-6	13-21	6-4
E	2.5-6	14-10	2.5-6	14-10
F	0.5-2.5	22-12		

Table 2-14 GE Supplied MDP - Range of Standard stranded Conductors Accepted for M70022MC

Item	Phase		Ground	
	sq mm	AWG/kcmil	sq mm	AWG/kcmil
A	35-95	2-3/0	35-125	2-250
B	10-95	8-3/0	35-125	2-250
C	6-35	10-1	6-35	10-1
D	2.5-10	14-8	13-21	6-4
E	2.5-6	14-10	2.5-6	14-10
F	0.5-2.5	22-12		

2.10.3 Customer-supplied Main Disconnect Panel (MDP) Requirements (exempt countries only*)

NOTE

* The requirements listed below apply only to exempt countries. Please contact your GE HealthCare Project Manager of Installation (PMI) for the list of exempt countries.

WARNING



PERSONNEL INJURY OR EQUIPMENT DAMAGE

Customer supplied MDP must have correctly sized wires and rated components to meet the MR System Power Requirements.

NOTE

Refer to [8.5 Sample control schematic for customer-supplied MDP on page 146](#).

1. MDP shall provide Auto-Restart to the Cryocooler Compressor.
2. Manual Restart Capability
 - a. The MDP shall disconnect the ISC circuits upon power loss.
 - b. The MDP shall require a manual restart on the ISC circuits when power is reapplied after an outage.
3. Emergency Off Circuit

- a. The MDP shall have an emergency off control circuit that disables power to the entire MR System.
 - b. The emergency off circuit shall be actuated by a push button on the panel, and shall also be capable of being actuated by two remotely located push buttons.
 - c. Manual reset of the emergency off circuit shall be required to restore power to the entire system.
4. The MDP shall include three breakers, as specified in [Figure 2-20 Customer-supplied MDP MR System Main Disconnect Panel \(MDP\) Setup on page 50](#) and [Table 2-15 Customer Supplied MDP - Required Breaker Size on page 50](#). Output breakers will feed the PDU (located in the Integrated Systems Cabinet [ISC]) and Cryocooler Compressor (located in the Integrated Cooling Cabinet [ICC]).
5. Lock-out/Tag-out:
- a. The MDP shall provide single point lock-out/tag-out for the entire system and a means to lock-out/tag-out each output breaker independently.
 - b. The lock-out/tag-out feature shall accommodate a standard sized lock hasp.
 - c. The lock-out/tag-out features shall be accessible from the outside of the panel, without the need to open the panel door(s).
6. The MDP shall have a Power ON indicator (Green light) on the panel.
7. The MDP shall meet national/local regulations.
8. The MDP shall provide terminations for all grounds entering, leaving and residing within the panel.
9. The MDP shall provide terminations of appropriate size for all power wiring entering and leaving the panel. Refer to the wire terminals indicated with letters shown in [Figure 2-20 Customer-supplied MDP MR System Main Disconnect Panel \(MDP\) Setup on page 50](#). All wire types, color, and sizing are to be selected in accordance with governing electrical codes.

Figure 2-20 Customer-supplied MDP MR System Main Disconnect Panel (MDP) Setup

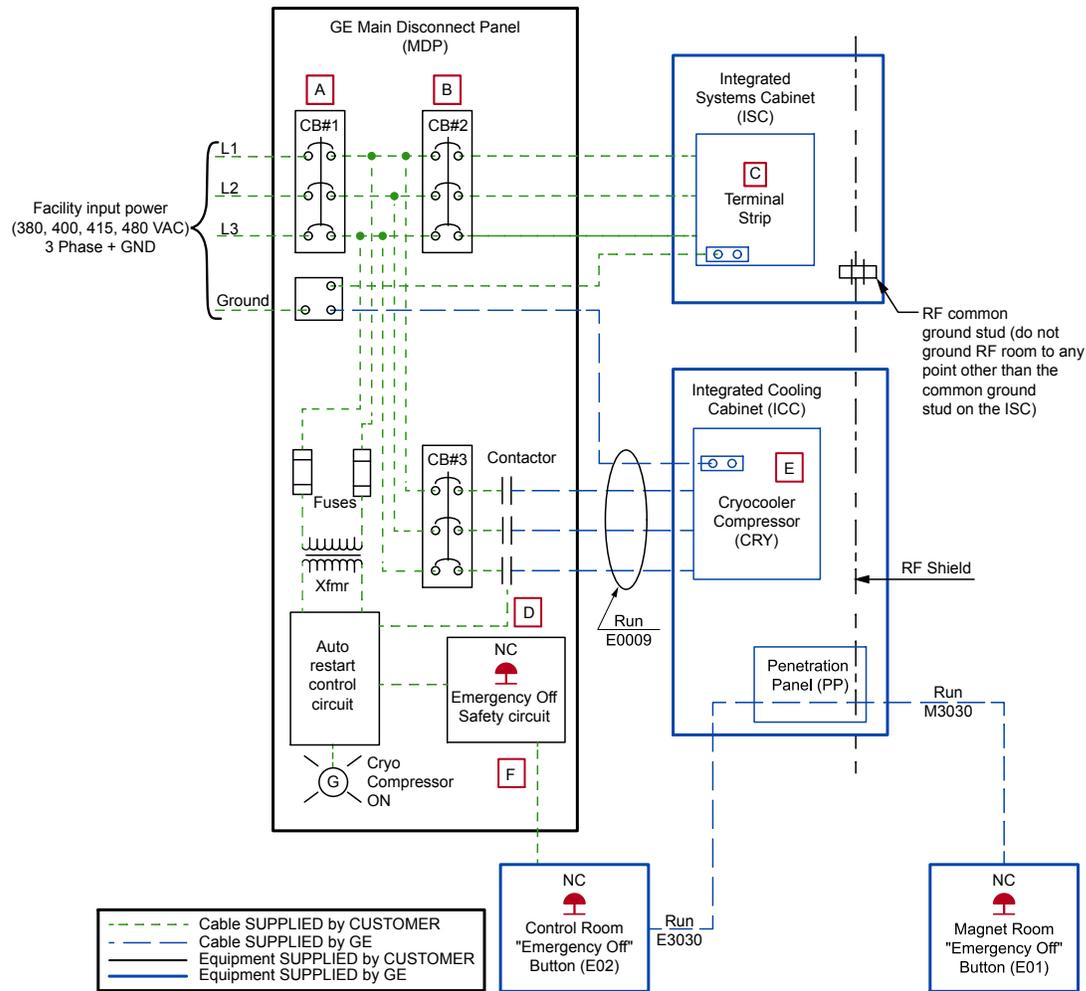


Table 2-15 Customer Supplied MDP - Required Breaker Size

Circuit Breaker	Breaker Size
CB1	125A minimum
CB2	110A
CB3	25-30A

The labeled connections shown in [Figure 2-20 Customer-supplied MDP MR System Main Disconnect Panel \(MDP\) Setup](#) on page 50 can accept the range of standard stranded conductors shown in [Table 2-16 Customer Supplied MDP - Range of Standard Stranded Conductors Accepted](#) on page 50.

Table 2-16 Customer Supplied MDP - Range of Standard Stranded Conductors Accepted

Item	Phase		Ground	
	sq mm	AWG/kcmil	sq mm	AWG/kcmil
A	NA			
B	NA			

Table 2-16 Customer Supplied MDP - Range of Standard Stranded Conductors Accepted (Table continued)

Item	Phase		Ground	
	sq mm	AWG/kcmil	sq mm	AWG/kcmil
C	6-35	10-1	6-35	10-1
D	NA			
E	2.5-6	14-10	2.5-6	14-10
F	NA			

2.10.4 Emergency Power Backup Specifications (Optional)

The following facility backup power is recommended for continuous operation of the cryocooler compressor and Magnet Monitor:

NOTE

If the compressor must operate on emergency backup power, it still requires chilled water defined in the [2.9.2 Requirements for Emergency Backup Facility Coolant \(Optional\)](#) on page 41.

- Dedicated, single power supply to the compressor
- Magnet Monitor emergency power (110V / 220V, 3A). Refer to [Magnet Monitor \(MON\) Requirements and Specifications](#) on page 104.
- Emergency Off Circuit (E-Off) for the emergency backup to the compressor. LOTO is required for the power source between the generator and compressor.
- A transfer switch to remove the primary power source from the compressor when in emergency backup power mode.

Table 2-17 Specifications for Emergency Power to Cryocooler Compressor

Parameter	Requirements
Power Line Voltage	AC 380, 400, 415V ($\pm 10\%$) / 50 Hz, 3 phase (3 Wire + Ground) AC 480V ($\pm 10\%$) / 60 Hz, 3 phase (3 Wire + Ground) Commercial Power Source WARNING  Do not use an inverter for the main power source.
Operating Current	Max. 13A (Both 50 and 60 Hz)
Starting current	75 / 80 A (50 / 60 Hz)
Maximum Fuse or Circuit Breaker Size	30A
Power Requirement	Minimum 9 kVA Note: The manufacturer recommends a connection capable of 12 kVA.
Power Consumption	Max. 8.3 kW / Steady State 7.5 kW at 60 Hz Max. 7.2 kW / Steady State 6.5 kW at 50 Hz

2.11 MR System Shipping and Receiving



(Applies to all subsections within this section)

Important

All shipping dimensions and weights are approximate and may vary based on ship-to location, required rigging, or other requirements. Some shipping or access routes may have requirements in addition to those listed in this section. Contact the GE HealthCare Project Manager of Installation (PMI) to verify magnet shipping, rigging, and access.

2.11.1 Receiving Requirements

1. The customer must provide an area for unloading system components from the truck and delivering to the MR suite

NOTE

Contact GE healthcare project manager for magnet handling document to be used by rigging companies.

2. The customer is responsible for ensuring:
 - a. All floors along the route will support the weight of the magnet (GE HealthCare recommends a structural analysis)
 - b. Doors or other openings are sufficiently wide to allow passage
 - c. Sufficient room is provided for any required rigging tools

2.11.2 Facility Delivery Route Requirements

The following table lists the delivery dimensions of system components. Upon delivery, verify the component dimensions and weight. The delivery route must be planned to accommodate the dimensions listed.

Table 2-18 Delivery Route Requirements

Component	Width		Depth		Height		Weight		Notes
	mm	in.	mm	in.	mm	in.	kg	lb.	
Magnet	See Table 2-19 MR System Component Shipping Specifications on page 53 for magnet shipping dimensions								
Cryogen	Dimensions vary depending on dewar type used. Verify with cryogen supplier.								
ISC	1275	50.4	1028	40.5	1985 *	78.1 *	1251	2758	Note: A rigger is required to remove the ISC from its shipping pallet. Four eye bolts are provided on the top of the cabinet for rigging purposes.

Table 2-18 Delivery Route Requirements (Table continued)

Component	Width		Depth		Height		Weight		Notes
	mm	in.	mm	in.	mm	in.	kg	lb.	
ICC	825	32.5	965	38.0	1975	77.8	349	770	* ISC height is height with top blocks removed After the cabinets are removed from the pallets and placed indoors, cabinets are moved with casters attached under the base.

2.11.3 MR System Component Shipping Specifications

MR System component shipping dimensions and weight are listed below:

Table 2-19 MR System Component Shipping Specifications

Component	W x D x H		Weight		Notes
	mm	in.	kg	lb.	
Magnet (as shipped with lifting bars)	2252 x 2388 x 2363	88.7 x 94 x 93	7621	16800	Domestic - Tarp
Magnet (Crated for International Shipping)	2438 x 2899 x 2438	96 x 114 x 96	8528	18800	International - crate/pallet
Magnet Accessory Equipment	1219 x 1219 x 711	48 x 48 x 28	182	400	Crate
VibroAcoustic Dampening Kit, seismic	914 x 1651 x 305	36 x 65 x 12	261	575	Box on pallet
VibroAcoustic Dampening Kit, non-seismic	610 x 610 x 203	24 x 24 x 8	32	70	Box
Cryocooler Compressor	660 x 711 x 1067	26 x 28 x 42	125	275	Pallet with box cover
Enclosure	2160 x 1397 x 1118	85 x 55 x 44	187	410	Crate
Patient Table (Comfort Plus)	2650 x 960 x 880	104 x 38 x 35	406	895	Pallet
Integrated System Cabinet (ISC)	1620 x 1290 x 2250	64 x 51 x 89	1300	2865	Box
Integrated Cooling Cabinet (ICC)	932 x 1118 x 2188	37 x 44 x 86	485	1069	Box
Penetration Panel for remote (Off the wall) siting configuration	1725 x 635 x 615	68 x 25 x 24	82	180	Box
Operator Workspace Cabinet	610 x 889 x 787	24 x 35 x 31	110	243	Wood pallet with cardboard cover

Table 2-19 MR System Component Shipping Specifications (Table continued)

Component	W x D x H		Weight		Notes
	mm	in.	kg	lb.	
Operator Workspace Display	686 x 838 x 686	27 x 33 x 27	9	19	Box
Operator Workspace Equipment	813 x 813 x 584	32 x 32 x 23	45	100	Box
Operator Workspace Table	1041 x 1372 x 381	41 x 54 x 15	75	165	Box

Table 2-20 MR System Service Component Shipping Specifications

Component	W x D x H		Weight		Notes
	mm	in.	kg	lb.	
Shim Tray Extraction Tool (Box 1)	1016 x 2591 x 648	40 x 102 x 25.5	216	477	Case on pallet (pallet weight 102 kg (225 lb.))
Shim Tray Extraction Tool (Box 2)	1219 x 1473 x 1372	48 x 58 x 54	268	591	Case on pallet (pallet weight 91 kg (200 lb.))

Figure 2-21 Magnet Dimensions (as Shipped)

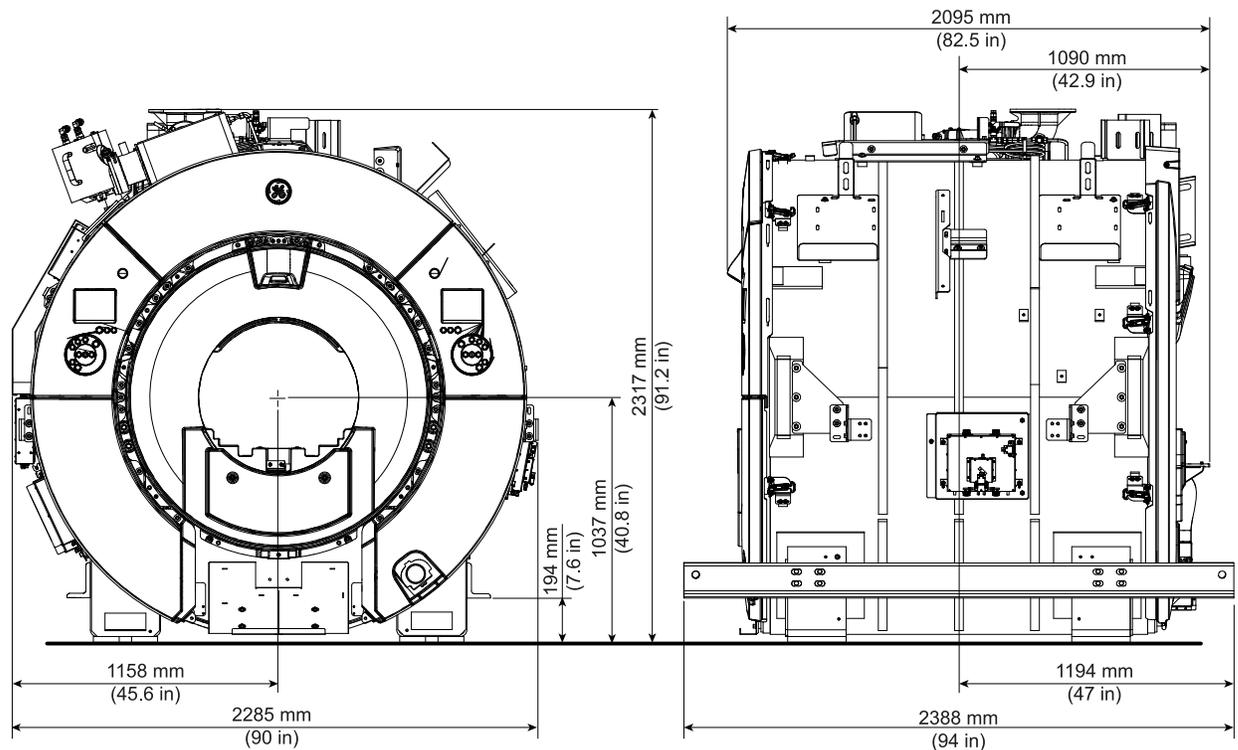


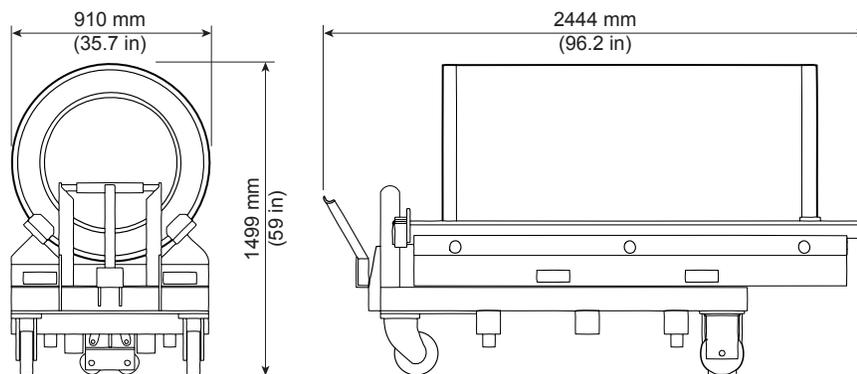
Table 2-21 MR System Component Replacement Shipping Specifications

Component	Component Location	W x D x H		Weight	
		mm	in.	kg	lb.
Split Bridge	Magnet Room	546 x 1963 x 178	21.5 x 77.3 x 7	18	40
Replacement RF Body Coil	Magnet Room	889 x 915 x 1880	35 x 36 x 74	132	291
Replacement VRMw Gradient Coil Assembly on a Shipping Cradle/Cart	Magnet Room	910 x 2444 x 1499	35.8 x 96.2 x 59	1449	3194
3.0T RF Amplifier	Equipment room (front of ISC)	671 x 864 x 437	26.4 x 34 x 17.2	181	400
Cabinet Cooling Unit (CCU)	Equipment room (front of ICC)	920 x 705 x 1550	36.2 x 27.8 x 61.0	195.5	431
Gradient Amplifier	Equipment room (front of ISC)	674 x 971 x 450	26.5 x 38.2 x 17.7	95	209
Gradient Coil Replacement Tool Kit Crate	At site near magnet room	787 x 2184 x 952	31 x 86 x 37.5	340	750

NOTE

The dimensions and weights listed for the components in [Table 2-21 MR System Component Replacement Shipping Specifications on page 55](#) include packaging.

Figure 2-22 Gradient Coil Cart



2.11.4 Temperature and Humidity Storage Requirements

MR systems and components must be stored within the environmental requirements listed below.

NOTE

Some equipment is liquid-cooled. After coolant is added, the equipment must be kept from freezing. Phantoms and the coolant itself must also be kept from freezing.

Room	Temperature		Humidity	
	Range °C (°F)	Change °C/Hr (°F/Hr)	Relative % (Non-condensing)	Change %/Hr
Electronic Cabinets and Equipment	-30-60 (-22-140)	20 (68)	8-90	30
Resonance Module	-30-50 (-22-122)	20 (68)	5-95	30

Room	Temperature		Humidity	
	Range °C (°F)	Change °C/Hr (°F/Hr)	Relative % (Non-condensing)	Change %/Hr
Surface Coil	-30-50 (-22-122)	20 (68)	10-95	30

3 Magnet Room

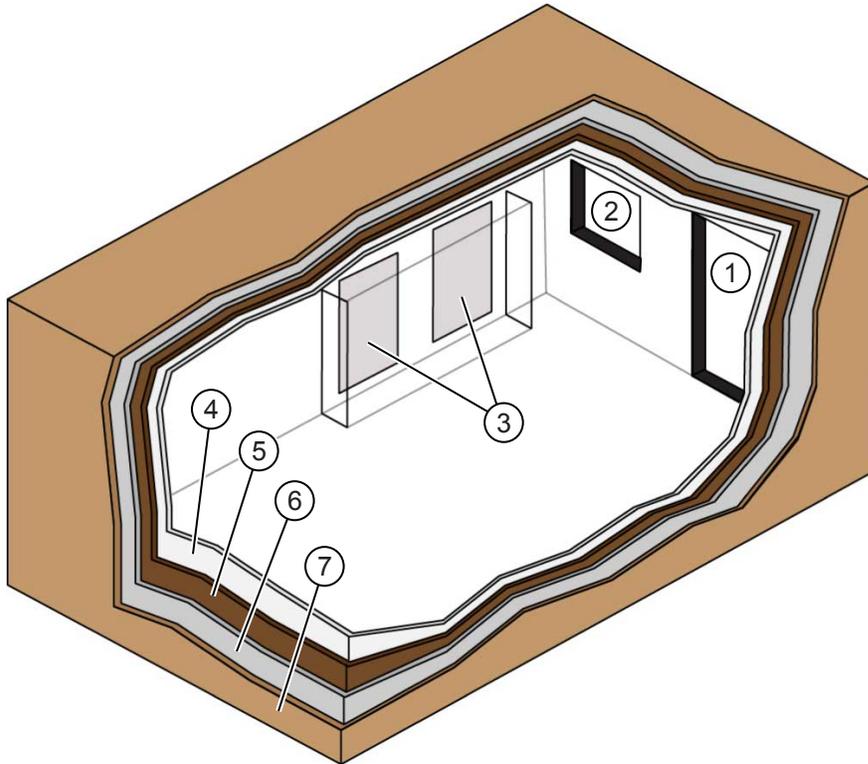
3.1 Magnet Room Introduction



The Magnet Room is best understood as a series of layers, or “rooms within a room.” Each of these rooms has a specific function and associated requirements. All requirements in this chapter must be followed to ensure safe and correct operation of the MR System.

1. The Magnetic shielded room contains the MR Magnet fringe field within a confined space. A site survey is required to determine magnet shield requirements (not all sites require magnetic shielding). Because of the added cost of magnetic shielding, room location should be carefully considered.
2. The Acoustic room is a layer used to help attenuate the noise produced during a scan. An acoustic engineer is strongly recommended to assess the environment.
3. The RF shielded room is critical to the correct MR System operation. RF shielding prevents interaction of external RF radiation with MR System operation and it also prevents MR System RF radiation from interfering with external systems, such as aircraft control. Special care must be used when installing all fixtures penetrating the RF shield (for example, vents, electrical conduit, penetration panels) to ensure the integrity of the RF shield is maintained. Refer to *RF Shielded Room Requirements*, 5850260-1EN.
4. The Finished room includes the wall coverings, ceiling tile, ceiling grid, other fixtures, Magnet (MAG) and Patient Table (PT). When planning the finished room, ensure the following:
 - a. All building codes are met (such as maintaining egress routes).
 - b. Items which may generate or create RF interference (including florescence lighting) are not allowed for installation within the Magnet Room.
 - c. Customer is responsible for the selection and installation of all locally required safety devices (for example, smoke detectors, oxygen monitors, and so on).
 - d. Smoke detectors should be located outside of the Magnet Room (for example, within the return air duct) whenever possible. If code does not allow this, use only simple two wire non-addressable smoke detectors in the Magnet Room.
 - e. Ferrous or metallic items which could become projectiles when the magnet is installed (including wall coverings, ceiling tile, ceiling grid, or other fixtures) are not used or are correctly secured.

Figure 3-1 Magnet Room Layers



Item	Description	Item	Description
1	Door	2	Window
3	Penetration wall(s)	4	Finished room
5	RF shielding	6	Acoustic barrier
7	Magnetic shielding	-	-

NOTE

The sequence of the room layers can vary based on siting needs.

3.2 Magnet Room Structural Requirements



This section lists the structural requirements that must be considered when performing site evaluation and planning of the Magnet Room.

3.2.1 Overview



1. When preparing a building plan or evaluating a potential site for an MR System, take care to ensure the MR suite will not interact with the surrounding environment (that is, magnetic, acoustic, environmental steel, and vibration).
2. The customer is responsible for vibration testing required to verify suitability of a proposed site. All test results and any questions regarding testing, results, or analysis must be forwarded to the GE HealthCare Project Manager of Installation (PMI).

3.2.2 Environmental Steel Limits



A static magnetic field extends in a three-dimensional space around the magnet isocenter. Environmental steel within the static magnetic field affects the uniformity (or homogeneity) of the field. Field uniformity is critical to both image quality and chemical shift analysis (spectroscopy). An analysis of the environmental steel is required within a 2.5 m (8.2 ft.) spherical radius of the magnet isocenter. Environmental steel includes ferrous pipes, beams, concrete rebar, or any other structural steel in the floors, walls, or ceiling.

The following floor items must be limited per [Table 3-1 Steel Mass Limits to Magnet Isocenter \(3 x 3 m \(10 x 10 ft.\) Area Under Magnet\)](#) on page 60.

1. Non-movable steel construction material such as rebar and metal decking
2. Existing or proposed RF/magnetic shielding or shim plates
3. [Table 3-1 Steel Mass Limits to Magnet Isocenter \(3 x 3 m \(10 x 10 ft.\) Area Under Magnet\)](#) on page 60 defines the limits of use as a guideline to help the customer understand allowable amounts of ferrous rebar, steel decking, or other components as they design the MR suite and Magnet Room floor structure.
4. The customer must provide detail defining ferrous material below the magnet to the Project Manager so the GE HealthCare MR Siting and Shielding (MRSS) team can review for compliance.

Table 3-1 Steel Mass Limits to Magnet Isocenter (3 x 3 m (10 x 10 ft.) Area Under Magnet)

Limits Of Steel Mass kg/m ² (lb./ft ²)	Distance Below Top Surface Of Floor mm (in.)
0 (0)	0-76 (0-3)
9.8 (2)	76-127 (3-5)
14.7 (3)	127-254 (5-10)
39.2 (8)	254-330 (10-13)
98.0 (20)	330+ (13+)

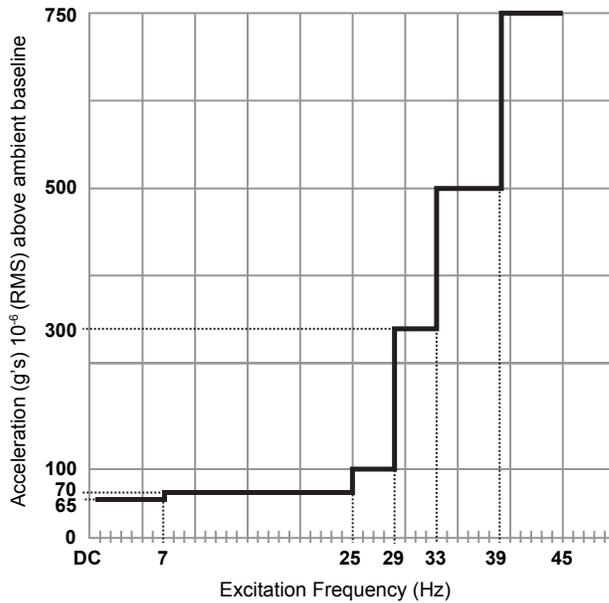
3.2.3 Vibration Requirements



Excessive vibration can affect MR image quality. Vibration testing must be performed early in the site planning process to ensure vibration is minimized. Both steady state vibration (exhaust fans, air conditioners, pumps, and so on) and transient vibrations (traffic, pedestrians, door slamming, and so on) must be assessed (see [Figure 3-2 Magnet Steady State Vibration Specifications on page 61](#)). Specific requirements for vibration mitigation, include:

1. The Magnet (MAG) cannot be directly isolated from vibration. Any vibration issue must be resolved at the source.
2. MR Suite HVAC must have vibration isolation.
3. A vibration analysis must be performed at the proposed site with the results (and any mitigation) forwarded to the GE HealthCare Project Manager of Installation (PMI). See the [8.2 MR Site Vibration Test Guidelines on page 139](#).
4. A transient vibration test must only be performed after a steady-state test has been performed and all steady-state sources of vibration have been mitigated.
5. Transient vibration levels above the specified limits in the [8.2 MR Site Vibration Test Guidelines on page 139](#) must be given to the PMI for review.
6. Any transient vibration that causes vibration to exceed the steady-state level must be mitigated.
7. The vibration test consultant must account for non-mechanically induced signals such as test equipment instabilities, thermal drift or RF interference.

Figure 3-2 Magnet Steady State Vibration Specifications



Acceleration (g) 10 ⁻⁶ (RMS) above ambient baseline	Excitation frequency (Hz)
65	0 – 7
70	7 – 25
100	25 – 29
300	29 – 33
500	33 – 39
750	39 – 45

3.3 Magnetic Shielded Room Requirements



Magnetic shielding prevents interaction between the magnet and nearby sensitive devices. Because of the added cost of magnetic shielding, room location should be carefully considered. All sites, including upgrade sites, must be evaluated for magnetic shielding requirements. Existing magnetic shielding at an upgrade site may not be sufficient for the new system. Contact the GE HealthCare Project Manager of Installation (PMI) to request a site evaluation.

See [MR Suite Magnetic Field Specifications on page 26](#) for detailed magnetic proximity limit information.

1. The GE HealthCare Project Manager of Installation (PMI) works with the customer to coordinate the magnetic shielding site evaluation.
2. The customer is responsible for installation of all magnetic shielding.
3. If rear wall magnetic shield or steel RF wall is closer than 2500mm (98.4 in.) from isocenter, it should be verified by GE HealthCare PMI.

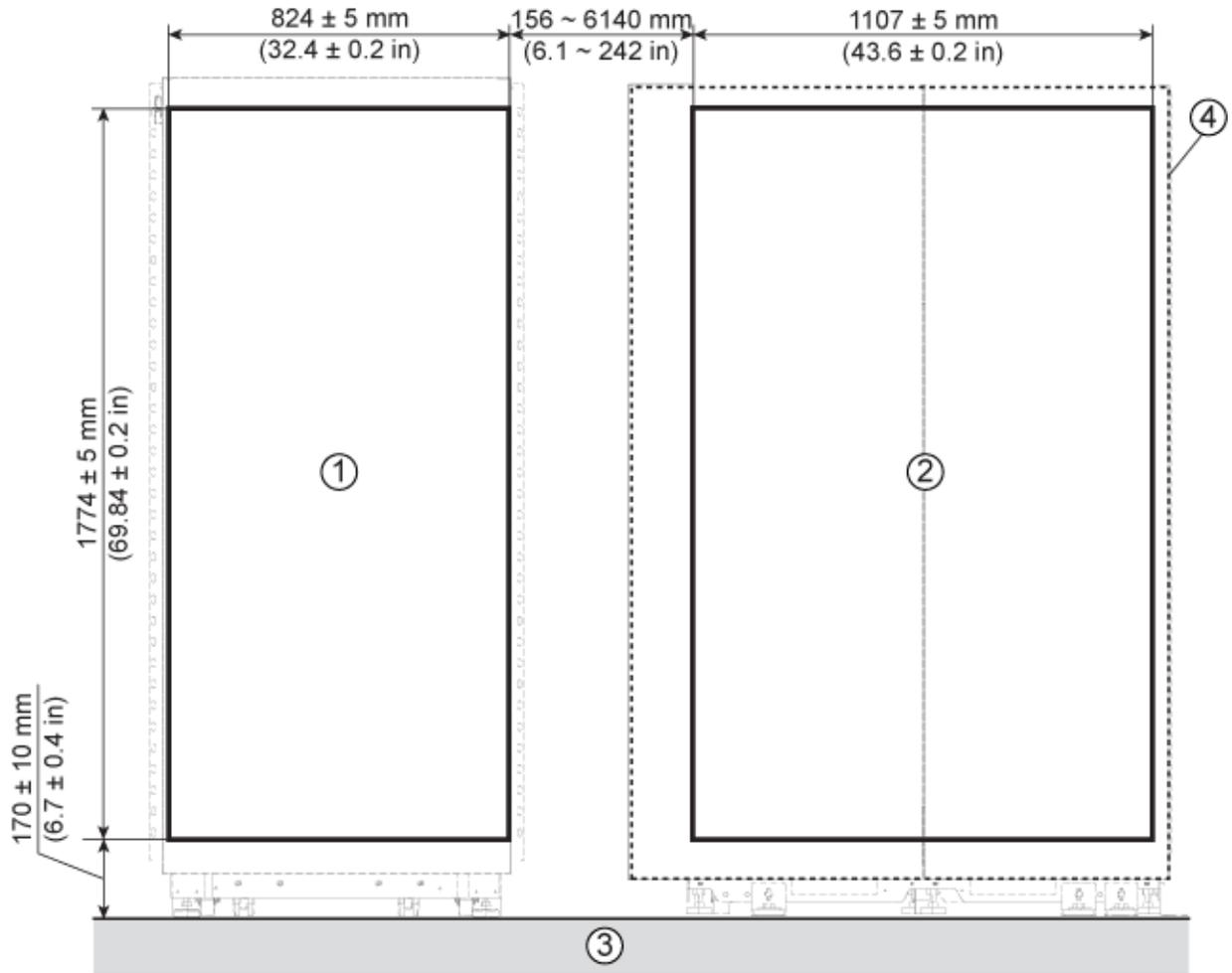
3.4 ISC and ICC Wall Opening Requirements for Standard (On the Wall) Siting Configuration



1. The Equipment Room and the Magnet Room must share at least one common wall to mount the ISC and ICC.
2. The penetration panel opening requirements are shown below.
3. The RF shielded room acceptance test must be performed before the opening is cut in the RF shielding for the GE Penetration Panel and Mesh Shield Tunnel. This acceptance test must be conducted with the vendor. It is the facility's responsibility to ensure that the RF shielded room vendor testing meets the attenuation specifications listed in *RF Shielded Room Requirements*, 5850260-1EN.

[Figure 3-3 Wall Opening Detail \(Equipment Room Side\)](#) on [page 63](#) shows the Equipment Room side view of the wall opening. The dotted line shows the out line of the ISC. Make sure that the wall cut out is not symmetric with the ISC center.

