



# **SIGNA™ PET/MR / SIGNA™ PET/MR AIR**

## Preinstallation Manual

5480759  
Revision 8

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# Language Policy

## DOC0371395 - Global Language Procedure

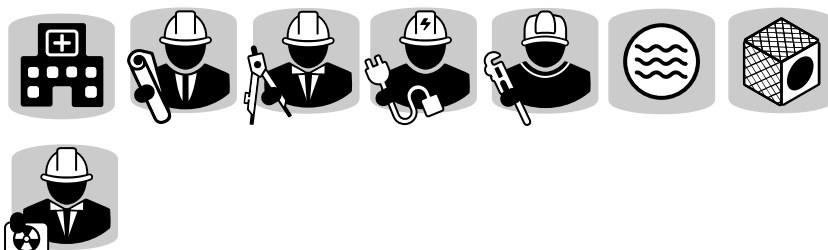
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# 1 Introduction

## 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:
  - 3.1. Compliance with all local and national codes and regulations
  - 3.2. Siting requirements for customer-specific site procedures (medical, MR, safety, and so on)
  - 3.3. Any special architectural requirements (for example, seismic codes)
  - 3.4. Radiation safety regulations

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	Radiological Health Physicist
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	x		
2.10 MR Suite Electrical Requirements	x			x				
2.11 MR System Shipping and Receiving	x							
3.1 Magnet Room Introduction	x	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		

**Table 1-1 Personnel Index** (Table continued)

Section	Personnel							
								
	Architect	General Contractor	Customer	Electrician	Plumber	HVAC	RF Vendor	Radiological Health Physicist
3.3 Shielding Requirements and Radiation Sources	x	x	x					x
3.4 Magnetic Shielded Room Requirements	x							
3.5 Penetration Panel Wall Opening Requirements on page 73	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 Panel Closet	x							
3.6.6 Doors, Magnet Access Openings, and Patient Viewing Windows	x							
3.6.7 Finished Ceiling	x							
3.6.8 Magnet Room Floors	x	x						
3.6.9 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						
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	Radiological Health Physicist
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 HealthCare 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 139](#).
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 22](#).
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:
  - 6.1. 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.
  - 6.2. 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 139](#)).
  - 6.3. Two penetration panel openings are required and must meet the requirements in: *RF Shielded Room Requirements*, 5850260-1EN.
  - 6.4. 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).
8. Magnet Room radiation shielding requirements must be reviewed by a qualified radiation health physicist because the location and layout of the site can affect shielding requirements.

## 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. Rear Pedestal (PED)
3. Patient Transport Table (PT)
4. PET/MR Insert (replaces RF Body Coil)
5. 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 exempt regions)
2. Power, Gradient, RF Cabinet (PGR)
3. Heat Exchanger Cabinet (HEC)
4. Penetration Cabinet (PEN)
5. Secondary Penetration Wall (SPW)
6. PET Cabinet (PET)
7. Cryocooler Compressor Cabinet (CRY)
8. PET Chiller (P-CHILL)
9. Magnet Monitor (MON)
10. Optional:
  - Magnetic Resonance Elastography (MRE)
  - Multi-Nuclear Spectroscopy (MNS)

### 2.2.3 Control Room

1. Operator Workspace equipment (OW)
2. Pneumatic Patient Alert System (PA1)
3. Optional:
  - Oxygen Monitor (OXY)
  - PET/MR SPiCE Workstation (SW)

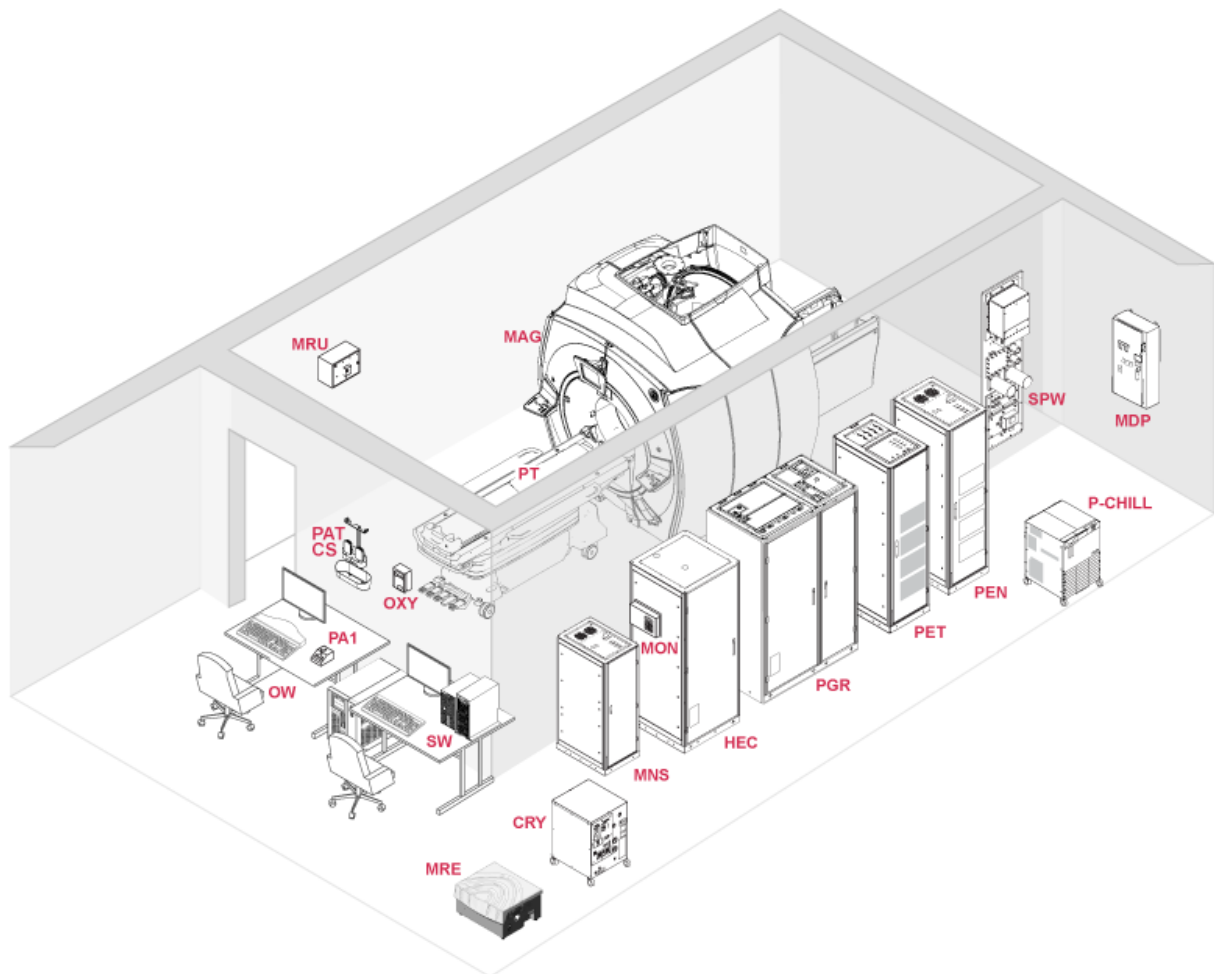
- Physiological Acquisition Transceiver (PAT) Charging Station

## 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 (example)



### NOTE

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

## 2.3 MR Suite Minimum Room Size Requirements



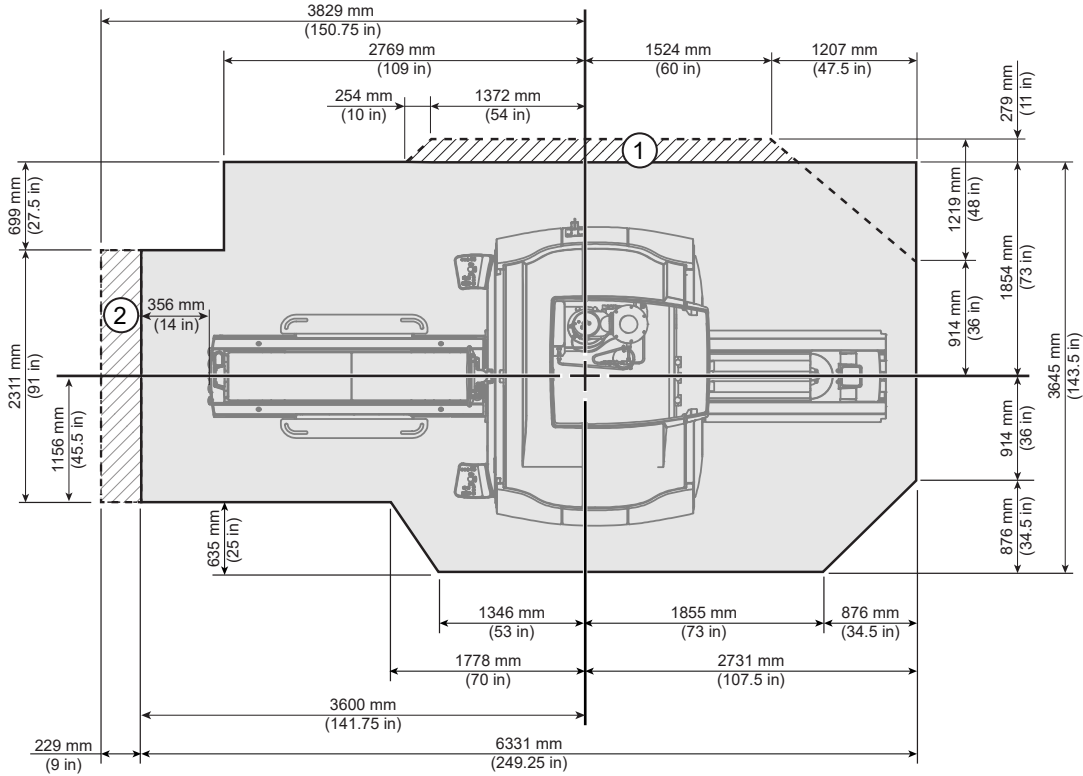
Room dimensions shown in the table below are the minimum finished room space requirements to safely install and service the MR System. Minimum dimensions are for service only. Room size may increase due to the items listed below, which are not included in the minimum area dimensions:

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 HealthCare 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 25](#).
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**

Configuration	Equipment Room <sup>1</sup>			Magnet Room <sup>2</sup>			Control Room		Total System Area m <sup>2</sup> (ft <sup>2</sup> )
	W x D mm (in.)	Area m <sup>2</sup> (ft <sup>2</sup> )	Ceiling Height mm (in.)	W x D mm (in.)	Area m <sup>2</sup> (ft <sup>2</sup> )	Finished Ceiling Height mm (in.)	W x D mm (in.)	Area m <sup>2</sup> (ft <sup>2</sup> )	
MR/PET Minimum Room Size (2050 mm Scan Range)	3787 x 2860 (149.1 x 112.6)	10.4 (111.6) <sup>1</sup>	2896 (114)	3645 x 6331 (143.5 x 249.3)	20.8 (224.1)	2500 (98.5)	1524 x 2134 (60 x 84)	3.2 (35)	34.4 (370.7)
With MNS (m <sup>2</sup> (ft <sup>2</sup> ))		Add: 1.4 (15)							
When upgrading from a 750w suite, the PET chiller and PET cabinet add 1.2 m <sup>2</sup> (13.4 ft <sup>2</sup> ) to the minimum Equipment Room size.									
<sup>1</sup> See <a href="#">Figure 4-1 Typical Minimum Equipment Room with Service Clearances on page 97</a> for specific dimensions									
<sup>2</sup> See <a href="#">Figure 2-2 Minimum Magnet Service Area (Top View) on page 20</a> for specific dimensions									

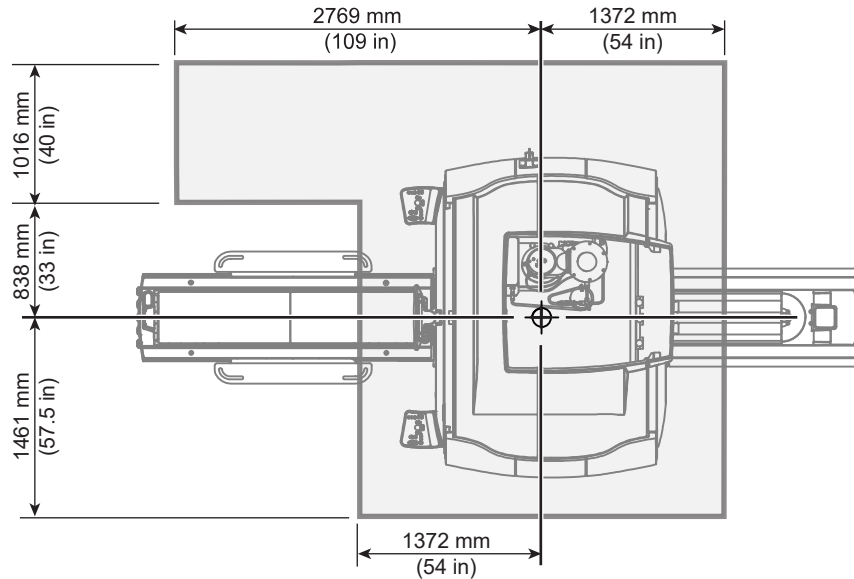
**Figure 2-2 Minimum Magnet Service Area (Top View)**



Item	Description	Item	Description
1	Alternate design tradeoff area	2	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 2-3 Area for Minimum Magnet Ceiling Height \(Top View\) on page 21](#).
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 2-3 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 HealthCare 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 90](#), [Equipment Room on page 96](#), and [Control Room on page 118](#)).