Figure 3-3 Wall Opening Detail (Equipment Room Side)



Item	Description	Item	Description
1	ICC Opening	3	View from Equipment Room
2	ISC Opening	4	ISC Outline

NOTE

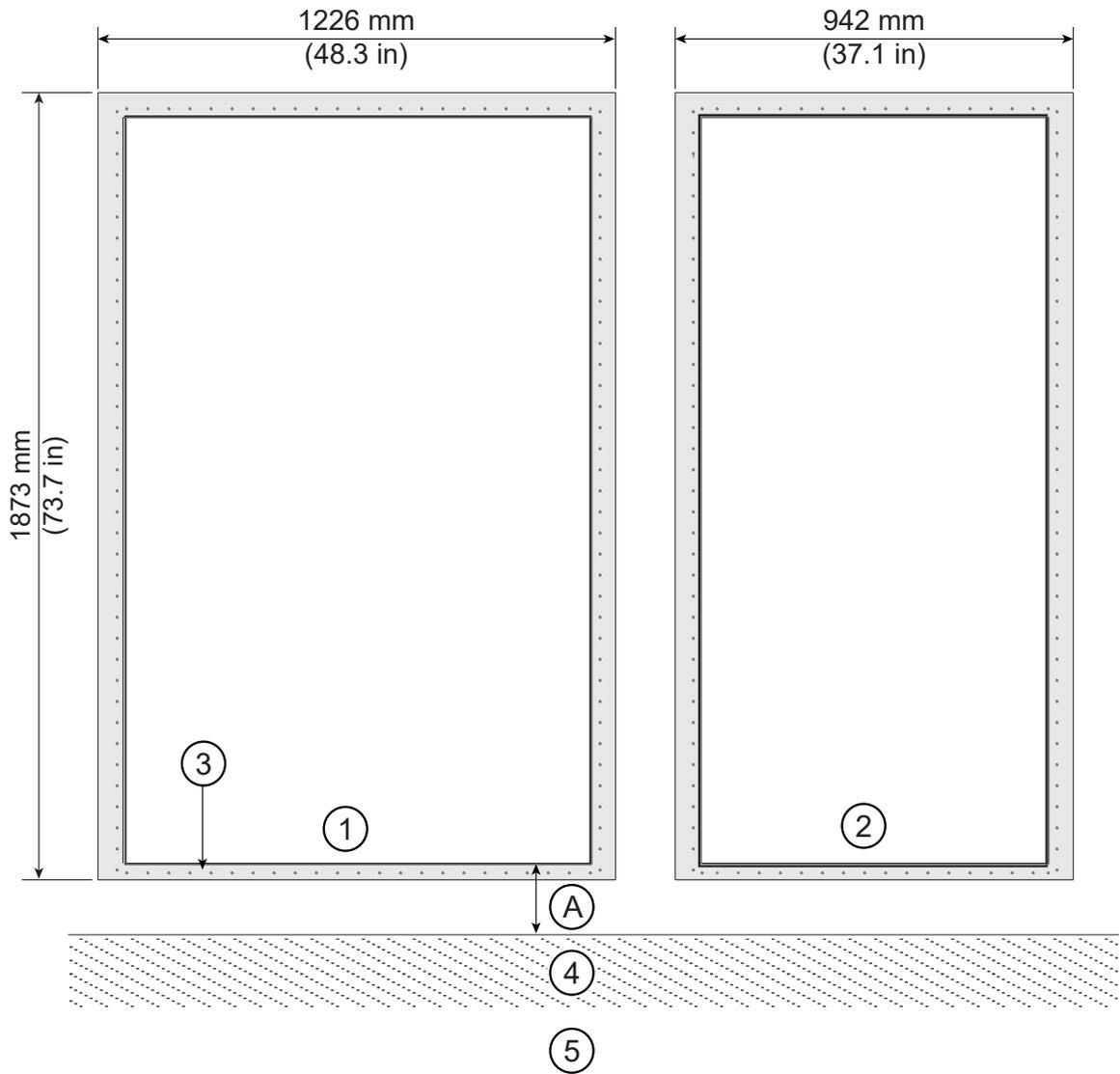
1. If the ISC and ICC are placed next to each other, the distance between openings is 156 mm (6.14 in.). If the ISC and ICC are installed separately, the maximum distance between openings is 6140 mm (242 in.).
2. Dimensions are measured from the Equipment Room floor, not from the Magnet Room floor.
3. If the distance between openings is 156 mm (6.14 in.), the distance between ISC and ICC will be 15 mm (0.6 in.).
4. When the position of the ICC and ISC cabinet is swapped, there must be at least 150 mm (5.90 in.) distance between ISC and ICC for ISC air flow.

Figure 3-4 Mesh Shield Frame area (Magnet Room Side) on page 64 shows the Mesh Shield frame attachment area of RF shield plane (view from Magnet Room side).

NOTE

The RF shield plane in the Mesh Shield frame attachment area must be flat.

Figure 3-4 Mesh Shield Frame area (Magnet Room Side)



Item	Description	Item	Description
1	ISC Opening	4	Floor
2	ICC Opening	5	View from Magnet Room
3	Mesh Shield Frame area	-	-

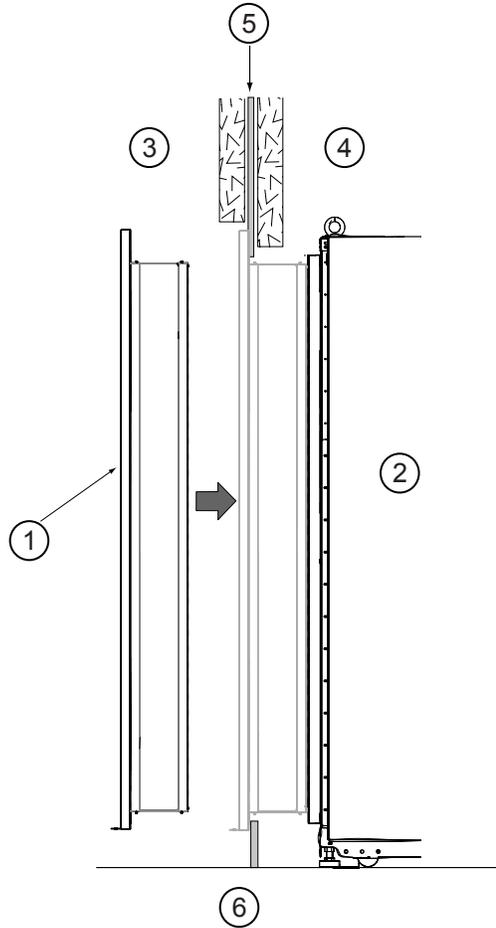
Important

Do not measure the distance “A” from the Magnet Room floor. Measure the distance from the Equipment Floor. See [Figure 3-3 Wall Opening Detail \(Equipment Room Side\)](#) on page 63.

NOTE

The Mesh Shield will be installed from the Magnet Room side. The Mesh Shield frame attachment area of the RF shield must be prepared at the Magnet Room side.

Figure 3-5 Mesh Shield Installation



Item	Description	Item	Description
1	Mesh Shield	4	Equipment Room
2	ISC / ICC	5	RF Shield
3	Magnet Room	6	Side View

Important

M5 screws are used to fix Mesh Shields to the RF Shield from Magnet Room side. It is the RF vendor’s responsibility to prepare M5 screws according to the site condition. Prepare 230 screws (and nuts). (This includes 120 pieces for the ISC and 110 pieces for the ICC.) Mesh Shields will be installed during system installation by the RF vendor.

- For Wooden RF Shield Wall: M5 Wood Screws (230 pieces)
- For RF Shield Wall which has holes for screws: M5 screws (230 pieces) and M5 Nuts (230 pieces)

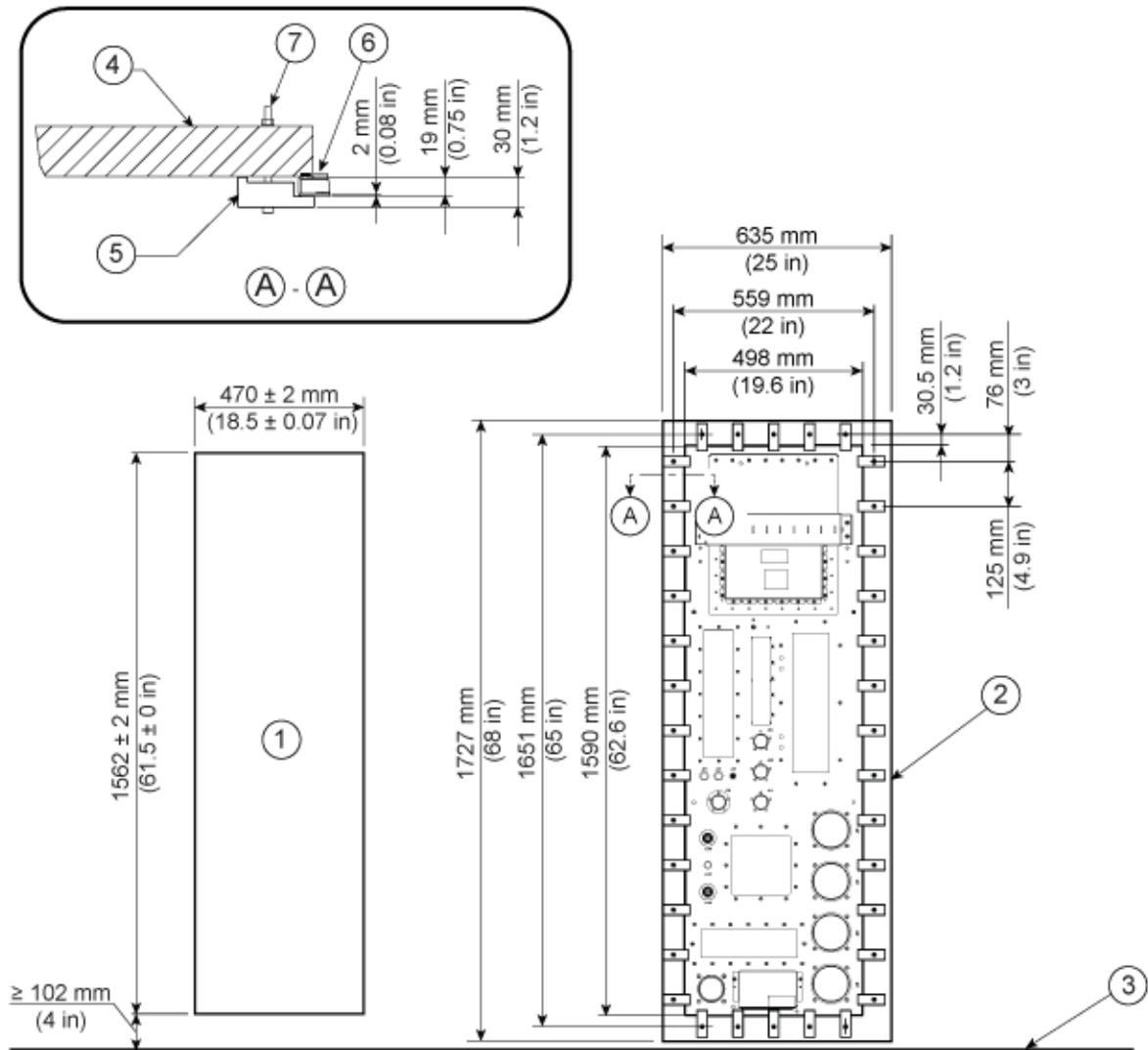
3. The RF vendor must supply fasteners and nuts (36 each), or wood screws to mount the penetration panel to the GE-supplied mounting blocks.

NOTE

The length of the fasteners should be based on the thickness of the RF Wall.

4. RF shielding in the Magnet Room walls must completely wrap around all edges of the penetration wall openings and continue through the openings to the inside of the Equipment Room to provide full shielding continuity with the penetration panel.
5. A minimum of 102 mm (4 in.) is required between the floor and the bottom of the penetration panel opening to provide clearance for the penetration panel.

Figure 3-7 Penetration Wall Openings



Item	Description	Item	Description
1	Wall opening	5	GE HealthCare-supplied Mounting block (36 total)
2	Clearance required around opening for mounting Penetration Panel (82.6 mm (3.25 in))	6	Penetration Panel
3	Finished floor on Equipment Room side of RF Shield	7	M6 fasteners, M6 nuts and M6 washers (36 each)
4	RF Shield Magnet Room		

3.6 Finished Room Requirements

3.6.1 Ferrous Materials in the Magnet Room



1. Non-ferrous (non-metallic) materials or components should be used in the Magnet Room.
2. Ferrous components or material in the Magnet Room that could be removed for servicing, cleaning, or replacement must be secured to prevent the ferrous material from becoming a projectile (ferrous components or material must also be identified as ferrous to prevent untrained personnel from working on the ferrous material while the magnet is energized).

3.6.2 Walls



Refer to *Acoustic Room Details*, 5850262-1EN. Hard, bare wall surfaces may create a harsh Magnet Room acoustic environment due to reflection of sound waves. Finished walls with acoustic properties can reduce reflected noise.

1. GE HealthCare recommends finished walls to protect the RF shielding.
2. Walls and any millwork, cabinets, storage areas, acoustic coverings, and so on, must remain outside the minimum service area.
3. A metallic electrical conduit inside walls and ceilings may be used. Conduit for receptacles must be metallic.

3.6.3 Magnet Preinstallation Markings



For correct cryogen venting, the magnet vent adaptor must align correctly with the ceiling vent when the magnet is installed.

1. The magnet isocenter position must be clearly marked, and the marking must be identifiable throughout construction.

NOTE

If there is no ceiling grid in the room, we recommend to also mark the magnet isocenter location on the ceiling. This can serve as a reference for positioning a new vent pipe, or can be used to reproduce the floor markings if they become lost during construction.

Refer to *Magnet Room Venting Requirements*, 5850263-1EN for the location of the magnet vent.

- If no ceiling vent pipe exists prior to construction, the location of the magnet isocenter and magnet z-axis orientation must be marked on the Magnet Room floor as shown below.

Figure 3-8 Marking Magnet Isocenter (in a Room Without a Vent Pipe)

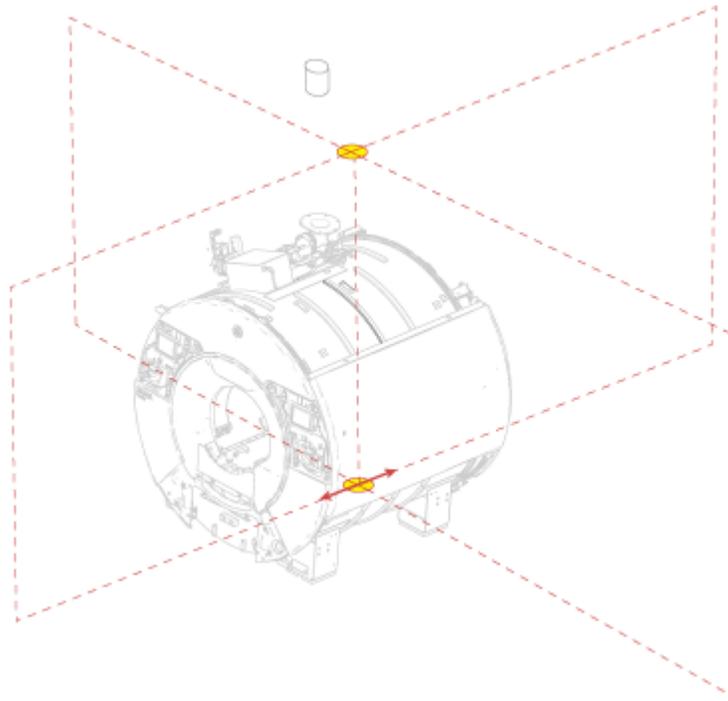
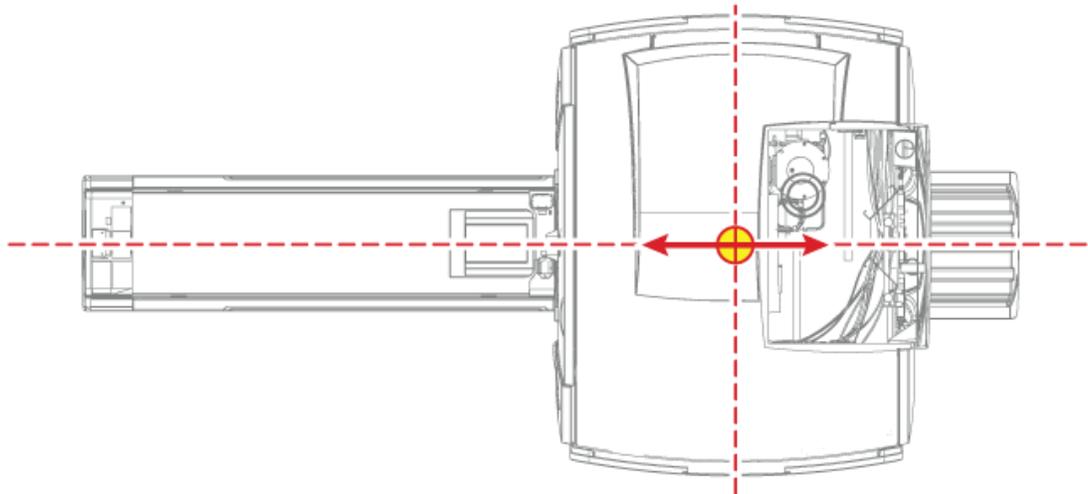


Figure 3-9 Marking the Magnet Isocenter and the Z-Axis Orientation on the Floor



- If a ceiling vent pipe already exists at the start of construction, the magnet isocenter marking must be correctly aligned relative to the position of the vent pipe. Refer to *Magnet Room Venting Requirements*, 5850263-1EN for the location of the magnet vent.

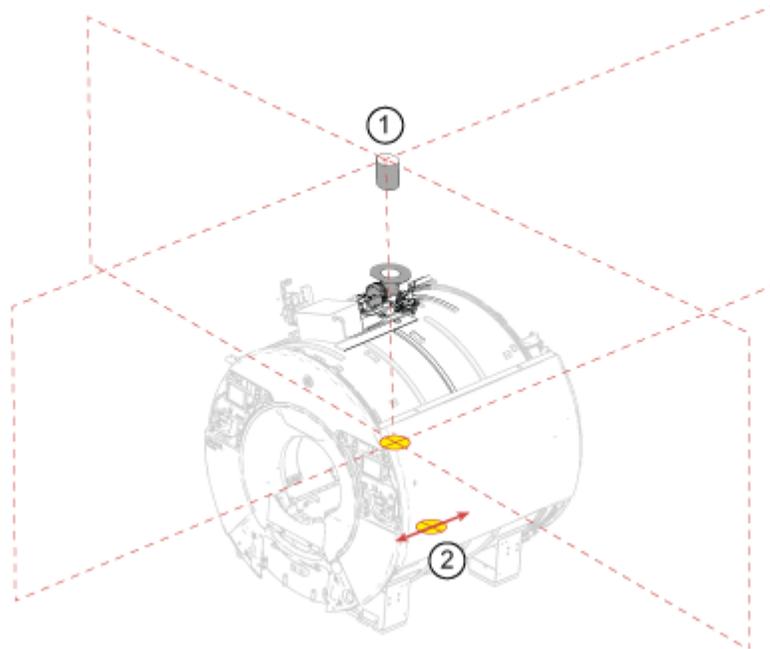
NOTE

We recommend:

- Marking the center of the vent pipe.
- Using a cross line laser or other accurate method to transcribe it to the floor directly below.

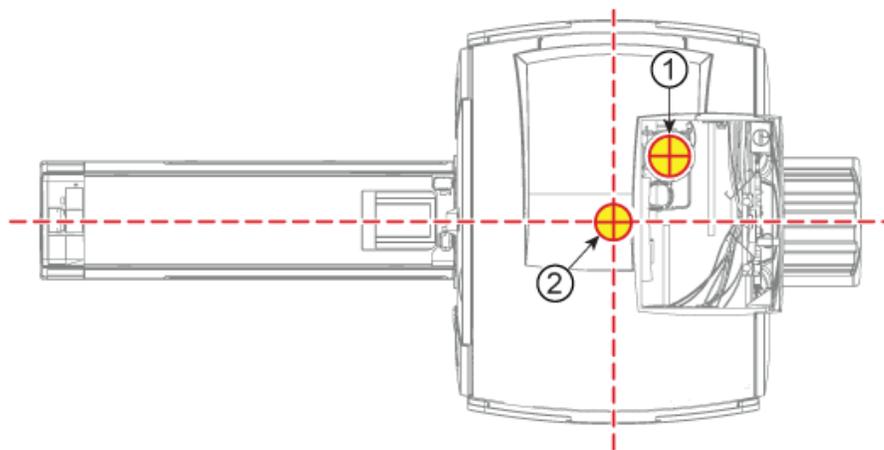
- Marking the magnet isocenter relative to the vent pipe marking on the floor. The positioning template can be used as a marking aid.

Figure 3-10 Marking the Center of the Vent Pipe



Item	Description
1	Vent center
2	Magnet isocenter

Figure 3-11 Marking the Vent Pipe and Magnet Isocenter on the Floor



Item	Description
1	Vent center
2	Magnet isocenter

3.6.4 Penetration Wall Closet



1. An enclosure (that is, the penetration wall closet) must be provided to restrict access to the penetration panel(s) and for storage of excess interconnections.
 - The whole section applies to standard (On the Wall) siting configuration.
 - From [a](#) to [e](#) content applies to remote (Off the Wall) siting configuration.
 - a. The penetration wall closet must meet the minimum penetration wall closet outline as shown in [3.6.5 PEN Wall Closet Outline for Standard \(On the Wall\) Siting Configuration on page 73](#) and [3.6.6 Penetration Panel Closet Specifications for Remote \(Off the Wall\) Siting Configuration on page 76](#).
 - b. The penetration wall closet must have a mechanical locking mechanism to restrict access to the penetration panels.
 - c. The penetration wall closet may be expanded to provide an area for excess cable storage with the following requirements:
 - i. Excess cable must not be stored within the minimum closet service area.
 - ii. Excess cable must not interfere with access or servicing of the ISC or ICC penetration walls .
 - iii. The area within the penetration wall closet to store the cable should be sized to accept a 300 mm (11.8 in.) cable loop.
 - iv. Refer to [7.1.6 Storage Requirements for Excess Gradient Cable for Remote \(Off the wall\) siting configuration on page 123](#) for additional excess cable storage requirements.
 - d. The penetration wall closet must allow free air exchange of 680 m³/hour (400 cfm) between the Magnet Room and penetration wall closet for MR System blowers. Airflow may be achieved through door louvers or other openings in the penetration wall closet that meet all other penetration wall closet requirements.
 - e. The primary source of airflow must be from the Magnet Room. Openings into the area above a false ceiling or other storage areas should be minimized.
 - f. The doors of the penetration wall closet must NOT interfere with the access to remove each cabinet's PEN Wall cover.
 - g. The ISC and ICC penetration walls may be enclosed by separate closets with the following requirements:
 - i. The separate closets must meet all other service area requirements for each penetration panel.
 - ii. Airflow as listed above must be provided for both closets.
 - iii. Both closets must have mechanical locks.

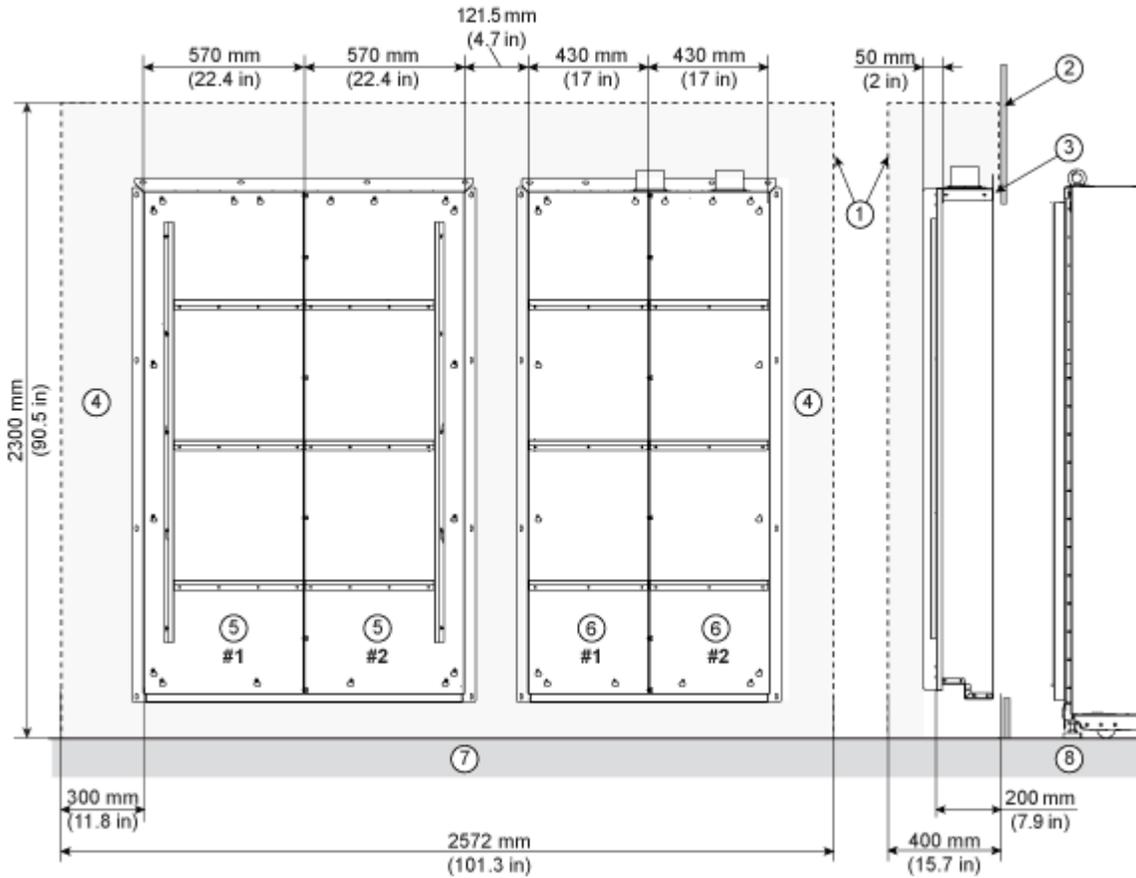
3.6.5 PEN Wall Closet Outline for Standard (On the Wall) Siting Configuration



PEN Wall Closet Outline (Case 1: Cabinets are installed side by side)

Figure 3-12 Minimum PEN Wall Closet Outline on page 73 shows the minimum PEN Wall Closet Outline.

Figure 3-12 Minimum PEN Wall Closet Outline

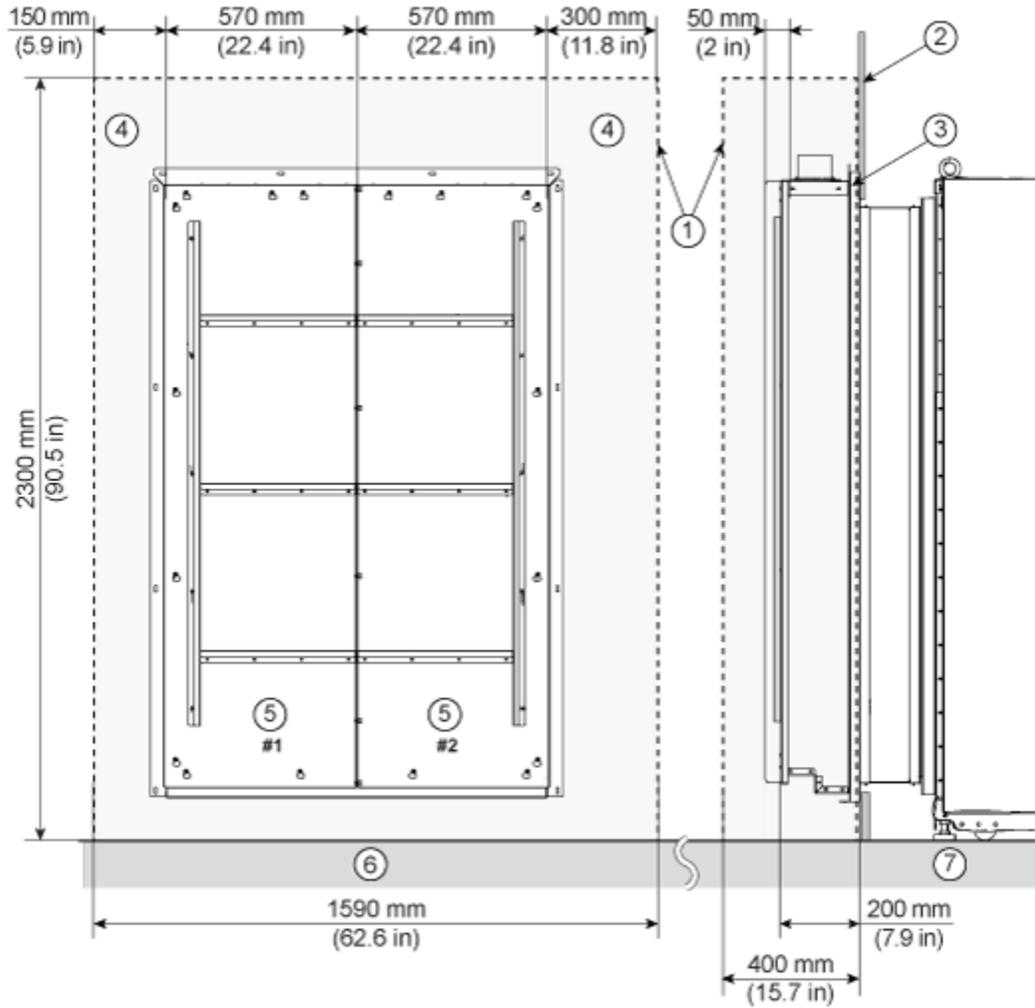


Item	Description	Item	Description
1	Minimum closet inner dimensions outline	5	ISC PW Cover
2	RF Shield	6	ICC PW Cover
3	Pen Wall Covers are fixed to mesh shield by GE-supplied screws	7	View from Magnet Room
4	300 mm (11.8 in.) side space is for excess cable storage Left side space and right side space 300 mm (11.8 in.) can be swapped.	8	Side view

PEN Wall Closet Outline (Case 2: Cabinets are installed separately)

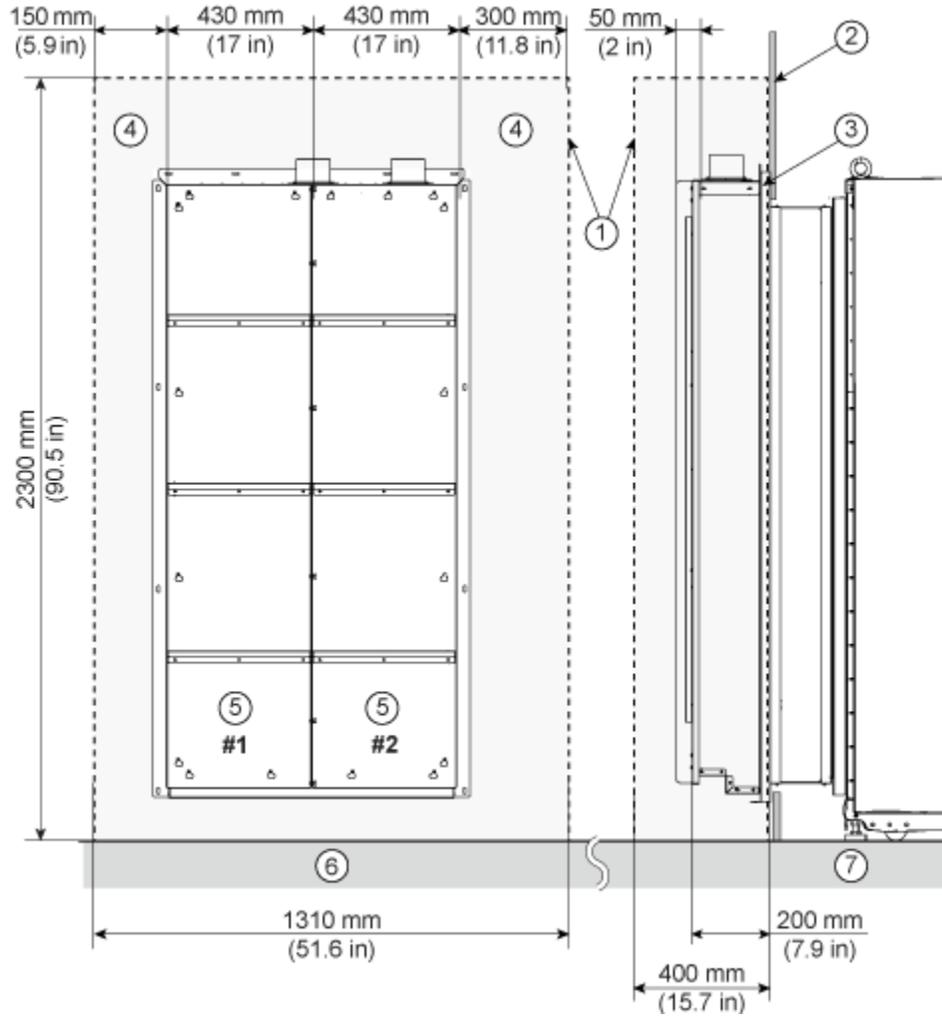
Figure 3-13 Minimum ISC PEN Wall Closet Outline on page 74 and Figure 3-14 Minimum ICC PEN Wall Closet Outline on page 75 show the minimum PEN Wall Closet Outline.

Figure 3-13 Minimum ISC PEN Wall Closet Outline



Item	Description	Item	Description
1	Minimum closet inner dimensions outline	5	ISC PW Cover
2	RF Shield	6	Front view (from Magnet Room side)
3	Pen Wall Covers are fixed to mesh shield by GE-supplied screws	7	Side view
4	300 mm (11.8 in.) side space is for excess cable storage Left side space 150 mm (5.9 in.) and right side space 300 mm (11.8 in.) can be swapped.	-	-

Figure 3-14 Minimum ICC PEN Wall Closet Outline



Item	Description	Item	Description
1	Minimum closet inner dimensions outline	5	ICC PW Cover
2	RF Shield	6	Front view (from Magnet Room side)
3	Pen Wall Covers are fixed to mesh shield by GE-supplied screws	7	Side view
4	300 mm (11.8 in.) side space is for excess cable storage Left side space 150 mm (5.9 in.) and right side space 300 mm (11.8 in.) can be swapped.	-	-

3.6.6 Penetration Panel Closet Specifications for Remote (Off the Wall) Siting Configuration

- Minimum Closet Depth: 650 mm (25.6 in)
- Minimum Closet Width: 1100 mm (43.3 in)
- Minimum Closet Height: 1900 mm (74.80 in)

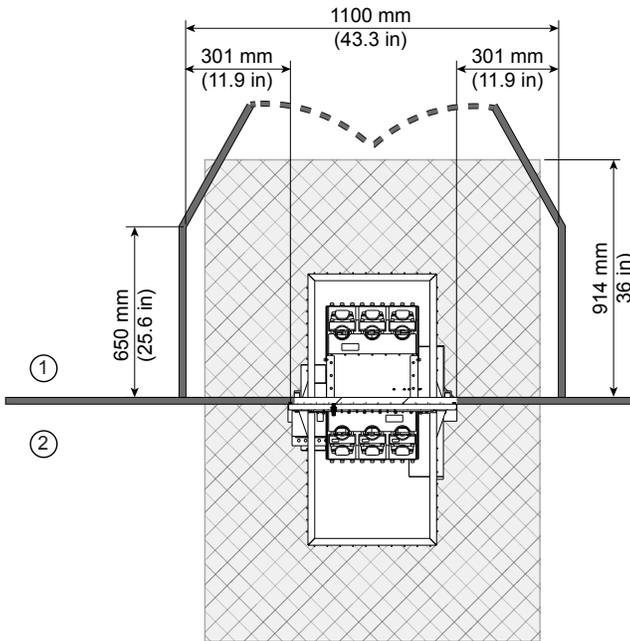
NOTE

If the closet depth is less than 914 mm (36 in), the closet must have door(s) configured to clear the service area for the Penetration Panel.

NOTE

Minimum closet specifications do not account for storage space for excess gradient cable. Refer to [7.1.6 Storage Requirements for Excess Gradient Cable for Remote \(Off the wall\) siting configuration on page 123](#) for additional excess cable storage requirements.

Figure 3-15 Minimum dimensions of closet in the Magnet Room for Remote (Off the Wall) Siting Configuration



Item	Description
1	Magnet Room
2	Equipment Room

3.6.7 Doors, Magnet Access Openings, and Patient Viewing Windows



1. The finished opening of the Magnet Room main door must be at least 1092 mm (43 in.) wide to allow for helium dewars and patient tables.
2. Threshold height must not exceed 15 mm (0.6 in.) on both sides of the door with a maximum 10-degree threshold inclination.
3. IEC requires the patient, while in the bore, be in full view of the operator.

NOTE

- GE HealthCare recommends using a window, although other means (for example, camera and video display) may be used as long as all IEC requirements are met.
 - The recommended dimensions for the patient viewing windows are 1219 mm wide x 762 mm high (48 in. wide x 30 in. high).
 - The recommended distance from the bottom edge of the patient viewing window to the finished floor is 1067 mm (42 in.).
4. The magnet delivery requires an opening into the room to allow access for the magnet delivery, rigging, and personnel access.

3.6.8 Finished Ceiling

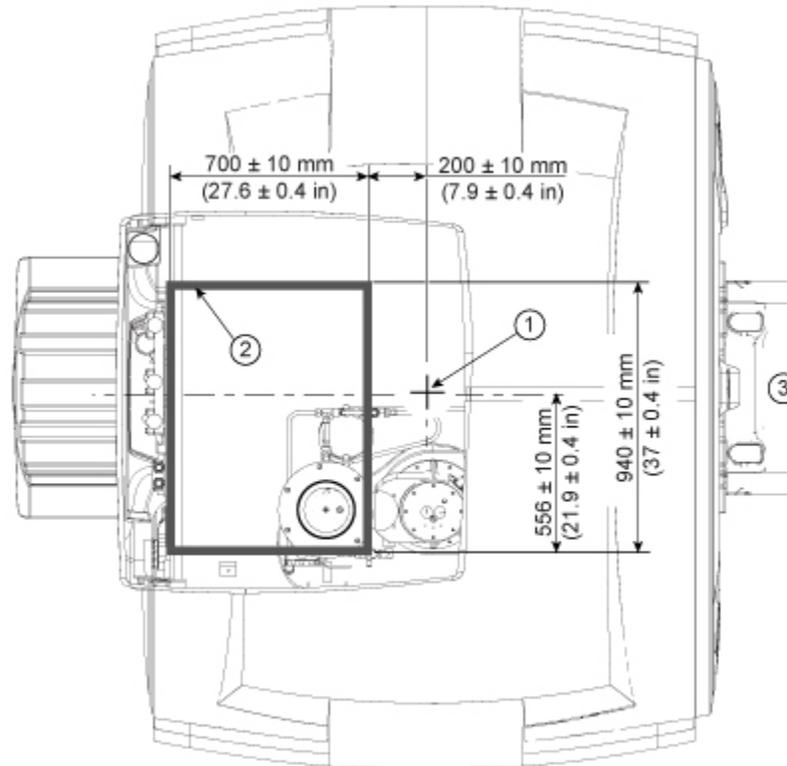


1. The customer is responsible for the finished ceiling.
2. The finished ceiling grid must be non-ferrous.
3. An optional cable concealment kit is available from GE HealthCare.
 - a. Ceiling preparation should be completed prior to magnet delivery and frame installation should be completed prior to magnet ramp.
 - b. See [Figure 3-16 Cable Concealment Kit Ceiling Opening Dimensions \(Top View\)](#) on page 78 for ceiling opening dimensions:
 - Ceiling opening measures 700 mm (27.6 in.) by 940 mm (37 in.)
 - Off-set from magnet center by 200 mm (7.85 in.) (Z direction) and 556 mm (21.9 in.)
 - c. The customer is responsible to work with the RF vendor to prepare a support frame which sustains Concealment Kit weight (30 kg (66 lb.)). The support frame area must be wider than the Concealment Kit frame fasten area shown in [Figure 3-17 Cable Concealment Kit Frame Fasten Area Dimensions with Example of Customer-Supplied Support Frame](#) on page 79.

NOTE

- The space above the cable concealment opening must be clear of any obstructions, up to a height of 2794 mm (110 in.) from the finished floor, for cables to be routed to the magnet. Refer to [7.2.4 Cable Tray Requirements and Examples on page 128](#) for height requirements for the trays that route cables through this opening.

Figure 3-16 Cable Concealment Kit Ceiling Opening Dimensions (Top View)

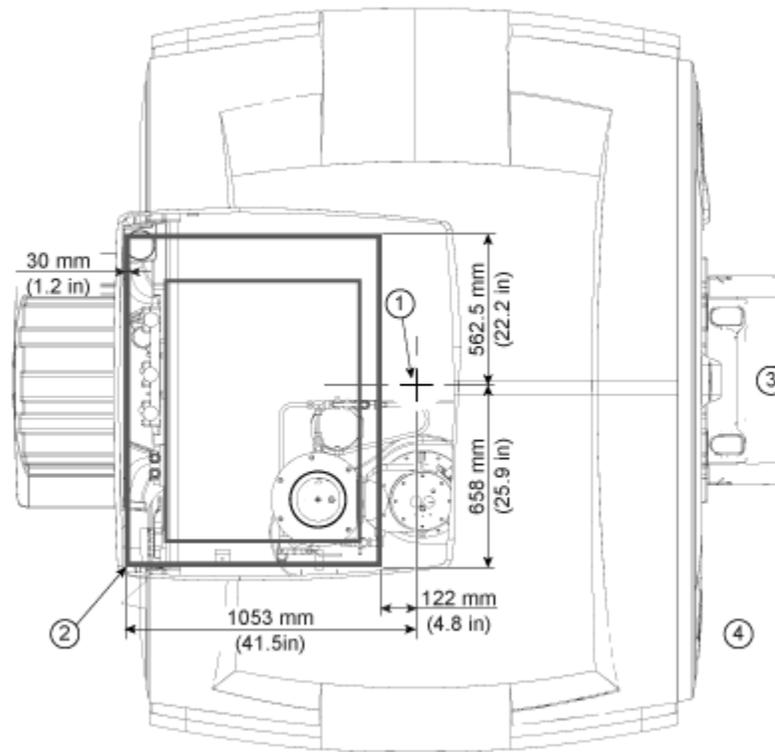


Item	Description	Item	Description
1	Magnet isocenter	3	Patient table
2	Ceiling opening outline	-	-

NOTE

[Figure 3-17 Cable Concealment Kit Frame Fasten Area Dimensions with Example of Customer-Supplied Support Frame on page 79](#) shows the Concealment Kit frame fasten area dimensions with example of customer-supplied support frame. Any types of support frame may be used, such as suspended support frame as example 1, supporting beams as example 2, and so on that meets all MR requirements.

Figure 3-17 Cable Concealment Kit Frame Fasten Area Dimensions with Example of Customer-Supplied Support Frame



Item	Description	Item	Description
1	Magnet isocenter	3	Patient table
2	Concealment Cover Frame Fasten area	4	Magnet front

3.6.9 Magnet Room Floors



1. The finished floor must support the weight of all components throughout operation and service life. This includes the magnet, patient table, and gradient coil replacement cart.

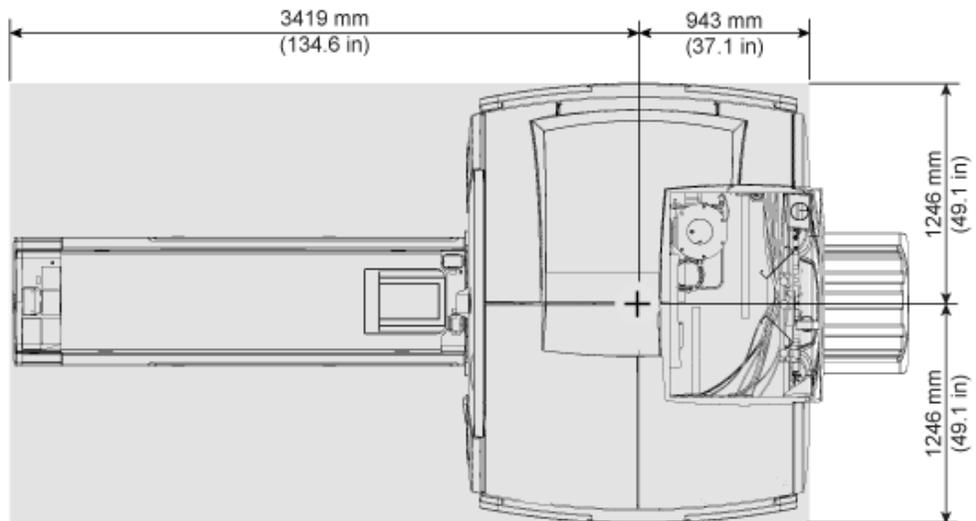
NOTE

For gradient coil replacement, field engineers remove the patient table from the Magnet Room before they move the gradient coil replacement cart into the Magnet Room.

2. The finished floor must be water resistant to protect the subfloor and shielding from water damage.
3. The customer is responsible for providing flooring to prevent ESD (Electrostatic Discharge) buildup to 8 kV for protection of the sensitive MR equipment.

4. Magnet, Enclosure, and Patient Table areas must be flat and level within 3 mm (0.125 in.), with the magnet in place, within the shaded area shown in [Figure 3-18 Magnet Room Floor Levelness Area on page 80](#).

Figure 3-18 Magnet Room Floor Levelness Area

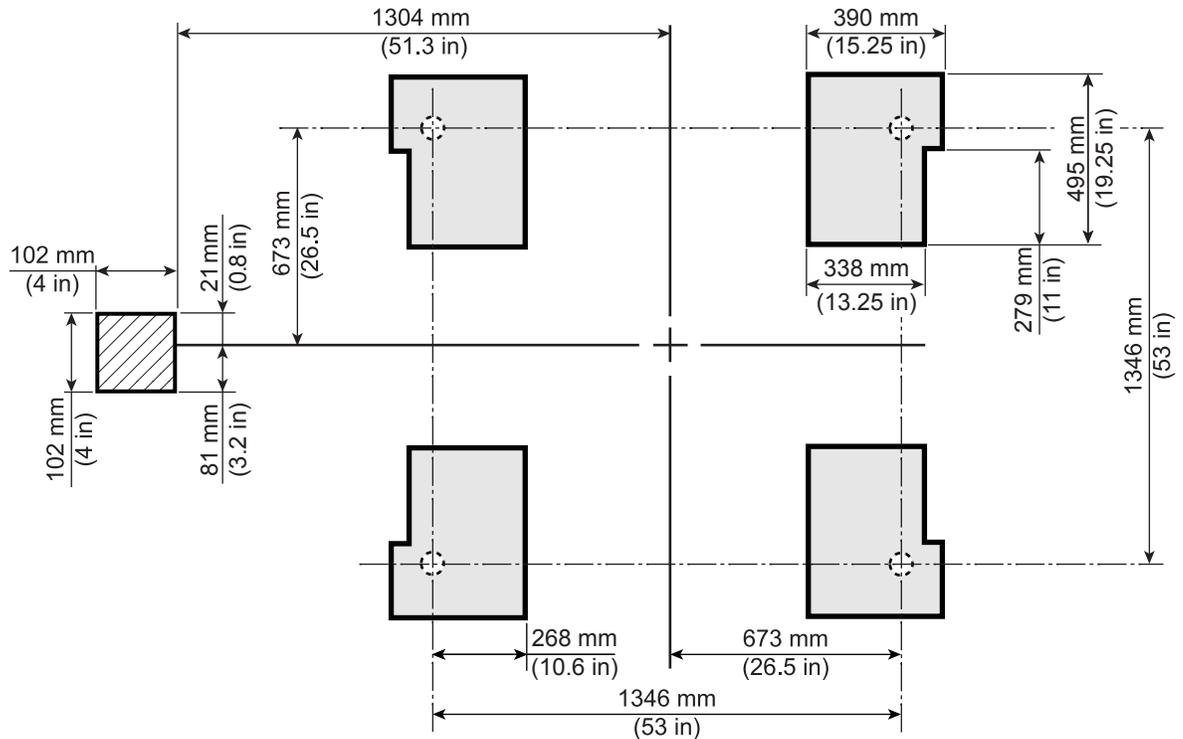


5. The VibroAcoustic Dampening kit for systems that do not require Seismic mounting is M7000VA. See below for dimensions that aid in the calculation for floor loading. See [Figure 3-19 Magnet Mounting Detail for M7000VA \(non-seismic\)—Patient End is on the Left Side on page 81](#) for details.

- Weight: 8 kg (17 lb.) each
- Size: 390 x 495 mm (15.25 x 19.25 in.) each
- A 132 x 139 mm (5.17 x 5.5 in.) rebar-free area is necessary under the table frame anchor, in the position shown in the figure below.

Important

The table frame anchor hole is drilled only after magnet installation.

Figure 3-19 Magnet Mounting Detail for M7000VA (non-seismic)—Patient End is on the Left Side

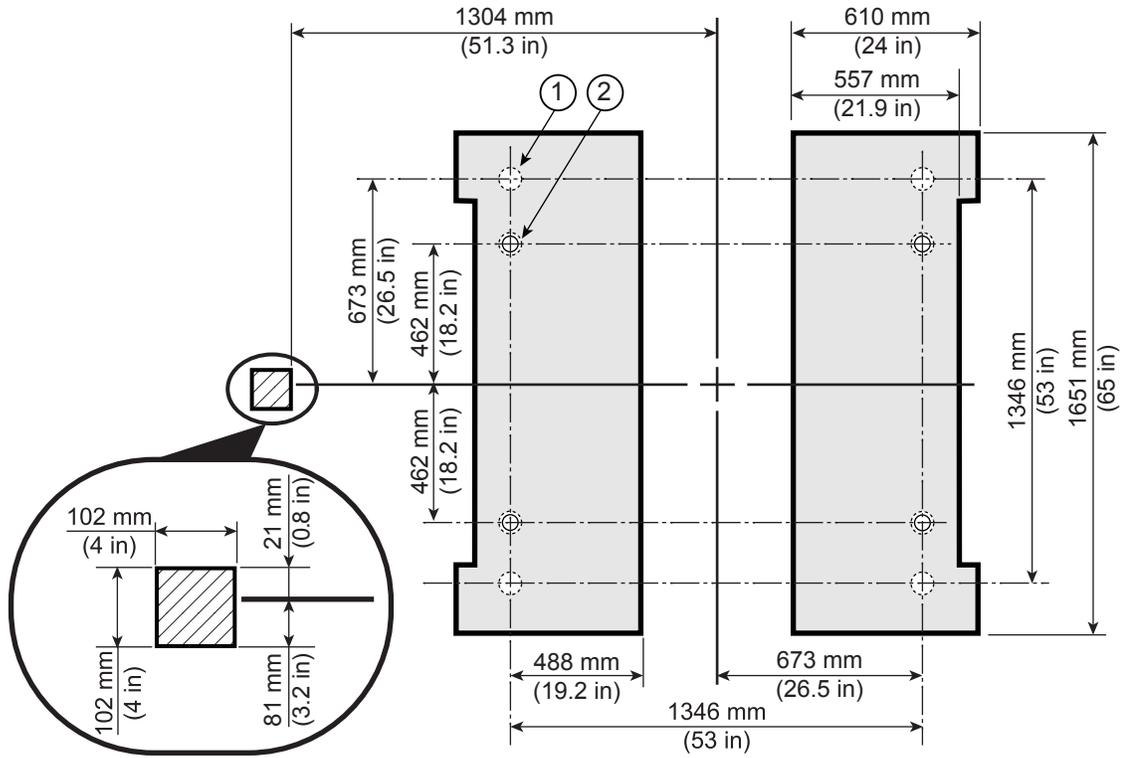
6. The VibroAcoustic Dampening kit for systems that require Seismic mounting is M7000VM. See below for dimensions that aid in the calculation for floor loading. See [Figure 3-20 Magnet Mounting Detail for M7000VM \(seismic\)—Patient End is on the Left Side on page 82](#) for details.

- 2 pads per magnet, 116 kg (255 lb.) each
- Nominal size: 610 x 1651 mm (24 x 65 in.) each
- Magnet anchor option 1: Corner seismic anchor points (x4)
- Magnet anchor option 2: Seismic anchor holes (x4) 38 mm (1.5 in.)
- Seismic anchors must be isolated from rebar.
- A 132 x 139 mm (5.17 x 5.5 in.) rebar-free area is necessary under the table frame anchor, in the position shown in the figure below.

Important

The table frame anchor hole is drilled only after magnet installation.

Figure 3-20 Magnet Mounting Detail for M7000VM (seismic)—Patient End is on the Left Side



Item	Description	Item	Description
1	Magnet mounting holes	2	Seismic mounting holes

7. RF shield seams, joints, or overlaps must not be located under the VibroAcoustic mats.

3.6.10 Storage Cabinets



NOTE

GE HealthCare no longer provides a storage solution for system phantoms.

1. The customer shall provide storage for phantoms in the magnet room (for example, a cart, shelving unit or cabinet). Storage needs to be large enough to accommodate system phantoms listed in Table 1-1 of *Customer Site Storage Requirements, 5182674* (available in the Customer Documentation Portal).
2. The storage solution can not interfere with the magnet room minimum service area.

3.7 Magnet Room Equipment Specifications

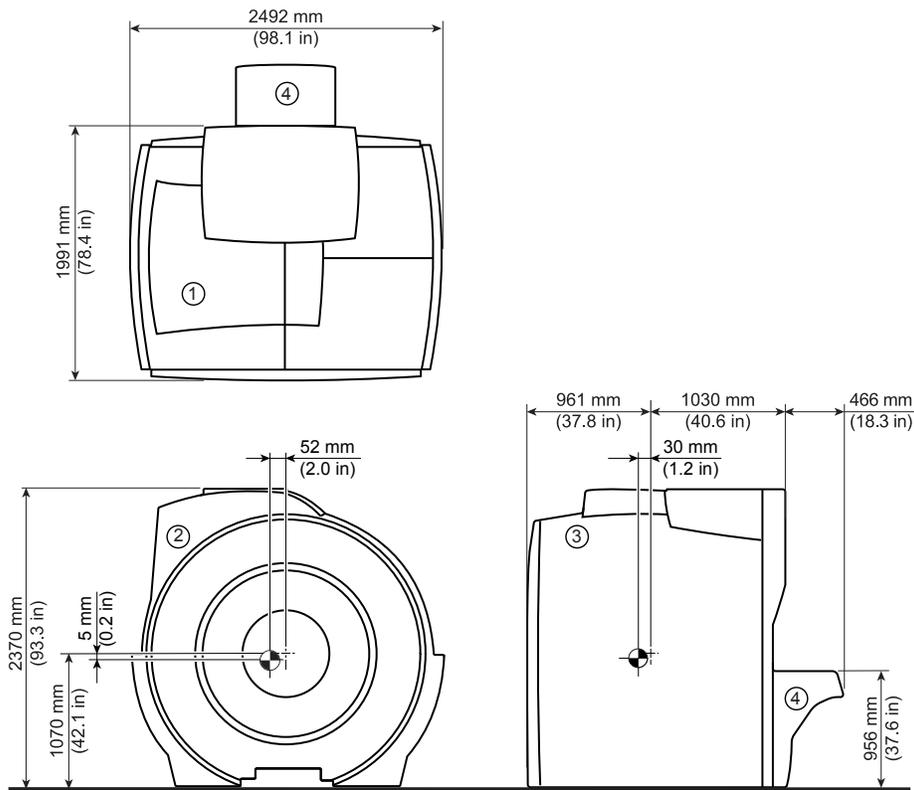


(Applies to all subsections within this section)

3.7.1 Magnet (MAG) Assembly Specifications

1. Magnet weight, with cryogenics at maximum capacity: 7500 kg (16500 lb.)

Figure 3-21 Magnet Enclosure Dimensions

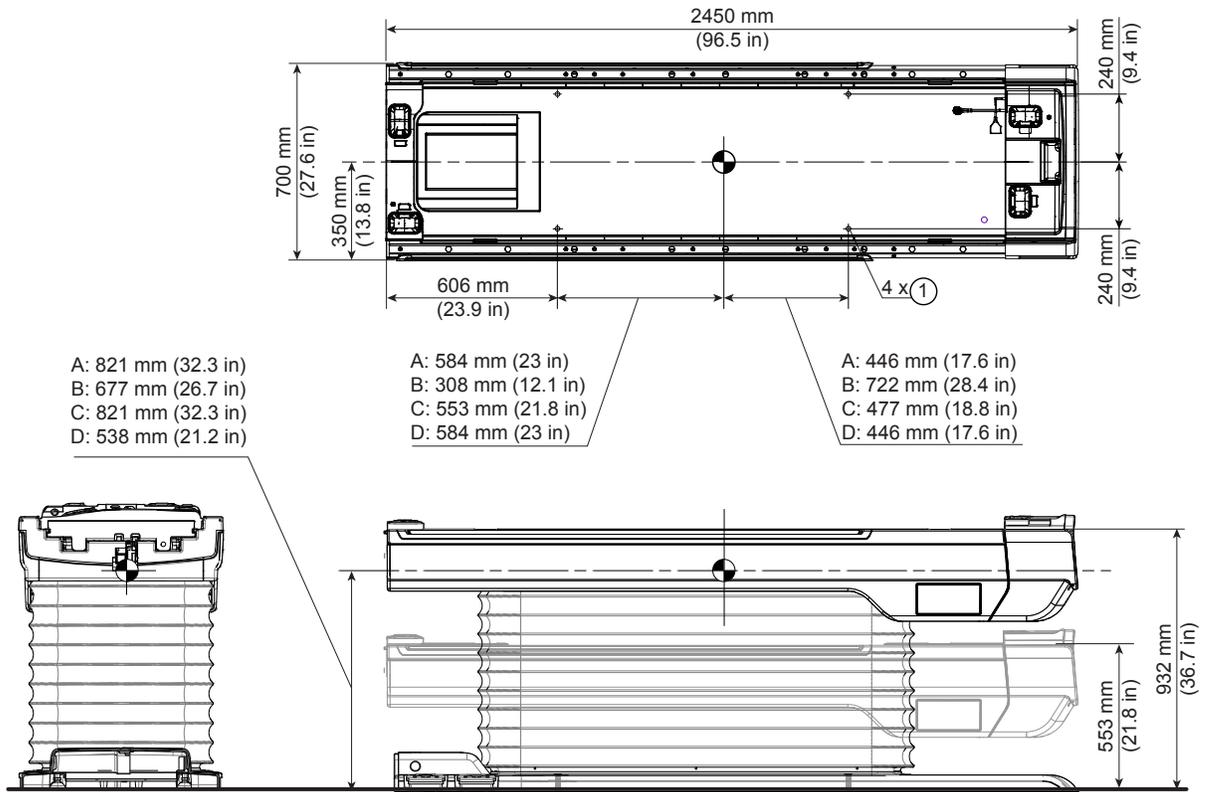


Item	Description	Item	Description
1	Top view	3	Side view
2	Front view	4	Rear Bridge

3.7.2 Patient Table (PT) Specifications

1. Comfort Plus Table weight, empty: 259.5 kg (572 lb.)
2. Comfort Plus Table weight, including maximum patient weight of 250 kg (551 lb.) and accessories: 538.5 kg (1187 lb.)

Figure 3-22 Comfort Plus Fixed Patient Table (PT)



Item	Description
1	4 Seismic mounting holes, \varnothing 13.5mm (17/32 in.)
A	538.5 kg (1187 lb.): Patient is on the table being prepared for scanning, not in the bore. Table is at the highest position.
B	335 kg (739 lbs): Patient is moved 1470 mm (58 in.) into the bore and scanning. Table is at the highest position.
C	538.5 kg (1187 lbs): Patient is on the table and cradle is 50 mm (2 in.) into the bore. Table is at the highest position.
D	259.5 kg (572 lbs): Patient is not on the table. Table is at the highest position.

NOTE

Seismic mounting studs cannot be positioned before table installation.

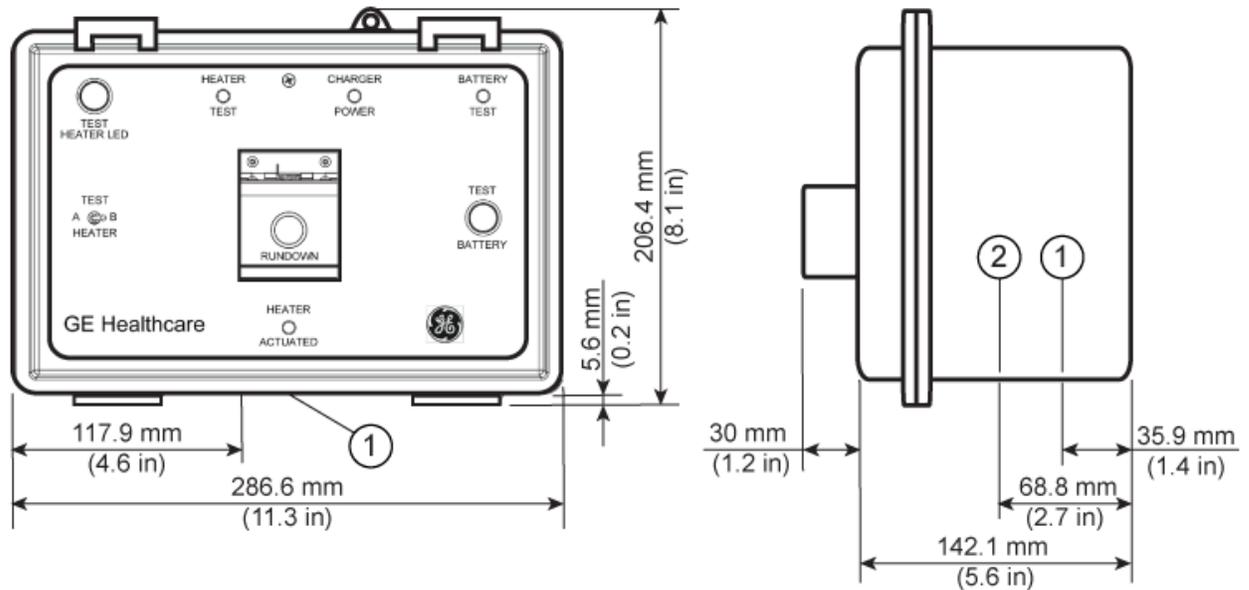
3.7.3 Magnet Rundown Unit (MRU) Specifications and Requirements

1. Location: The bottom edge of the MRU must be mounted 1524 ± 25 mm (60 ± 1 in.) above the Magnet Room floor near the front of the magnet enclosure.
2. Weight: 3.2 kg (7 lb.)
3. Magnetic Field Limit: 20 mT (200 G)
4. The MRU is installed by the facility contractor.

NOTE

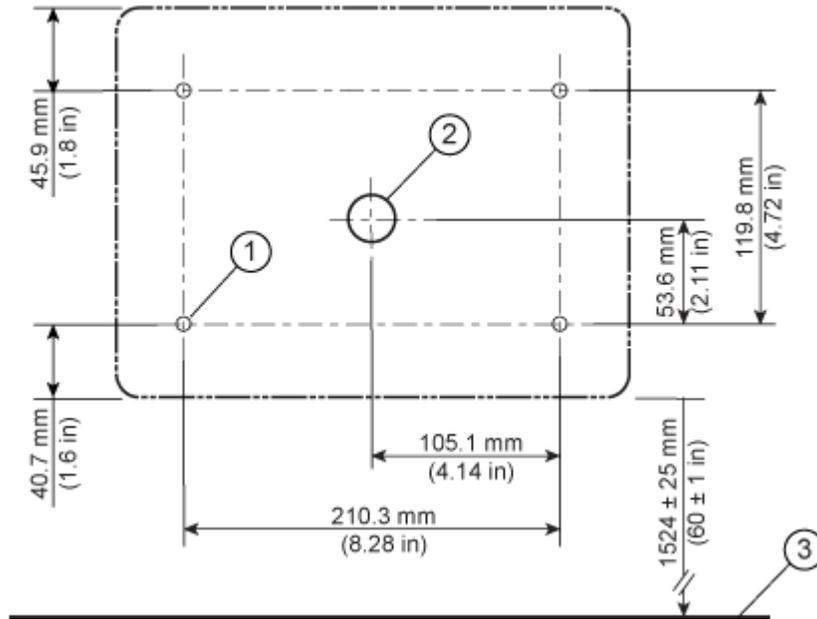
An optional remote MRU may be installed outside the Magnet Room. The remote MRU does not require facility power. For more information, refer to MRU vendor manual.

Figure 3-23 Magnet Rundown Unit (MRU)



Item	Description
1	Cable access
2	Power access

Figure 3-24 MRU Mounting Pattern



Item	Description	Item	Description
1	7 mm (0.275 in.) diameter mounting hole	3	Finished floor
2	26 mm (1.025 in.) diameter cable access	-	-

3.7.4 Oxygen Monitor Option Sensor Specifications

See [Oxygen Monitor \(OXY\) Option](#) on page 114.

3.8 Magnet Room Lighting Requirements



1. All lighting fixtures and associated components must meet all RF shielded room and RF grounding requirements (for example, track lighting is not recommended due to possible RF noise).
2. All removable lighting fixtures and associated components must be non-magnetic.
3. All lighting must use direct current (the DC must have less than 5% ripple).
4. At least 300 lux must be provided at the front of the magnet for patient access and above the magnet for servicing.
5. Fluorescent lighting must not be used in the Magnet Room.
6. Lighting must be adjusted using a discrete switch or a variable DC lighting controller.
7. SCR dimmers or rheostats must not be used.
8. DC LED lighting may be used if the DC power converter and RF sources are all located outside the Magnet Room RF Shield.

NOTE

LED lighting could cause image quality issues due to RF interference. Make sure a MR-compatible LED lighting solution is chosen.

9. Battery chargers (for example, used for emergency lighting) must be located outside the Magnet Room.
10. LED Lighting or short filament length incandescent bulbs are recommended.
11. Linear lamps are not recommended due to the high burnout rate.

4 Equipment Room

4.1 Equipment Room Overview



(Applies to all sections within this chapter)

1. The vertical distance between the coolant connection points of the ICC and the Gradient Coil must be less than 5 meters (196.8 in.).
2. The ICC and ISC must be located on the same floor.

NOTE

The ICC contains the cryocooler compressor.

The following illustration shows minimum equipment room service clearances. Refer to [MR Suite Minimum Room Size Requirements on page 20](#) and [Figure 4-2 Typical Minimum Equipment Room with Service Clearances for Remote \(Off the Wall\) Siting Configuration on page 91](#) for a list of considerations not included in the minimum area dimensions.

NOTE

Colored areas indicate service/installation areas. These areas can overlap as necessary as shown below. See individual component descriptions and room requirements for service area details. Magnet Monitor (MON) can be mounted on the side of the wall near the ICC. Optional equipment is not shown; additional space may be required for options.

NOTE

Refer to [Table 2-21 MR System Component Replacement Shipping Specifications on page 55](#) for the dimensions of the replacement parts. The parts must be able to be positioned in front of the noted cabinet for replacement procedures after the system has been installed.

Figure 4-1 Typical Minimum Equipment Room with Service Clearances for Standard (On the Wall) Siting Configuration

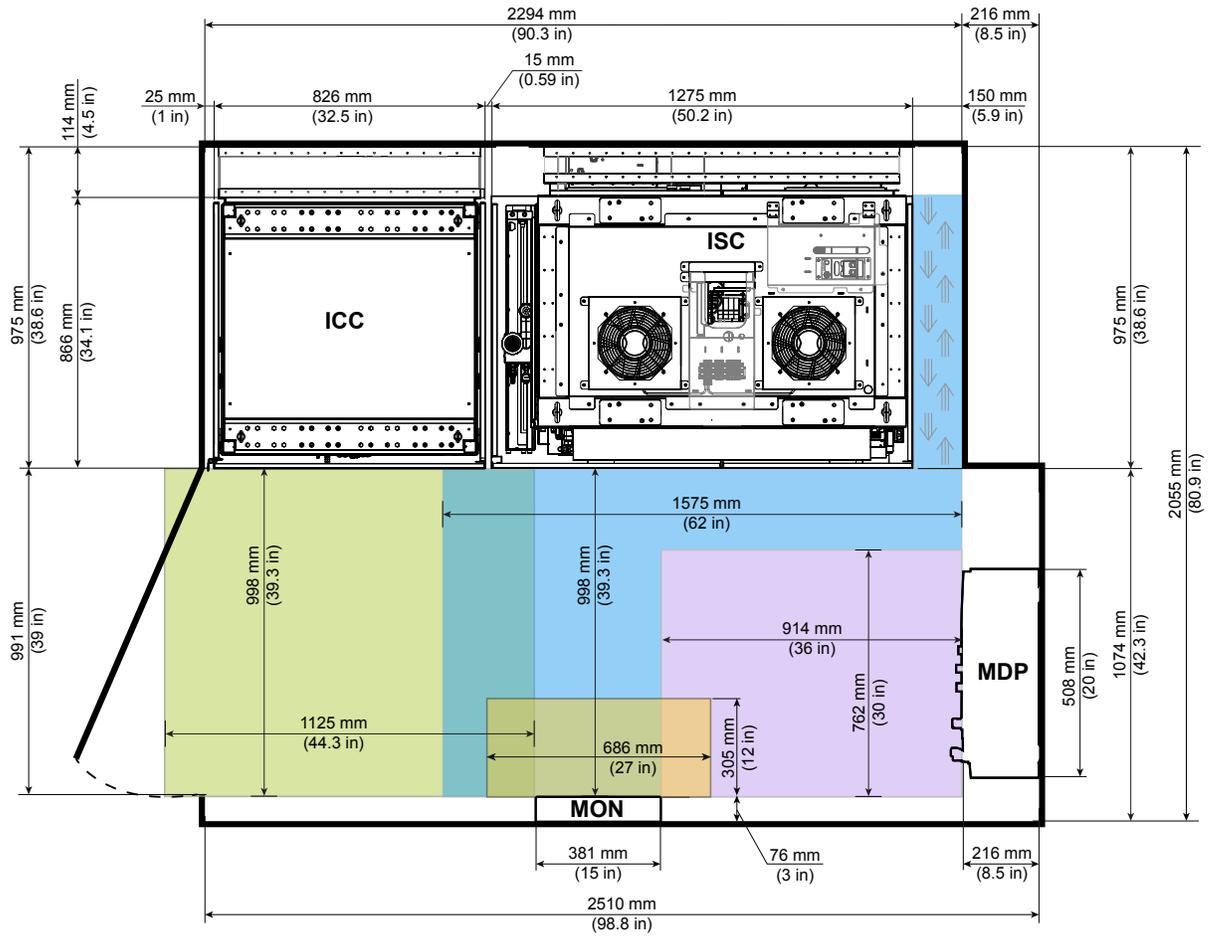
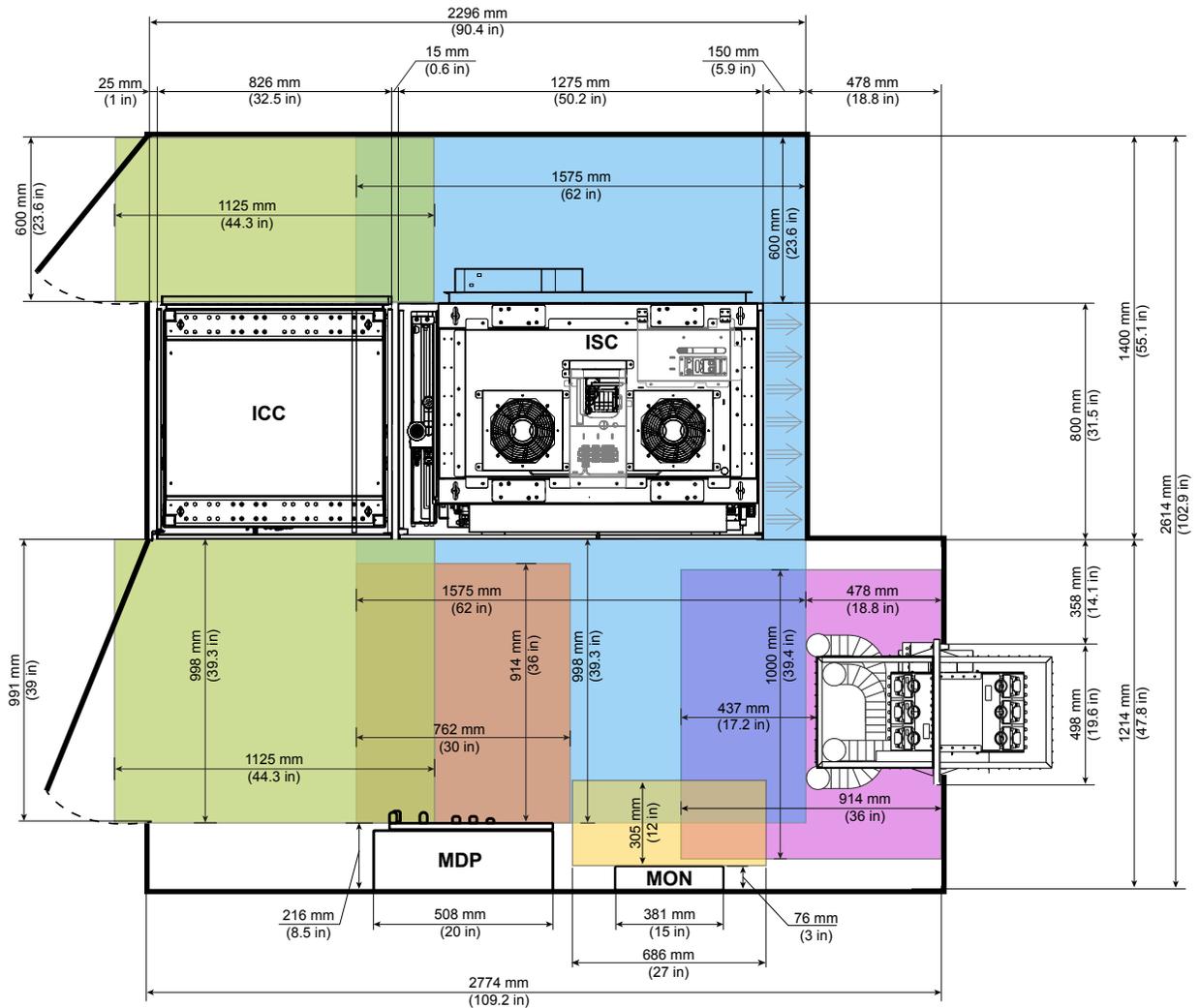


Figure 4-2 Typical Minimum Equipment Room with Service Clearances for Remote (Off the Wall) Siting Configuration



4.2 Main Disconnect Panel (MDP) Requirements and Specifications

4.2.1 Requirements

1. It is recommended to install the following items to support a power monitor:
 - a. A T100 network connection with RJ45 connector near the MDP
 - b. An electrical outlet
2. The cable must be Cat 5 or better.
3. The network connection must not be routed through the Ethernet switch in the Global Operator Cabinet (GOC).