## 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:

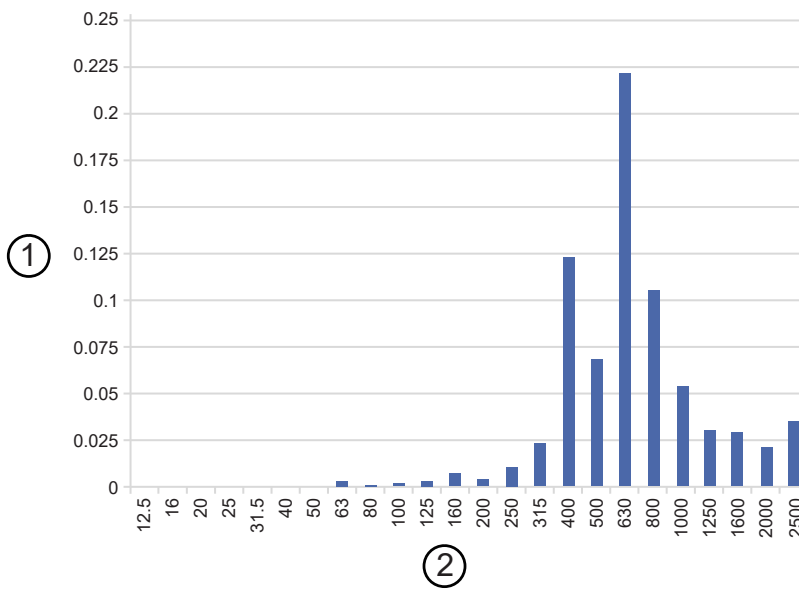
1. GE HealthCare provides a VibroAcoustic Damping kit (which must be surface mounted). Contact the GE HealthCare Project Manager of Installation for information.
2. The customer may design and implement a custom solution in addition to the VibroAcoustic Damping kit. See [Figure 2-4 Vibration Transmitted through VibroAcoustic Mat for UA Magnet on page 22](#) and [Figure 2-5 Vibration Transmitted through VibroAcoustic Mat for AR Magnet on page 23](#) 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**

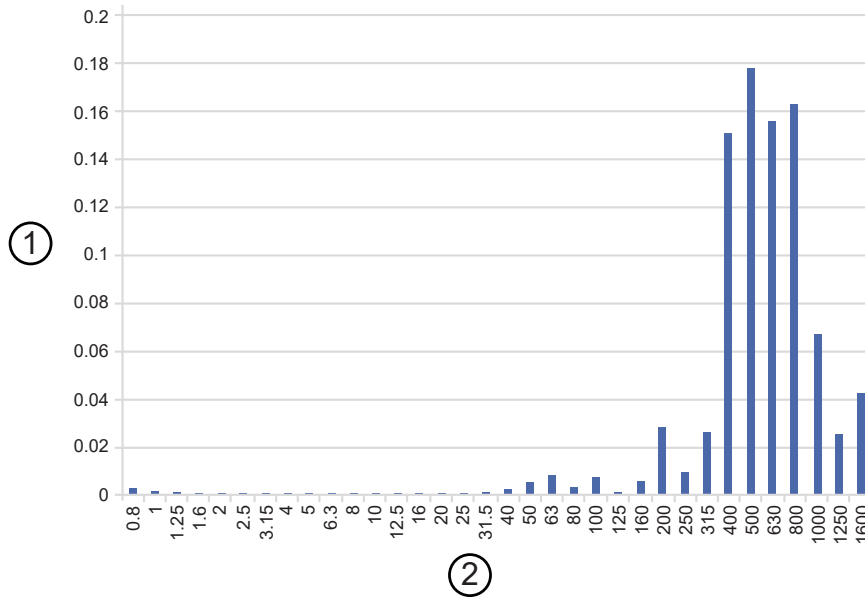
The amount of vibration attenuation provided by the VibroAcoustic Damping kit will be site dependent.

**Figure 2-4 Vibration Transmitted through VibroAcoustic Mat for UA Magnet**



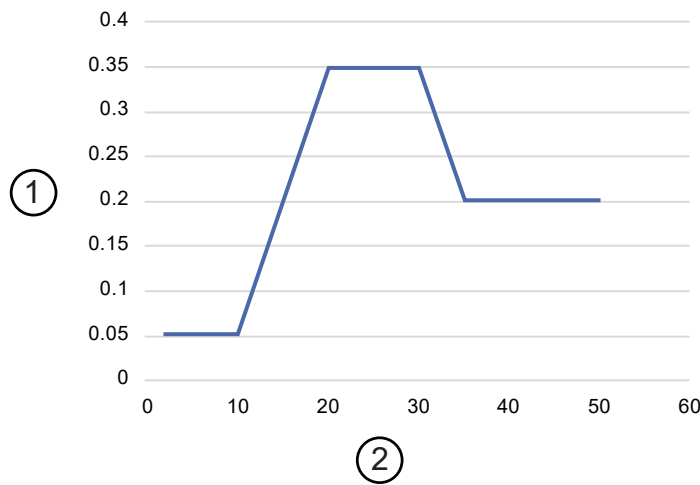
Item	Description
1	Acceleration [m/s <sup>2</sup> ]
2	1/3 Octave Frequency [Hz]

**Figure 2-5 Vibration Transmitted through VibroAcoustic Mat for AR Magnet**



Item	Description
1	Acceleration [m/s <sup>2</sup> ]
2	1/3 Octave Frequency [Hz]

**Figure 2-6 Low Frequency Magnet Floor Vibration (Vibration Amplitude at Each Foot) for AR and UA magnet**



Item	Description
1	Vibration Amplitude (m/s <sup>2</sup> )
2	Frequency (Hz)

Frequency (Hz)	Amplitude (m/s <sup>2</sup> )
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 2-4 Vibration Transmitted through VibroAcoustic Mat for UA Magnet on page 22](#) and [Figure 2-5 Vibration Transmitted through VibroAcoustic Mat for AR Magnet on page 23](#) is the high frequency audible vibration. [Figure 2-6 Low Frequency Magnet Floor Vibration \(Vibration Amplitude at Each Foot\) for AR and UA magnet on page 24](#) 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.

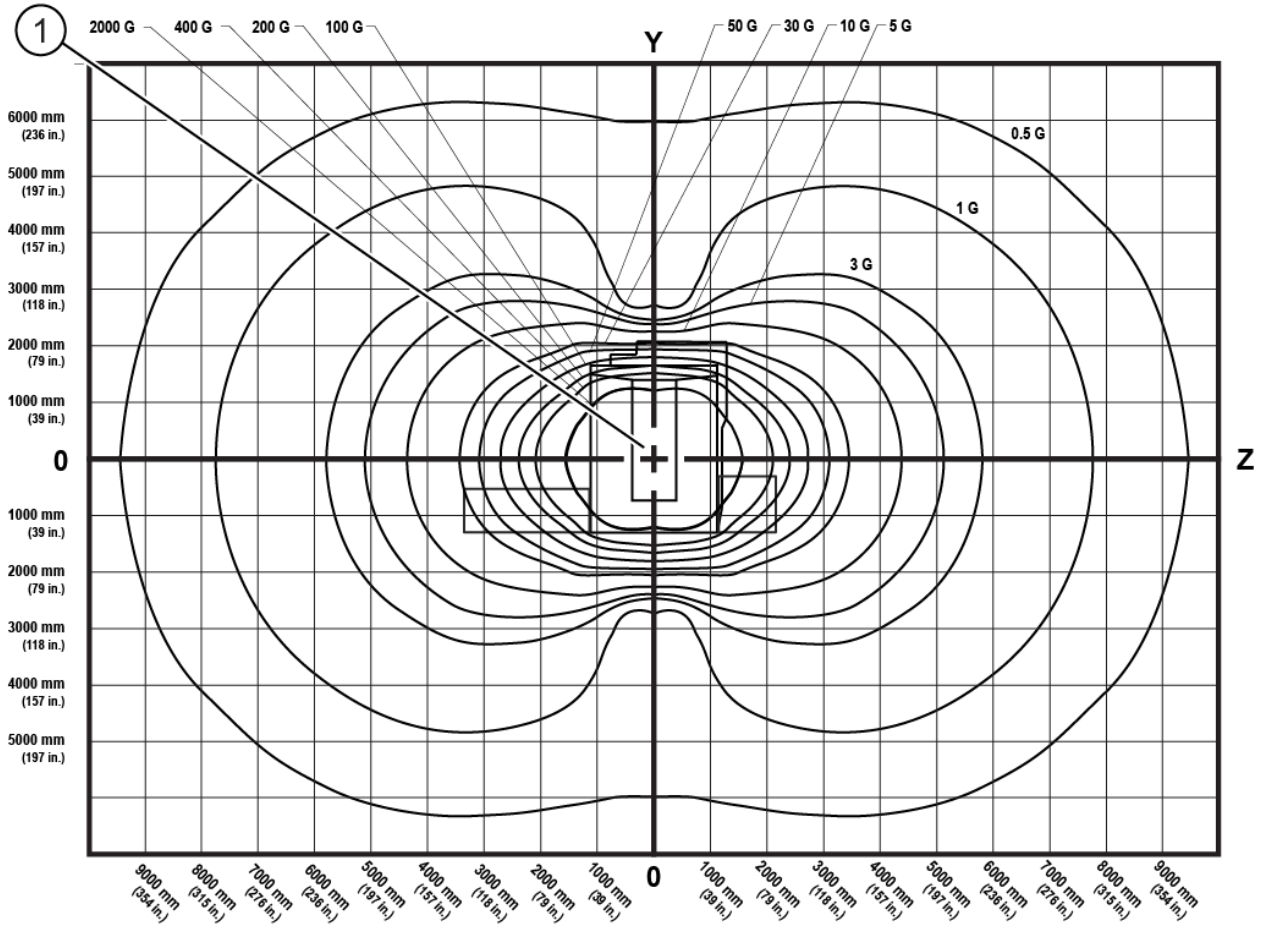
**For UA magnet:** The 0.5 mT (5G) line can expand to 6.0 m (19.7 ft.) axially and 4.5 m (14.8 ft.) radially for up to 8 seconds in the rare event of a quench.

**For AR magnet:** The 0.5mT (5G) line can expand to 6.5 m (21.33 ft.) axially and 3.5 m (11.48 ft.) radially for up to 2 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:

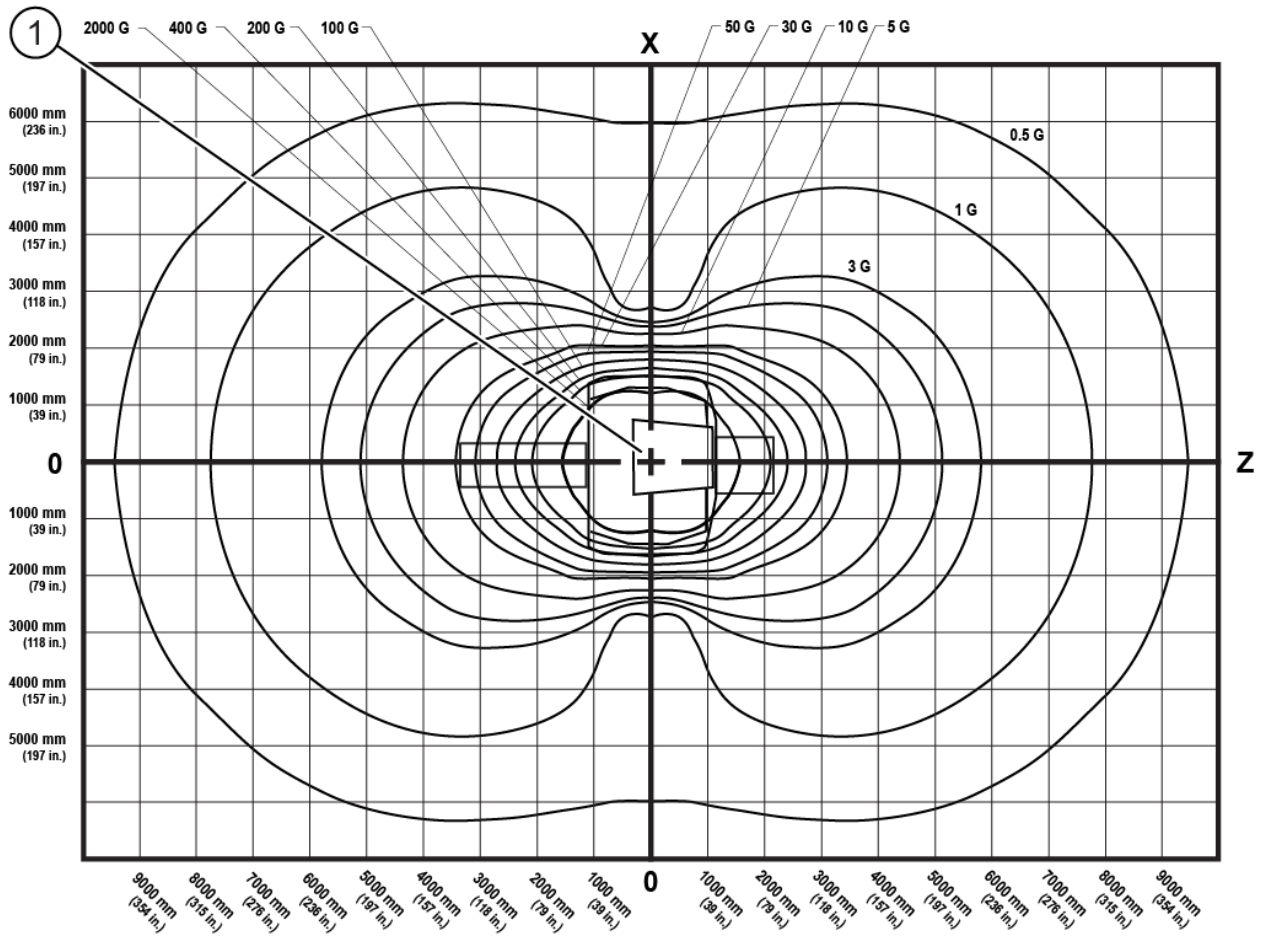
- Magnetic shielding
- Earth's magnetic field
- Other magnetic fields
- Stationary or moving metal