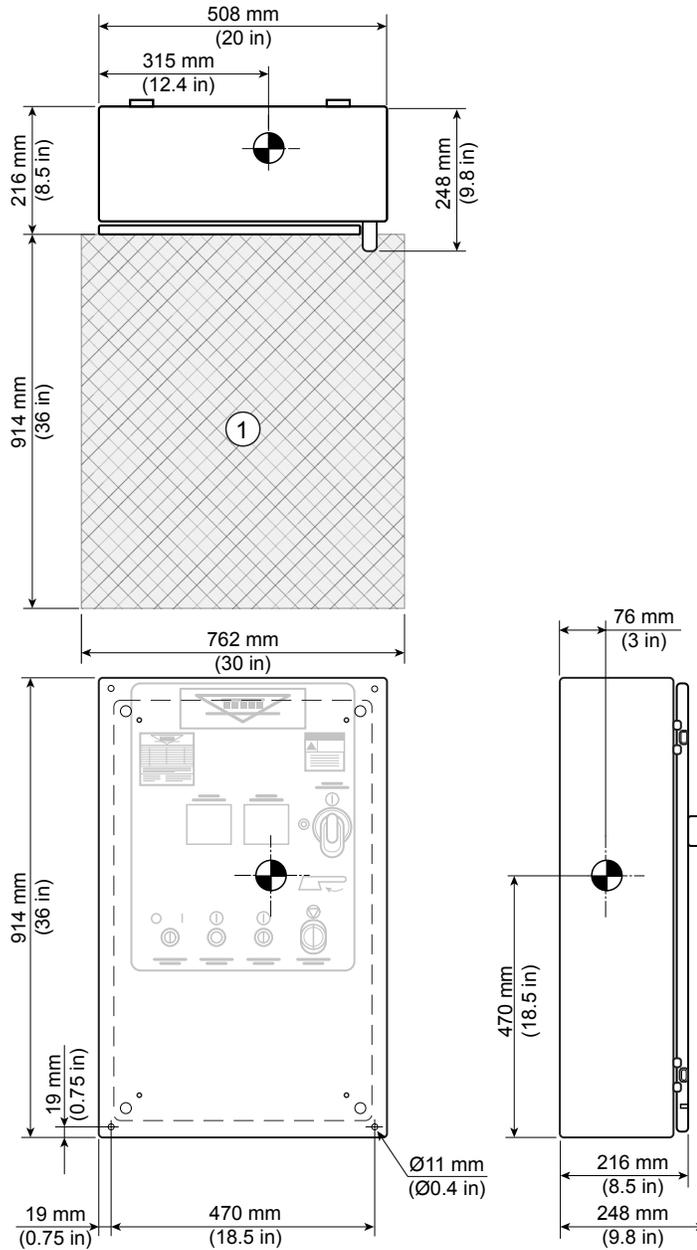
4.2.2 Specifications

The Main Disconnect Panel (MDP) is provided with the MR System. Only exempt countries can supply their own MDP (see [2.10.3 Customer-supplied Main Disconnect Panel \(MDP\) Requirements \(exempt countries only*\)](#) on page 48).

M70022MB and M70022MC

1. Weight: 43.5 kg (96 lb.)
2. Magnetic Field Limit: 5 mT (50 G)

Figure 4-3 GE HealthCare supplied Main Disconnect Panel (MDP) M70022MB and M70022MC



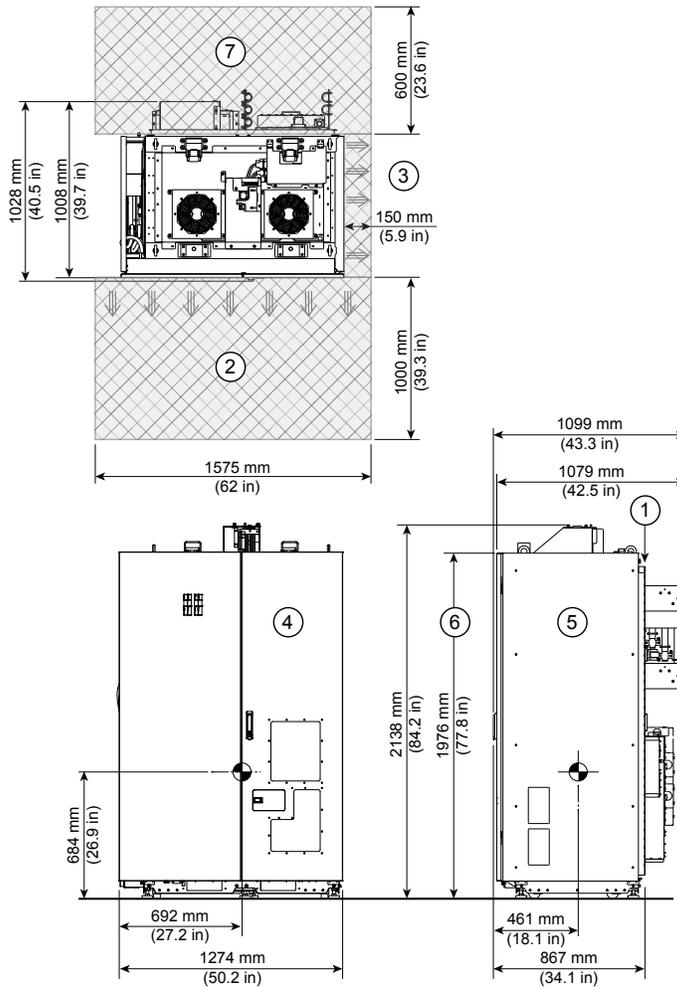
Item	Description
1	Service Clearance

4.3 Integrated System Cabinet (ISC) Specifications

Weight: 1251 kg (2758 lb.)

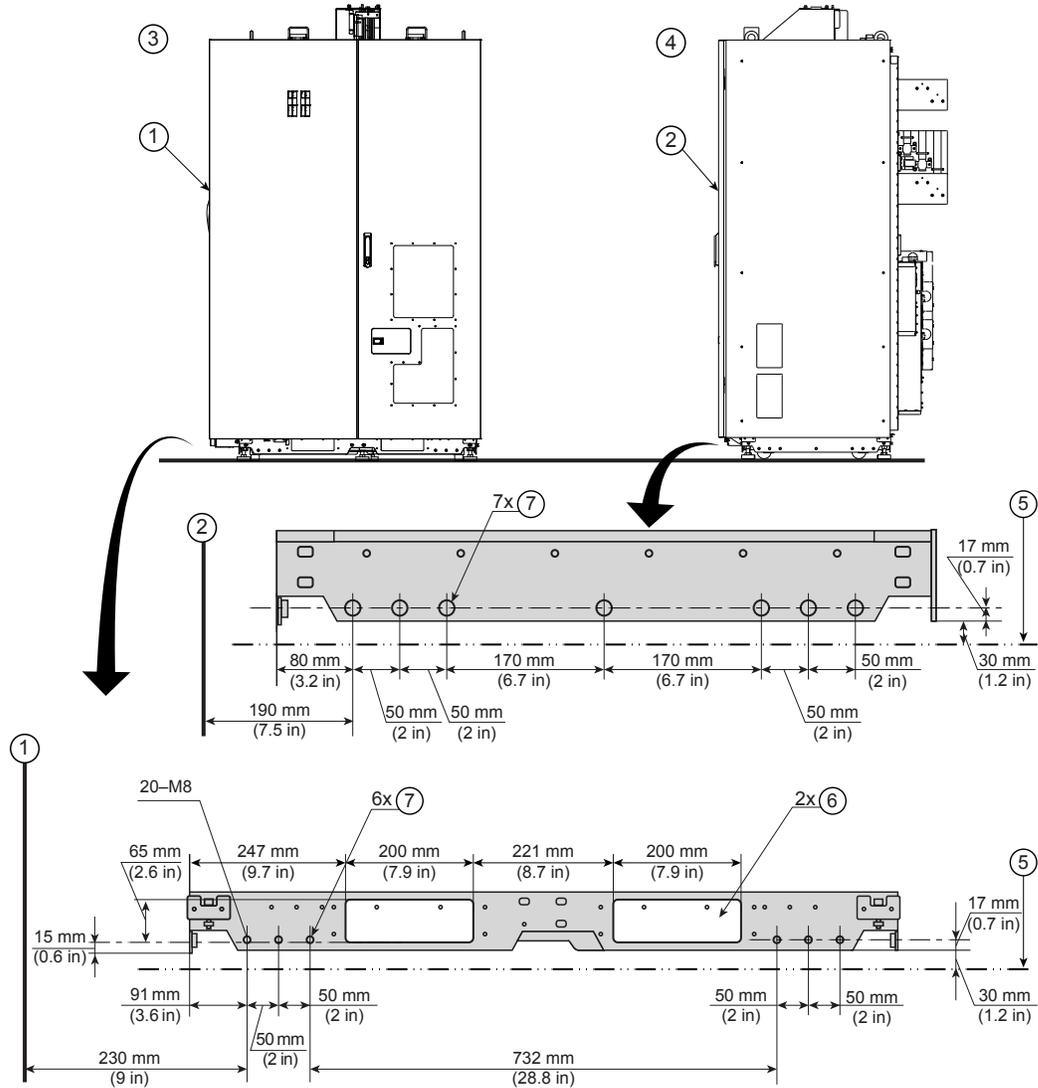
Magnetic Field Limit: 5 mT (50 G) (Penetration Panel side)

Figure 4-4 Integrated System Cabinet (ISC)



Item	Description	Item	Description
1	50G limit	5	Side View
2	Service Clearance	6	Height when removing the top blocks and covers
3	Top View	7	Service Clearance for remote (Off the wall) siting configuration
4	Front View	-	-

Figure 4-5 ISC Anchor Bracket Location For Seismic Wall Mounting



Item	Description	Item	Description
1	Side Cover	5	Floor
2	Front Cover	6	Airflow opening (must not be obstructed)
3	Front View	7	(20) M8 Seismic Anchor Mounting Holes
4	Side View		

NOTE

The left side and the right side of the ISC anchor bracket locations are symmetrical.

4.4 Integrated Cooling Cabinet (ICC) Specifications

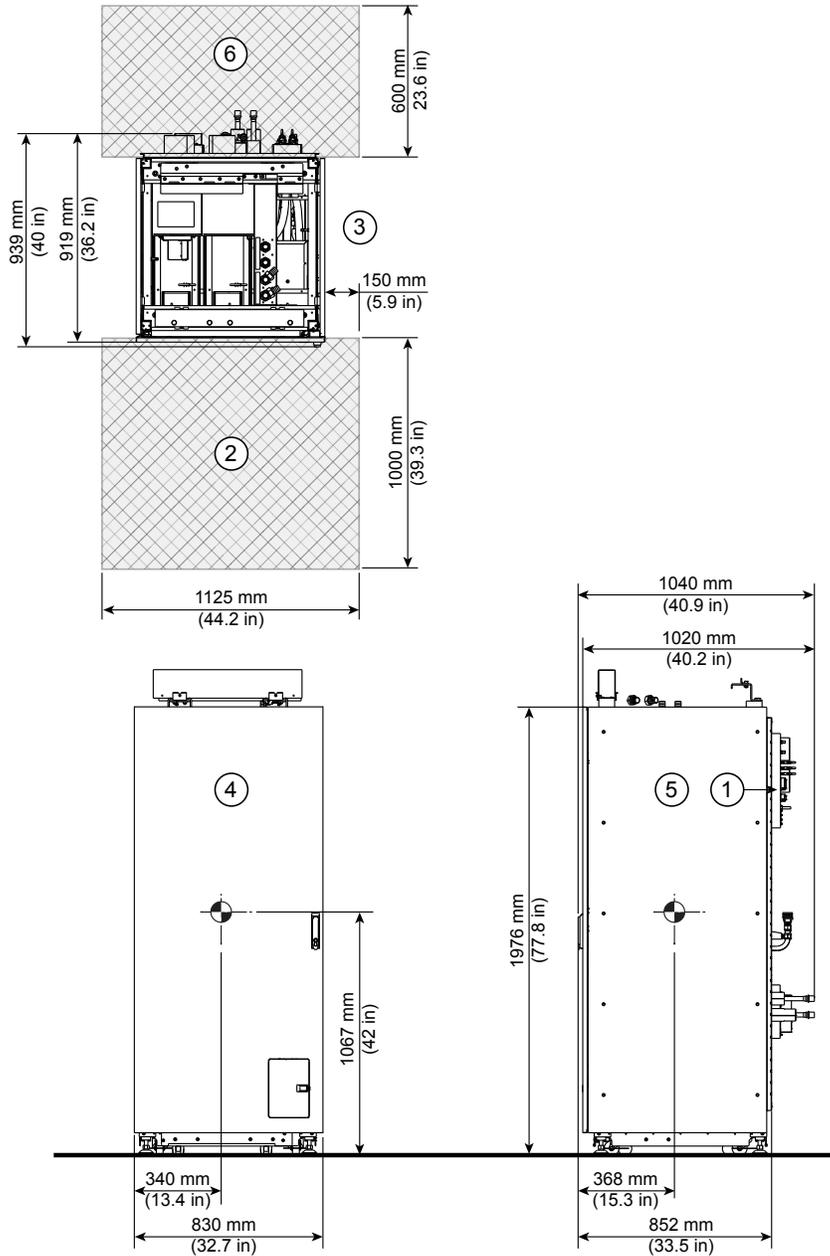
Weight without Cryocooler Compressor: 349 kg (770 lb.)

Weight with F-50SH Cryocooler Compressor: 474 kg (1045 lb.)

F-50SH Cryocooler Compressor weight: Approx 125 kg (276 lb.)

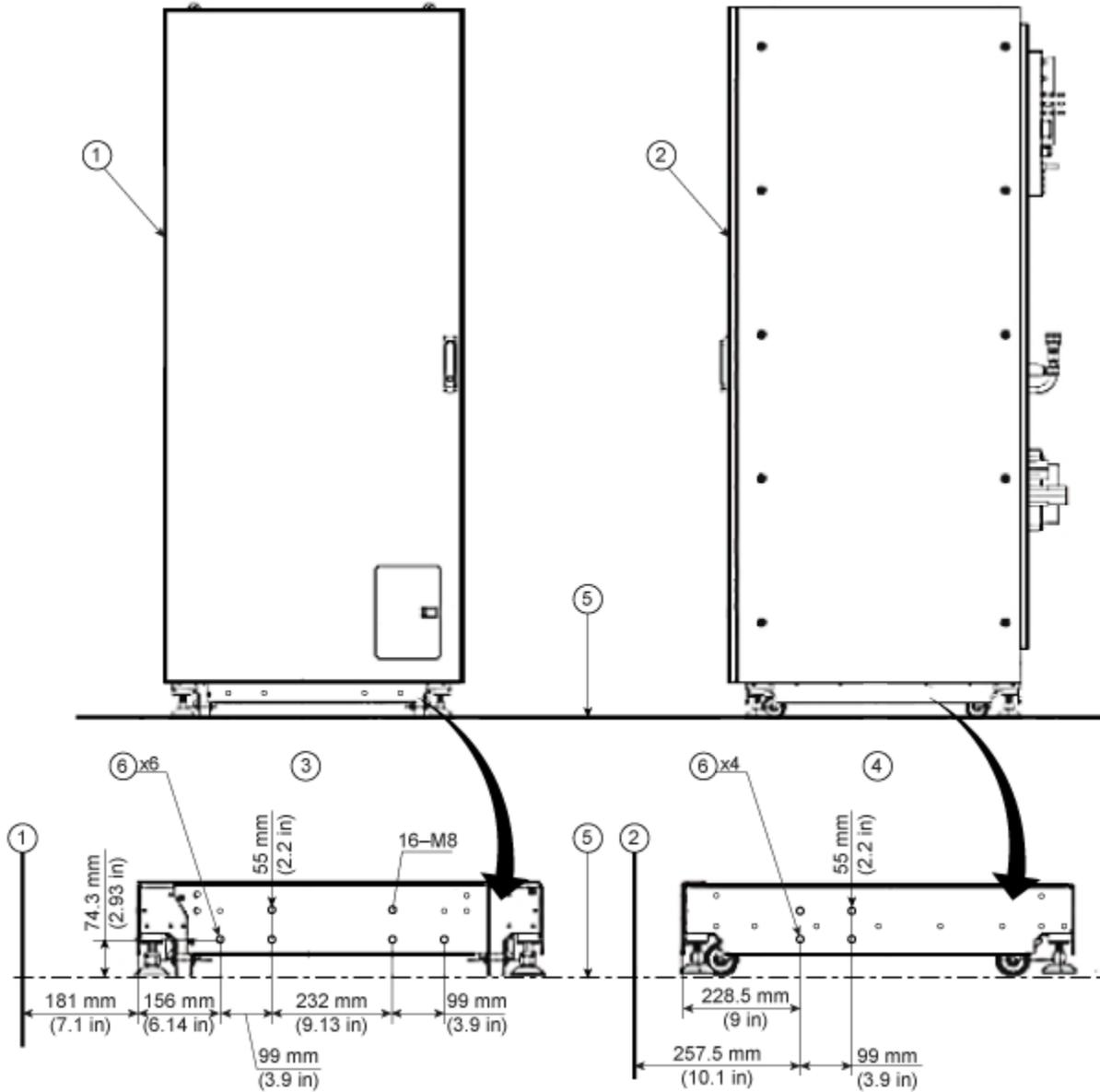
Magnetic Field Limit: 5 mT (50 G) (Penetration Panel side)

Figure 4-6 Integrated Cooling Cabinet (ICC)



Item	Description	Item	Description
1	50G limit	4	Front View
2	Service Clearance	5	Side View
3	Top View	6	Service Clearance for remote (Off the wall) siting configuration

Figure 4-7 ICC Anchor Bracket Location For Seismic Mounting

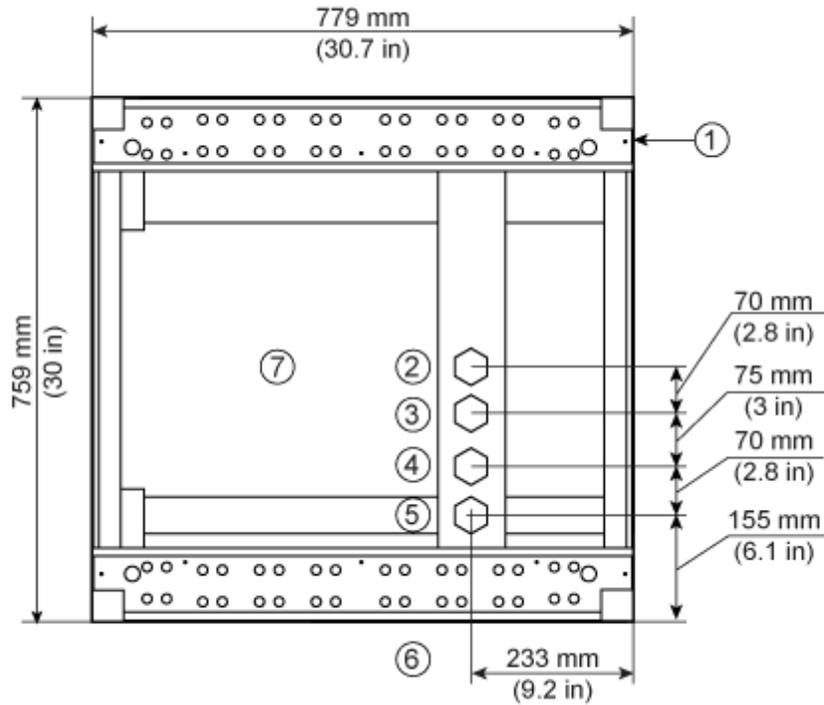


Item	Description	Item	Description
1	Side Cover	4	Side View
2	Front Cover	5	Floor
3	Front View	6	(16) M8 Seismic Anchor Mounting Holes

NOTE

The left side and the right side of the ICC anchor bracket locations are symmetrical.

Figure 4-8 ICC Facility Water Supply and Return Connections Location



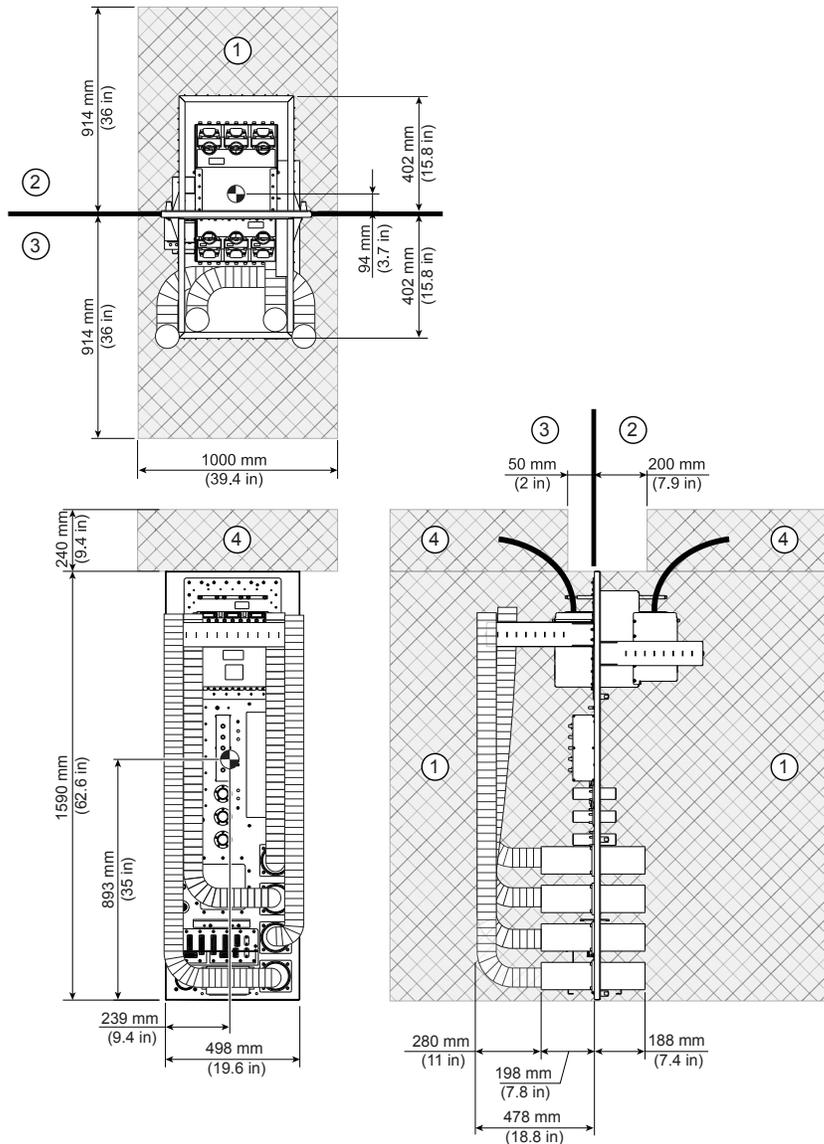
Item	Description	Item	Description
1	ICC Frame	5	ISC Supply
2	Facility Supply	6	Cabinet Front
3	Facility Return	7	Top View
4	ISC Return	-	-

4.5 Penetration Panel Specifications for Remote (Off the Wall) Siting Configuration

The Penetration Panel provides interconnects from the Equipment Room through the Magnet Room RF Shield.

1. Magnetic Field Limit: 20 mT (200 G)
2. Refer to [3.5 Penetration Panel Wall Opening Requirements for Remote \(Off the Wall\) Siting Configuration](#) on page 66 for mounting and location requirements.

Figure 4-9 Penetration Panel



Item	Description	Item	Description
1	Service Clearance	3	Equipment Room
2	Magnet Room	-	-

4.6 ISC and ICC Construction Requirements

This section describes the special considerations of Integrated System Cabinet (ISC) and Integrated Cooling Cabinet (ICC).

Specification of Floor under ISC and ICC:

1. Floor slope: $< \pm 0.5 \text{ deg}$ ($< \pm 8.7 \text{ mm / m}$)
2. Floor surface: $< \pm 5 \text{ mm}$ in cabinet installation area

- Do not place the carpet under the cabinets.

Figure 4-10 Area to be leveled

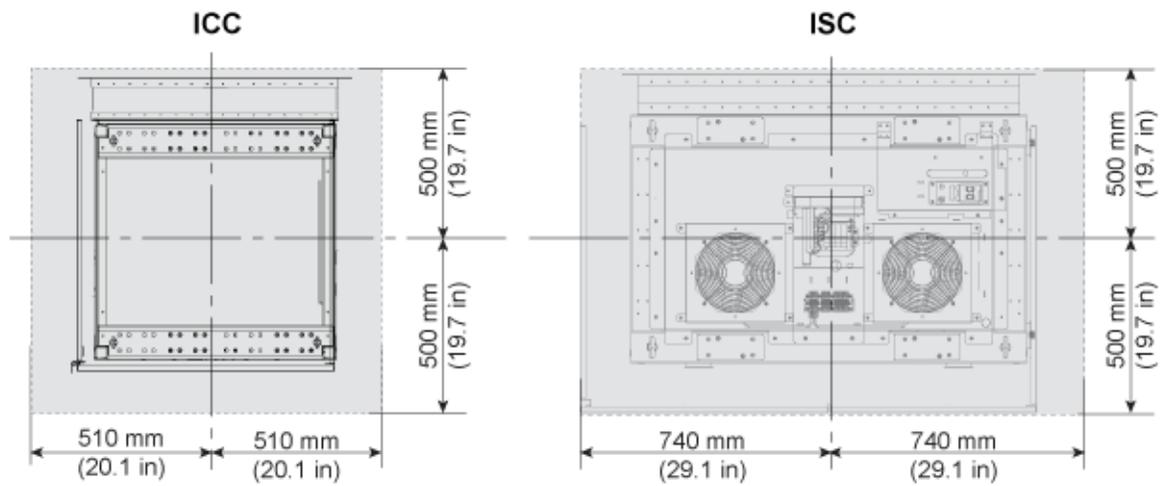
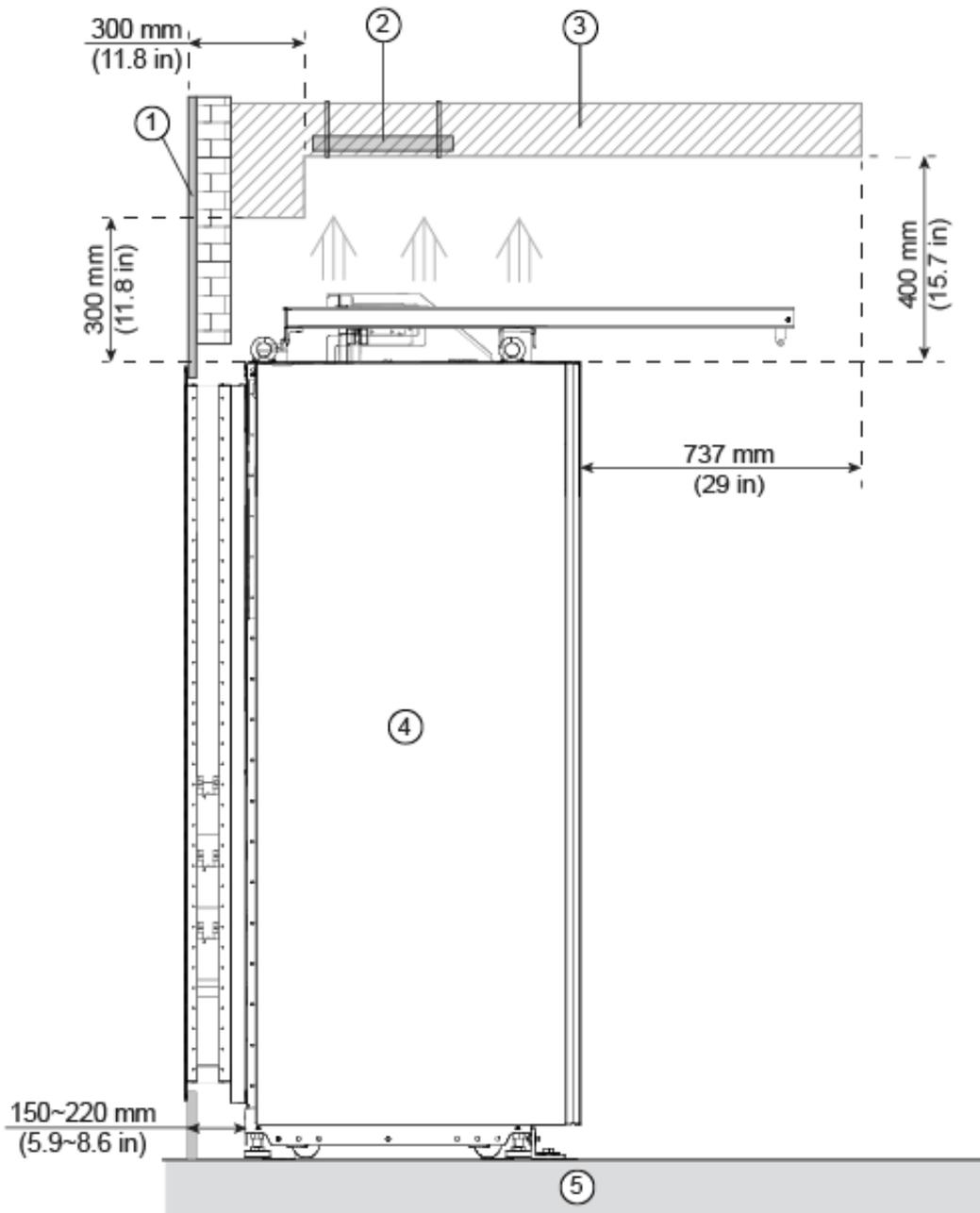


Figure 4-11 Minimum top area and Mesh Shield Specification for Standard (On the Wall) siting Configuration on page 102 and Figure 4-12 Minimum top area and Mesh Shield Specification for Remote (Off the Wall) siting Configuration on page 103 show the following specifications:

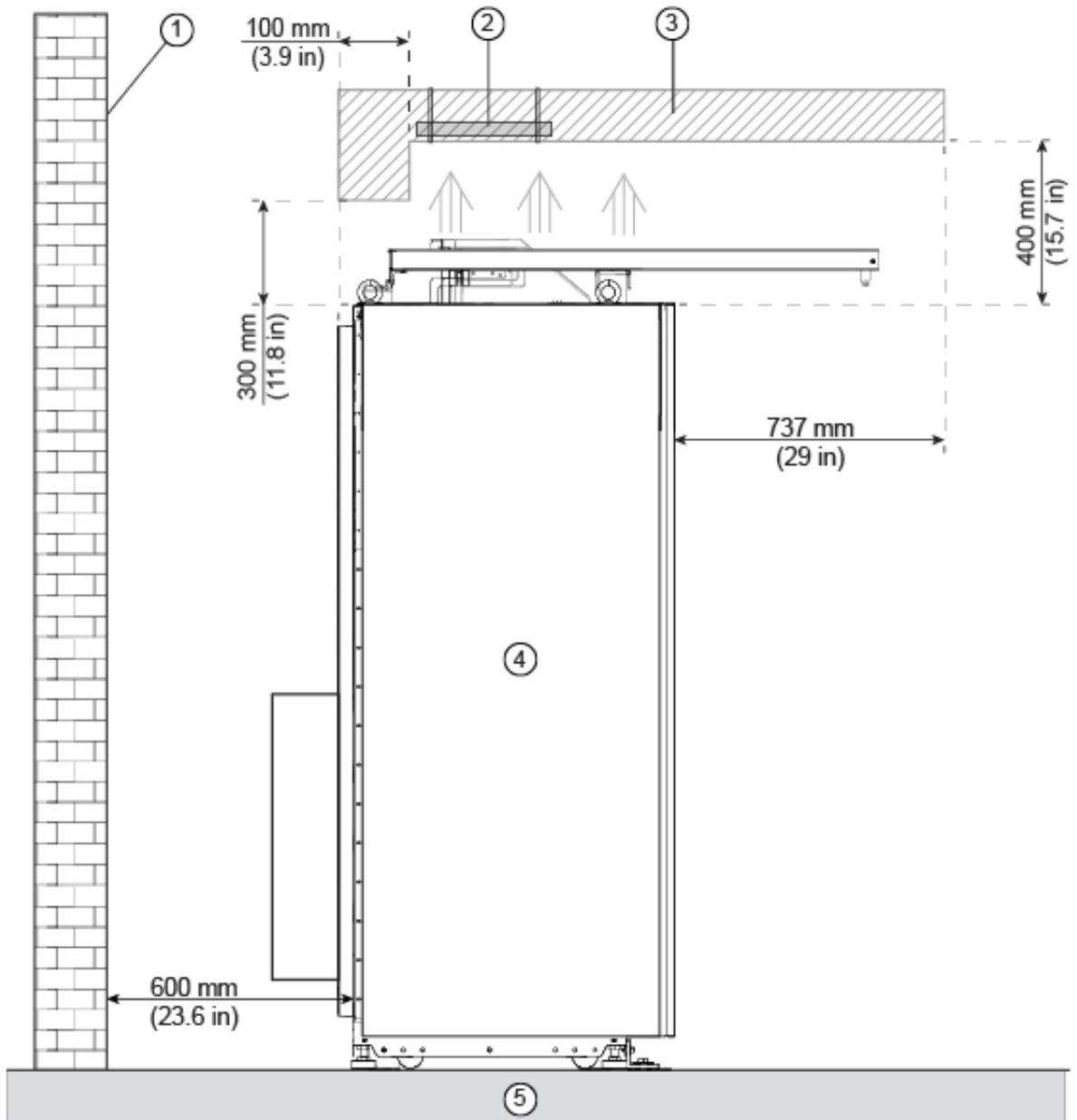
- Minimum top area including cable tray or ceiling for air flow and servicing.
- (For Standard (On the wall) siting configuration only)** Distance between RF shield (from Magnet Room) and ISC/ICC PEN Wall per Mesh Shield flexibility.