Figure 2-7 Magnetic Fringe Field Side View (UA series magnet)



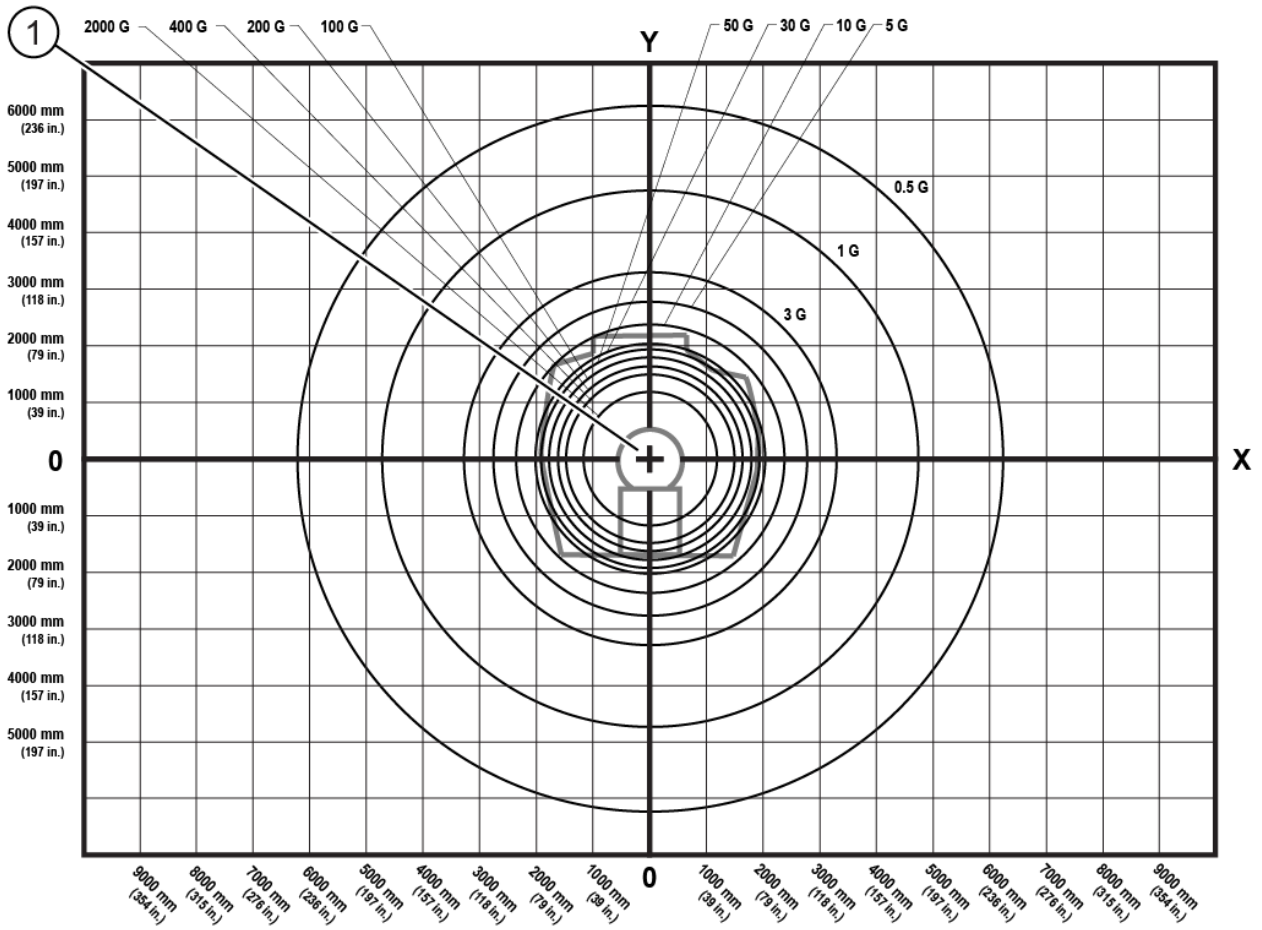
Item	Description
1	Magnet isocenter

Figure 2-8 Magnetic Fringe Field Top View (UA series magnet)



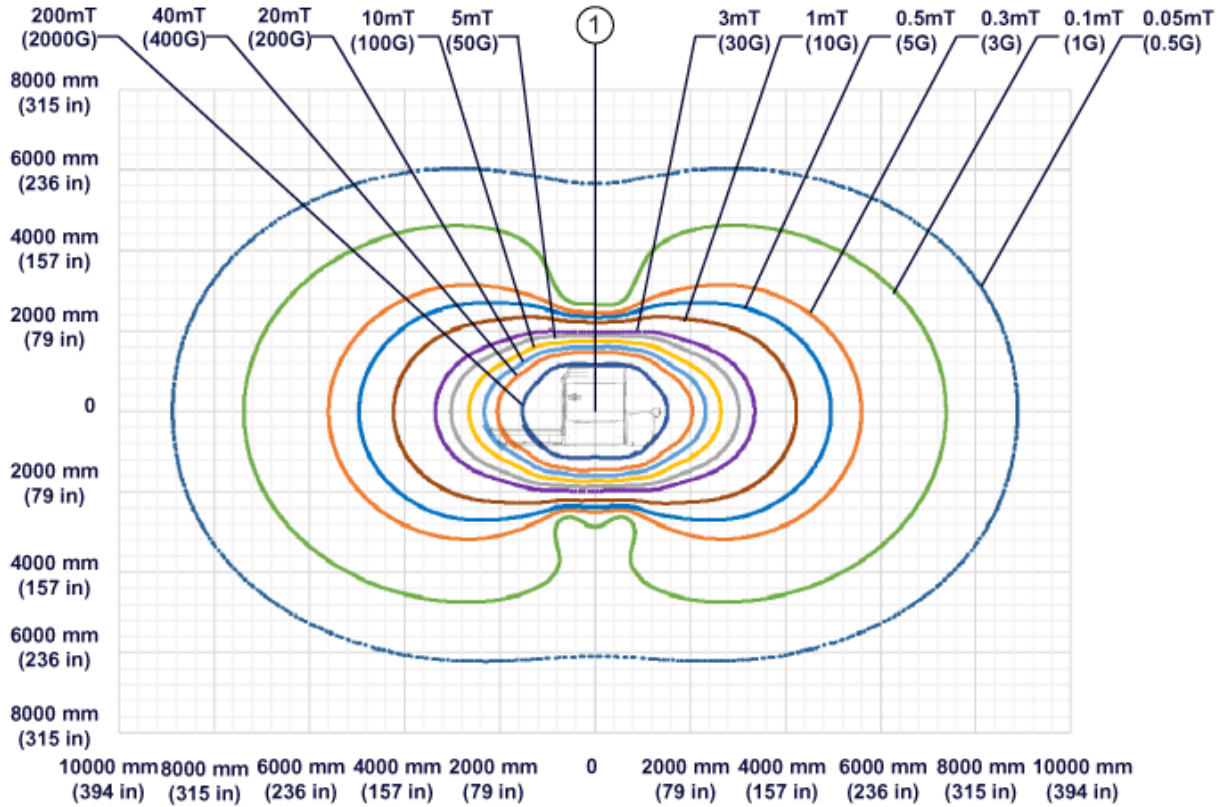
Item	Description
1	Magnet isocenter

**Figure 2-9 Magnetic Fringe Field Front View (UA series magnet)**



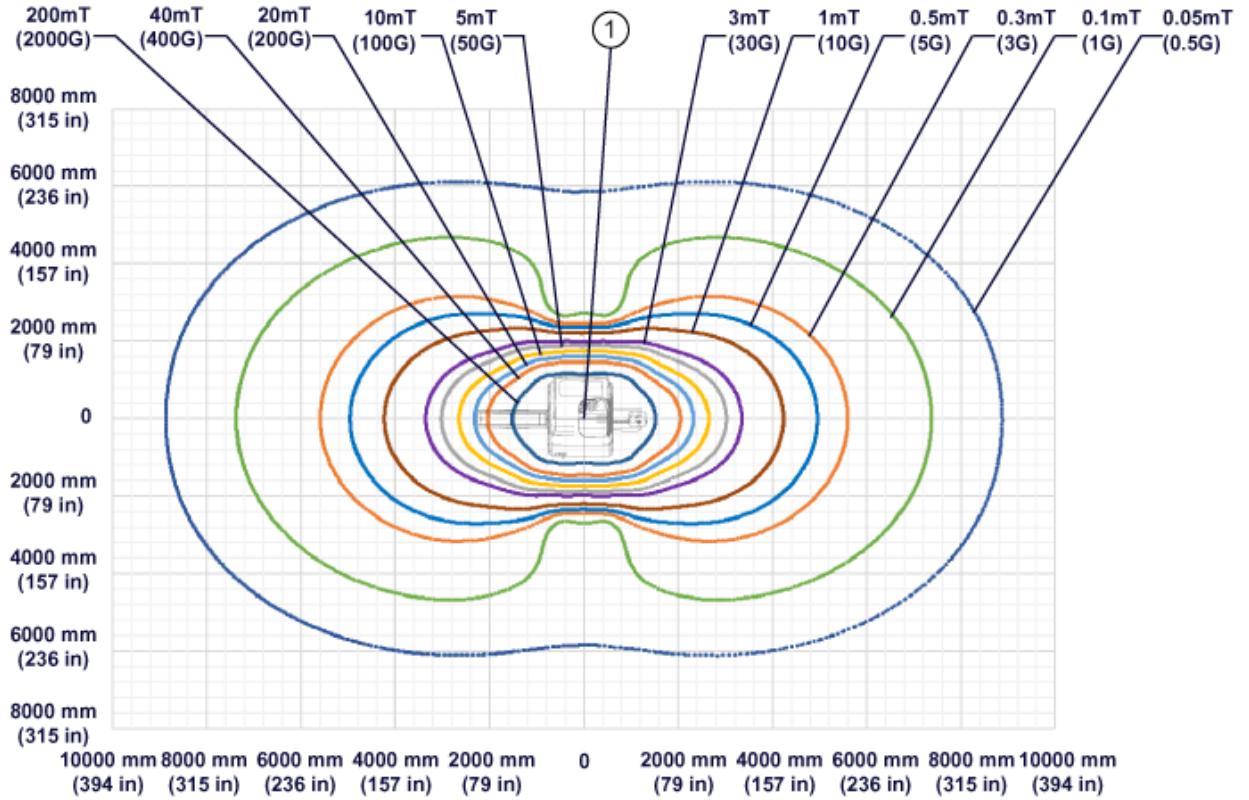
Item	Description
1	Magnet isocenter

**Figure 2-10 Magnetic Fringe Field Side View (AR series magnet)**



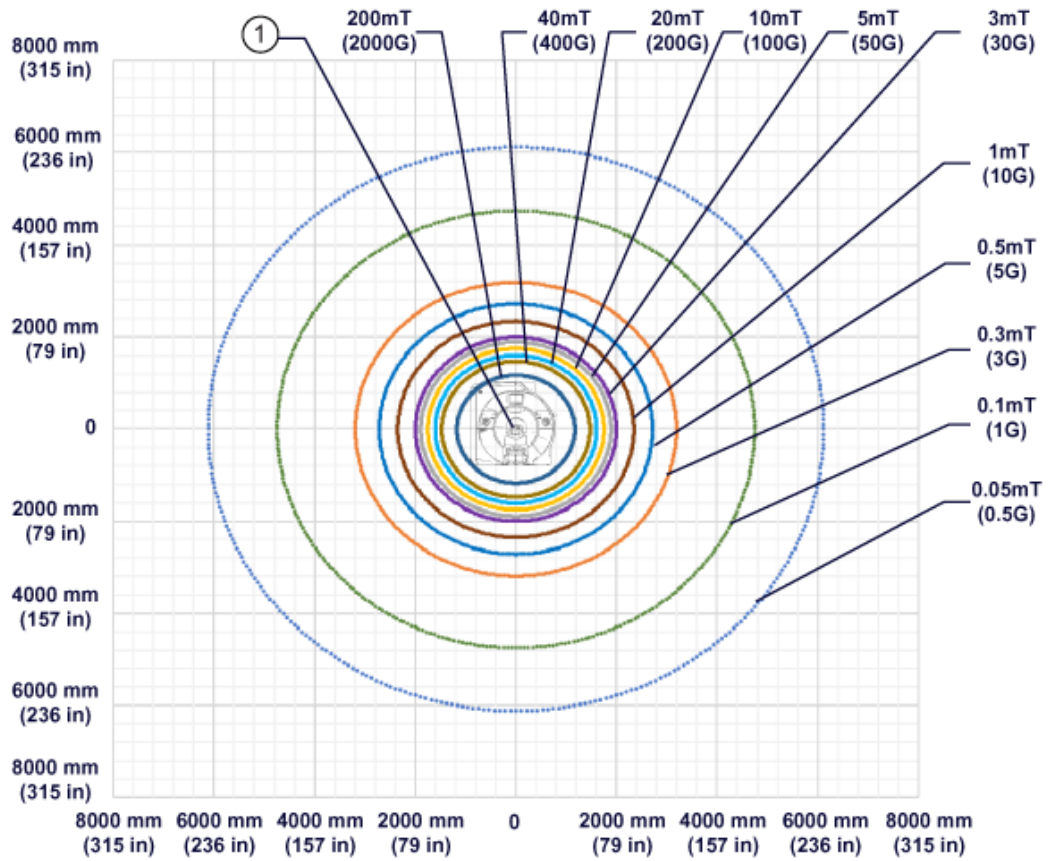
Item	Description
1	Magnet isocenter

**Figure 2-11 Magnetic Fringe Field Top View (AR series magnet)**



Item	Description
1	Magnet isocenter

**Figure 2-12 Magnetic Fringe Field Front View (AR series magnet)**

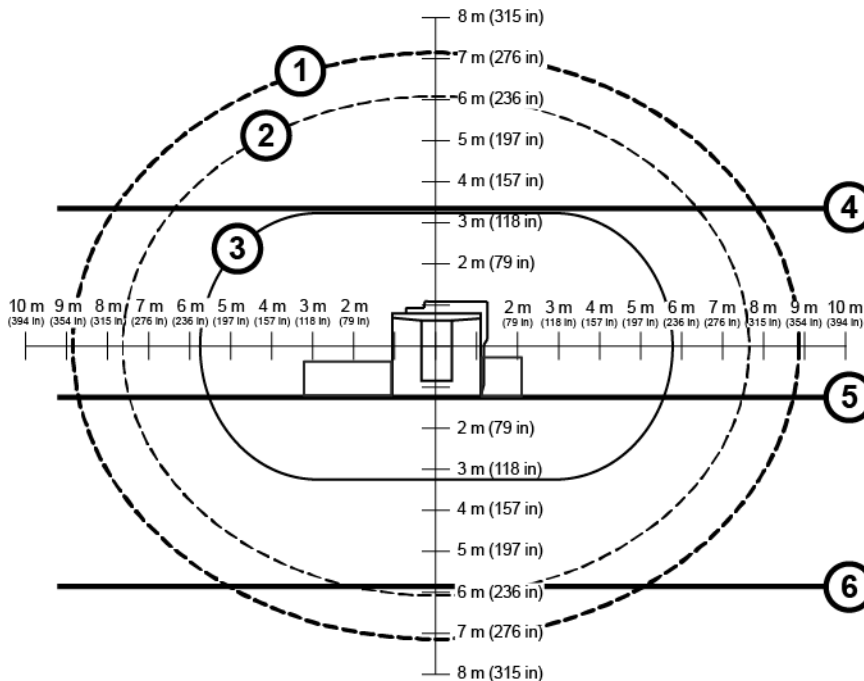


Item	Description
1	Magnet isocenter

## 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 2-13 Magnet Moving Metal Sensitivity Line Plot (Side View, UA series magnet)**



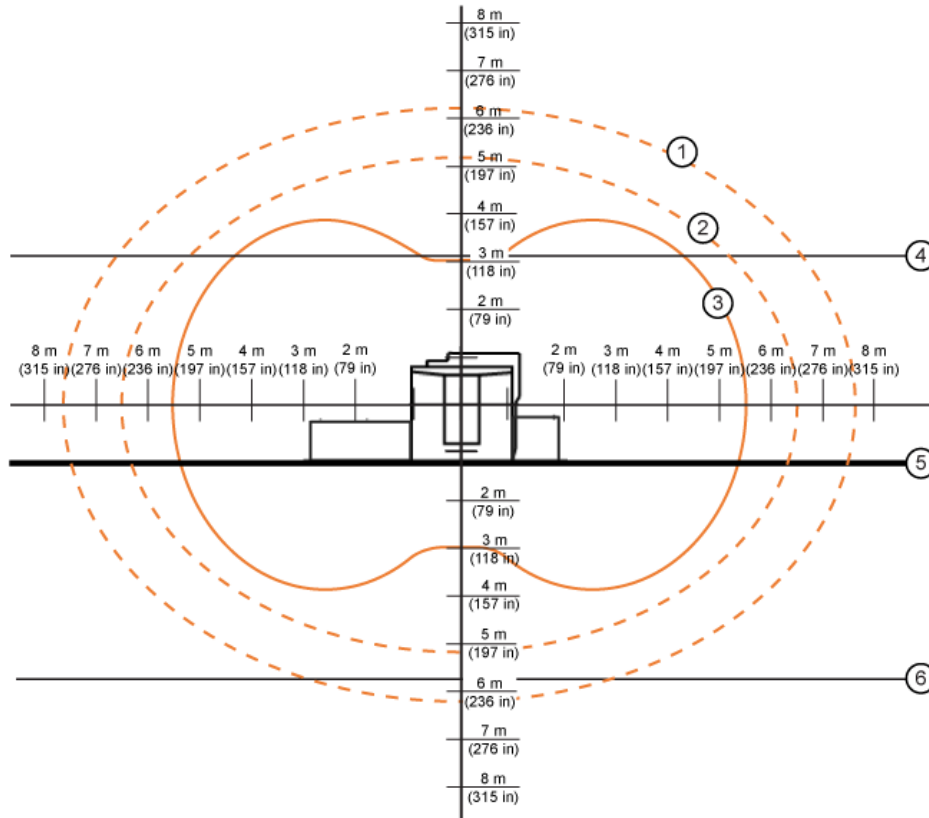
Item	Description	Item	Description
1	Trucks, Buses	4	Floor Above
2	Cars, Pickups, Vans, Ambulances	5	Magnet Room Floor
3	3 Gauss line	6	Floor Below



**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 2-14 Magnet Moving Metal Sensitivity Line Plot (Side View, AR series magnet)**



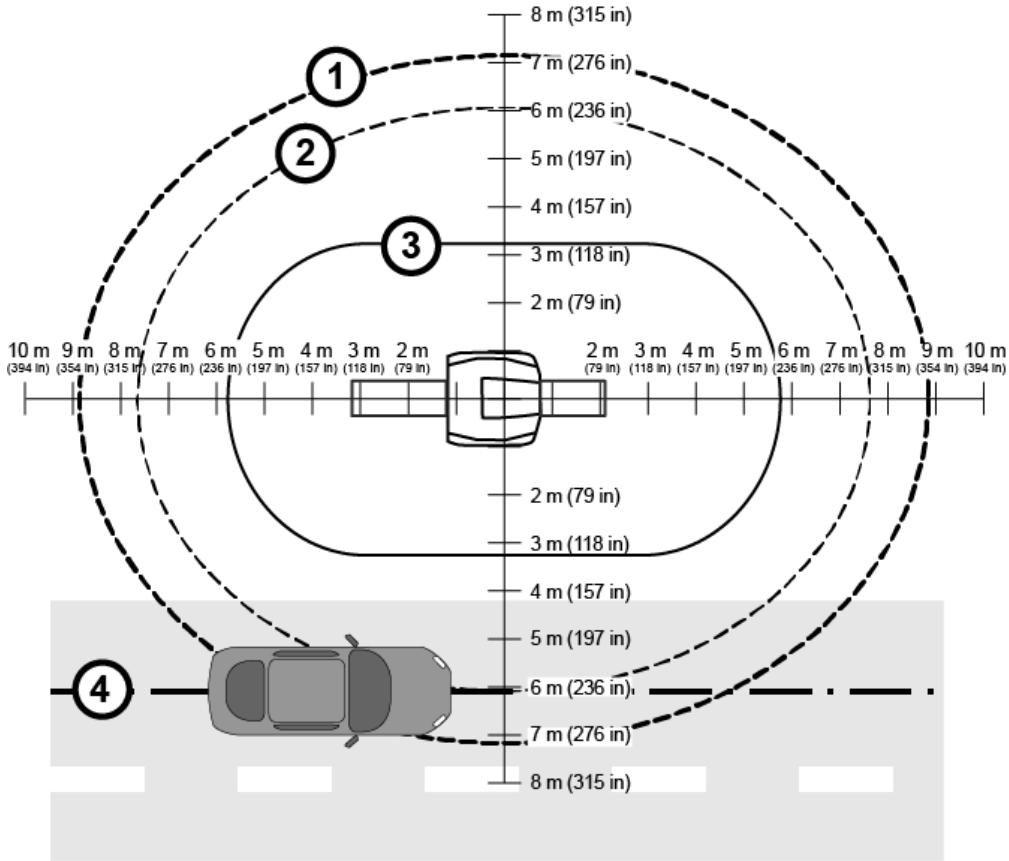
Item	Description	Item	Description
1	Trucks, Buses	4	Floor Above
2	Cars, Pickups, Vans, Ambulances	5	Magnet Room Floor
3	3 Gauss line	6	Floor Below



**NOTE**

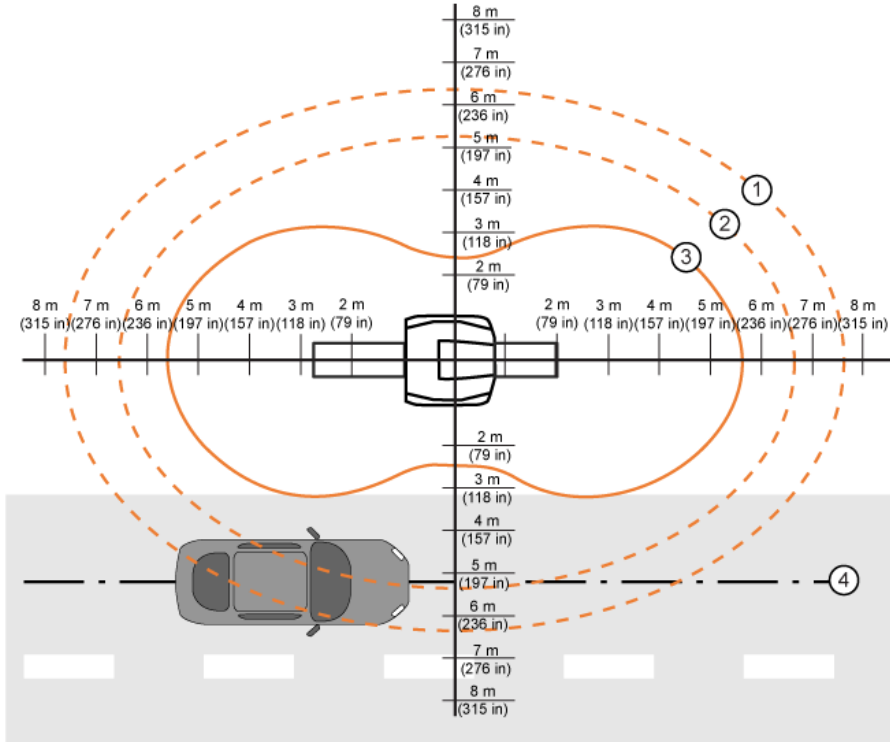
The magnet isocenter, which is 1070 mm (42.1 in.) above the floor, is the origin of both the x-axis and the y-axis.