Figure 4-11 Minimum top area and Mesh Shield Specification for Standard (On the Wall) siting Configuration



Item	Description		
1	RF Shield	4	ISC/ICC Side View
2	Cable tray (as an example)	5	Floor
3	Any obstacles including cable tray and ceiling must be in this area or above		

Figure 4-12 Minimum top area and Mesh Shield Specification for Remote (Off the Wall) siting Configuration



Item	Description		
1	Wall	4	ISC/ICC Side View
2	Cable tray (as an example)	5	Floor
3	Any obstacles including cable tray and ceiling must be in this area or above		

4.7 Magnet Monitor (MON) Requirements and Specifications

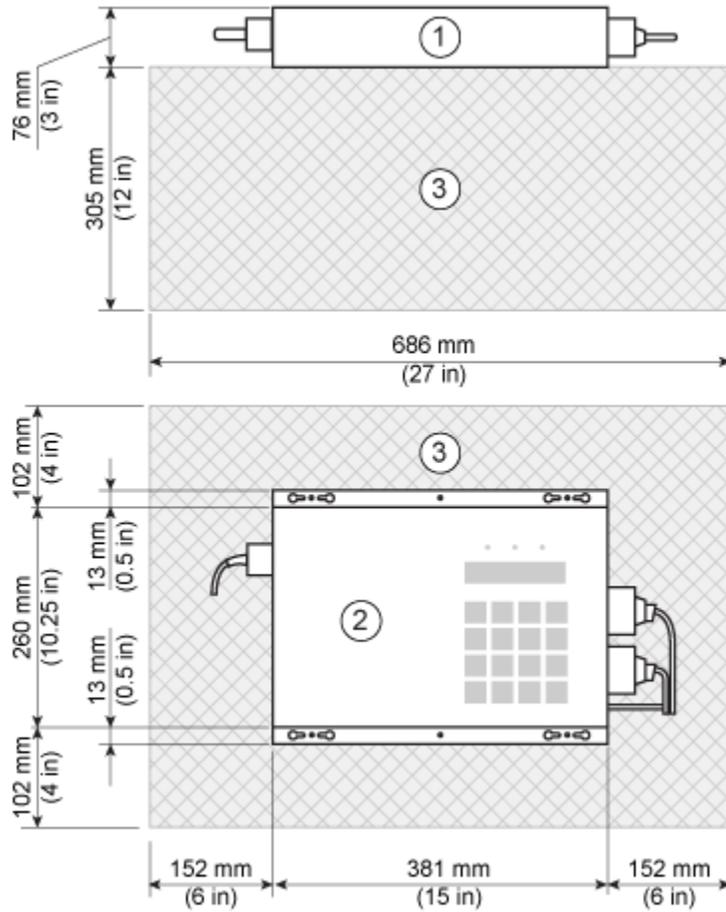
4.7.1 Requirements

1. Customer must supply T100 network connection with RJ45 connector to the Magnet Monitor (MON). Network connectivity must be active prior to magnet delivery.
2. The cable must be Cat 5 or better.
3. The network connection must not be routed through the Ethernet switch in the Global Operator Cabinet (GOC).

4.7.2 Specifications

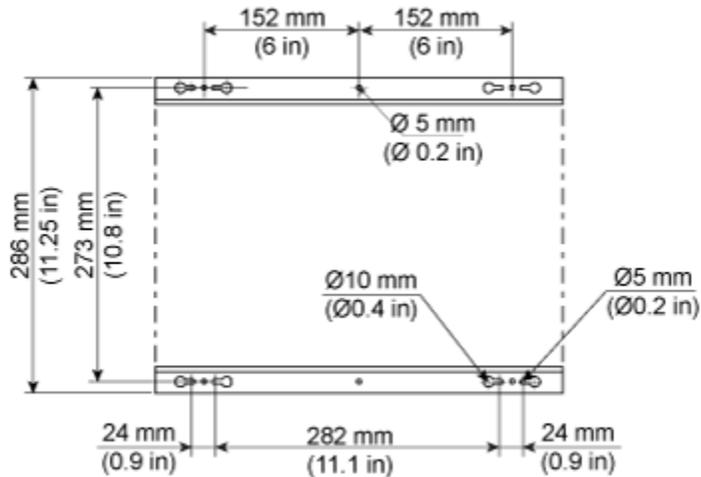
1. Mounting location: On the wall or on either side of the ICC
2. Weight: 4.5 kg (10 lb.)
3. Magnetic Field Limit: 20 mT (200 gauss)
4. Power cord length: 1829 mm (72 in.)

Figure 4-13 Magnet Monitor (MON)



Item	Description	Item	Description
1	Top View	3	Service area
2	Front View	-	-

Figure 4-14 Magnet Monitor (MON) Mounting Patterns



4.8 Magnetic Resonance Elastography (MRE) Specifications (Optional Equipment)

4.8.1 Requirements

1. **(For Standard (On the wall) siting configuration)** The customer must work with the RF shield vendor to provide a waveguide for the 25 mm (1 in.) diameter tube. The waveguide plate can be installed at the ICC rear panel to accommodate the 25 mm (1 in.) diameter tube. Refer to [Figure 4-16 Facility provided wave guide for ICC for Standard \(On the Wall\) Siting Configuration on page 107](#) for dimensions.
2. **(For Remote (Off the wall) siting configuration only)** The waveguide plate is mounted directly to the penetration panel. The 25 mm (1 in.) diameter tube will pass directly through the GE-provided waveguide on the penetration panel. Refer to [Figure 4-17 Wave guide on Penetration Panel for MRE For Remote \(Off the wall\) siting configuration on page 108](#).
3. MRE Resonant Acoustic Driver location is limited to the length of the 25 mm (1 in.) tube (see the available cable lengths in [7.1.5 Magnetic Resonance Elastography \(MRE\) Option on page 123](#)).

4.8.2 Specifications

1. Weight: 24.22 kg (53.4 lb.)
2. Magnetic Field Limit: 5 mT (50 G)
3. Power Cord Length:
 - 60 Hz: 6096 mm (240 in.)
 - 50 Hz: 7620 mm (300 in.)

Figure 4-15 Magnetic Resonance Elastography (MRE) Resonant Acoustic Driver

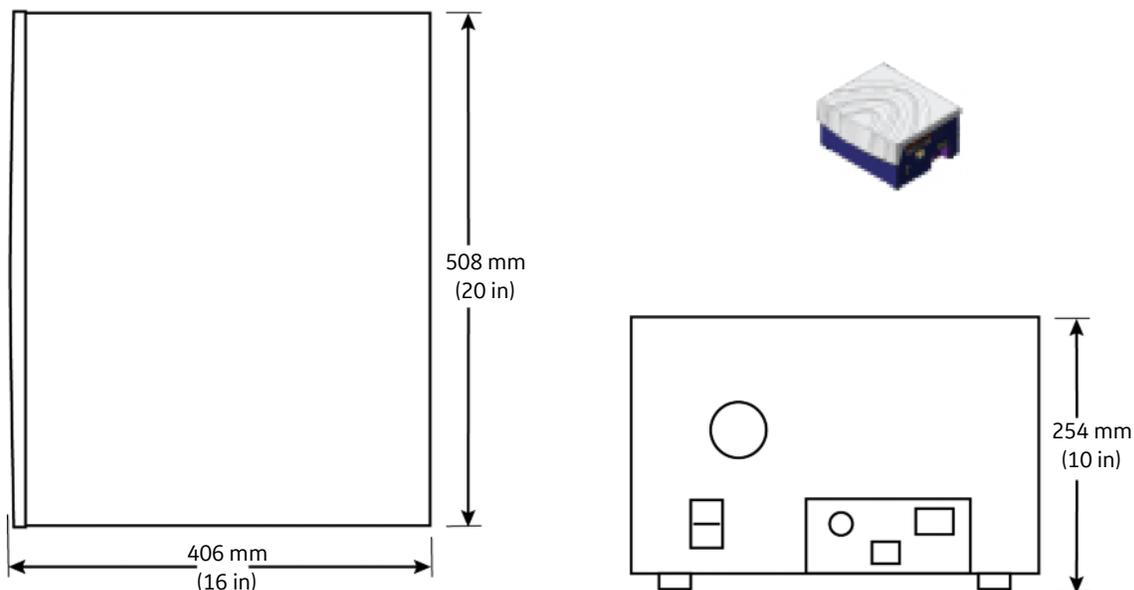
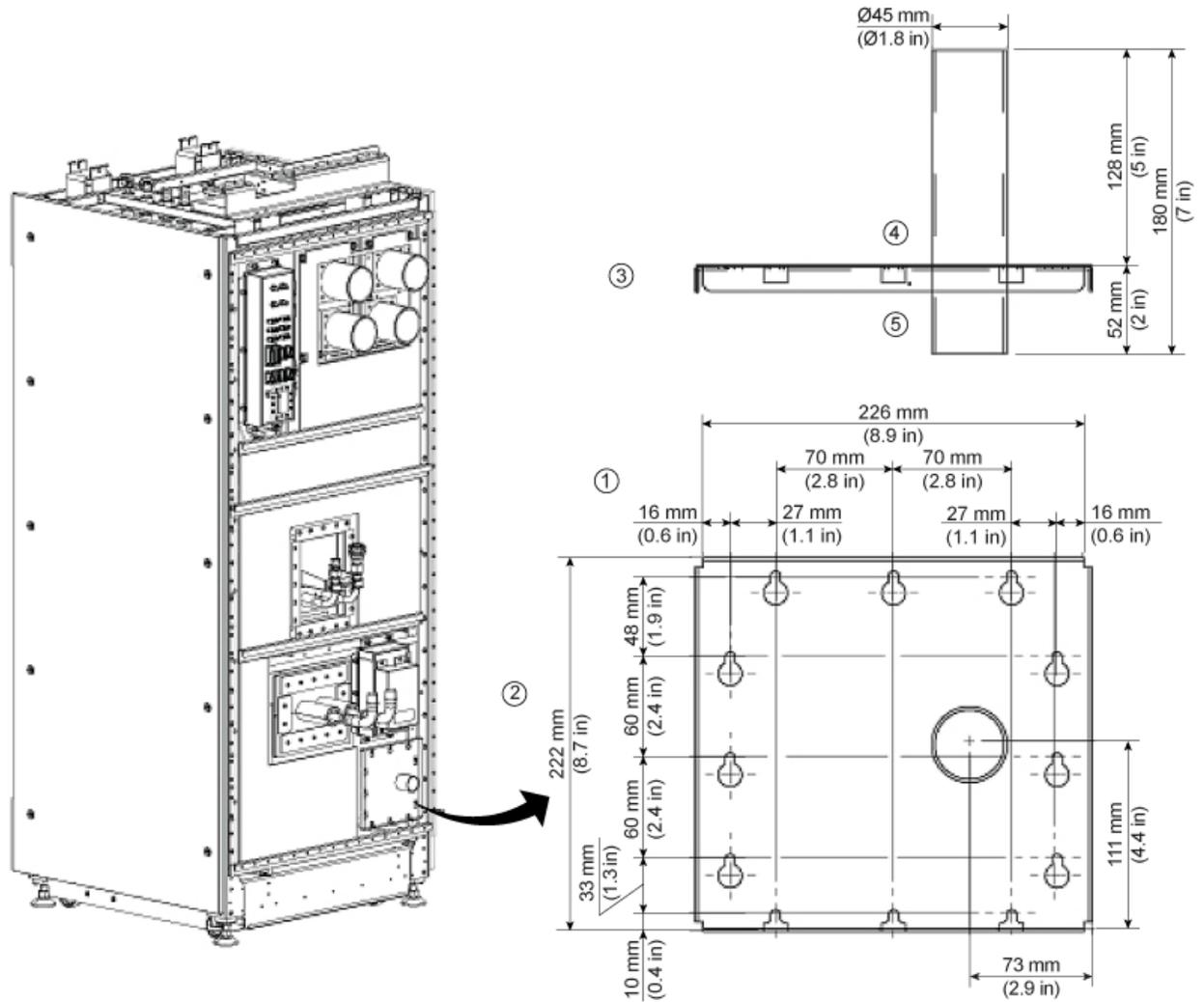
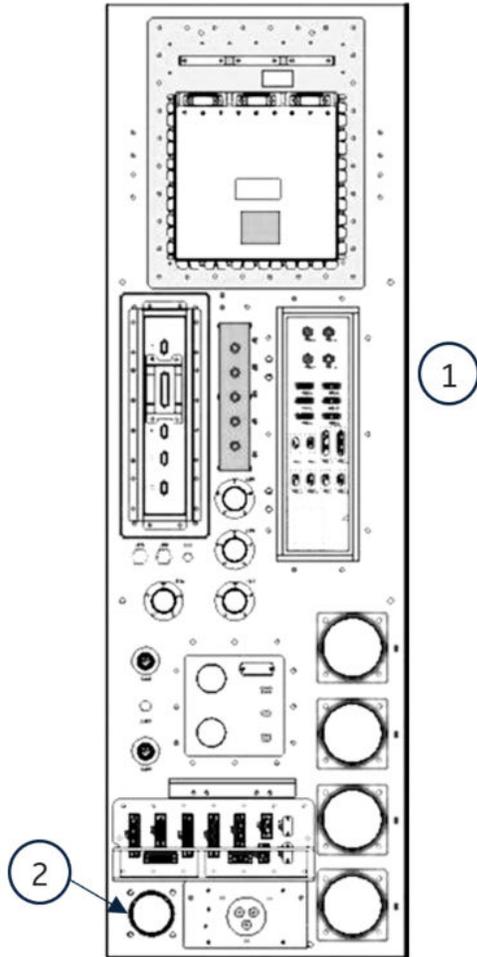


Figure 4-16 Facility provided wave guide for ICC for Standard (On the Wall) Siting Configuration



Item	Description	Item	Description
1	Front View	4	Equipment Room
2	Facility provided wave guide	5	Magnet Room
3	Top View		

Figure 4-17 Wave guide on Penetration Panel for MRE For Remote (Off the wall) siting configuration



Item	Description
1	Equipment room
2	Wave Guide for MRE

5 Control Room

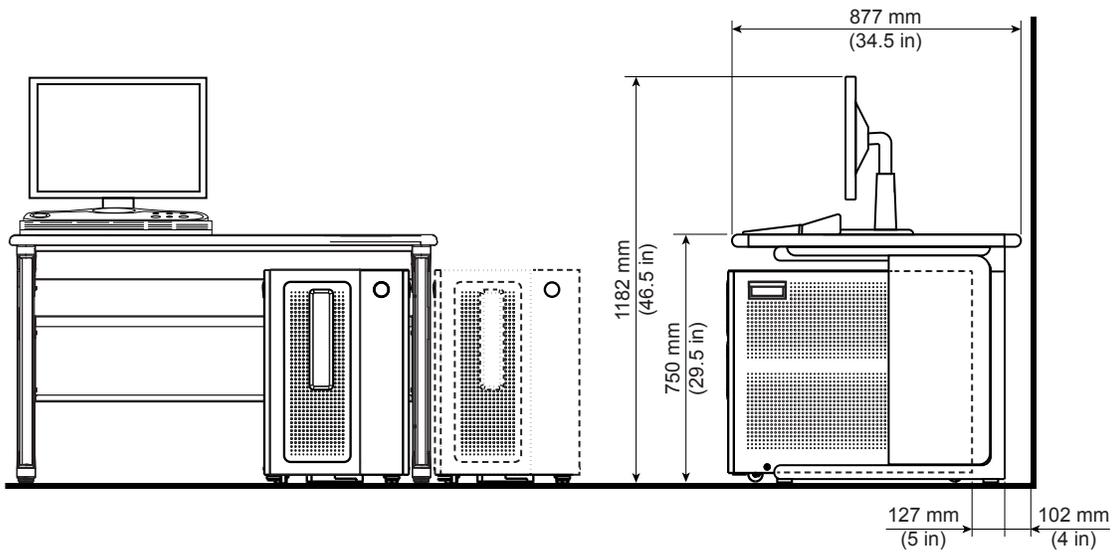
5.1 Operator Workspace Equipment Specifications



(Applies to all sections within this chapter)

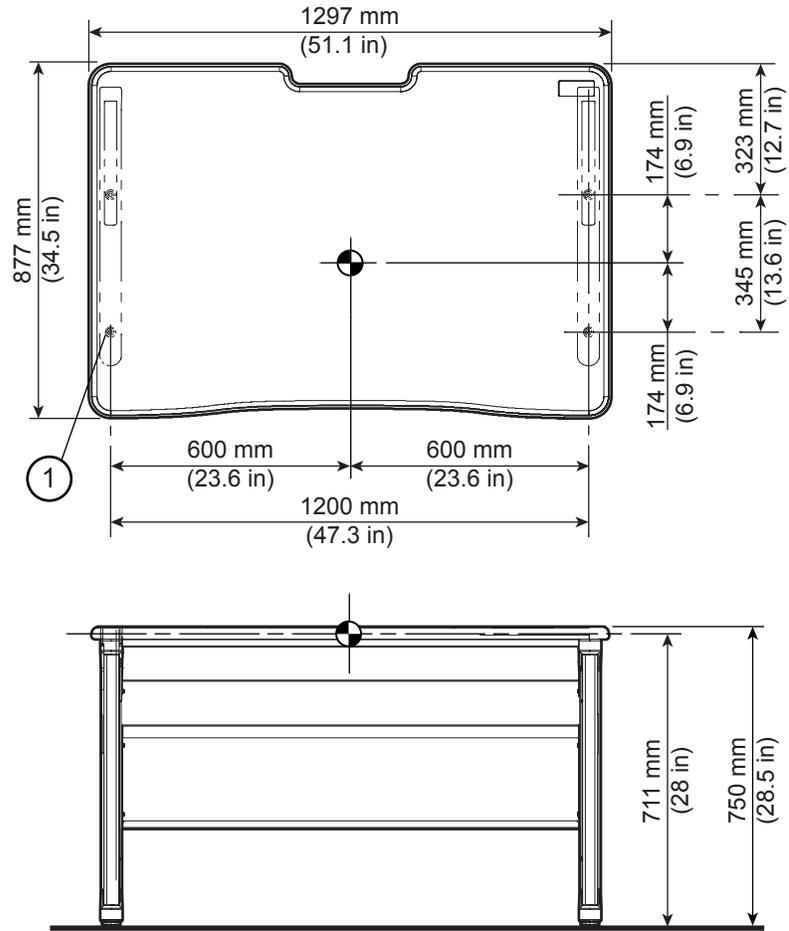
5.1.1 Operator Workspace Assembly

Figure 5-1 Operator Workspace Assembly



5.1.2 Operator Workspace (OW) (Optional Equipment)

Figure 5-2 Operator Workspace (OW) Table (Top and Front View)

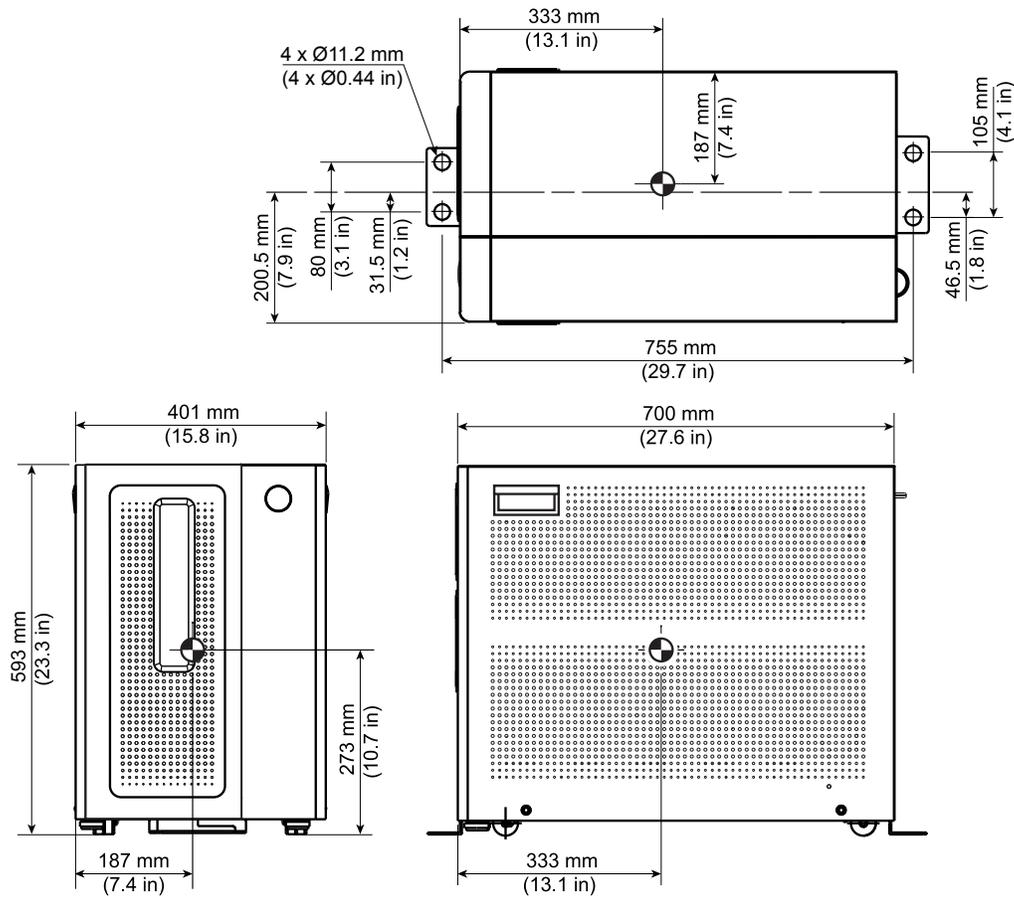


Item	Description
1	Four (4) 15.9 mm (5/8 in.) thru mounting holes for 9.5 mm (3/8 in.) seismic anchors

5.1.3 Global Operator Cabinet (GOC)

1. Weight: 59.3 kg (130.7 lb.)
2. Magnetic Field Limit: 5 mT (50 G)
3. Anchor size: M10 (3/8 in.)

Figure 5-3 Global Operator Cabinet (GOC)

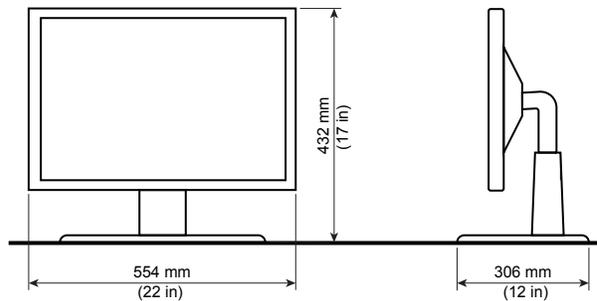


5.1.4 Host Display

Weight and dimensions for the Host Display are approximate and might vary depending on the display model.

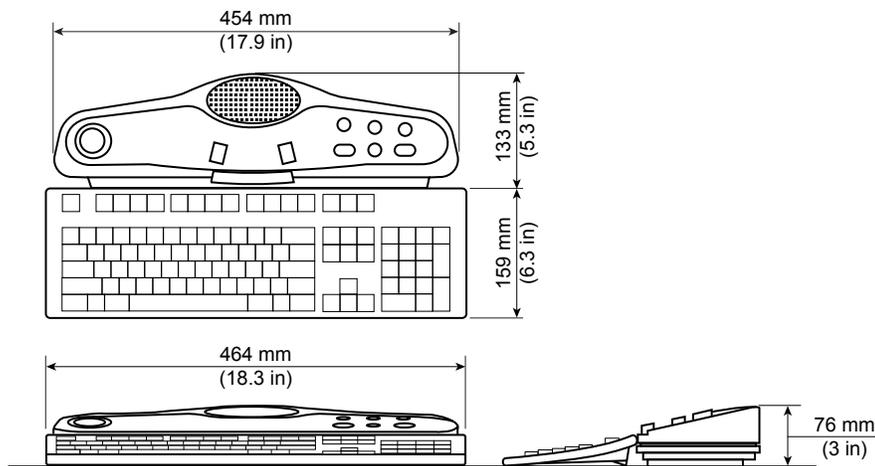
1. Weight: 6.7kg (14.8 lb.)
2. Magnetic Field Limit: 5 mT (50 G)

Figure 5-4 Host Display



5.1.5 Host Keyboard

Figure 5-5 Host Keyboard

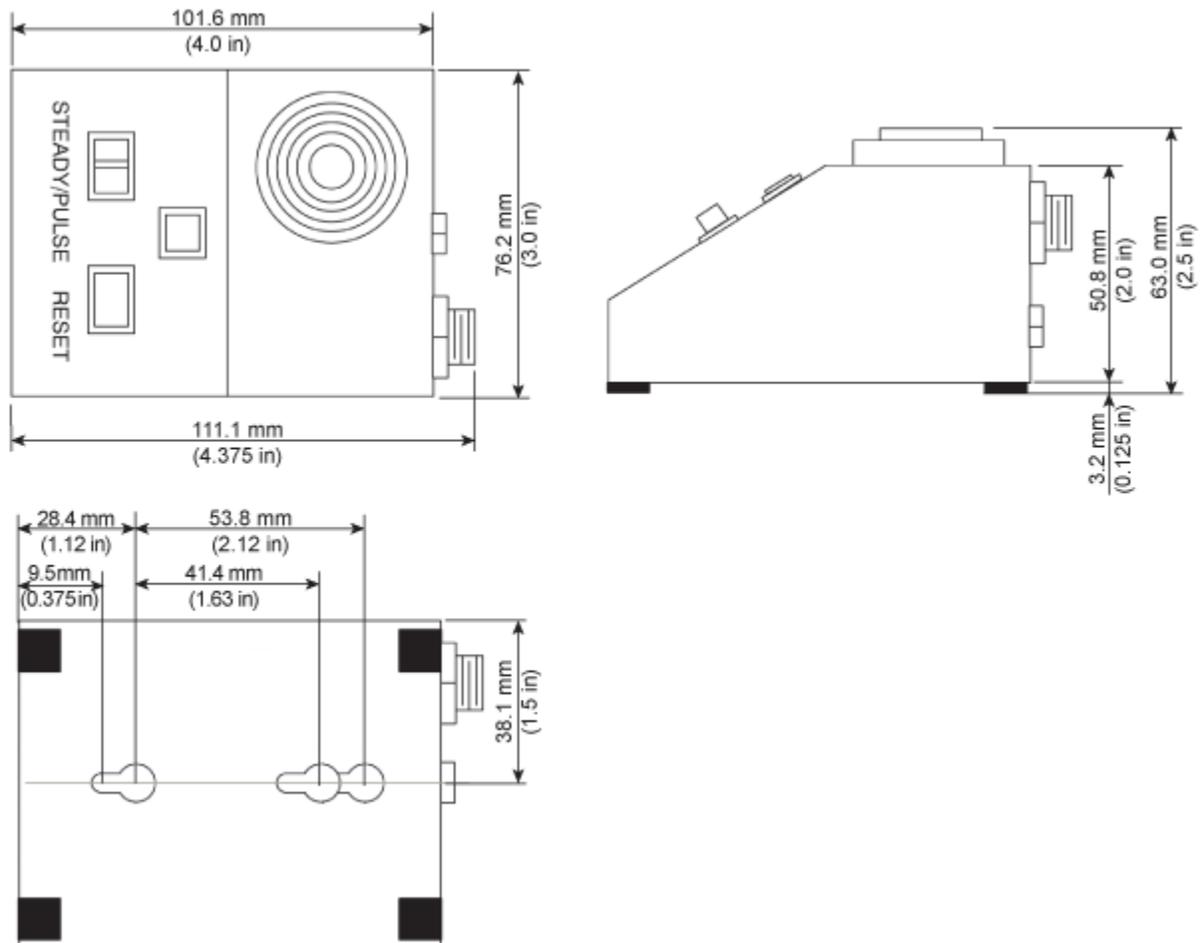


5.1.6 Pneumatic Patient Alert

The Pneumatic Patient Alert system allows the patient to contact the operator. The Control Box audible and visual alarm will be activated by the patient squeeze bulb which is located on the Magnet Enclosure and connected by pneumatic tubing through the Penetration Panel to the Control Box.

1. Weight 0.2 kg (0.5 lb.)
2. Magnetic Field Limit: 5 mT (50 G)
3. The Control Box must be placed or mounted within reach of the operator and within 1.5 m (5 ft.) of an electrical outlet.

Figure 5-6 Pneumatic Patient Alert (PA) with Mounting Pattern

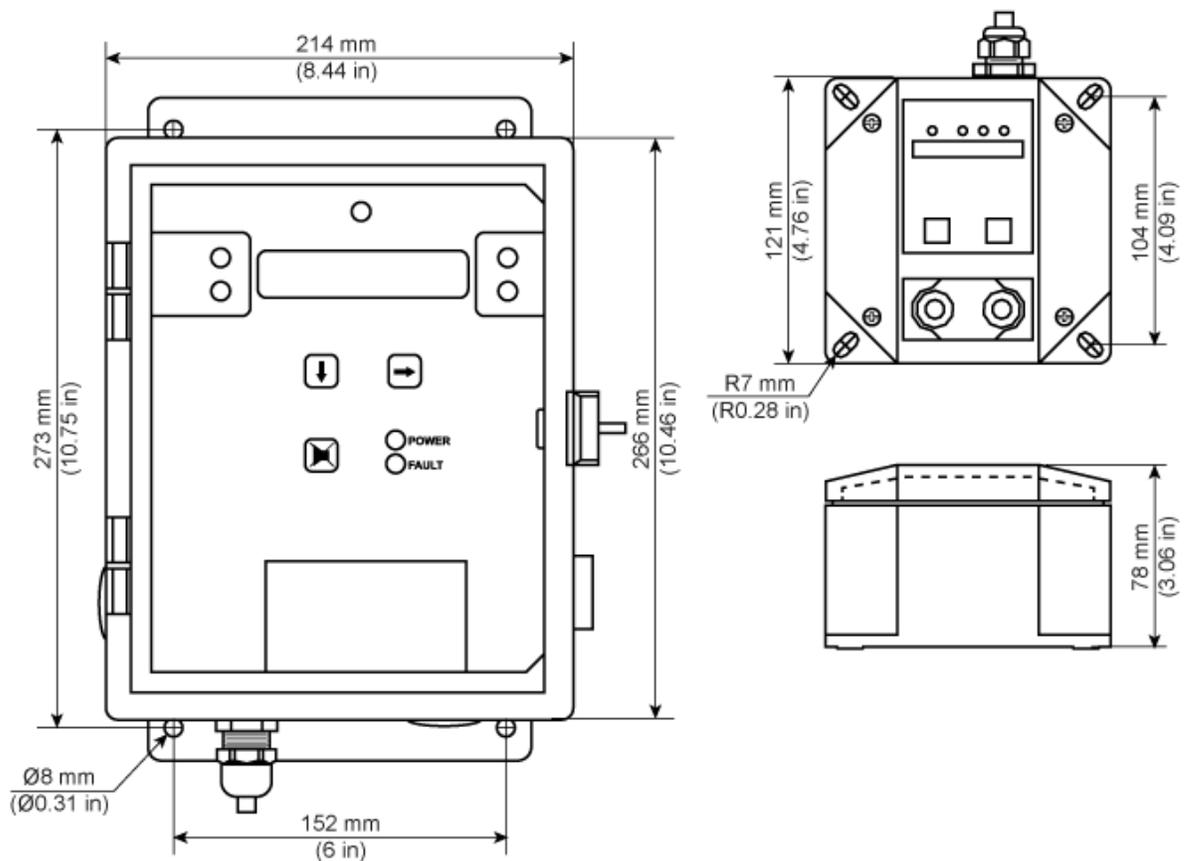


5.2 Oxygen Monitor (OXY) Specifications (Optional Equipment)

The optional Oxygen Monitor system consists of the Oxygen Monitor, the Remote Oxygen Sensor Module, and interconnects through the Pen Wall in ICC. The Oxygen Monitor alarm is located near the Operator Workspace and is activated by the Remote Oxygen Sensor Module in the Magnet Room.

1. Oxygen Monitor Weight: 3.6 kg (8 lb.)
2. Oxygen Sensor Module Weight: 0.9 kg (2 lb.)
3. Magnetic Field Limit: 5 mT (50 G)

Figure 5-7 Oxygen Monitor and Remote Sensor

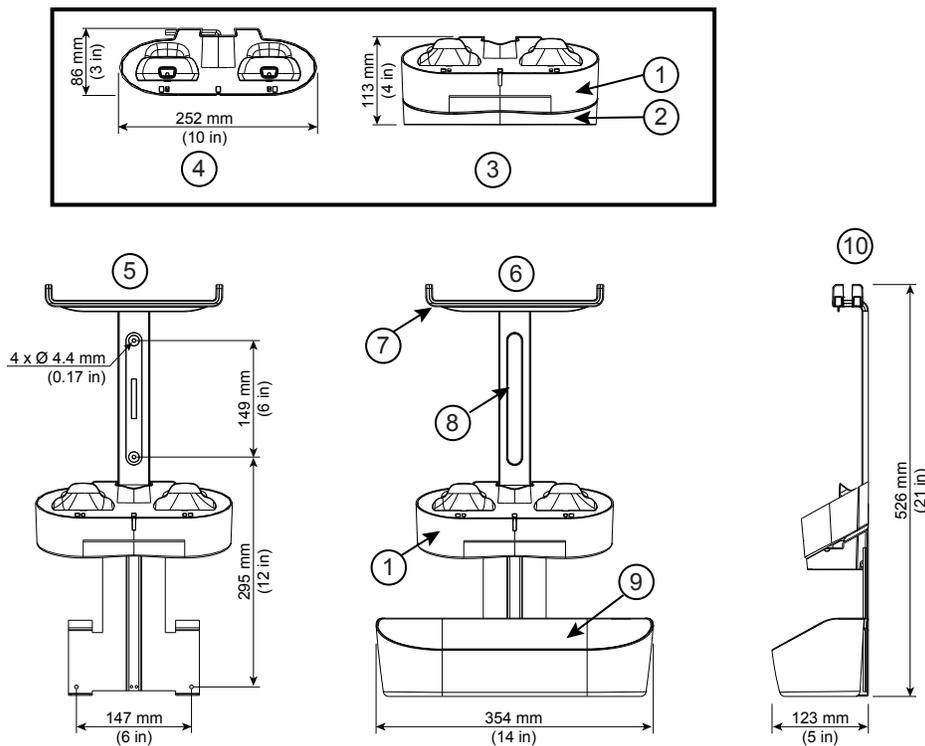


5.3 Physiological Acquisition Transceiver (PAT) Charging Station Specification (Optional Equipment)

The charging station supports the docking and charging of the Physiological Acquisition Transceiver (PAT). It is intended for installing outside the MR scanner magnet room, typically in the Control room. The charging station provides hooks for draping the ECG cable and respiratory sensor cable to facilitate cable management.

1. The charging cradle can be placed on the desktop or mounted on the wall.
2. A clean, level surface tabletop is required for desktop placement method.
3. Charging station wall mounted configuration maximum weight: 4.2kg (9.3 lbs)
4. Magnetic Field Limit: 5 mT (50 G)
5. The charging cradle must be placed or mounted within 3000 mm (118 in.) of an electrical outlet.

Figure 5-8 Charging Cradle Desktop and Wall Mounting Configuration



Item	Description	Item	Description
1	Charging cradle	6	Front View - wall mounting configuration with storage basket
2	Desktop base adapter	7	Storage hooks
3	Front View - desktop configuration	8	Wall mount support
4	Top View - desktop configuration	9	Storage basket
5	Front View - wall mounting configuration	10	Side View - wall mounting configuration with storage basket

6 Digital Service and Connectivity Requirements

6.1 InSite RSvP (Remote Service Platform) Requirements



(Applies to all sections within this chapter)

6.1.1 InSite RSvP Connectivity Requirements

Following are the requirements for InSite RSvP connectivity:

1. The customer shall provide a physical connection or a route to an existing enterprise LAN.
2. The cable must be Cat 5 or better.
3. The customer shall provide outbound internet access for the device using HTTPS protocol over port 443.
4. The customer's network administrators shall provide DNS IP Address or Proxy IP address and authentication information (if applicable for the proxy server).
5. The customer's network administrators shall whitelist the following URLs:
 - Enterprise production:
 - <https://insite.gehealthcare.com:443>
 - <https://as1-insite.gehealthcare.com>
 - <https://as2-insite.gehealthcare.com>
 - Flexera URL: <https://gehealthcare-ns.flexnetoperations.com>
 - Flexera Software Download URL: <https://download.flexnetoperations.com>
 - For EU regions, whitelist the following:
 - <https://as1-insite-eu.gehealthcare.com>
 - <https://insite-eu.gehealthcare.com>

7 MR System Interconnects

7.1 MR System Interconnects Specifications



(Applies to all subsections within this section)

7.1.1 Component Designator Definitions

GE HealthCare uses Component Designators to identify system components. All subsystem cabinets and other components are referred to by their component designators in the Interconnect Data diagrams and tables.

Table 7-1 MR System Component Designators

Component Designator	Description
CRY	Cryocooler Compressor Cabinet
DS, DS1	Door Switch
E01, E02, and so on	Emergency-Off (E-Off) Buttons
ICC	Integrated Cooling Cabinet
ISC	Integrated System Cabinet
MAG	Magnet and Enclosure (all magnet enclosure components in Magnet Room)
MDP	Main Disconnect Panel
MON	Magnet Monitor
MRU	Magnet Rundown Unit
OW	Operator Workstation
PA1	Pneumatic Patient Alert Control Box
PDU	Power Distribution Unit (PDU) is a module in the ISC cabinet
PP	Penetration Panel for remote (Off the wall) siting configuration
PT	Patient Transport Table

Table 7-2 MR System Options Component Designators

Component Designator	Description
OXY	Oxygen Monitor
MRE	Magnetic Resonance Elastography
PAT CS	Physiological Acquisition Transceiver Charging Station

7.1.2 Available Cable Lengths for Standard (On the Wall) Siting Configuration

Three configurations of cable lengths are available for order. To determine required cable lengths, find the total distance of the cable path between the specified equipment by measuring the following:

- distance from the top of the specified equipment up to the cable tray
- horizontal distance across the cable tray
- distance from the cable tray to the top of the other specified equipment

Compare the total distance to the lengths specified in [Table 7-4 Available Cable Lengths on page 118](#). If your total distance is more than the "Short" distance, but less than the "Long" distance, the Site Option is "Long." If both of your Site Options are "Long", or if either option is more than the "Long" distance, you must reconfigure the layout of the room.

Table 7-3 Order Configuration Options

Configuration	Equipment Room — Site Option	Magnet Room — Site Option
A	Short	Short
B	Long	Short
C	Short	Long

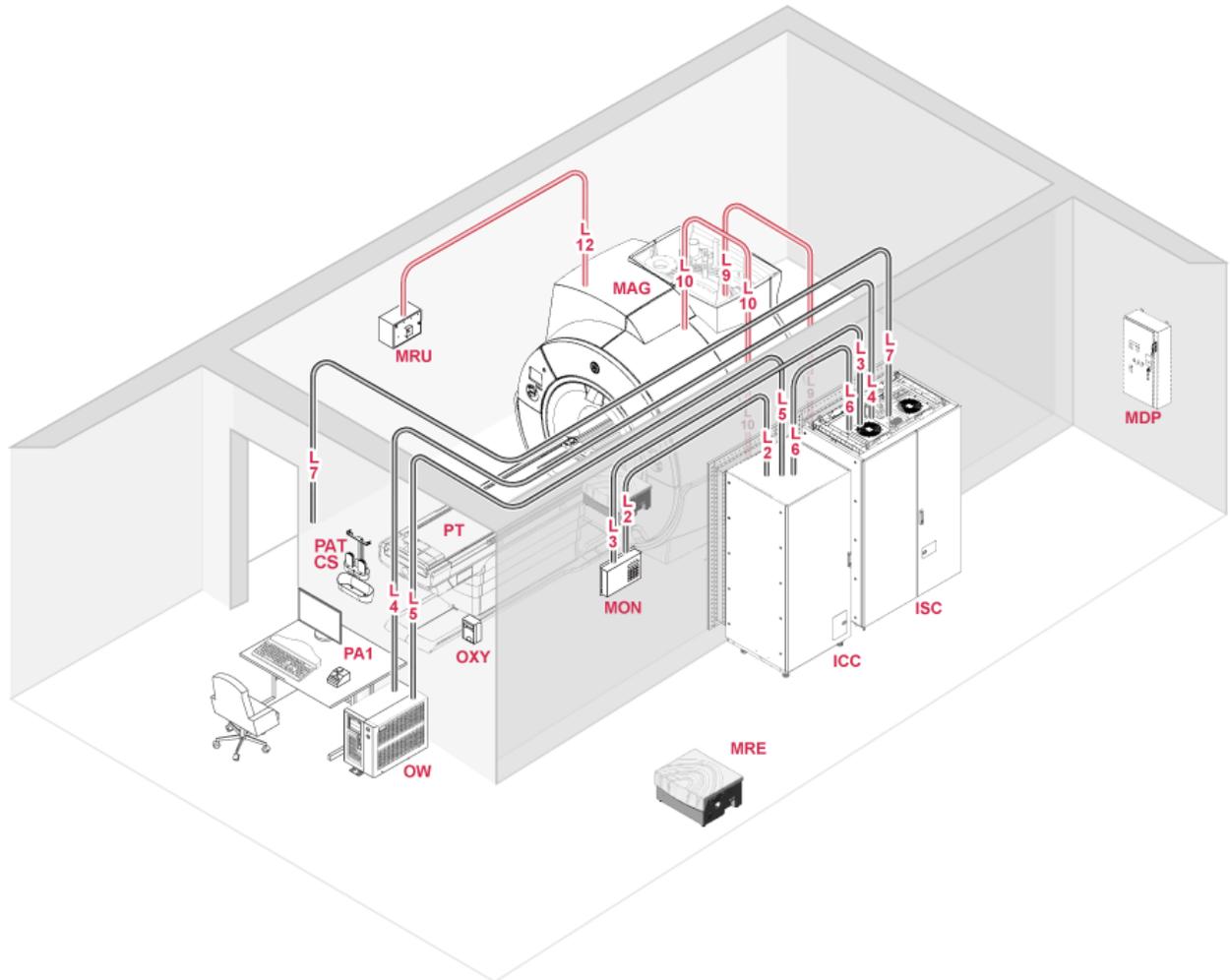
Table 7-4 Available Cable Lengths

Length Identifier (shown in the figure below)	Point A	Point B	Site Option: Short	Site Option: Long
			mm (in.)	
Equipment Room				
Not shown	CRY	MON	10000 (393.7)	
L2	MON	ICC	16800 (661.4)	
L3	ISC, top panel	MON	16400 (645.7)	
L4	ISC, top panel	OW, rear panel	25000 (97.5)	
L5	ICC, top panel	OW, rear panel	25000 (97.5)	
L6	ICC, top panel	ISC, top panel	4000 (157.5)	6400 (252)
L7	ISC, top panel	Magnet Room door switch	24400 (960.6)	
Not shown	ICC, PEN Panel	E-Off switch, Control Room or Equipment Room	16800 (661.4)	
Magnet Room				
L9	MAG, gradient cable clamp block	ISC PEN Panel	5400 (210.6)	9400 (370.1)
L10	MAG	ICC PEN Panel	13000 (511.8)	
Not shown	ICC PEN Panel	E-Off switch, Magnet Room	29800 (1173.2)	

Table 7-4 Available Cable Lengths (Table continued)

Length Identifier (shown in the figure below)	Point A	Point B	Site Option: Short	Site Option: Long
			mm (in.)	
L12	MRU	MAG, gradient cable clamp block	24700 (972.4)	

Figure 7-1 Available Cable/Hose Lengths for Standard (On the Wall) Configuration



NOTE

MRE, PAT Charging Station and OXY shown above are optional components of the system.

7.1.3 Available Cable Lengths for Remote (Off the Wall) Configuration

Only one cable length is available for Remote (Off the Wall) configuration except gradient cables and RF cables.

Table 7-5 Available Cable and Hose Lengths for Remote (Off the Wall) Configuration

Length Identifier (shown in the figure below)	Point A	Point B	Available Cable Length mm (in.)
Equipment Room			
Not shown	CRY	MON	10000 (393.7)
L2	MON	ICC	16800 (661.4)
L3	ISC, top panel	MON	16400 (645.7)
L4	ISC, top panel	OW, back of PC	25000 (97.5)
L5	ICC, top panel	OW, back of PC	25000 (97.5)
L6	ICC, top panel	ISC, top panel	6400 (252)
L7	ISC, top panel	Magnet room door switch	24400 (960.6)
Not shown	PP, top edge	E-off switch, Control room or Equipment room	16800 (661.4)
L9	ICC, top panel	PP top edge	14000 (551.2)
L10 (This length is for all cables and hoses except for gradient cables and RF cables. For gradient cable and RF cable available lengths, refer to Table 7-6 Available Cable Lengths for Gradient Cable and RF Cable (Equipment Room, Top of ISC to Pen Panel Top Edge) on page 121)	ISC, top panel	PP top edge	13500 (531.5)
L11	ISC, top panel	MAG, gradient cable clamp block	29800 (1173.2)
L12	ICC, top panel	MAG	27500 (1082.6)
L16	MON	PP, top edge	16400 (645.7)
Magnet Room			
L13 (This length is for all cables and hoses except for gradient cables and RF cables. For gradient cable and RF cable available lengths, refer to Table 7-7 Available Cable Lengths for Gradient Cable and RF Cable (Magnet Room, Magnet Gradient Cable Strain Relief Plate to Pen Panel Top Edge) on page 121)	MAG, gradient cable clamp block	PP top edge	13000 (511.8)
Not shown	PP top edge	E-off switch, Magnet Room	29800 (1173.2)
L15	MRU	MAG, gradient cable clamp block	24700 (972.4)

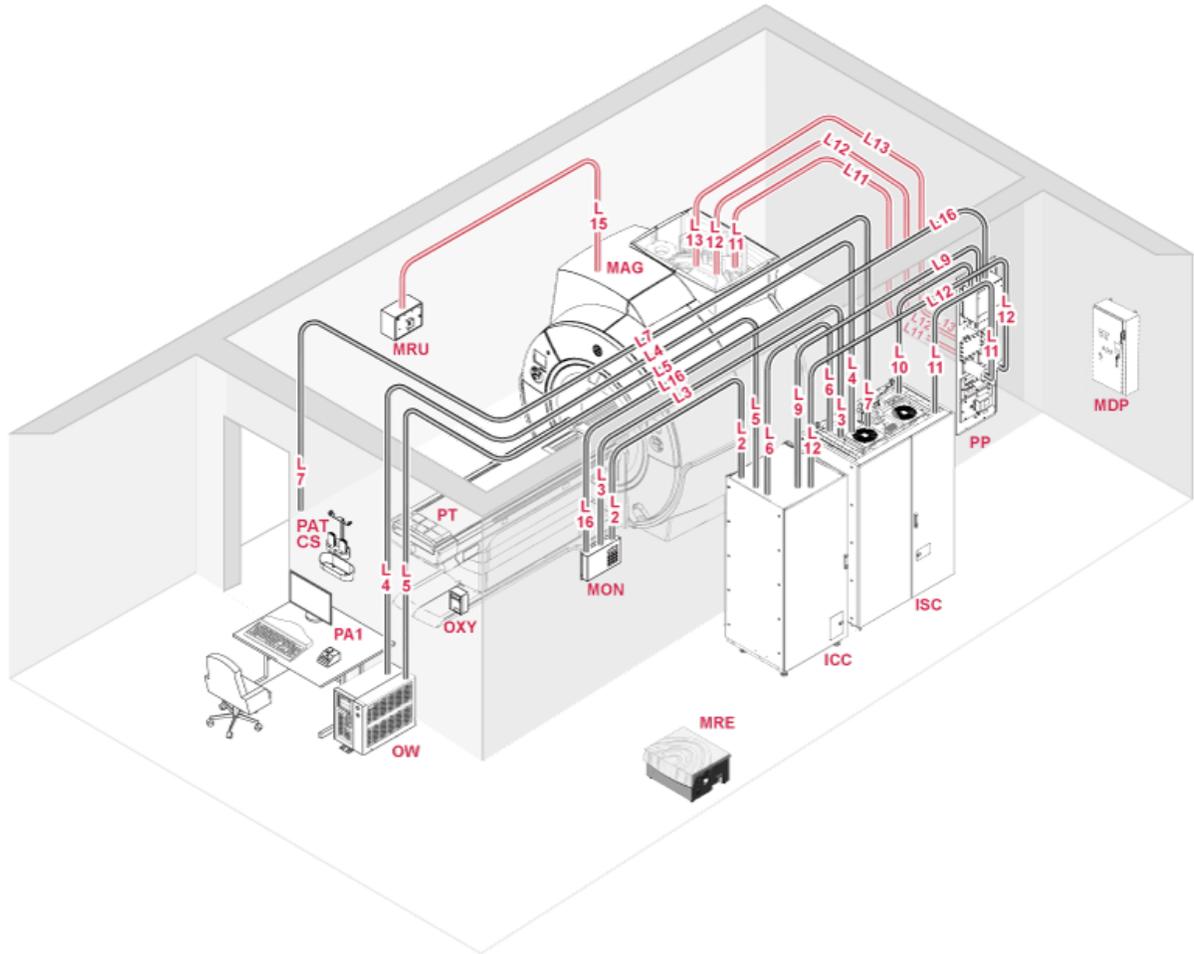
Table 7-6 Available Cable Lengths for Gradient Cable and RF Cable (Equipment Room, Top of ISC to Pen Panel Top Edge)

Length Identifier (shown in the figure below)	Available lengths mm (in.)
L10 Gradient cable	4800 (189)
	6800 (268)
	8800 (346)
	10800 (425)
	12800 (504)
	14800 (583)
L10 RF Cable (Body and Head)	7000 (276)
	13000 (512)

Table 7-7 Available Cable Lengths for Gradient Cable and RF Cable (Magnet Room, Magnet Gradient Cable Strain Relief Plate to Pen Panel Top Edge)

Length Identifier (shown in the figure below)	Available lengths mm (in.)
L13 Gradient cable	4600 (181)
	6600 (260)
	8600 (339)
	10600 (417)
	12600 (496)
L13 RF Cables (Body and Head)	9000 (354)
	13000 (512)

Figure 7-2 Available Cable/Hose Lengths for Remote (Off the Wall) Siting Configuration



NOTE

MRE, PAT Charging Station and OXY shown above are optional components of the system.

7.1.4 BrainWave Option

Table 7-8 BrainWave Option Usable Cable Lengths

Cable	From	To	Cable Length mm (in.)
9-pin D-sub to JF-50	For Remote (Off the wall) configuration: PP, top edge For Standard (On the Wall) configuration: ICC, top edge	Top of GOC	For Remote (Off the wall) configuration: 33799 (1331) For Standard (On the Wall) configuration: 32538 (1281)
9-pin D-sub to BNC	ISC, top edge	Top of GOC	26532 (1045)
9-pin D-sub to Coax	For Remote (Off the wall) configuration: PP, top edge For Standard (On the Wall) configuration: ICC, top edge	MAG, gradient cable clamp block	For Remote (Off the wall) configuration: 13479 (531) For Standard (On the Wall) configuration: 13046 (514)

7.1.5 Magnetic Resonance Elastography (MRE) Option

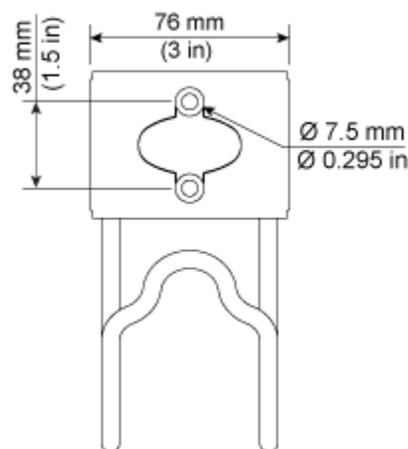
Table 7-9 MRE Option Available Cable Lengths

Cable	Point A	Point B	Configura- tion A	Configura- tion B	Configura- tion C	Configuration D
			See Table 7-3 Order Configuration Options on page 118			
			mm (in.)			
25 mm (1 in.) Tubing	Resoundant Ac- tive Driver	Magnet (Isocen- ter)	Nominal 7315 (288) Maximum 10058 (396)			Maximum 11900 (468)
BNC	Resoundant Ac- tive Driver	ISC Cabinet J6	15240 (600)			
Ethernet	Resoundant Ac- tive Driver	Ethernet Hub in ISC	15240 (600)			
Power	Resoundant Ac- tive Driver	Customer-Sup- plied Outlet	60 Hz: 6096 (240) 50 Hz: 7620 (300)			

7.1.6 Storage Requirements for Excess Gradient Cable for Remote (Off the wall) siting configuration

1. Excess gradient cable must be stored on a wall hook inside the penetration closet in the Magnet Room and on a hook anchored into the Equipment Room wall. GE supplies one hook per cable.
2. Supports and anchorage must be able to hold up to 22.7 kg (50 lb.) of weight per cable.
3. Excess gradient cable can be stored in a single loop (no more than one loop per cable) with a minimum bend radius of 284 mm (11.18 in.).
4. Supports shall be anchored no more than 2591 mm (102 in.) above the floor.

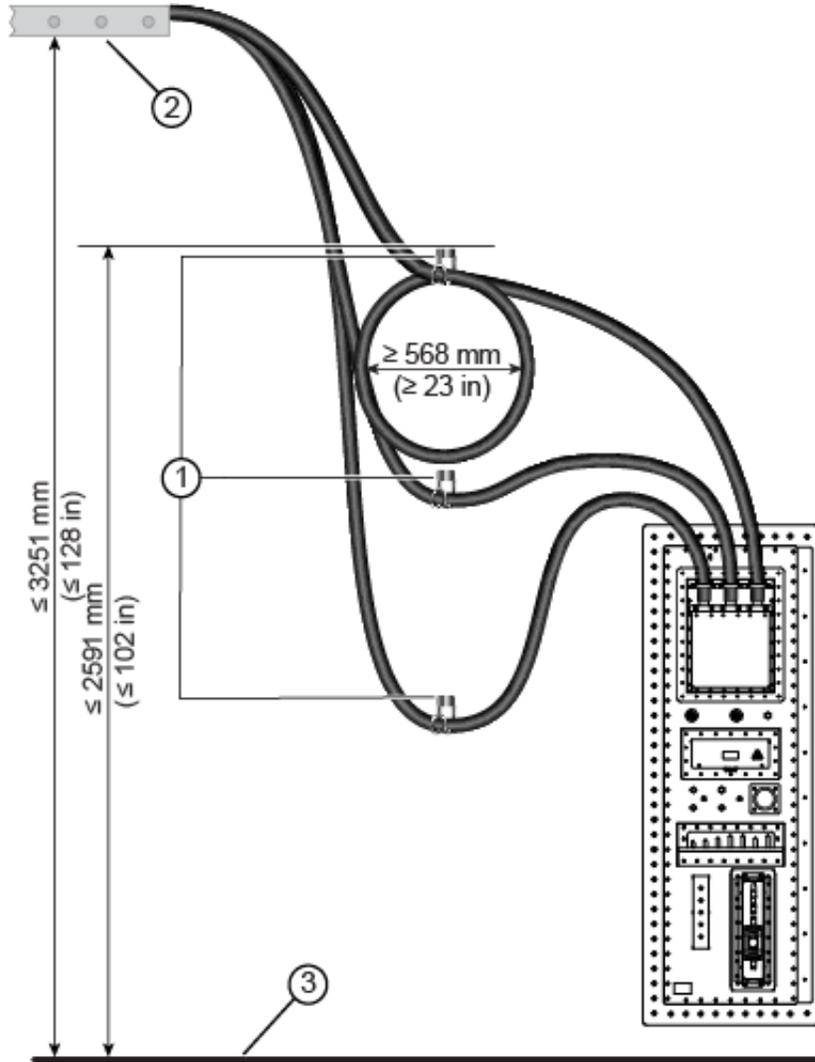
Figure 7-3 Gradient Cable Mounting Hook Mounting Detail



NOTE

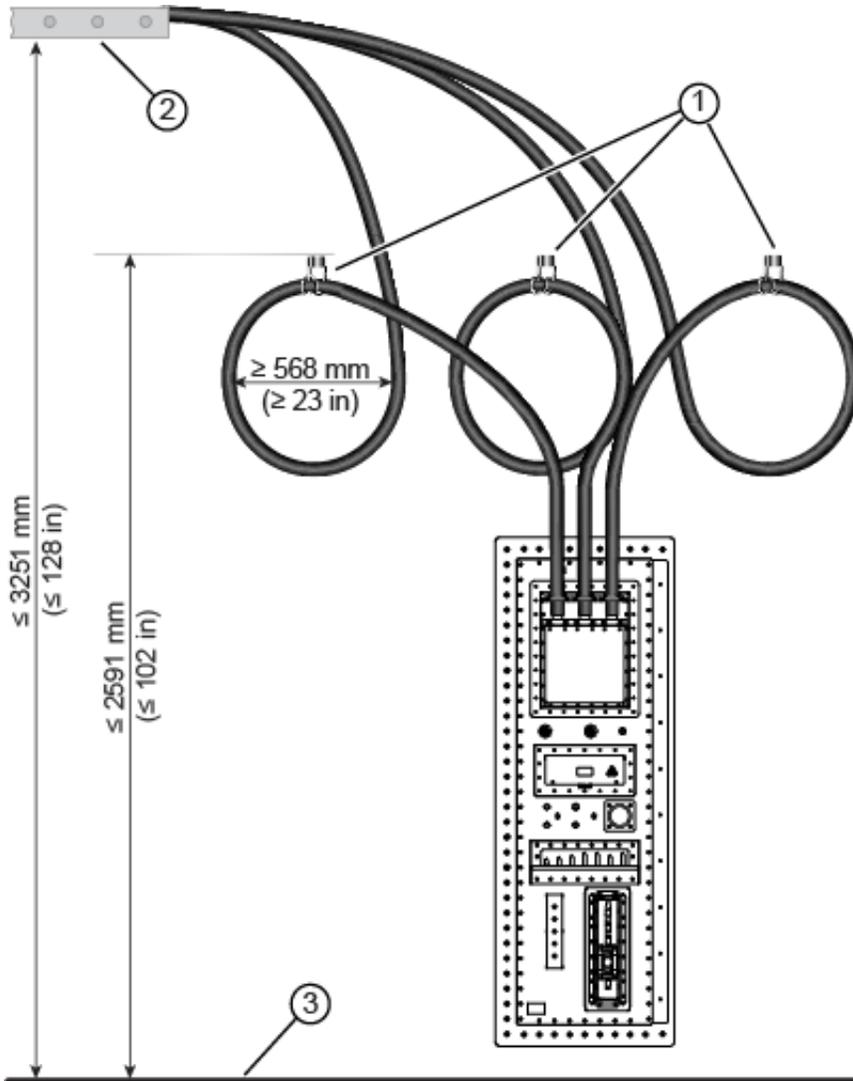
The examples below are representative of possible cable layout or configuration. Layout may vary depending on size, shape and configuration of the pen wall closet. Configure cables to best suit the install configuration without violating the requirements above.

Figure 7-4 Gradient Cable Storage Vertical Layout (Example)



Item	Description	Item	Description
1	GE-supplied gradient cable mounting hooks	3	Finished floor
2	Cable tray		

Figure 7-5 Gradient Cable Storage Horizontal Layout (Example)



Item	Description	Item	Description
1	GE-supplied gradient cable mounting hooks	3	Finished floor
2	Cable tray		

7.2 MR System Interconnects Routing Requirements



(Applies to all subsections within this section)

7.2.1 General Requirements

1. The customer is responsible for the purchase and installation of all cable support mechanisms.
2. Any type of nonferrous cable support can be used, such as a commercially available ladder or wire rack style cable trays, if the cable trays meet all MR System requirements.
3. The distance between cable supports must be less than 305 mm (12 in.). For example, the distance between rungs on a ladder tray, or the distance from the end of a cable tray to a final nonferrous cable support must be 305 mm (12 in.) or less.
4. The cable supports must have a minimum cable bend radius per MR System Cable Specifications. For example, the vertical and horizontal bends of the gradient cables must have a bend radius of 213 mm (8.39 in.) for Standard (On the Wall) siting configuration and 284 mm (11.18 in.) for Remote (Off the Wall) siting configuration.
5. Cable supports can be stacked or side-to-side.
6. If trays are stacked, the air, water, and cryogen lines must be run in the lower support (see [Figure 7-7 Cable Groupings on page 128](#)).
7. Each cable tray must support a weight of at least 74.8 kg/m (50 lb./ft.).

NOTE

If stacked, each cable tray must support the weight of both cable trays: that is 149.6 kg/m (100 lb./ft.).

8. Cables must be accessible on at least one side of the cable support and require a minimum of 254 mm (10 in.) from the top of the tray. (For example, see [Figure 7-8 Cable Tray Requirements Example \(Side-By-Side\) on page 130](#) or [Figure 7-9 Cable Tray Requirements Example \(Stacked\) on page 131](#).) If this is not possible due to obstructions, see the exceptions below.
9. All individual cable supports (for example, rungs) require lateral support to maintain the positions specified in the illustrations both during installation and after installation of the interconnects (for example, cables).

Exceptions for Obstructions:

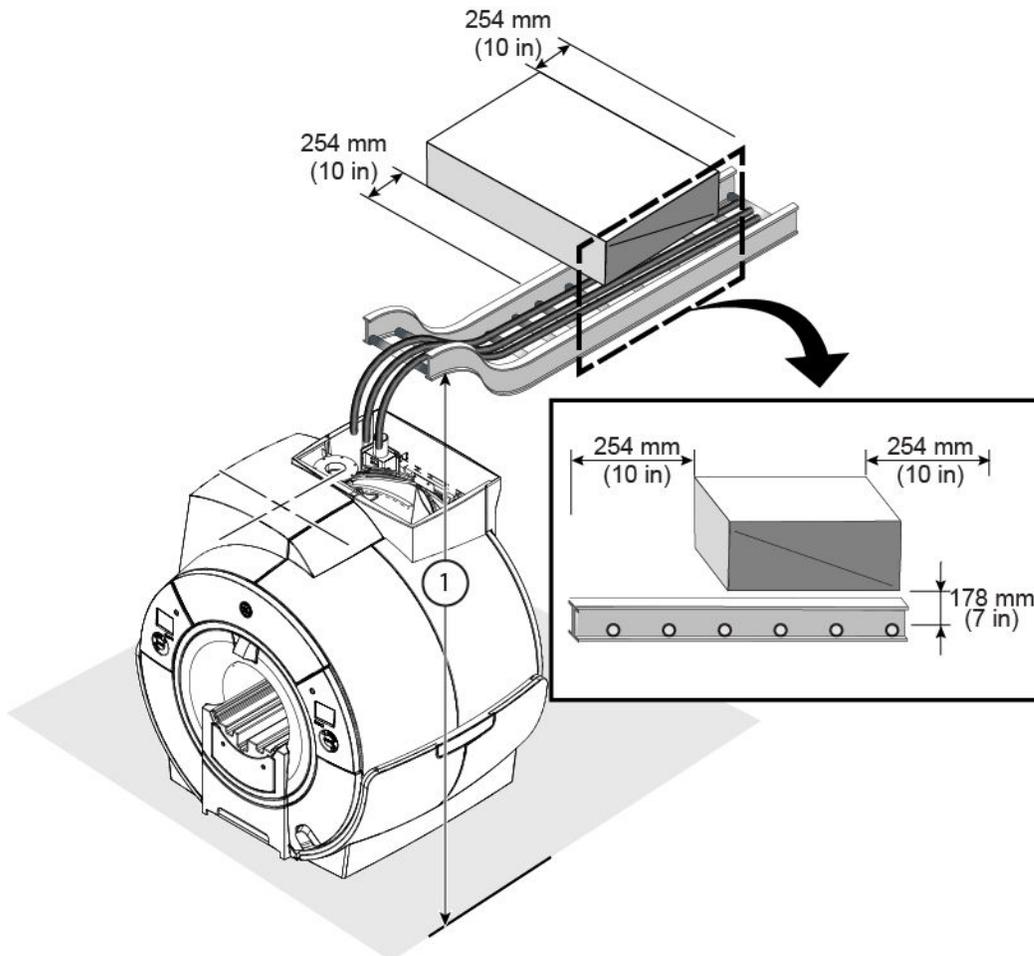
1. The top of the cable tray must not touch an obstruction. A minimum of 254 mm (10 in.) of clearance is required on either side of the obstruction. See [Figure 7-6 Obstruction Example on page 127](#).
2. A minimum of 178 mm (7 in.) of clearance is required from the top of the tray rung to the lowest point of any obstruction.

NOTE

The illustration below shows how to route cable trays around HVAC ducts, light fixtures, medical gases, structural beams, and other obstructions. If local code permits, a tray with a bend can route the cables underneath an obstruction. At the rear of the magnet, the cable

tray must be installed at the minimum height. The part of the cable tray that is under the obstruction can be installed at a lower height. The tray bend must provide the minimum cable bend radius.

Figure 7-6 Obstruction Example



Item	Description
1	≥2449 mm (≥ 96.4 in.) is for Standard (On the Wall) Siting Configuration ≥2520 mm (≥ 99.21 in.) is for Remote (Off the Wall) Siting Configuration

7.2.2 Magnet Room Requirements

1. Two cable trays must be used, each at least 450 mm or 18 in. wide.
2. Installation and routing of cable trays must be coordinated with the RF shield vendor.
3. Side-to-side trays in the Magnet Room must not touch to prevent RF broadband noise caused by metal-to-metal sidewall contact.
4. Ceiling grid work, medical gas lines, lighting fixtures, and so on, must not touch MR System cabling or cable supports.
5. Excess cable length in the Magnet Room must be stored in either:
 - a. Penetration Panel closet. If utilizing the Penetration Panel Closet for cable storage, the supports and anchors must be able to hold up to 22.7 kg (50 lb.).

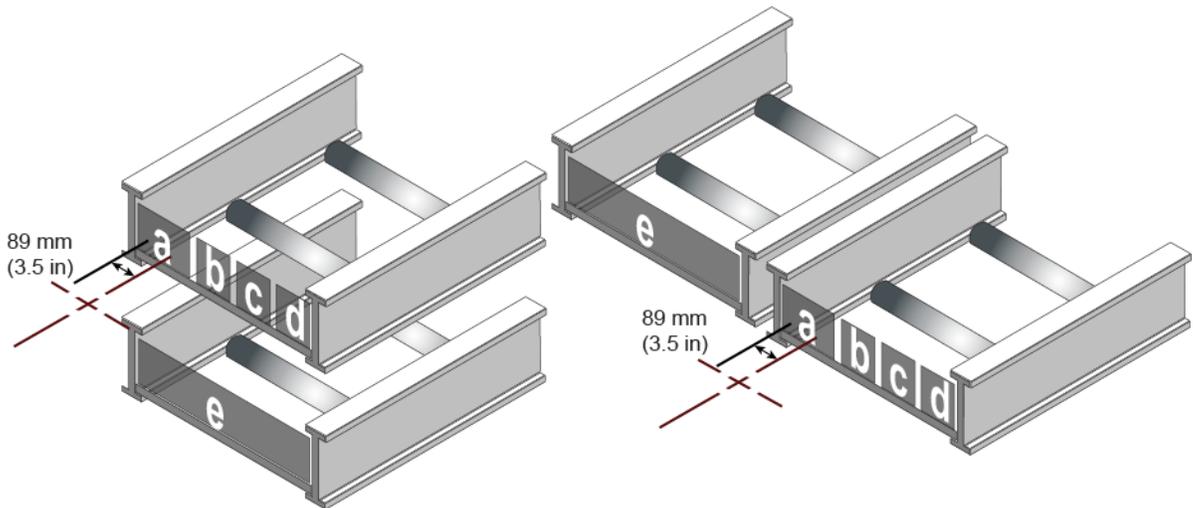
- b. Magnet Room cable trays (excess cable must be at least 915 mm (36 in.) from the magnet end of the tray)

7.2.3 Recommended Cable Groupings

We recommend the grouping order shown below. The cable groups must not touch. Local code may require dividers, channeling, bundling, and so on.

- Group a — Gradient and RF common ground cables
 - In the Magnet Room, the gradient cable group must be laid in a single layer. The center of cable group “a” is 89 mm (3.5 in.) from the inside edge of the tray, in line with the magnet center. See [Figure 7-7 Cable Groupings on page 128](#).
- Group b — Coax, RF, and AC power cables with jacket rating of 600V and above
- Group c — Data and fiber optic and 300V coax or RF clock cables
- Group d — 300V signal, 300V power, and 300V power and signal cables
- Group e — Air, water, and cryogen lines

Figure 7-7 Cable Groupings



7.2.4 Cable Tray Requirements and Examples

1. The gradient cable support must end at the back of the magnet 1067 ± 12 mm (42 ± 0.5 in.) for Standard (On the Wall) siting configuration and 1132 ± 12 mm (44.57 ± 0.5 in.) for Remote (Off the Wall) siting configuration from the geometric isocenter, and must be parallel to the rear face of the magnet. See [Figure 7-8 Cable Tray Requirements Example \(Side-By-Side\) on page 130](#), [Figure 7-9 Cable Tray Requirements Example \(Stacked\) on page 131](#), and [Figure 7-10 Cable Tray Requirements Example \(90° Magnet Interface\) on page 132](#).
2. Supports for all other cables and hoses must end at the back of the magnet 864 ± 12 mm (34 ± 0.5 in.) from the geometric isocenter, and must be parallel to the rear face of the magnet.
3. Cable supports must have a minimum height of 2449 mm (96.4 in.) for Standard (On the Wall) siting configuration and 2520 mm (99.21 in.) for Remote (Off the Wall) siting configuration at the back of the magnet measured from the floor. See [Figure 7-8 Cable Tray Requirements Example \(Side-By-Side\) on page 130](#).