**Figure 2-15 Magnet Moving Metal Sensitivity Line Plot (Top View, UA series magnet)**



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

**Figure 2-16 Magnet Moving Metal Sensitivity Line Plot (Top View, AR series magnet)**



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 <sup>1</sup> 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) 5.29 x 6.58 (17.4 x 21.6) (AR 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) 6.17 x 7.69 (20.3 x 25.2) (AR 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) Z-axis EMI disturbances must not exceed 520 nanotesla (5.2 milligauss) peak-to-peak. (AR series magnet)

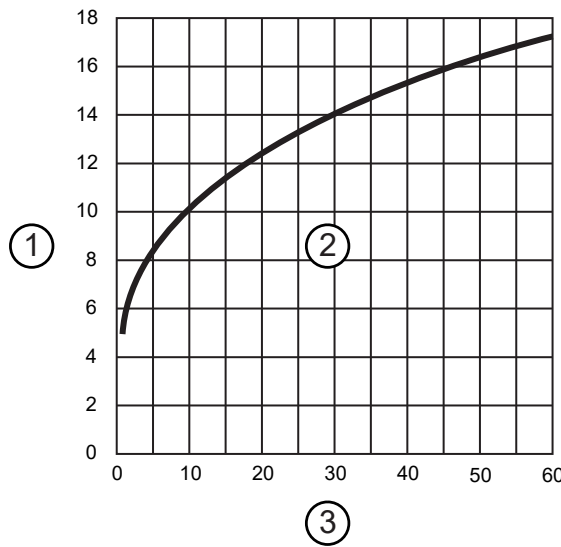
**Notes:**

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  $\mu\text{T}$  (16.22 mG) or 1.710  $\mu\text{T}$  (17.10 mG) RMS respectively at the magnet location (see [Figure 2-17 Magnet Allowable Milligauss vs. Line Frequency for AC Equipment on page 36](#)).
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:
  - 3.1. For 3.0T Magnet:  $I = (8.55X^2)/S$ , where:
    - 3.2. I = Maximum allowable RMS single phase current (in amps) or maximum allowable RMS line current (in amps) in three phase feeder lines
    - 3.3. S = Separation (in meters) between single phase conductors or greatest separation between three phase conductors
    - 3.4. X = Minimum distance (in meters) from the feeder lines to isocenter of the magnet

**Figure 2-17 Magnet Allowable Milligauss vs. Line Frequency for AC Equipment**



Item	Description	Item	Description
1	Milligauss	3	Excitation Frequency (Hz)
2	No Impact on Imaging		

Refer to [Sample Calculation AC Power Equipment Minimum Distance on page 156](#) 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)**

<b>mT (Gauss) Limit</b>	<b>Equipment</b>	
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



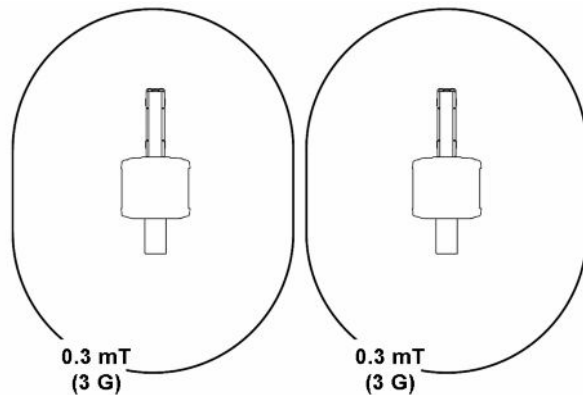
(Applies to all subsections within this section)

### 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 2-18 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. Refer to [Figure 2-19 Cabinet Separations in Shared Equipment Room \(Top View\) on page 39](#) for cabinet location examples.

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

This requirement does not apply if the existing 3.0T system is one of the following: SIGNA Pioneer, SIGNA Hero, SIGNA Performer, SIGNA Pilot, Discovery MR750, Discovery MR750w, SIGNA Architect, SIGNA Premier, or SIGNA PET/MR.

2. Penetration panels must be separated 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 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 2-19 Cabinet Separations in Shared Equipment Room (Top View)

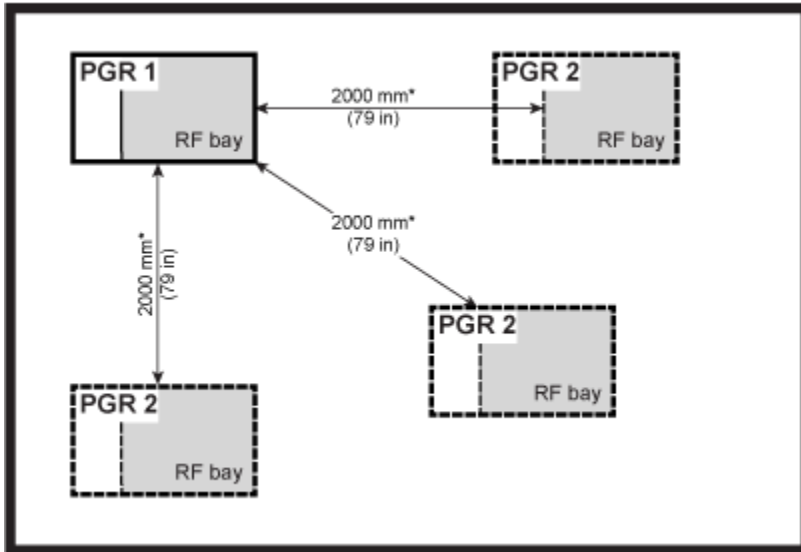
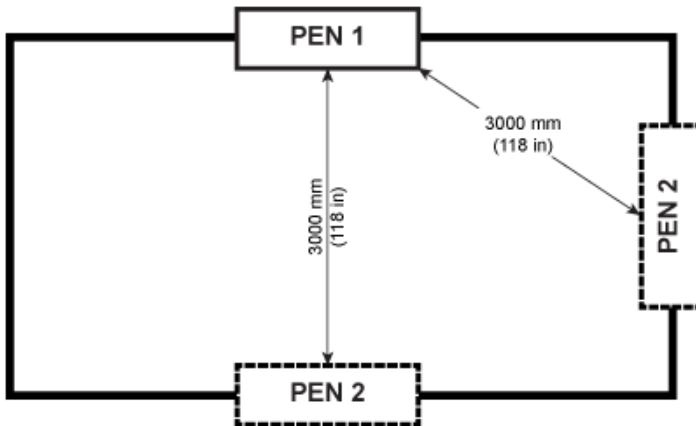


Figure 2-20 Panel Separations in Shared Equipment Room (Top View)



## 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) <sup>1</sup>	Range %RH	Change %RH/Hr <sup>2</sup>
Equipment Room (at Inlet to Equipment)	15-32 (59-89.6) <sup>3</sup>	3 (5)	30-70	5
Magnet Room	15-21 (59-69.8)	3 (5)	30-60	5
Operator Room	15-32 (59-89.6)	3 (5)	30-70	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.

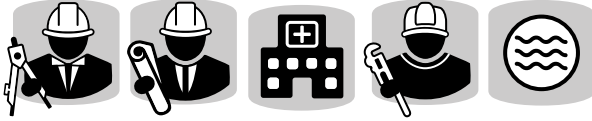
**Table 2-5 System Heat Output for Air Cooling**

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)						
Blower Box	450 (1535)	450 (1535)	450 (1535)						
Penetration Panel Cabinet (PEN)	300 (1024)	150 (512)	0	3135 (10697)	1568 (5349)	1568 (5349)			
Secondary Penetration Wall (SPW)	0			0					
Main Disconnect Panel (MDP)				264 (901)	132 (450)	132 (450)			
Power Gradient RF Cabinet (PGR)				6137 (20940)	3068 (10470)	2500 (8530)			
Cryocooler Compressor (CRY)				500 (1706)	500 (1706)	500 (1706)			
Heat Exchanger Cabinet (HEC)				1000 (3412)	500 (1706)	500 (1706)			
Magnet Monitor (MON)				240 (819)	240 (819)	240 (819)			
Operator Workspace Equipment (OW)							1450 (4947)		
PET Cabinet (PET)				3820 (13041)	3195 (10908)	3195 (10908)			
PET Electronics	1090 (3721)	1090 (3721)	1090 (3721)						
PET Chiller (P-Chill)				7000 (24000)	2500 (8500)	2500 (8500)			

**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
Multi-Nuclear Spectroscopy Cabinet (MNS)				7205 (24584)					
MR Elastography (MRE)				141 (480)					
SPiCE Workstation (SW)							632 (2157)		

## 2.9 Facility Coolant Requirements



(Applies to all subsections within this section)



### IMPORTANT

Equipment Failure. A continuous supply of facility liquid coolant to the Heat Exchanger Cabinet (HEC) 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 Heat Exchanger Cabinet (HEC) Coolant Requirements

1. The facility must provide an uninterrupted supply of liquid coolant to the Heat Exchanger Cabinet (HEC) at magnet delivery. Coolant circuit must be operational at magnet delivery.
2. The facility must provide pipe/hose, filter, and connectors to the HEC.
3. 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 76 and 189 L/min (20 and 50 GPM) and configured for the properties of the cooling fluid in use.

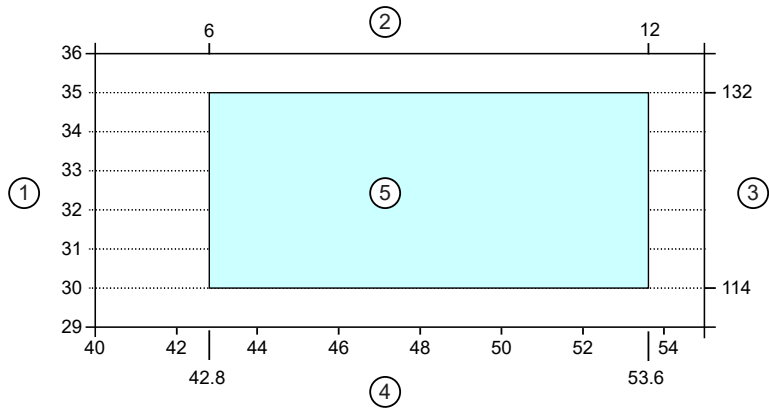
**Table 2-7 Facility Liquid Coolant Requirements**

Parameter	Requirements
Availability	Continuous
Antifreeze	No more than 40% propylene glycol-water (PGW) or ethylene glycol-water (EGW)
Minimum Flow	114 L/min (30 GPM)
Maximum Flow	132 L/min (35 GPM)
Maximum Pressure Drop in HEC at Minimum Flow	2.4 bar (34.8 psi) with 40% propylene glycol-water (PGW) or ethylene glycol-water (EGW); 1021 kg/m <sup>3</sup> density 1.5 bar (21.8 psi) with pure water; 1000 kg/m <sup>3</sup> density
Maximum Pressure Drop in HEC at Maximum Flow	3.3 bar (47.8 psi) with 40% propylene glycol-water (PGW) or ethylene glycol-water (EGW); 1021 kg/m <sup>3</sup> density 2.25 bar (32.6 psi) with pure water; 1000 kg/m <sup>3</sup> density
Temperature rise at Minimum Flow	9.6°C (17.3°F) with 40% propylene glycol-water; 3730 J/(kg K) specific heat; 1021 kg/m <sup>3</sup> density; 70 kW heat
Temperature rise at Maximum Flow	8.4°C (15.1°F) with 40% propylene glycol-water; 3730 J/(kg K) specific heat; 1021 kg/m <sup>3</sup> density; 70 kW heat
Maximum Inlet Pressure to HEC	6 bar (87 psi)
Chiller Size	Minimum 70 kW
Condensation Protection	Facility Plumbing to the HEC must be properly routed and insulated to prevent equipment damage or safety hazards.
Minimum Continuous Heat Load	7.5 kW
Inlet Temperature	6 to 12°C (42.8 to 53.6°F) measured at the inlet to the HEC

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

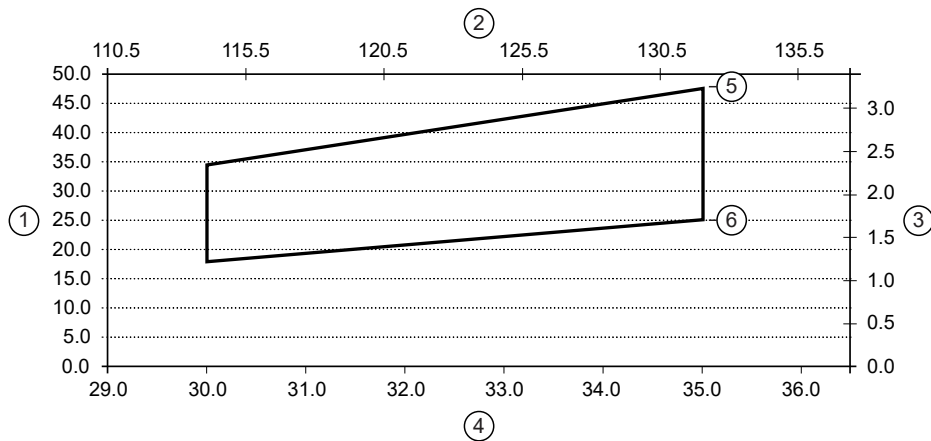
Parameter	Requirements
Customer supplied feeder hose (from main water supply to HEC)	38.1 mm (1.5 in.) minimum hose inside diameter
Hose connections to the HEC	38.1 mm (1.5 in.) male NPT

**Figure 2-21 Allowable Facility Water Temperature and Flow**



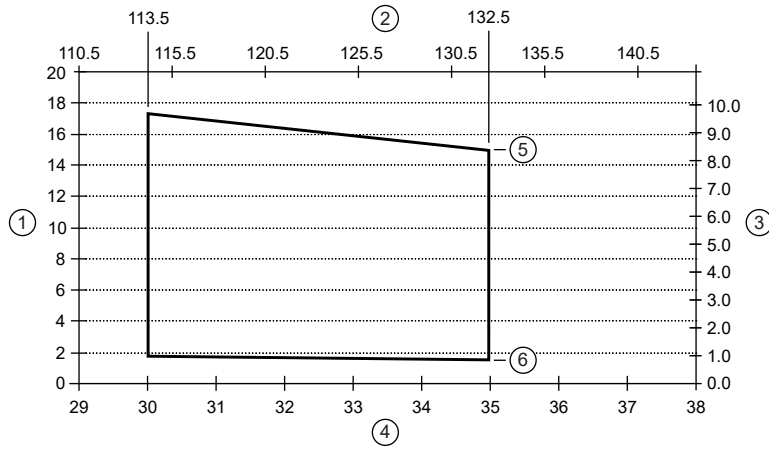
Item	Description	Item	Description
1	Flow [gpm]	4	Temperature [°F]
2	Temperature [°C]	5	No more than 40% Propylene Glycol
3	Flow [L/min]		

**Figure 2-22 Pressure Drop through HEC (40% PGW, 1021 kg/m<sup>3</sup>)**



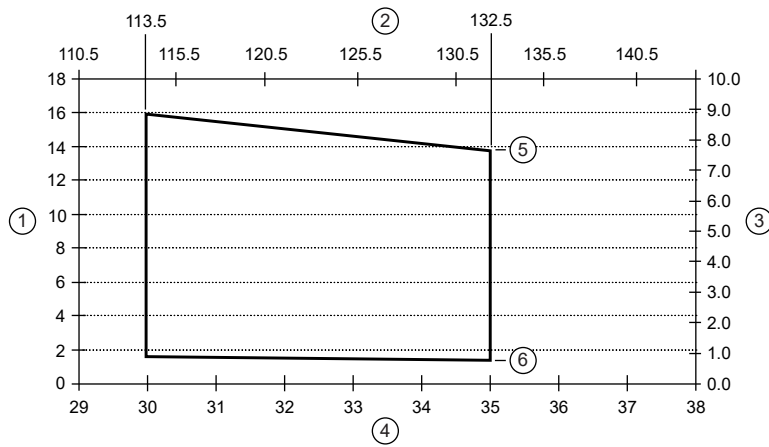
Item	Description	Item	Description
1	Pressure [psig]	4	Flowrate [gpm]
2	Flowrate [L/min]	5	Max HEC Cooling
3	Pressure [bar]	6	Min HEC Cooling

**Figure 2-23 Temperature Rise through HEC (40% PGW, 3730 J/kg-K, 1021 kg/m<sup>3</sup>)**



Item	Description	Item	Description
1	Temperature Rise [°F]	4	Flowrate [gpm]
2	Flowrate [L/min]	5	Max Heat Load: 70kW
3	Temperature Rise [°C]	6	Min Heat Load: 7.5kW

**Figure 2-24 Temperature Rise through HEC (0% PGW, 4182 J/kg-K, 997 kg/m<sup>3</sup>)**



Item	Description	Item	Description
1	Temperature Rise [°F]	4	Flowrate [gpm]
2	Flowrate [L/min]	5	Max Heat Load: 70kW
3	Temperature Rise [°C]	6	Min Heat Load: 7.5kW

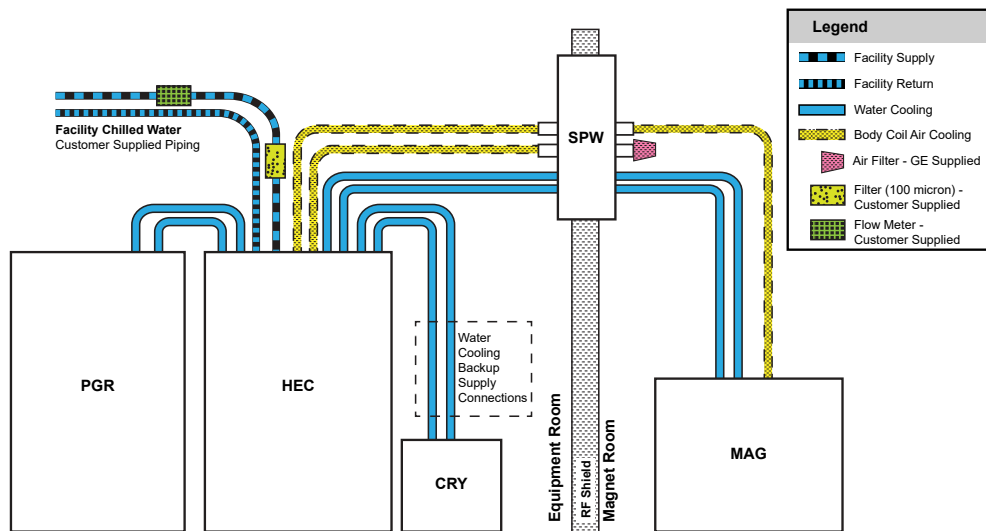
**Table 2-8 Facility Water Quality Requirements**

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

**Table 2-8 Facility Water Quality Requirements** (Table continued)

Parameter	Requirement
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 2-25 MR System Water Cooling Block Diagram**



## 2.9.2 Requirements for Emergency Backup Facility Coolant (Optional)

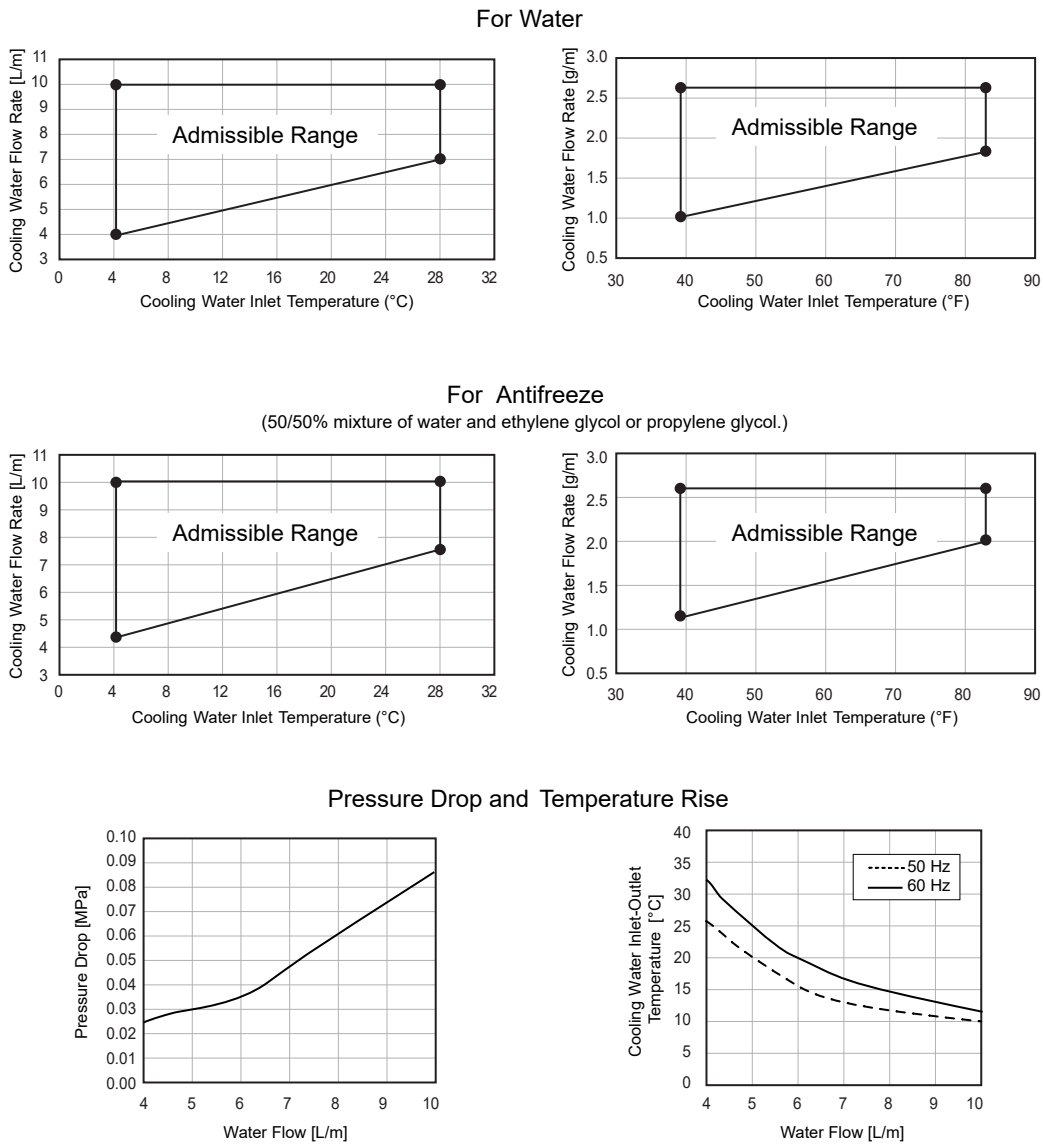
The customer must balance the cost of cryogenes and local controls with the cost of emergency backup facility coolant. There are two options for emergency backup, either total HEC backup or Cryocooler Compressor backup.

The facility is responsible for either option.

1. Total HEC backup:
  - 1.1. The facility is responsible for the connection of all hoses of a backup system.

- 1.2. Coolant must meet all other HEC coolant requirements listed in [Table 2-7 Facility Liquid Coolant Requirements on page 43](#) and [Table 2-8 Facility Water Quality Requirements on page 45](#).
2. Cryocooler Compressor backup only:  
Coolant may be routed directly to the Cryocooler compressor at the location indicated in [Figure 2-25 MR System Water Cooling Block Diagram on page 46](#) with the following requirements:
  - 2.1. The emergency coolant supply must isolate the Cryocooler Compressor and not back-feed the HEC.
  - 2.2. Coolant must meet all other HEC coolant requirements listed in [Table 2-8 Facility Water Quality Requirements on page 45](#).
  - 2.3. The charts below show the coolant flow rate and temperature requirements for the Cryocooler Compressor:
3. The supplied water cooling hoses between the HEC and CRY are Parker Push-lok 801-8, 12.5 mm (0.5 in.) I.D.

**Figure 2-26 Cryocooler Water Cooling Requirements**



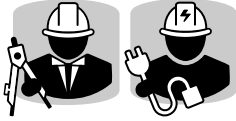
### 2.9.3 PET Coolant

PET cooling is a closed-loop system that is not connected to facility cooling.

Only GE provided “Blue Water” must be used in the PET Chiller loop. Tap water cannot be used to top off fluid levels or for cleaning purposes. This can cause contamination that can impact system performance.

Refer to [Table 2-5 System Heat Output for Air Cooling on page 41](#) for thermal output of the PET Chiller.

## 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):
  - 1.1. For GE HealthCare supplied MDP, M8000PH Design setup, see [2.10.2 GE HealthCare supplied Main Disconnect Panel \(MDP\) Specifications for M8000PH on page 52](#).
  - 1.2. For Customer-supplied MDP:
    - 1.2.1. Customer-supplied MDP may not be permissible in all regions. Contact your GE HealthCare Project Manager of Installation (PMI) to verify local requirements.
    - 1.2.2. MDP Design Requirements: [2.10.3 Customer-supplied Main Disconnect Panel \(MDP\) Requirements \(exempt countries only\\*\) on page 54](#).
    - 1.2.3. MDP Design Setup [Figure 2-28 Customer-supplied MDP MR System Main Disconnect Panel \(MDP\) Setup on page 56](#).
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 to the Cryocooler Compressor (F-50SH).
6. Runs E0009, E3030, EP0003, M3030 and E4002 are supplied by GE HealthCare. All other wiring shown in [Figure 2-27 GE HealthCare supplied Main Disconnect Panel \(MDP\) Setup for M8000PH on page 53](#) and [Figure 2-28 Customer-supplied MDP MR System Main Disconnect Panel \(MDP\) Setup on page 56](#) 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"> <li>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 HealthCare-supplied MDP.</li> <li>A 3 phase floating DELTA with Ground (3 Wire + Ground). Do not connect a corner grounded DELTA source.</li> </ul> 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"> <li>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.</li> <li>Main facility ground conductor to Main Disconnect Panel (MDP) must be appropriately sized insulated copper wire.</li> <li>The main facility ground to the Main Disconnect Panel (MDP) must meet local codes.</li> </ul>	
	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	
PET/MR SPICE Workstation (SW) Option	Voltage / Frequency	100-120 VAC 60 Hz (North America) 200-240 VAC 50/60 Hz (International)	
	Phase	1	
	Maximum Current	5A	
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)
MR PDU Continuous Power	79
PET PDU Continuous Power	10
HEC Continuous Power (including Cyrocooler)	20
MR PDU 50 millisecond peak power	120
Cryocooler Compressor Continuous Power	9
Total system Continuous Power	109