NOTE

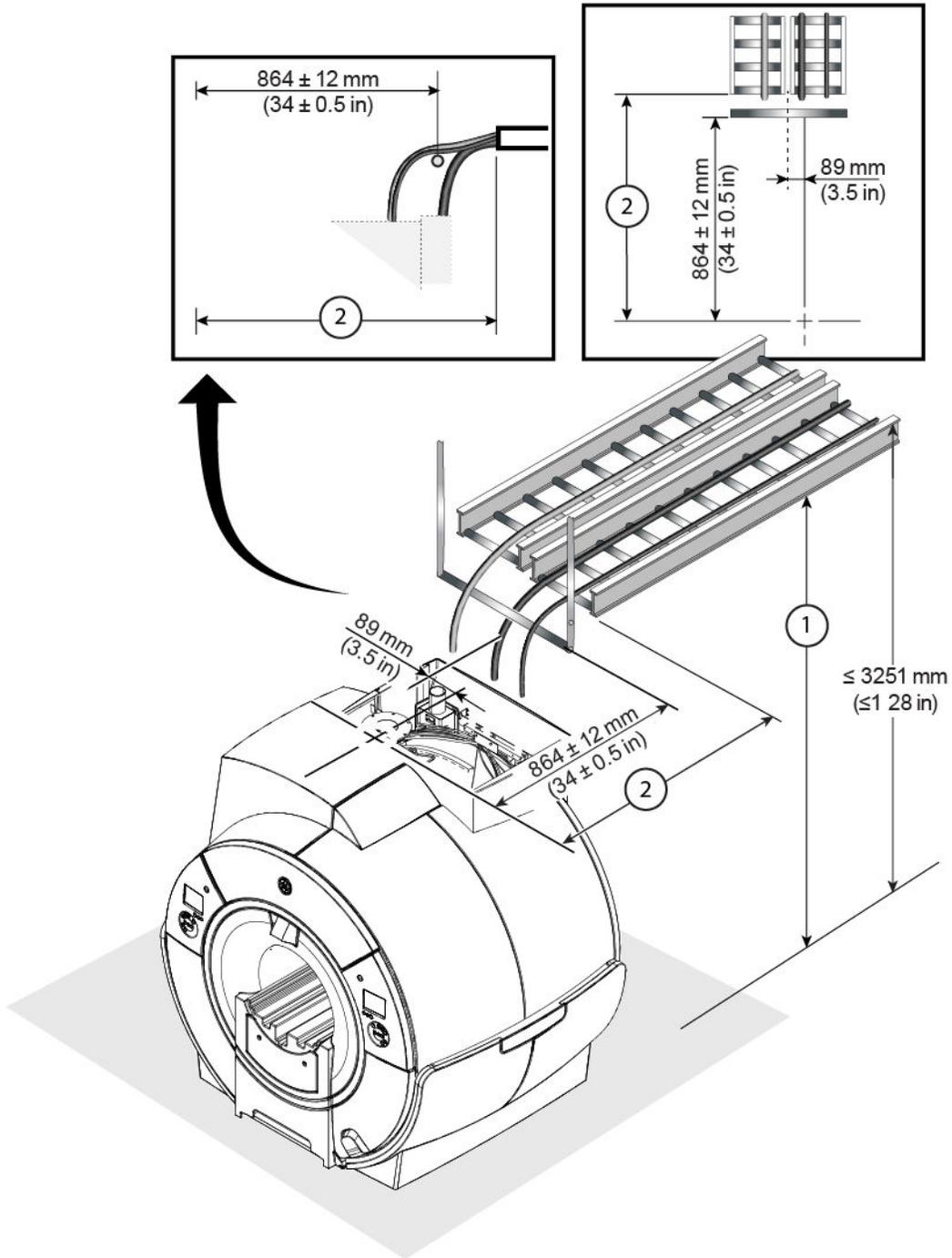
This height is lower than the recommended minimum magnet room suspended ceiling height at the back of the magnet. The cable tray will be exposed and visible below the ceiling. Refer to “[2.3 MR Suite Minimum Room Size Requirements on page 20](#)” for minimum magnet room suspended ceiling height.

NOTE

Supports may be lower at other points along the route to clear obstructions as long as all other requirements are met.

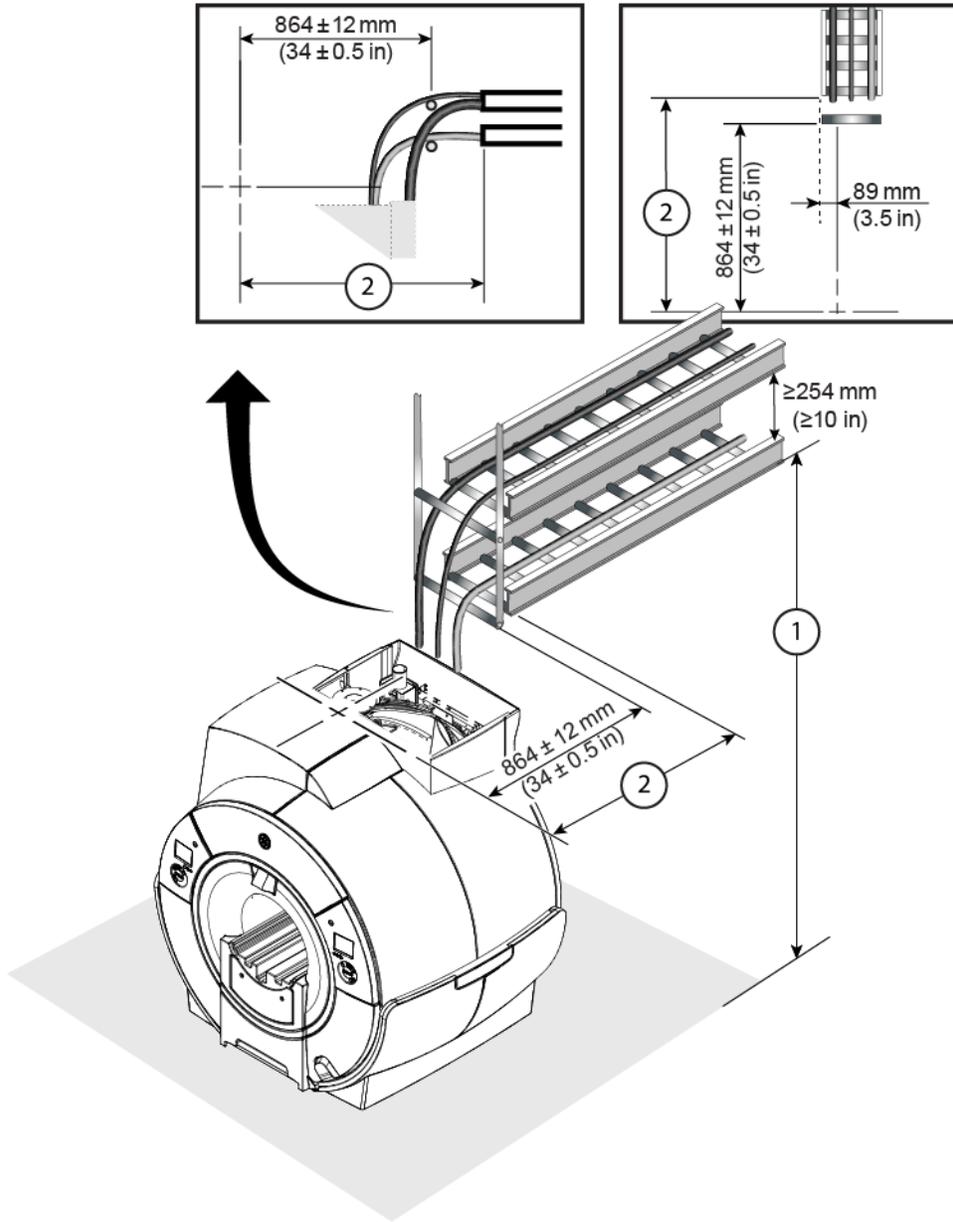
4. The top of the cable tray must be less than 3251 mm (128 in.) above the finished floor. See [Figure 7-8 Cable Tray Requirements Example \(Side-By-Side\) on page 130](#).

Figure 7-8 Cable Tray Requirements Example (Side-By-Side)



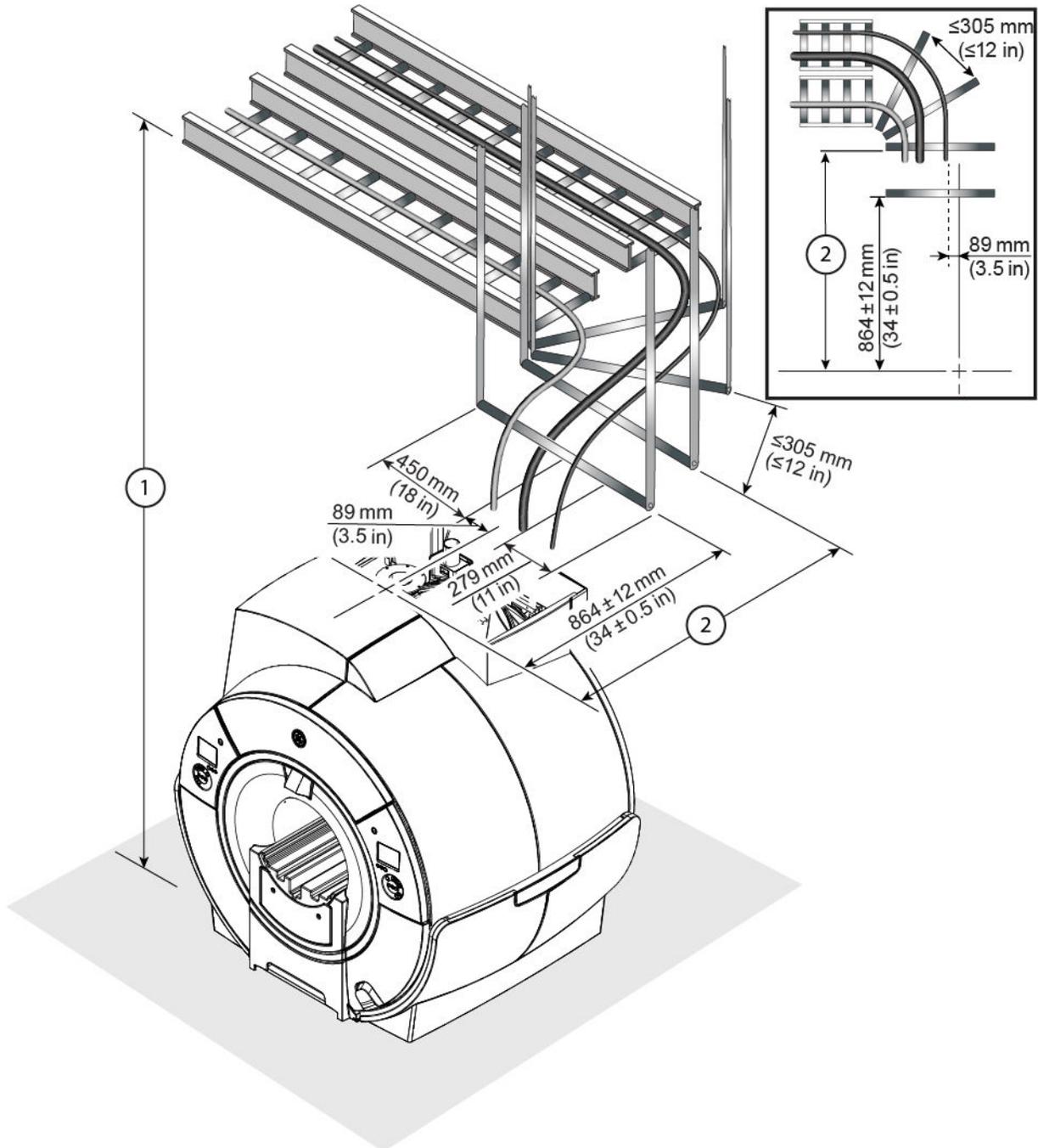
Item	Description
1	≥2449 mm (≥ 96.4 in) is for Standard (On the Wall) Siting Configuration ≥2520 mm (≥ 99.21 in) is for Remote (Off the Wall) Siting Configuration
2	≥1067 mm (≥ 42 in) is for Standard (On the Wall) Siting Configuration ≥1132 mm (≥ 44.57 in) is for Remote (Off the Wall) Siting Configuration

Figure 7-9 Cable Tray Requirements Example (Stacked)



Item	Description
1	≥2449 mm (≥ 96.4 in) is for Standard (On the Wall) Siting Configuration ≥2520 mm (≥ 99.21 in) is for Remote (Off the Wall) Siting Configuration
2	≥1067 mm (≥ 42 in) is for Standard (On the Wall) Siting Configuration ≥1132 mm (≥ 44.57 in) is for Remote (Off the Wall) Siting Configuration

Figure 7-10 Cable Tray Requirements Example (90° Magnet Interface)



Item	Description
1	≥2449 mm (≥ 96.4 in) is for Standard (On the Wall) Siting Configuration ≥2520 mm (≥ 99.21 in) is for Remote (Off the Wall) Siting Configuration
2	≥1067 mm (≥ 42 in) is for Standard (On the Wall) Siting Configuration ≥1132 mm (≥ 44.57 in) is for Remote (Off the Wall) Siting Configuration

7.2.5 Penetration Panel Closet Requirements

1. The cable support must be positioned to prevent cables from resting on the top of the Penetration Panel Closet. The final cable support must end at a distance between 230 mm (9.1 in.) and 375 mm (14.8 in.) from the RF shield opening for Standard (On the wall) siting configurations and between 294 mm (11.6 in.) and 625 mm (24.6 in.) from the RF shield opening for Remote (Off the wall) configurations.
2. The gradient cable support height and distance from the Pen Panel must support a minimum cable bend radius of 213 mm (8.39 in.) for Standard (On the Wall) siting configuration and 284 mm (11.18 in.) for Remote (Off the Wall) siting configuration to accommodate gradient cables.

7.2.6 Equipment Room Requirements

1. All equipment interconnects must route overhead
2. Cables or hoses must drop through the bottom or off the end of the cable support directly to the top of the cabinets (see individual components in Chapter 4 for height requirements).
3. Cable supports do not have minimum height restrictions except above Equipment Room components. Refer to [Figure 4-4 Integrated System Cabinet \(ISC\) on page 94](#) and [Figure 4-6 Integrated Cooling Cabinet \(ICC\) on page 97](#) for the service restrictions above the cabinets.
4. Excess cable length must be stored in the Equipment Room.
5. For multiple MR System installations, cables from different MR Systems must not share the same cable support.
6. The table below lists the minimum width for cable trays between Equipment Room (and Operator Workspace) components.

Table 7-10 Minimum Cable Tray Width for Standard (On the Wall) Siting Configuration

From	To	Minimum Cable Tray Width mm (in.)	For
ISC	ICC	450 mm (18 in.)	Electrical, Water
ISC	OW	300 mm (12 in.)	Electrical

Table 7-11 Minimum Cable Tray Width for Remote (Off the Wall) Siting Configuration

From	To	Minimum Cable Tray Width mm (in.)	For
ISC	ICC	76 mm (3 in.)	Electrical
		150 mm (6 in.)	Air and Water
ISC	OW	76 mm (3 in.)	Electrical
ISC	PP	300 mm (12 in.)	Electrical
ICC	OW	76 mm (3 in.)	Electrical
ICC	PP	450 mm (18 in.)	Air and Water

7.3 Facility-Supplied System Interconnects Specifications



On installation sites in China, make sure that the power cables and ground cables provided by customers have China Compulsory Certification (CCC). This information is supplied to the customer in China Power Cable Requirements, 5159493. (Go to the Customer Documentation Portal or contact the PMI.)

The following table lists the required facility-supplied system interconnects. Refer to [Figure 7-11 Facility-Supplied System Interconnects for standard \(On the Wall\) siting configuration on page 135](#) for additional information.

Table 7-12 Facility-Supplied System Interconnects

Group	Between Units		Comments	Requirements
	From	To		
C01	Facility Power	MDP	Facility Power and Ground	MR Suite Electrical Requirements on page 43
C02	MDP	ICC	Cryo Power (GE-supplied)	
C03	MDP	ISC	PDU Power	
	Facility Cooling Water	ICC	Cooling Water Supply	MR System Facility Water Requirements on page 38
	Facility Cooling Water	ICC	Cooling Water Return	
C04	Facility Network	MON	Facility must provide separate network access for the Magnet Monitor (MON), the Global Operator Cabinet (GOC) and the MDP. The MON connection must be available at all times.	Magnet Monitor (MON) Requirements and Specifications on page 104
	Facility Network	GOC		6.1 InSite RSvP (Remote Service Platform) Requirements on page 116
	Facility Network	Receptacle near MDP		4.2 Main Disconnect Panel (MDP) Requirements and Specifications on page 92
C05	MDP	E-Off Switch	Facility must supply cable from the MDP to the E-Off Switch in the Control Room.	MR Suite Electrical Requirements on page 43
	Facility Power	Outlet near MON	Facility outlet for MON power	MR Suite Electrical Requirements on page 43
C06	ISC PEN	E-Off Switch in Control Room or Equipment Room	Facility must supply additional wiring between the GE-supplied cable and the E-Off switch if the length needed is greater than the available length listed in MR System Interconnects Specifications on page 117 .	MR Suite Electrical Requirements on page 43
	Facility Power	MRU	Facility power to MRU	Magnet Room Equipment Specifications on page 84

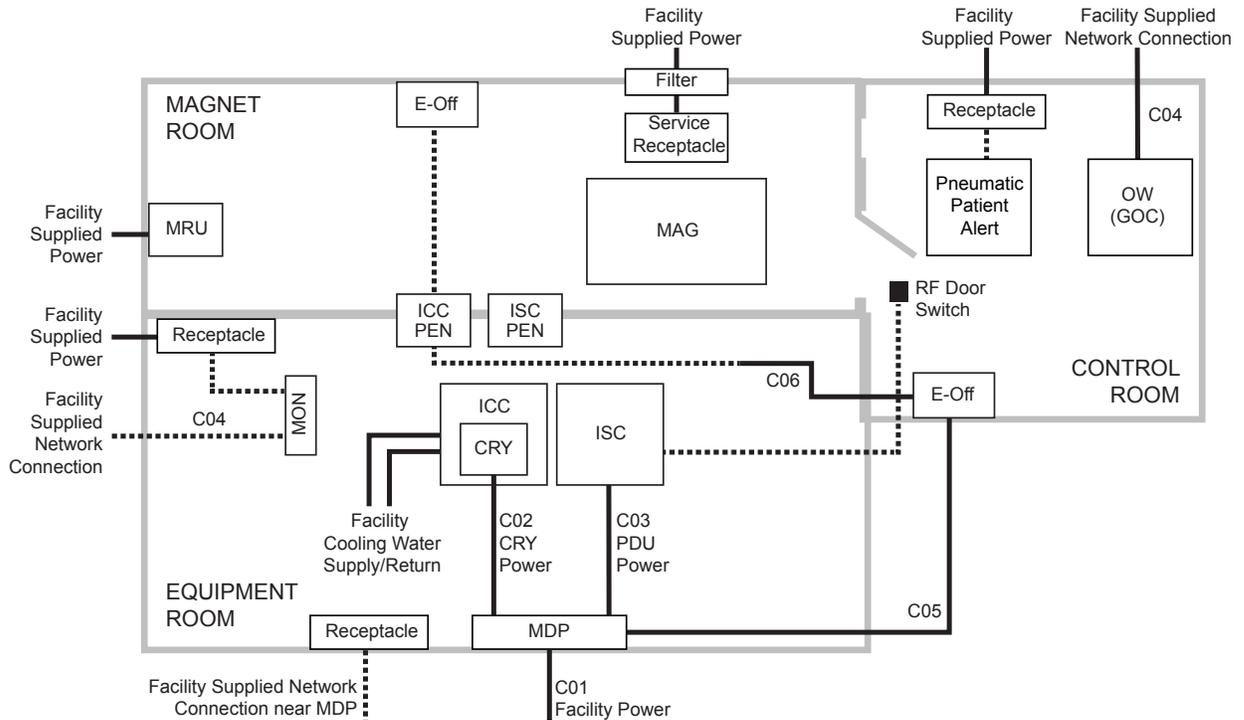
Table 7-12 Facility-Supplied System Interconnects (Table continued)

Group	Between Units		Comments	Requirements
	From	To		
	Facility Power	Service Receptacle	Receptacle to be installed in Magnet Room, using appropriate filter.	MR Suite Electrical Requirements on page 43
	Facility Power	Pneumatic Patient Alert	Facility Power to Pneumatic Patient Alert	MR Suite Electrical Requirements on page 43

Table 7-13 Optional Facility-Supplied System Interconnects

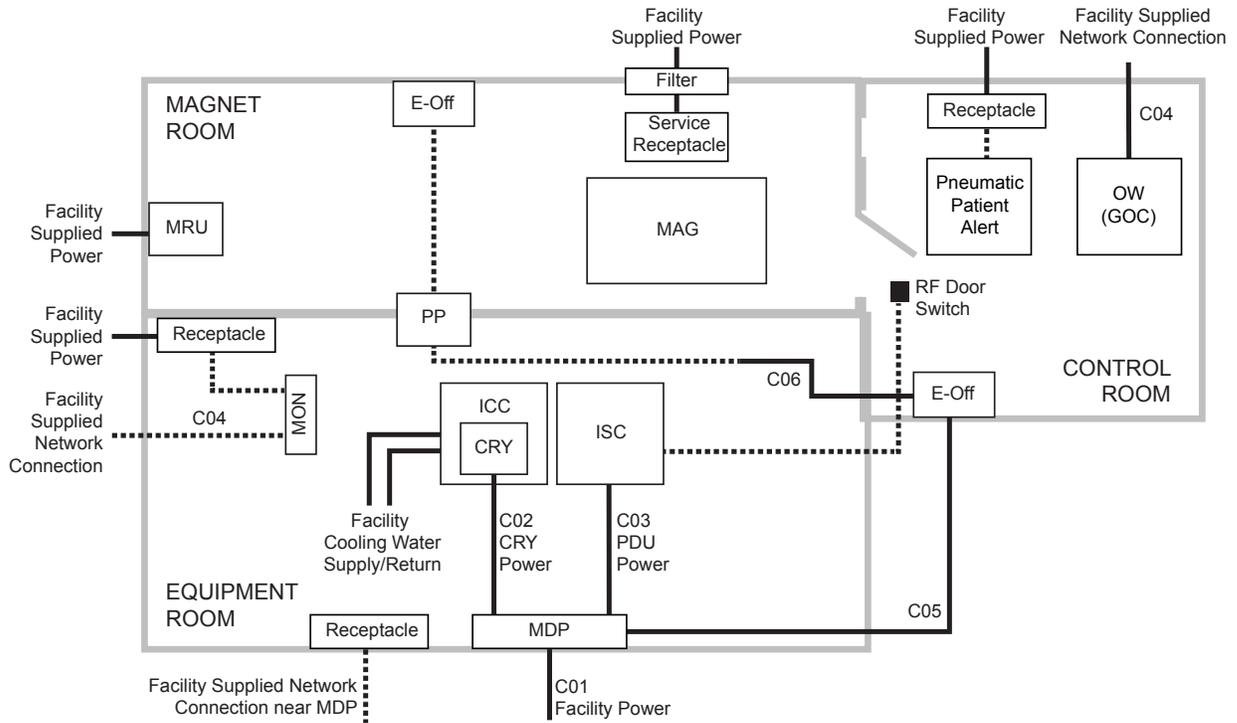
Group	From	To	Comments	Requirements
C01	Facility Power	Outlet near MRE	Facility outlet for MRE power (optional, not shown)	2.10 MR Suite Electrical Requirements on page 43
C01	Facility Power	Control room	Hardwired connection for OXY power (optional, not shown)	2.10 MR Suite Electrical Requirements on page 43
C01	Facility Power	Outlet near PAT Charging Station	Facility outlet for PAT Charging Station (optional, not shown)	2.10 MR Suite Electrical Requirements on page 43

Figure 7-11 Facility-Supplied System Interconnects for standard (On the Wall) siting configuration



Legend			
—————	Facility supplied interconnect	- - - - -	GE-supplied interconnect

Figure 7-12 Facility-Supplied System Interconnects for remote (Off the Wall) siting configuration



Legend			
—————	Facility supplied interconnect	GE-supplied interconnect

NOTE

- GE HealthCare recommends installing the RF Door switch on the outside wall of the Magnet Room.
- The illustration is not to scale and component positioning/interconnect runs are typical.
- Only GE HealthCare equipment interconnects are shown. Additional facility interconnects are required for non-GE HealthCare equipment (for example, Magnet Room DC Lighting).
- The E-Off button placement and cable routing shown indicates one possible configuration. Final E-Off button placement and cable routing is the responsibility of the customer. Refer to [2.10.1 General Electrical Requirements on page 43](#) for requirements for E-Off button placement.

The RF Shielded Room Vendor is responsible for installing the RF door switches. Refer to *RF Shielded Room Requirements*, 5850260-1EN.

8 Appendix

8.1 Glossary



Cryogen

A substance for producing low temperatures. Liquid helium is the cryogen used to cool the magnet to approximately 4 K (-269°C or -452°F).

Dewar

A container with an evacuated space between two highly reflective walls used to keep low temperature substances at near-constant temperatures. Liquid helium is usually stored and shipped in dewars.

Ferrous Material

Any substance containing iron which is strongly attracted by a magnetic field.

Gauss (G)

A unit of magnetic flux density. The earth's magnetic field strength is approximately one half Gauss to one Gauss depending on location. The internationally accepted unit is the tesla (1 tesla = 10000 G and 1 millitesla = 10 G).

Homogeneity

Uniformity. The homogeneity of the static magnetic field is an important quality of the magnet.

Isocenter

Center of the imaging volume ideally located at the magnet center.

Isogauss Line

A line on a field plot connecting identical magnetic field strength points.

Magnetic Field

A condition in a region of space established by the presence of a magnet and characterized by the presence of a detectable magnetic force at every point in the region. A magnetic field exists in the space around a magnet (or current carrying conductor) and can produce a magnetizing force on a body within it.

Magnetic Resonance (MR)

The absorption or emission of electromagnetic energy by nuclei in a static magnetic field, after excitation by a suitable radio frequency field.

Magnetic Shielding

Using material (for example, steel) to redistribute a magnetic field, usually to reduce fringe fields.

Quench

Condition when a superconducting magnet becomes resistive thus rapidly boiling off liquid helium. The magnetic field reduces rapidly after a quench.

Radio Frequency (RF)

Frequency intermediate between audio frequency and infrared frequencies. Used in magnetic resonance systems to excite nuclei.

Radio Frequency Shielding

Using material (for example, copper, aluminum, or steel) to reduce interference from external radio frequencies. A radio frequency shielded room usually encloses the entire Magnet Room.

Resonance

A large amplitude vibration caused by a relative small periodic stimulus of the same or nearly the same period as the natural vibration period of the system. In magnetic resonance imaging, the radio frequency pulses are the periodic stimuli which are at the same vibration period as the hydrogen nuclei being imaged.

Superconducting Magnet

A magnet whose magnetic field originates from current flowing through a superconductor. Such a magnet is enclosed in a cryostat.

Superconductor

A substance whose electrical resistance essentially disappears at temperatures near zero Kelvin. A commonly used superconductor in magnetic resonance imaging system magnets is niobium-titanium embedded in a copper matrix.

Tesla

The internationally accepted unit of magnetic flux density. One tesla is equal to 10000 Gauss. One millitesla is equal to 10 Gauss.

Waveguide

A hollow linear structure used in components such as the penetration wall to route cables and hoses, while limiting and controlling electromagnetic waves from entering the Magnet Room.

8.2 MR Site Vibration Test Guidelines



(Applies to all subsections within this section)

8.2.1 Test Measurements

1. Vibration measurements must be in the range of 10^{-6} g. Test equipment must have the required sensitivity to these levels.
2. Instrumentation must have a low tolerance to temperature effects since many times the low frequency thermal drift may influence the measurements.
3. All measured data must be acquired real time. Recording of vibration data will not allow for a correct site survey, specifically when studying transient vibration and when searching for specific vibration sources.
4. All analyses must be narrow-band Fast Fourier Transforms (FFT) over the frequency bands listed in [Table 8-1 Frequency Bands for FFT on page 139](#).
5. Time histories of the vibration must be recorded as acceleration levels vs. time. The resolution of the time history must be adjusted to clearly capture the transient event. The analyzer set-up will be site dependent and, in special cases, vibration response dependent. It is the responsibility of the vibration consultant to study the transient environment, capture data to confirm that transient activity exceeds the trigger level, then expand the time history data to exhibit the structural response.

Table 8-1 Frequency Bands for FFT

Frequency Band	Frequency Resolution
0.2 to 50 Hz	$\Delta f = 0.125$ Hz

8.2.2 Equipment (Spectral Analyzer) Set-Up

1. Frequency average should be a minimum of 20 linear averages (Do not use peak hold or 1/3 octave analysis).
2. Average and store should be a minimum of 20 plots steady state and 20 plots transient to support the consistency of the site vibrations.
3. Hanning windows must be applied to the entire spectra.
4. Spectrum analyzers capable of these measurements are readily available for purchase or rental. Models, such as the HP 3560A, Nicolet Phaszer, B&K Pulse, and HP 35670, are all capable of making the site vibration measurements. Accelerometers must have the capability to measure from 0.2 Hz beyond 50 Hz. Time histories can be recorded using any of the analyzers listed above.

NOTE

The equipment mentioned is for example only. It is the responsibility of the Engineering Test Firm to provide equipment that will allow measurements compliant with this guideline.

8.2.3 Data Collection

8.2.3.1 Ambient Baseline Condition

1. All of the measurements listed above must be made in a “quiet” environment—that is, areas where excessive traffic, subway trains, and so on, do not exist. A vibration measurement must also be made during periods without traffic or during periods of light traffic. Measurements must define the lowest levels of vibration possible at the site.
2. The source of any steady state vibration, whose level exceeds the magnet specifications found in [Magnet Room Structural Requirements on page 59](#), must be identified. A second measurement should be made with all of the identified contributors powered down if possible. In situations where it is not possible to power down equipment, vibration data must be collected to identify the specific source of the vibration concern. The majority of steady state vibration problems can be negated by isolating the vibration source.

8.2.3.2 Normal Condition

1. All of the vibration measurements listed above must be repeated during periods of “normal” environmental conditions, including the Fast Fourier Transforms (FFTs) and time histories. The transient measurements must be provided to define the dynamic disturbances the MR System may be exposed to. Transient analysis is required for a true assessment of the site.
2. Special attention must be paid to the site assessment during the entire analysis. Since transient vibration is not easily addressed once the MR suite is fully constructed, the test consultant must fully understand the needs for this analysis. The source of any transient vibration must be identified and supported with vibration plots. If the source of any transient vibration is not locatable, it is recommended that the customer have an alternate location identified and the vibration studied.
3. Transient vibration can be difficult to assess if the details are not understood. The **0.0005 g, zero-to-peak trigger level** is a starting point to understanding the vibration stability. The transient vibration peak amplitude, structural (time variant) response, decay rate and an estimate of the number of events per unit of time would constitute a complete transient analysis. All transient failures must be supported by time history plots. The plots must clearly show the structural response, the frequency of the signature and the decay rate. From this data, GE HealthCare can help determine compliance with the vibration guidelines.
4. The test consultant must provide site data to show the design recommendations for all sites/building structures meet the magnet specifications found in [Magnet Room Structural Requirements on page 59](#).

8.2.4 Presentation/Interpretation of Results

1. The recommended format for site vibration data collection, presentation, and analysis is demonstrated in the examples in [Figure 8-1 Example of Site Environmental Vibration Levels on page 141](#), [Figure 8-3 Acceleration Time History on page 142](#), and [Figure 8-4 Acceleration Time History \(Zoomed In on Transient Event\) on page 143](#). Presentation of the data in any other format (linear units only) may result in incorrect interpretation and diagnosis of the site. Additional data collection or presentation methods are at the option of the vibration testing service.
2. All plots must be properly annotated with:

- a. Instrumentation setup including number of averages, frequency resolution, and so on
- b. Test location
- c. Test conditions:
 - i. Steady state
 - ii. Transient
 - iii. Heel drop
 - iv. Normal environment
 - v. Typical traffic
 - vi. Any other conditions necessary to demonstrate understanding of potential sources of vibration
3. The customer's vibration testing service is responsible for interpreting the results and determining if that site meets GE HealthCare specifications.
4. If the vibration levels are too high, additional data acquisition may be necessary to:
 - a. Determine the source of the vibration
 - b. Propose a solution to the problem
 - c. Find an alternate site location
5. Any questions regarding test equipment requirements, test parameters, or general questions should be discussed with the GE HealthCare Project Manager of Installation (PMI).

Figure 8-1 Example of Site Environmental Vibration Levels

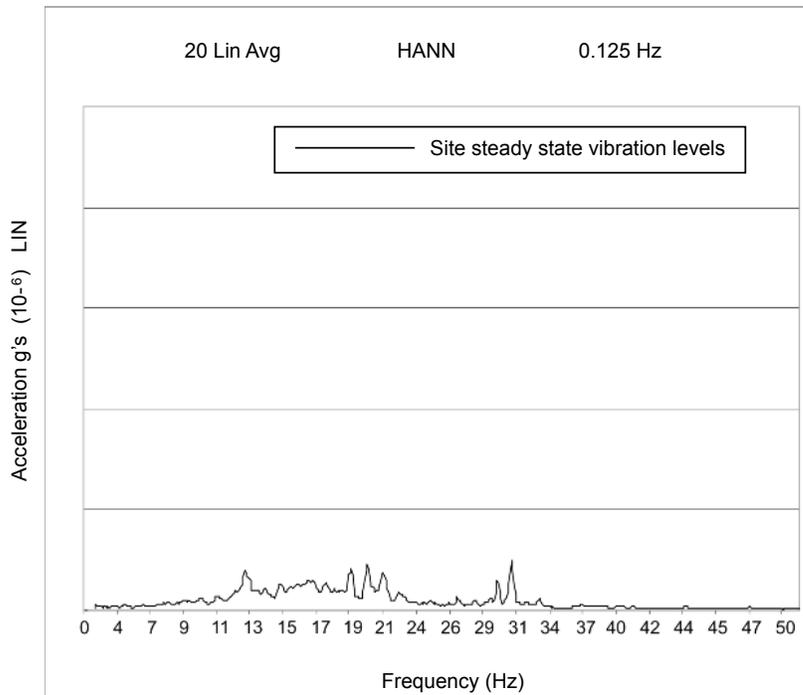


Figure 8-2 Example Site Environmental Vibration

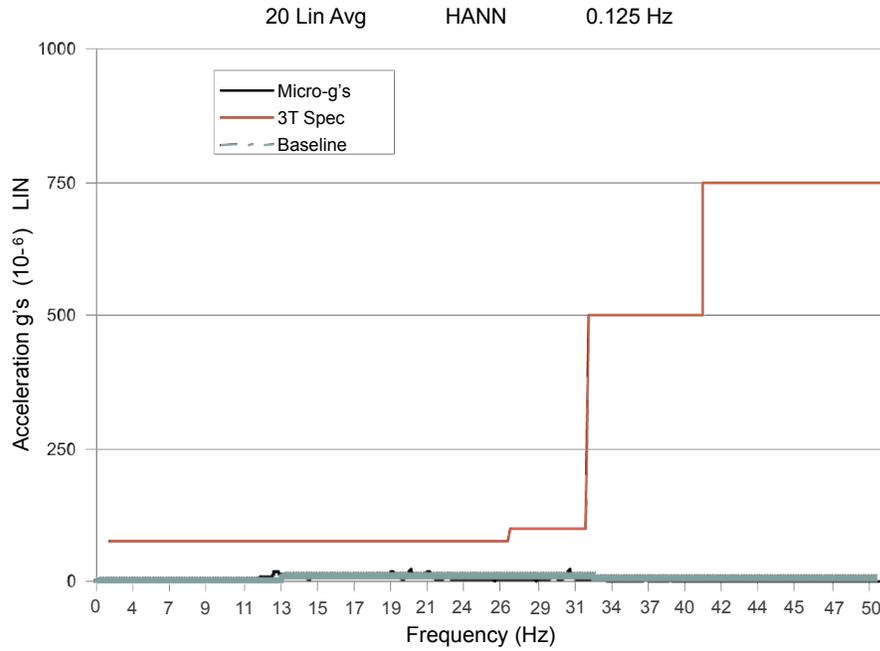


Figure 8-3 Acceleration Time History

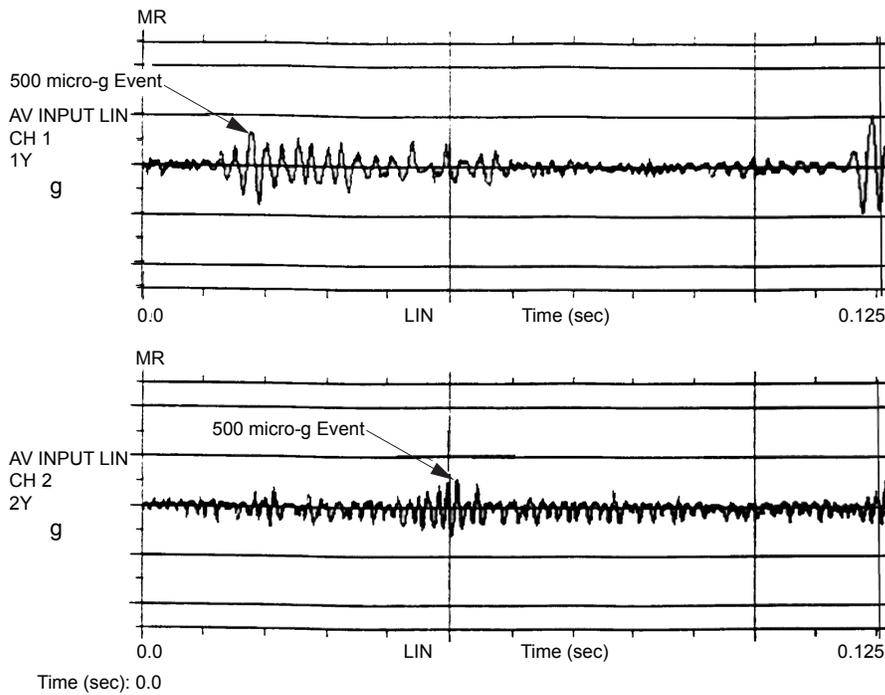
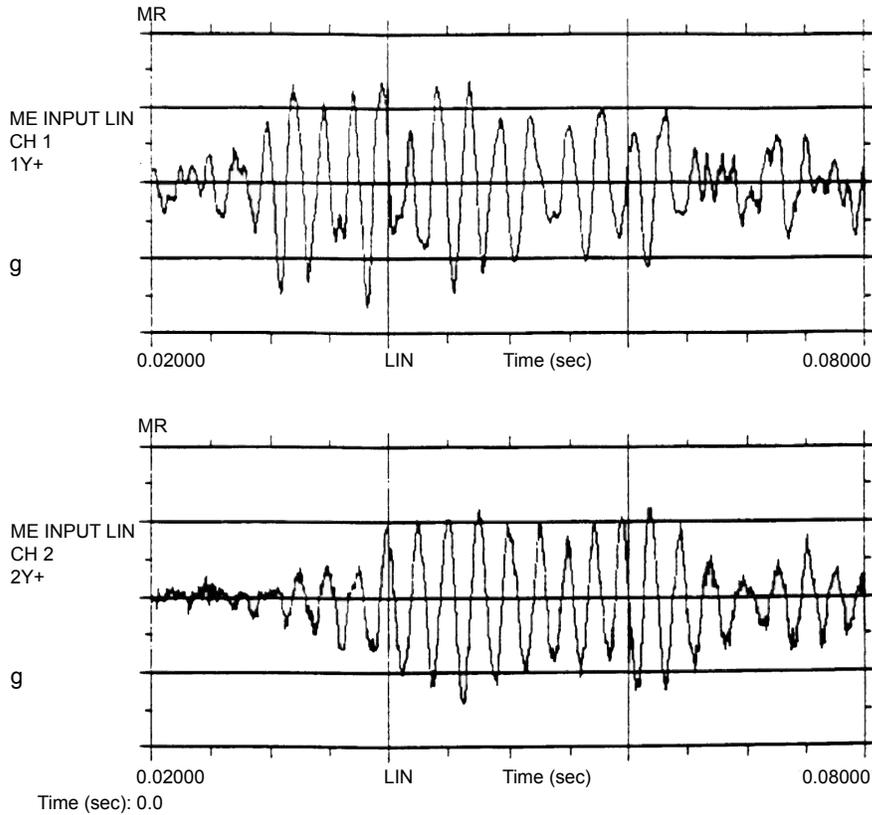


Figure 8-4 Acceleration Time History (Zoomed In on Transient Event)



8.3 Sample Calculation AC Power Equipment Minimum Distance



This is a sample calculation to determine minimum distance from a feeder, transformer, or other AC electrical source, using the formula found in [2.6.3 Electrical Current on page 32](#) to determine minimum distance from a feeder, transformer, or other AC electrical source.

$$I \text{ (amps)} = 8.55x^2 \text{ (meters)} \div S \text{ (meters)}$$

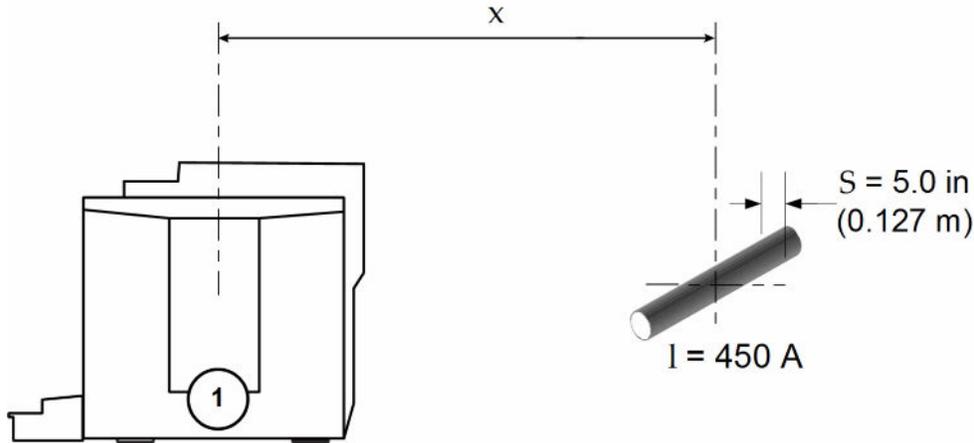
Note that the formula has three variables. If you have two of them, you can calculate the third. In this example, we calculate the minimum distance *x* from the source—in this case, a main electrical feeder carrying 450 amps of current in a 127 mm (5 in.) conduit.

Rearranging:	$x^2 = \frac{I \times S}{8.55}$ $x = \sqrt{\frac{I \times S}{8.55}}$
--------------	----------------------------------------------------------------------

where:	
x	Minimum distance (in meters) from the feeder lines to isocenter of the magnet
I	Maximum allowable RMS single phase current (in amps) or maximum allowable RMS line current (in amps) in three phase feeder lines
S	Separation (in meters) between single phase conductors or greatest separation between three phase conductors

The separation **S** is the spacing between the conductors, and when all 3 conductors are run in a single conduit, **S** is simply the diameter of the conduit.

S = 5 inches = 0.127 meters



Item	Description
1	Magnet

$$x = \sqrt{\frac{450 \text{ A} \times 0.127 \text{ m}}{8.55}}$$

The conduit should be 2.6 m (8.5 ft.) from the magnet isocenter.

In other situations, the spacing **S** may be the spacing between HV feeders, the distance between transformer lugs, or the spacing between conduits when the phase conductors are run in separate conduits.

What if it is too close?

If this is an existing condition, you should request an *EMI study* to quantify the magnitude and direction of the AC disturbances. The calculation is worst-case and does not take into account the vector direction of the AC interference. The magnet is only sensitive to AC disturbances that are directed horizontally (magnet z-axis). Also, the calculation does not account for any magnetic shielding effect of steel conduit.

8.4 Selecting Anchor Size



The following is an example to illustrate the selection of correct anchors to install a magnet in a building with 13.8 MPa (2000 psi) concrete. For this example the area is not under seismic requirements.

1. Determine the magnet clamping force (for the Magnet: 11100 N + 900 N = 12000 N (2500 lb. + 200 lb. = 2700 lb.)).
2. Refer to the examples of anchor vendor catalogs below to select the anchor diameter and embedment that meets the clamping force (tension) determined in Step 1.

Diameter : ≥ 15.875 mm (0.625 in.) ≤ 31.75 mm (1.25 in.)

For 203 mm (8 in.) embedment select 19 mm (0.75 in.) diameter

For 114.3 mm (4.5 in.) embedment select 25.4 mm (1 in.) diameter

or

Diameter : Min. M16 Max. M32

For 130 mm embedment select M20 diameter

For 114 mm embedment select M24 diameter

3. The vendor instructions and torque to the maximum recommended level for the anchor selected in Step 2 must be provided to the RF shielded room vendor for correct installation of the anchor and equipment.

Table 8-2 Allowable Anchor Loads in Concrete (English Units)

Anchor Diameter mm (in.)	Embedment Depth mm (in.)	13.8 MPa (2000 psi)		20.7 MPa (3000 psi)		27.6 MPa (4000 psi)		41.4 MPa (6000 psi)	
		Tension kN (lb.)	Shear kN (lb.)	Tension kN (lb.)	Shear kN (lb.)	Tension kN (lb.)	Shear kN (lb.)	Tension kN (lb.)	Shear kN (lb.)
15.9 (5/8)	70 (2 3/4)	5.6 (1250)	12.5 (2800)	7.1 (1600)	13.7 (3070)	8.1 (1810)	14.8 (3300)	8.5 (1920)	12.5 (3330)
	102 (4)	8.3 (1870)	14.8 (3330)	10.7 (2400)	14.8 (3330)	13.0 (2930)	14.8 (3330)	14.2 (3200)	12.5 (3330)
	178 (7)	11.2 (2500)	14.8 (3330)	13.4 (3010)	14.8 (3330)	16.2 (3650)	14.8 (3330)	16.2 (3650)	12.5 (3330)
19.1 (3/4)	83 (3 1/4)	6.9 (1550)	12.8 (2880)	8.7 (1950)	14.7 (3310)	10.5 (2350)	16.6 (3730)	11.6 (2610)	21.4 (4800)
	121 (4 3/4)	11.2 (2510)	20.1 (4510)	14.5 (3250)	20.7 (4650)	17.2 (3870)	21.4 (4800)	20.8 (4670)	21.4 (4800)
	203 (8)	13.0 (2930)	21.4 (4800)	17.2 (3870)	21.4 (4800)	20.2 (4530)	21.4 (4800)	22.8 (5120)	21.4 (4800)

Table 8-2 Allowable Anchor Loads in Concrete (English Units) (Table continued)

Anchor Diameter mm (in.)	Embedment Depth mm (in.)	13.8 MPa (2000 psi)		20.7 MPa (3000 psi)		27.6 MPa (4000 psi)		41.4 MPa (6000 psi)	
		Tension kN (lb.)	Shear kN (lb.)	Tension kN (lb.)	Shear kN (lb.)	Tension kN (lb.)	Shear kN (lb.)	Tension kN (lb.)	Shear kN (lb.)
25.4 (1)	114 (4 1/2)	13.9 (3120)	27.0 (6080)	17.2 (3870)	30.1 (6770)	20.5 (4610)	33.2 (7470)	21.4 (4800)	33.2 (7470)
	152 (6)	19.6 (4400)	33.2 (7470)	28.5 (6400)	33.2 (7470)	32.0 (7200)	33.2 (7470)	32.6 (7330)	33.2 (7470)
	229 (9)	24.9 (5600)	33.2 (7470)	35.59 (8000)	33.2 (7470)	41.77 (9390)	33.2 (7470)	41.8 (9390)	33.2 (7470)

NOTE

All bolded values in this table fail to meet the clamping force (tension), and are therefore not acceptable anchors.

Table 8-3 Allowable Anchor Loads in Concrete (Metric Units)

Anchor Diameter	Embedment Depth mm (in.)	13.8 MPa (2000 psi)		20.7 MPa (3000 psi)		27.6 MPa (4000 psi)		41.4 MPa (6000 psi)	
		Tension kN (lb.)	Shear kN (lb.)	Tension kN (lb.)	Shear kN (lb.)	Tension kN (lb.)	Shear kN (lb.)	Tension kN (lb.)	Shear kN (lb.)
M16	105 (4 1/8)	11.2 (2500)	25.1 (5650)	20.9 (4705)	39.9 (8965)	24.2 (5450)	45.0 (10125)	30.7 (6900)	46.9 (10550)
M20	130 (5 1/8)	25.1 (5650)	52.9 (11900)	30.7 (6910)	58.7 (13195)	36.4 (8175)	64.5 (14490)	44.5 (10005)	64.5 (14490)
M24	155 (6 1/8)	30.0 (6735)	61.2 (13760)	36.9 (8300)	70.5 (15855)	43.9 (9860)	29.8 (17950)	57.7 (12980)	95.6 (21490)

NOTE

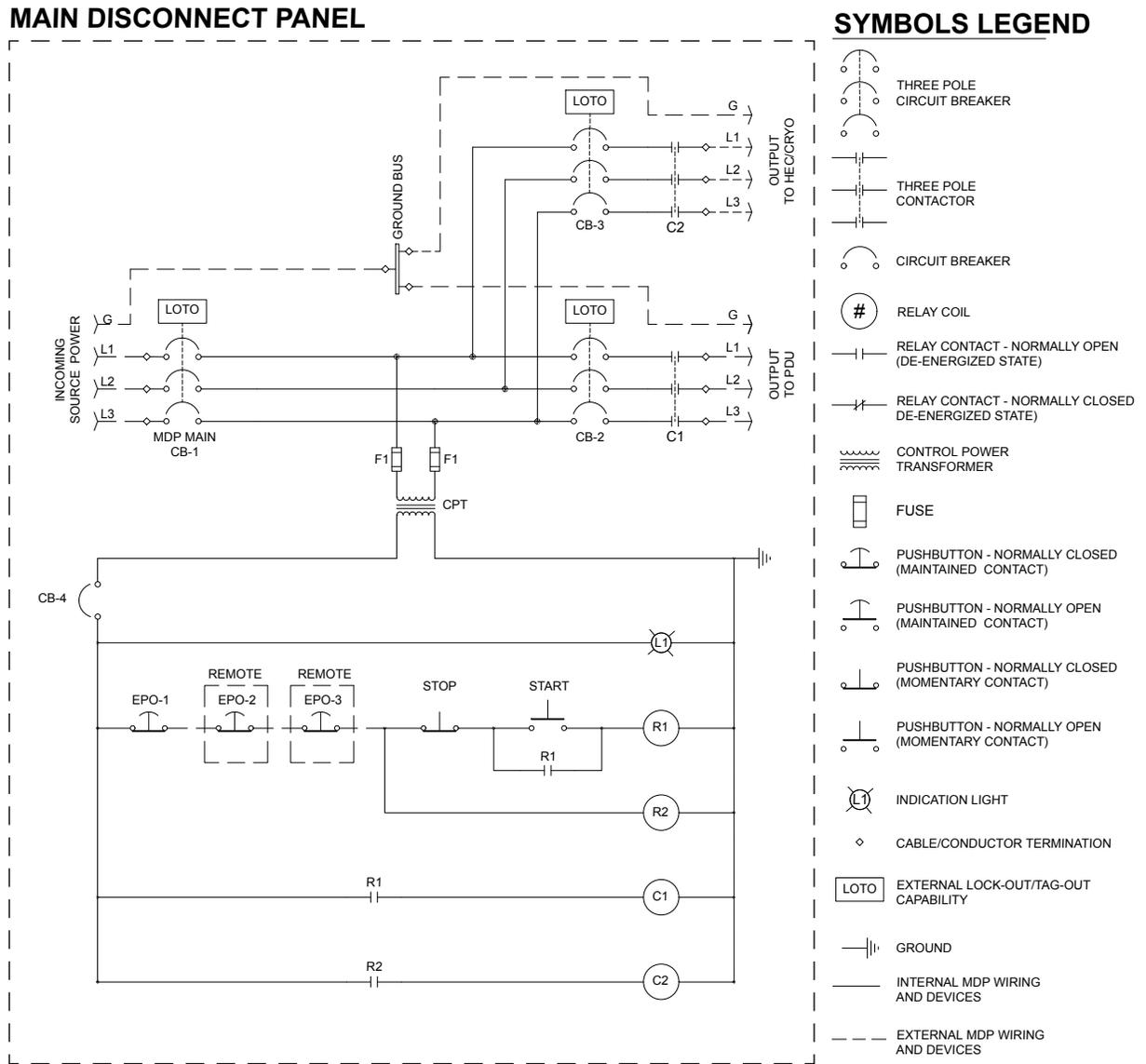
All bolded values in this table fail to meet the clamping force (tension), and are therefore not acceptable anchors.

8.5 Sample control schematic for customer-supplied MDP



This section provides an example of a control schematic for the auto-restart and Emergency Power Off (EPO) functions that meets the minimum GE HealthCare PIM requirements. This schematic does not include control, protection, wiring or devices that may be required due to local safety and regulatory requirements. Only the minimum equipment, devices and wiring is shown to meet the performance requirements of GE HealthCare equipment. The final MDP design must be compliant with applicable local codes and regulations.

Figure 8-5 Customer MDP control schematic



Revision History

Revision 9.0, April 2023, English Document review and approval per DOC2240728	
Location	Description
Chapter 1	<ul style="list-style-type: none"> Table 1-2: Updated manual numbers
Chapter 2	<ul style="list-style-type: none"> Section 2.3, Table 2-1: Updated ceiling height for standard configuration Section 2.3, Step 1 after table 2-1: Updated sentence for clarity Section 2.7.2, Step 1: Added additional products Table 2-10: Removed "Standby Consumption" Section 2.10.3: Added note to explain exempt countries Table 2-17: removed "Minimum Circuit Ampacity" Table 2-18: Updated depth for ISC and ICC Table 2-19: Updated weight for Operator Workspace Display
Chapter 4	<ul style="list-style-type: none"> Section 4.2.1: Added requirement for an electrical outlet Section 4.2.2: Added sentence that only exempt countries can supply their own MDP Figure 4-4: Updated dimensions Figure 4-6: Updated dimensions
Chapter 5	<ul style="list-style-type: none"> Section 5.1.3: Changed anchor size from 9.5mm to M10 Section 5.1.4: Changed weight from 11.8 kg to 6.7 kg
Chapter 7	<ul style="list-style-type: none"> Table 7-6 and Table 7-7: Updated length of gradient cables Table 7-8: Updated "From" "To" entries and cable lengths Section 7.2.5, Step 1: Updated sentence for clarity Section 7.2.6, Step 3: Updated sentence for clarity
Chapter 8	<ul style="list-style-type: none"> Section 8.1: Removed definitions "Exclusion Zone", "Gradient" and "Security Zone"
Revision 8.0, June 2022, English Document review and approval per DOC2240728	
Location	Description
Chapter 2	<ul style="list-style-type: none"> Section 2.2.3: Added Physiological Acquisition Transceiver (PAT) Charging Station Table 2-1: Updated values for Equipment Room Table 2-2: Corrected units (nanotesla instead of microtesla) Section 2.6.3: Corrected units (μT instead of mT) Section 2.7.2: Added Figure 2-14 and 2-15 Table 2-9: Added Physiological Acquisition Transceiver (PAT) Charging Station Figure 2-19: Added Terminal for Power Monitor to schematic Table 2-17: Changed Maximum Fuse or Circuit Breaker Size from 25A to 30A Table 2-19: Updated specifications for magnet Table 2-21: Updated specifications and added new column for Component Location
Chapter 3	<ul style="list-style-type: none"> Section 3.5: Added "The penetration panel will mount directly to the wall." Section 3.6.6: Changed title of section and updated specifications to match figure Figure 3-16: Updated dimensions Section 3.6.10: New section for Storage Cabinets
Chapter 4	<ul style="list-style-type: none"> Section 4.1: Added Note for replacement components Figure 4-2: Updated dimensions Figure 4-9: Updated dimensions

Revision 8.0, June 2022, English Document review and approval per DOC2240728	
Location	Description
Chapter 5	Section 5.3: New section for Physiological Acquisition Transceiver (PAT) Charging Station
Chapter 7	<ul style="list-style-type: none"> Section 7.1.4: New section for Brainwave Option Table 7-2: Added Physiological Acquisition Transceiver (PAT) Charging Station Table 7-12: Added rows for OXY and Physiological Acquisition Transceiver (PAT) Charging Station
Revision 7.0, October 2021, English Document review and approval per DOC2240728	
Location	Description
Chapter 2	<ul style="list-style-type: none"> New Figure 2-2, System overview for Remote (Off the wall) siting configuration Update to Table 2-1 for Remote (Off the wall) siting configuration New Figure 2-15, MR System Water Cooling Block Diagram for remote (Off the Wall) siting configuration Removed Main Disconnect Panel (MDP) M70022MA information Table 2-21: Updated dimension and weight for Replacement RF Body Coil
Chapter 3	New section 3.5 Penetration Panel Wall Opening Requirements and section 3.6.6 PEN Wall Closet Outline for Remote (Off the Wall) Siting Configuration
Chapter 4	<ul style="list-style-type: none"> New Figure 4-2 Typical Minimum Equipment Room with Service Clearances for remote(Off the Wall) siting configuration New Figure 4-12 Minimum top area and Mesh Shield Specification for Remote (Off the Wall) siting configuration New section 4.5 Penetration Panel Specifications for Remote (Off the Wall) Siting Configuration Removed Main Disconnect Panel (MDP) M70022MA information
Chapter 7	<ul style="list-style-type: none"> Removed section Long and Short cable selection guidance New section 7.1.3 Available Cable Lengths for Remote(Off the Wall) siting configuration New section 7.1.5 Storage Requirements for Excess Gradient Cable for Remote (Off the wall) siting configuration. Section 7.2.4 Cable Tray Requirements and Examples: new dimensions for Remote (Off the Wall) siting configuration
Revision 6.0, February 2021, English Document review and approval per DOC2240728	
Location	Description
All chapters	<ul style="list-style-type: none"> Major content re-organization throughout the manual, and some content was moved to separate documents. See the Related Documents section in this manual for document numbers. New personnel matrix and icons added throughout the manual to help contractors and customers locate the content they need for their respective project work.
Chapter 2	2.10.2 GE Supplied Main Disconnect Panel (MDP) Requirements and Specifications for M70022MA, M70022MB and M70022MC: Adding specs and schematics for new GEHC-supplied MDP option, M70022MB and M70022MC.

Revision 5.0, February 2020	
Location	Description
Chapter 2	<ul style="list-style-type: none"> • 2.1 System Level Requirements for Installing into Existing MR Suite: Added requirements; specified requirements for system upgrades. • 2.7.1 Magnetic Fringe Field: Specified magnet series. • 2.8.2 Shared Equipment Rooms: RF Cabinet separation is only necessary for some older systems; exceptions are specified. • 2.11.1 General Electrical Requirements: Adding specs and schematics for new GEHC-supplied MDP option, M70022MA; removed M7000WL. • 2.11.2 Customer Supplied Main Disconnect Panel (MDP) Requirements: Lock-out/tag-out features shall be accessible from the outside of the panel. • 2.11.3 GE Supplied Main Disconnect Panel (MDP) Requirements and Specifications for M70022MA: New section • 2.11.4 Emergency Power Backup Specifications: Changed Emergency Power Backup Requirements to just "Specifications" and is no longer a requirement; maximum fuse or circuit breaker size for the cryocooler compressor is 25A. • 2.12.2 Facility Delivery Route Requirements: Added an important note that a rigger is required to lift the ISC.
Chapter 3	<ul style="list-style-type: none"> • 3.2.2 Environmental Steel Limits: Expanded the scope of the required environmental steel analysis from a 5 ft (1524 mm) spherical radius to a 8.2 ft (2500 mm) spherical radius. • 3.4 Acoustic Room Specifications: Updating magnet bore acoustic specifications. • 3.5.5 Dock/Table Frame Anchor Mounting Requirements: Updated the requirements to say the dock/table anchor bolt must be drilled after the magnet is installed (not before the magnet is delivered). • 3.5.7 RF Shielding Integrity (Shielding Effectiveness) Reliability Requirements: Removed lower limit of 90 dB for RF shielding effectiveness; RF switches must be rated for 12V. • 3.7.2 Patient Table Specifications: Updated with current images of the Comfort Plus table. • 3.7.3 Magnet Rundown Unit (MRU) Specifications and Requirements: Specified tolerance of distance from the unit to the floor as installed. • 3.8.6 Vent Requirements Inside the Magnet Room: Update per SPR HCSDM00539134 to specify that the vent system must be installed and connected to the waveguide outside of the Magnet Room prior to magnet installation. • 3.9.2 Lighting Requirements: Added note about LED bulbs and their potential effect on image quality. • 3.9.3 Grounding Requirements: Removed requirement for all RF Power Filters over 30V (incoming) and metallic pipes to be located at a specified distance from RF Common Ground Stud.
Chapter 4	4.2 Main Disconnect Panel (MDP) Specifications: Adding specifications for GEHC-supplied MDP, M70022MA; removing M7000WL.
Chapter 7	<ul style="list-style-type: none"> • 7.2.4 Cable Tray Requirements and Examples: Clarifying that cable supports at the end of the cable trays must be parallel to the back face of the magnet. Adding tolerances for cable tray height from the floor. • 7.4 Facility Supplied System Interconnects Specifications: RF switches must be rated for 12V (not 10V).
Appendix	Added Sample Control Schematic for Customer-supplied MDP.
	(Rev 5.0 of 5680003-1EN based on DOC2240728 Rev. 2)

Revision 4.0, March 2019	
Location	Description
All	<ul style="list-style-type: none"> Applied new style for Preinstallation Manual per global platform change Created DOC2240728, Rev 1, as a document container for direction number 5680003-1EN, Rev 4.
Chapter 1	Applied common updates for Document Purpose and Symbol Keys.
Chapter 2	<ul style="list-style-type: none"> Applied common updates for description of MR Suite Minimum Room Size Requirements Updated Equipment Room minimum Ceiling Height per engineering investigation. Removed Typical Minimum Room Layout because this information is not appropriate for Preinstallation manual. Revised IEC EMC Compliance section; added new table: Guidance And Manufacturer's Declaration – Electromagnetic Proximity field Immunity Applied the correct data for Vibration Transmitted through VibroAcoustic Mat. (Same data as 750w) Updated Main Disconnect Panel section per SN DOC1927899. Revised requirements and images for both customer supplied and GE supplied MDP.
Chapter 3	<ul style="list-style-type: none"> Applied common updates for Magnet Shield Room Requirements Applied common updates for RF Shield Room Requirements Updated Table Frame Anchor drill description in Table Frame Anchor Mounting Requirements ISC and ICC Wall opening Requirements are moved to RF Shield Room Section. Removed examples of Cable Concealment Frame installation from illustration Added Anchor Hole position in Magnet Mounting details. Removed Magnet Position line illustration as it is not appropriate in Preinstallation manual
Chapter 4	<ul style="list-style-type: none"> Updated Minimum Equipment Service Clearance to clarify the service space for each cabinets Added ISC and ICC anchor bracket locations (Same information as Voyager PIM)
Chapter 6	New chapter created for Digital Service and Connectivity Requirements to add InSite RSVP requirements
Chapter 7	Updated cable run lengths for 1265 and 1266
Revision 3.0, Oct, 2016	
Location	Description
Chapter 1 section 1	<ul style="list-style-type: none"> Removed unnecessary Warning Message. Updated the wording to "System Interconnections" for item 6 in Section 1.3.
Chapter 1 section 2	Added "Symbol Key" section.
Chapter 2 section 3.1	Corrected the following values in Table 2-1. <ul style="list-style-type: none"> Magnet Room Area: 231.7 ft²(21.53 m²) Total System Area: 319.6 ft²(29.69 m²)
Chapter 2 section 3.2	Corrected reference layout number in item 3.
Chapter 2 section 6	<ul style="list-style-type: none"> Updated title to "6. MR Suite Acoustic Definition" Updated title to "6.2 Structureborne Vibration Control Definition"
Chapter 2 section 8.1	Updated illustration 2-17 using the common drawing with DVMR PIM.

Revision 3.0, Oct, 2016	
Location	Description
Chapter 2 section 9	Removed unnecessary Warning Message
Chapter 2 section 11.1	Added MCAT number for GE HealthCare supplied MDP
Chapter 2 section 11.3	Added Emergency Power Backup Requirements
Chapter 2	Removed “Communication Requirements” Section since it’s covered in “System Interconnections”
Chapter 2 section 13.3	Corrected the following dimension in Illustration 2-21. <ul style="list-style-type: none"> • Magnet front cover to rear bridge frame : 84.2 inch (2140 mm) •
Chapter 3 section 2.2	Clean up Table 3-1
Chapter 3 section 2.3	Removed Table under Illustration 3-2 since it’s covered in the illustration.
Chapter 3 section 6.5	Added item 6 about location of RF shield seams, joints, or overlaps.
Chapter 3 section 8	<ul style="list-style-type: none"> • Overall: Added new vent graphics for clarity. Added combined vent illustration and details. • section 8.5: Clarified information in “Cryogenic Venting” overview. • section 8.6.5: Clarified vent construction requirements.
Chapter 4 section 1.1	Removed “option” from “MDP option” in item 4 of the Note.
Chapter 4 section 2.4	Added MCAT number for GE supplied MDP
Chapter 5 section 3	Fit the illustration 5-6 in one page.
Chapter 6 section 1.3	Added “A” and “B” in the illustration that corresponds to Table 6-4
Chapter 6 section 2	Update to eliminate the call outs in the illustrations and added the dimensions.
Chapter 6 section 4	Updated illustration to include Emergency backup power for cryogen compressor
Chapter 7 section 4.3.2	Removed item 6 since this requirement cannot be applied for SIGNA Pioneer.

Revision 2.0, Document review and approved per MTR-MIBD-E445, Dec 18, 2015	
Location	Description
Overall	Updated the section structure as DVMR PIM.
Chapter 2	Added section 1 System Level Requirements for Installing into Existing MR Suite
	Updated to remove circled number in Illustration 2-1: System Overview.
	Updated dimensions in Illustration 2-2: Minimum Magnet Service Area (Top View)
	Updated dimensions in Illustration 2-3: Minimum Magnet Ceiling Height (Top View)

Revision 2.0, Document review and approved per MTR-MIBD-E445, Dec 18, 2015	
Location	Description
	Newly added section 3.2 Typical Minimum Room Layouts
	Removed item 3 described in “5 MR Seismic Requirements” as it's not a requirement of Seismic Requirements
	Added “6 MR Suite Acoustic Specifications” as it was missing in Rev1
	Corrected plots in “Illustration 2-14 and 2-15: Magnet Moving Metal Sensitivity Line Plots”
	Reworded the description in “7.4 Non-MR System Equipment Sensitivity to Magnetic Fields”.
	Removed description for "Equipment Room Cabinet Separations (Equipment Room, Top View)" in “8.2 Shared Equipment Rooms” as it may confuse the reader and the wording is explaining enough in requirements.
	Updated to add average and idle in “Table 2-8: System Heat Output for Air Cooling”
	Updated Minimum Chiller Size to 36 kW per Engineering Specification update in Table 2–10: Facility Liquid Coolant Requirements
	Updated illustration to remove circle numbers and adding backup water hose in Illustration 2-18: MR System Water Cooling Block Diagram.
	Updated to add pressure drop (psig) and temperature rise (F) in Illustration 2-19: Cryocooler Water Cooling Requirements.
	Added 30A CB as customer supplied equipment to meet F-50 specification in “Illustration 2-20: Main Disconnect Panel (MDP) Set-Up”
	Added cable requirement of customer supplied 30A CB at item 8.g in 11.2 Main Disconnect Panel (MDP) Requirements.
Chapter 3	Updated to remove circled number in Illustration 3-1: Magnet Room Layers.
	Updated graph by measurement of using SIGNA Pioneer 3.0T system in Illustration 3-3: Sound Pressure Spectral Distribution (1/3 Band Relative SPL).
	Updated overall description of “5 RF Shielded Room Requirements” to describe RF Shield Room purpose and customer responsibility clearly. .
	Added item 13 in 5.4.2 RF Shield Test Report.
	Added item 8 in 5.4.3 Dock Frame Anchor Mounting Requirements.
	Updated dimensions from isocenter in Illustration 3-5: Cable Concealment Kit Ceiling Opening Dimensions (Top View).
	Updated “Illustration 3-6: Customer supplied Support Frame and Cable Concealment Kit Frame” for clarification.
	Corrected the distance in “Illustration 3-7: Magnet Room Floor Levelness Area”.
	Added detail dimensions of vibro mat in Illustration 3-8: Magnet Mounting Detail.
	Added Vibro Mat for Seismic locations in Illustration 3-9: Magnet Mounting Detail (For Seismic Locations).
	Separated illustration from Illustration 3–8 and created “Illustration 3-10: Magnet positioning line and Dock Frame anchor position Detail” to focus only for alignment lines.
Chapter 4	Updated dimensions in Illustration 4-1: Equipment Room Layout Example.
	Removed Hoist from the dimensions, added Service Area, and updated dimensions in Illustration 4-2: Integrated System Cabinet (ISC).
	Added seismic anchor bracket information in Illustration 4-3: ISC Anchor Location (For Seismic Area).

Revision 2.0, Document review and approved per MTR-MIBD-E445, Dec 18, 2015		
Location	Description	
	Added Service Area and removed Hoist from dimensions in Illustration 4-4: Integrated Cooling Cabinet (ICC).	
	Added seismic anchor bracket information in Illustration 4-5: ICC Anchor Location (For Seismic Area).	
	Updated dimensions to add the tolerance of mesh shield in Illustration 4-12: Minimum top area and Mesh Shield Specification.	
	Added maximum distance between openings in Illustration 4-13: Wall Opening Detail (Equipment Room Side).	
	Clean up illustration to show mesh shield fringe area in Illustration 4-14: Mesh Shield Frame area (Magnet Room Side).	
	Added to explain the direction of mesh shield attachment in Illustration 4-15: Mesh shield Attachment Note.	
	Updated the dimensions in Illustration 4-17: Minimum PEN Wall Closet Outline.	
	Added "Illustration 4-18: Minimum ISC PEN Wall Closet Outline" to consider the separate cabinets positioning.	
	Added "Illustration 4-19: Minimum ICC PEN Wall Closet Outline" to consider the separate cabinets positioning.	
Chapter 5	Clean up image in Illustration 5-1: Operator Workspace (OW1) Overall Dimensions.	
Chapter 6	Updated "Table 6-4: Usable Cable Lengths" per engineering input.	
	Added "1.3 Long / Short cable selection guidance"	
	Cleaned up "2 MR System Interconnects Routing Requirements".	
	Updated minimum gradient cable minimum bending radius to 213mm per Design Engineer's input in "2 MR System Interconnects Routing Requirements".	
	Updated "Table 6-6: Minimum Cable Tray Width" per engineering input.	
	Updated "Table 6-7: MR System Cable Information" to add detail information for cable.	
Chapter 7	Corrected "Table 7-3: 3.0T Magnet Cryogenic Vent System Pressure Drop Matrix" for 3T Magnet.	
Rev	Date	Description
1.0	Nov 2014	Initial Release.



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