**Table 2-10 System Power Demand** (Table continued)

Equipment	Power Draw (kVA)
Total system 50 millisecond peak power	150

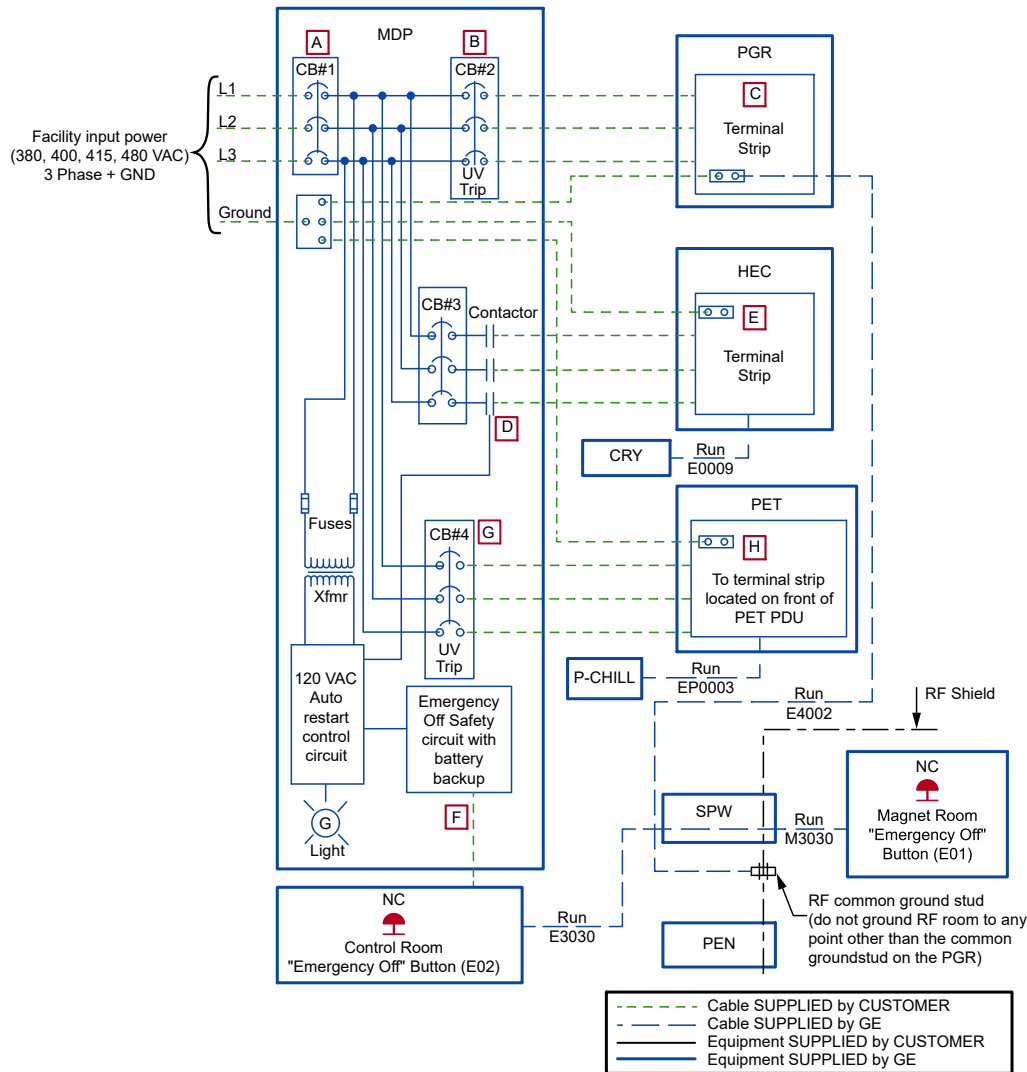
## 2.10.2 GE HealthCare supplied Main Disconnect Panel (MDP) Specifications for M8000PH

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

The GE HealthCare MDP consists of the following:

- A 3-pole 200A main circuit breaker rated for the total current of all the sub-breaker circuits.
- A 3-pole 150A circuit breaker rated for the current of the MR PDU circuit.
- A 3-pole 30A circuit breaker rated for the current of the PET PDU circuit.
- A 3-pole 50A circuit breaker rated for the current of the HEC circuit.
- All circuit breakers have a short circuit current interrupting rating of 25000 Amps.
- Auto restart on the HEC circuit.
- 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 are listed in [Table 2-12 Range of Standard connector accepted for M8000PH on page 54](#).
- Provision for terminating facility incoming neutral wire on the neutral terminal block.
- Multiple ground terminal blocks as required by panel design.
- The MDP is listed and labeled by Nationally Recognized Testing Lab (NRTL) and bears UL and CE mark. The MDP is certified as per “UL 508A and IEC 61439-2” standards.
- Power on indicators.
- 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 2-27 GE HealthCare supplied Main Disconnect Panel (MDP) Setup for M8000PH**



**Table 2-11 Specifications for GE HealthCare supplied MDPs**

Catalog No.	M8000PH - 5436386
Description	MDP 380V - 480V
Mains Input Breaker, CB1	200A
PDU Breaker, CB2	150A
HEC Breaker, CB3	50A
PET PDU Breaker, CB4	30A

The labeled connections shown in [Figure 2-27 GE HealthCare supplied Main Disconnect Panel \(MDP\) Setup for M8000PH on page 53](#) can accept the range of standard stranded conductors shown in [Table 2-12 Range of Standard connector accepted for M8000PH on page 54](#). All wire types, color, and sizing are to be selected in accordance with governing electrical codes.

**Table 2-12 Range of Standard connector accepted for M8000PH**

Item	Phase		Ground	
	sq. mm	AWG/kcmil	sq. mm	AWG/kcmil
A	16 to 185	6 to 350	16 to 185	6 to 350
B	35 to 120	2 to 4/0	2.5 to 70	14 to 2/0
C	2.5 to 70	14 to 2/0	2.5 to 70	14 to 2/0
D	2.5 to 55	14 to 1/0	2.5 to 70	14 to 2/0
E	1.5 to 50	10 to 1/0	1.5 to 50	10 to 1/0
F	0.22 to 4	22 to 10	N/A	N//A
G	2.5 to 55	14 to 1/0	2.5 to 70	14 to 2/0
H	0.14 to 4	26 to 12	0.14 to 4	26 to 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**

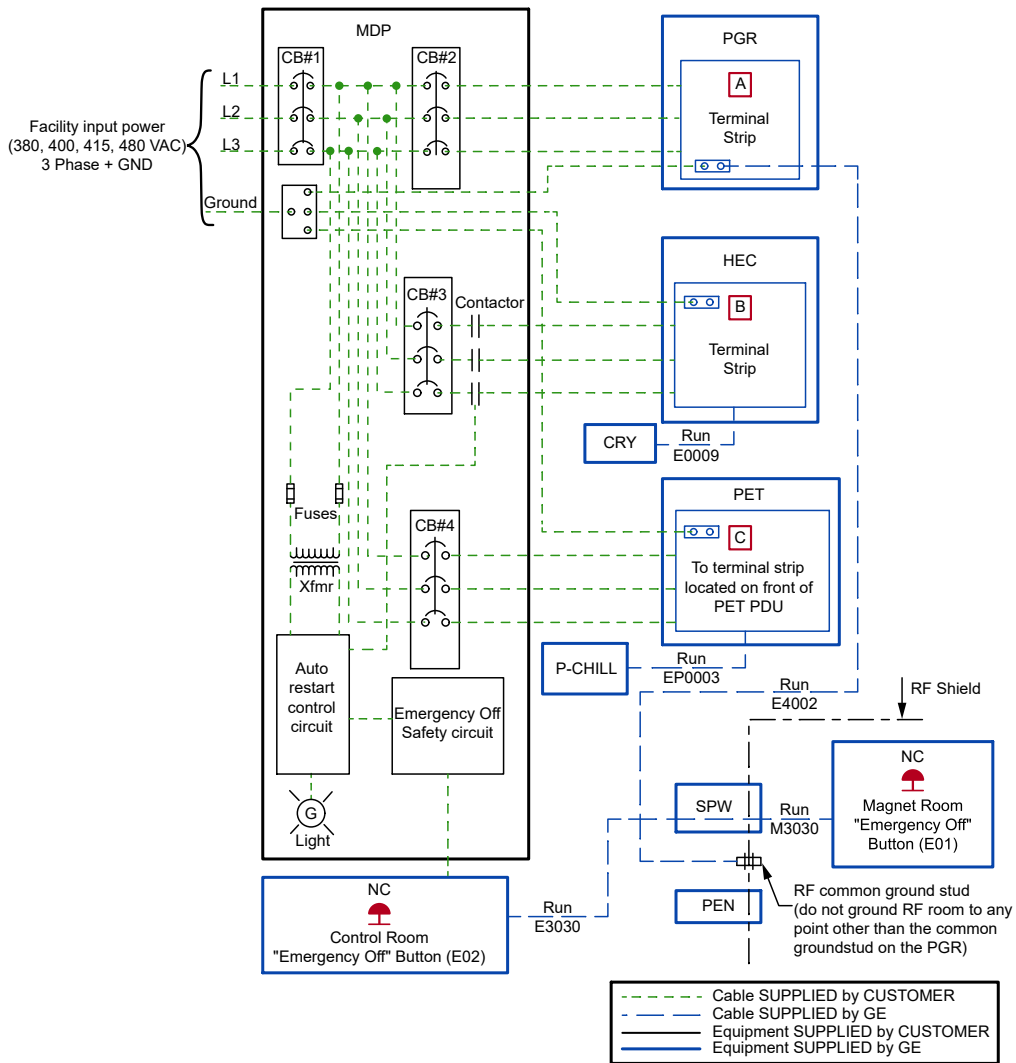
Refer to [8.5 Sample control schematic for customer-supplied MDP on page 159](#).

1. MDP shall provide Auto-Restart to the Cryocooler Compressor.
2. Manual Restart Capability
  - 2.1. The MDP shall disconnect the PDU circuits upon power loss.
  - 2.2. The MDP shall require a manual restart on the PDU circuits when power is reapplied after an outage.
3. Emergency Off Circuit
  - 3.1. The MDP shall have an emergency off control circuit that disables power to the entire MR System.
  - 3.2. The emergency off circuit shall be actuated by a push button on the panel, and shall also be capable of being actuated by remotely located push button(s).
  - 3.3. Manual reset of the emergency off circuit shall be required to restore power to the entire system.
4. The MDP shall include four breakers, as specified in [Figure 2-28 Customer-supplied MDP MR System Main Disconnect Panel \(MDP\) Setup on page 56](#) and [Table 2-13 Customer Supplied MDP -](#)

[Required Breaker Size on page 56](#). Output breakers will feed the terminal block on the top of the PGR cabinet and HEC and the terminal block on the front the PET PDU.

5. Lock-out/Tag-out:
  - 5.1. 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.
  - 5.2. The lock-out/tag-out feature shall accommodate a standard sized lock hasp.
  - 5.3. 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. All wire types, color, and sizing are to be selected in accordance with governing electrical codes.

**Figure 2-28 Customer-supplied MDP MR System Main Disconnect Panel (MDP) Setup**



**Table 2-13 Customer Supplied MDP - Required Breaker Size**

Circuit Breaker	Breaker Size
CB1	200A minimum
CB2	150A
CB3	50A
CB4	30A

**Table 2-14 Customer Supplied MDP - Range of Standard Stranded Conductors Accepted**

Item	Phase		Ground	
	sq mm	AWG/kcmil	sq mm	AWG/kcmil
A	2.5 to 70	14 to 2/0	2.5 to 70	14 to 2/0
B	1.5 to 50	10 to 1/0	1.5 to 50	10 to 1/0
C	0.14 to 4	26 to 12	0.14 to 4	26 to 12

## 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 46.

- Dedicated, single power supply to the compressor
- Magnet Monitor emergency power (110V / 220V, 3A). Refer to [Magnet Monitor \(MON\) Requirements and Specifications](#) on page 113.
- 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 2-15 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  <div style="text-align: center;"> <p><b>WARNING</b></p>  <p>Do not use an inverter for the main power source.</p> </div>
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:
  - 2.1. All floors along the route will support the weight of the magnet (GE HealthCare recommends a structural analysis)
  - 2.2. Doors or other openings are sufficiently wide to allow passage
  - 2.3. 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 2-16 Delivery Route Requirements**

Component	Width		Depth		Height		Weight		Notes
	mm	in.	mm	in.	mm	in.	kg	lb.	
Magnet	See Magnet shipping dimensions in <a href="#">Table 2-17 MR System Component Shipping Specifications on page 59</a> for magnet shipping dimensions								
Cryogen	Dimensions vary depending on dewar type used. Verify with cryogen supplier.								
PGR Cabinet	2000	78.75	890	35.03	2108	83	1510	3329	Cabinets are moved with dollies attached to each side (adding 520 mm (20 in.) to the width and 82 kg (180 lb.) to the weight). Cabinets must be raised to
HEC Cabinet	1402	55.2	871	34.3	1905	75	513	1130	
PEN Cabinet	1120	44.1	1001	39.4	1930	76	313	691	

**Table 2-16 Delivery Route Requirements** (Table continued)

Component	Width		Depth		Height		Weight		Notes
	mm	in.	mm	in.	mm	in.	kg	lb.	
PET Cabinet	600	23.6	872	34.4	1895	74.6	370	816	remove the pallet but may be lowered almost to floor level while moving.
PET/MR Insert and Cart	844	33.25	1,854	73	1600	63	Insert and Cart: 354	Insert and Cart: 782	See <a href="#">Figure 2-31 PET/MR Insert and Cart</a> on page 62 for dimensions
PET/MR Insert Installation tool	1753	69	1194	47	787	31	129	284	

## 2.11.3 MR System Component Shipping Specifications

MR System component shipping dimensions and weight are listed below:

**Table 2-17 MR System Component Shipping Specifications**

Component	W x D x H		Weight		Notes
	mm	in.	kg	lb.	
UA Magnet (as shipped with lifting bars)	2316 x 2388 x 2317	91 x 94 x 91.2	7621	16800	Domestic - Tarp
UA Magnet (Crated for International Shipping)	2438 x 2896 x 2438	96 x 114 x 96	8528	18800	International - crate/pallet
AR Magnet (as shipped with lifting bars)	2311 x 2388 x 2250	91 x 94 x 88.6	5882	12968	Domestic - Tarp
AR Magnet (Crated for International Shipping)	2438 x 2896 x 2438	96 x 114 x 96	6633	14622	International - crate/pallet
Magnet Accessory Equipment	1219 x 1219 x 711	48 x 48 x 28	182	400	Crate
VibroAcoustic Dampening Kit	914 x 1651 x 305	36 x 65 x 12	261	575	Box on pallet
Cryocooler Compressor	660 x 711 x 1067	26 x 28 x 42	125	275	Pallet with box cover
Rear Pedestal Assembly with Rear Split Bridge Assembly, Low Profile Carriage Cover	864 x 1473 x 1219	34 x 58 x 48	141	310	Box on pallet
GEM Enclosure, Domestic	2362 x 991 x 874	93 x 39 x 34	68	150	Box on pallet
GEM Enclosure, International	2388 x 1675 x 711	94 x 66 x 28	68	150	Box on pallet
Patient Table	2388 x 737 x 965	94 x 29 x 38	301	663	Pallet

**Table 2-17 MR System Component Shipping Specifications** (Table continued)

Component	W x D x H		Weight		Notes
	mm	in.	kg	lb.	
Power Gradient RF Cabinet (PGR) (Domestic)	1701 x 1041 x 2235	67.25 x 41 x 88	1567	3455	Pallet
Power Gradient RF Cabinet (PGR) (International)	1727 x 1067 x 2337	68.25 x 42 x 92	1680	3704	Pallet
Penetration Panel Cabinet (PEN) (Domestic)	1117 x 895 x 2051	43.75 x 35.25 x 80.75	345	761	Pallet
Penetration Panel Cabinet (PEN) (International)	1137 x 895 x 2153	44.75 x 35.25 x 84.75	373	823	Pallet
Heat Exchanger Cabinet (HEC) (Domestic)	1143 x 1137 x 2032	45 x 44.75 x 80	488	1075	Pallet
Heat Exchanger Cabinet (HEC) (International)	1168 x 1162 x 2134	46 x 45.75 x 84	522	1150	Pallet
Secondary Penetration Wall	533 x 610 x 1626	21 x 24 x 64	46	101	Pallet with cardboard cover
Operator Workspace Cabinet	610 x 889 x 787	24 x 35 x 31	110	243	Wood pallet with cardboard cover
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
PET Cabinet, Domestic (houses PDU)	1111 x 895 x 2501	43.75 x 35.25 x 80.75	388	856	Pallet
PET Cabinet, International (houses PDU)	1111 x 895 x 2501	43.75 x 35.25 x 80.75	388	856	
PET Chiller	495 x 787 x 991	19.5 x 31 x 39	137	302	

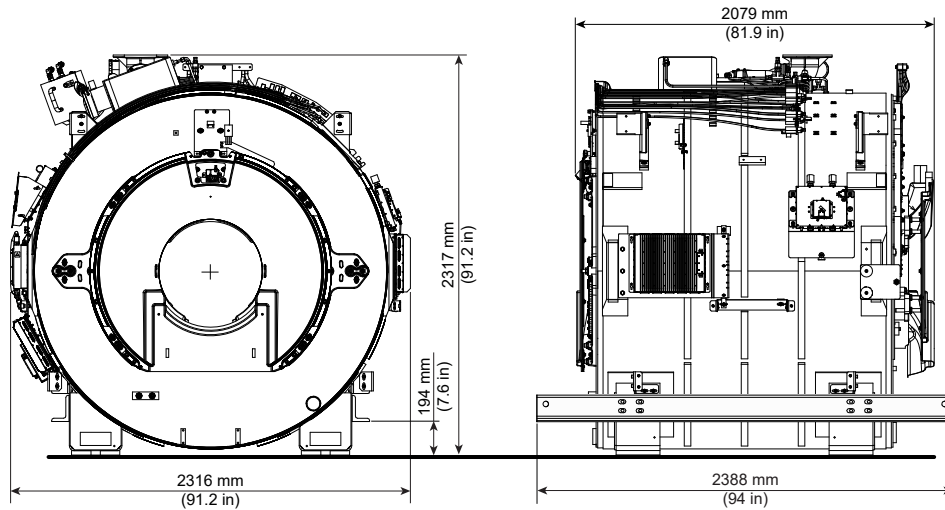
**Table 2-18 MR System Service Component Shipping Specifications**

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.))
PET/MR Insert Installation Tool (Box 3)	813 x 1778 x 1219	32 x 70 x 48	Tool and Box: 222	Tool and Box: 489	Domestic: Ships in a case with wheels International: Pallet

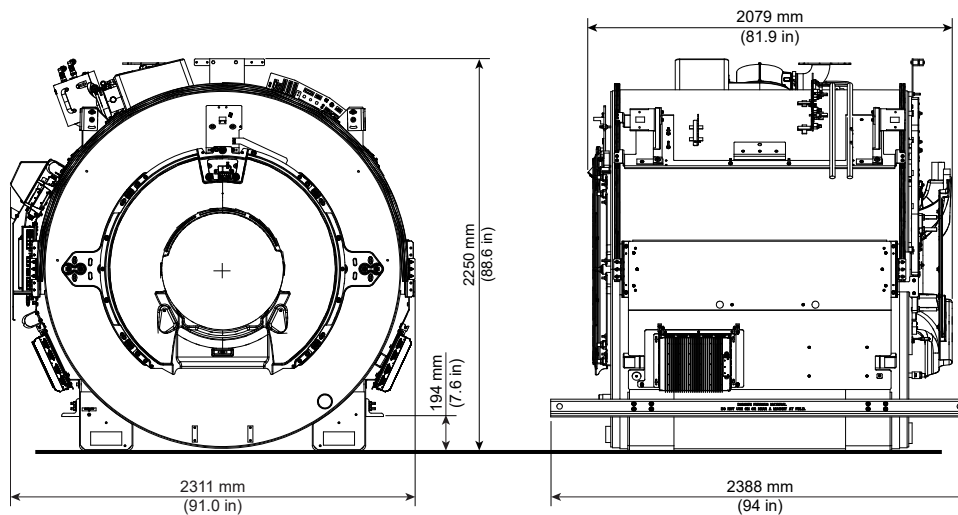
**Table 2-19 MR System Optional Component Shipping Specifications**

Component	W x D x H		Weight		Notes
	mm	in.	kg	lb.	
8 kW MNS Amplifier Cabinet	600 x 1016 x 1637	23.6 x 40 x 64.4	276.7	610	On cabinet casters, wrapped with plastic
PET Computer for SIGNA PET/MR SPiCE Workstation - SPiCE 2	305 x 686 x 610	12 x 27 x 24	55	120	Box on pallet
PET Computer for SIGNA PET/MR SPiCE Workstation - SPiCE 3	305 x 724 x 635	12 x 28.5 x 25	25	55	Box
Other SIGNA PET/MR SPiCE Workstation Components	1219 x 1016 x 127	48 x 40 x 5	62	135	Pallet

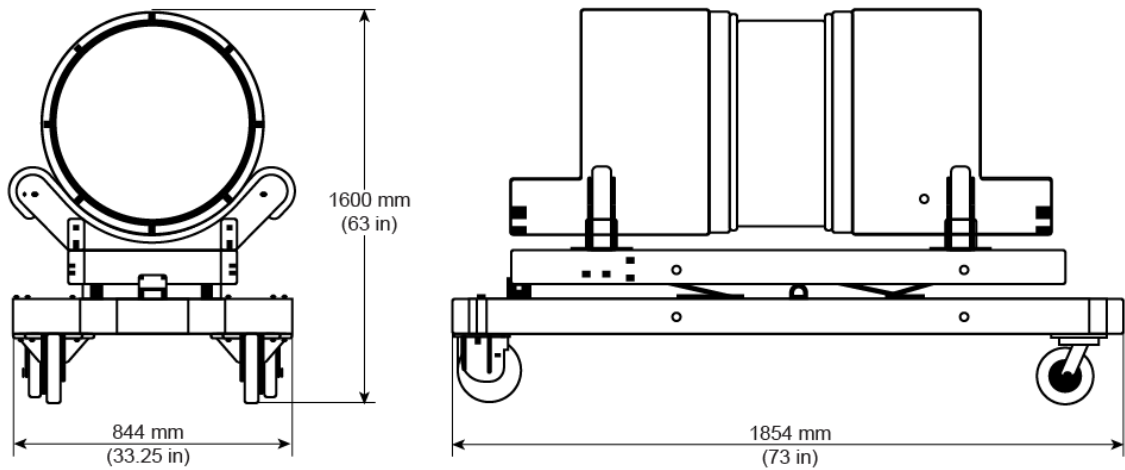
**Figure 2-29 Magnet Dimensions (as Shipped) for UA Magnet**



**Figure 2-30 Magnet Dimensions (as Shipped) for AR Magnet**



**Figure 2-31 PET/MR Insert and Cart**



**Table 2-20 MR System Component Replacement Shipping Specifications**

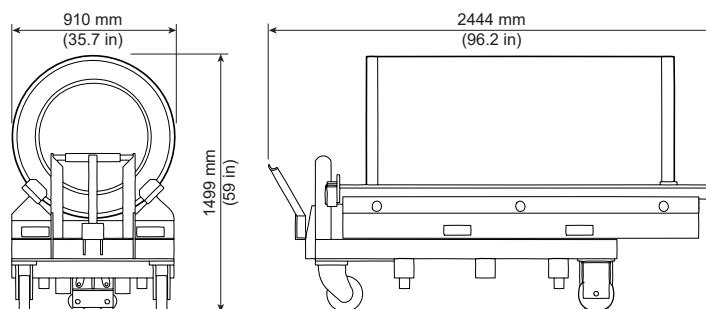
Component	Component Location	W x D x H		Weight	
		mm	in.	kg	lb.
Replacement XRM Gradient Coil Assembly on a Shipping Cradle/Cart	Magnet Room	910 x 2444 x 1499	35.8 x 96.2 x 59	1449	3194
3.0T RF Amplifier	Equipment room (front of PGR)	671 x 864 x 437	26.4 x 34 x 17.2	181	400
HEC Pump	Equipment room (front of HEC)	1041 x 635 x 991	41 x 25 x 39	100	220
HEC Blower	Equipment room (front of HEC)	1041 x 635 x 991	41 x 25 x 39	68	150
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 2-20 MR System Component Replacement Shipping Specifications](#) on page 62 include packaging.

**Figure 2-32 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)	10 — 80	30
Magnet Assembly	-30 — 60 (-22 — 140)	20 (68)	10 — 80	30
Surface Coil	-30 — 50 (-22 — 122)	20 (68)	10 — 95	30

## 3 Magnet Room

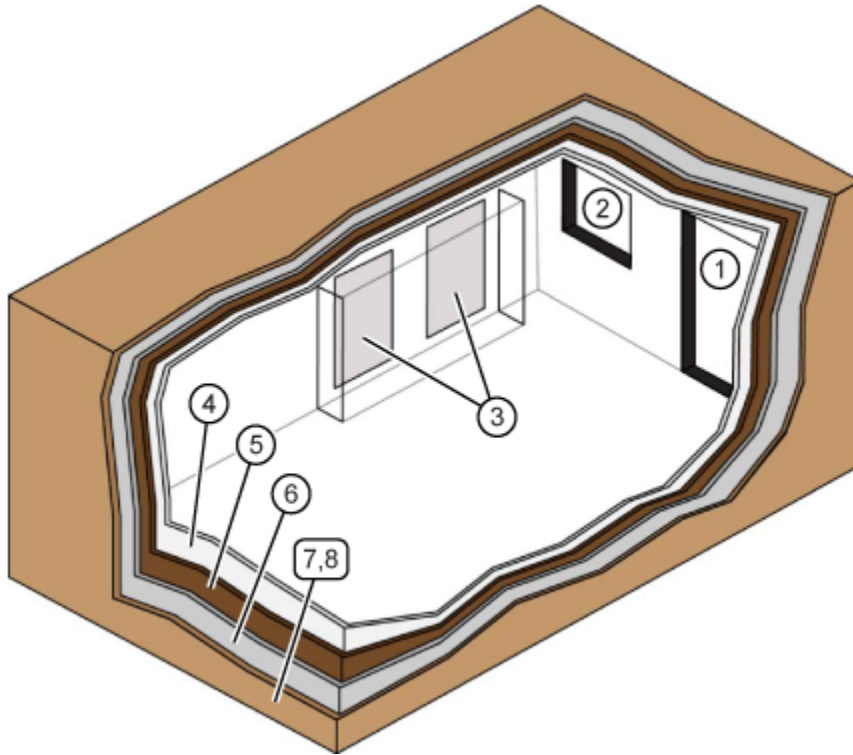
### 3.1 Magnet Room Introduction



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 Radiation Room must be verified by a qualified Radiological Health Physicist so that the Magnet Room’s shielding will provide adequate radiation protection for the planned system.
2. 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.
3. 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.
4. 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.
5. 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:
  - 5.1. All building codes are met (such as maintaining egress routes).
  - 5.2. Items which may generate or create RF interference (including fluorescent lighting) are not allowed for installation within the Magnet Room.
  - 5.3. Customer is responsible for the selection and installation of all locally required safety devices (for example, smoke detectors, oxygen monitors, and so on).
  - 5.4. 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.
  - 5.5. 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/Radiation 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	8	Radiation room



**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 67.

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 67 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 <sup>2</sup> (lb./ft <sup>2</sup> )	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+)

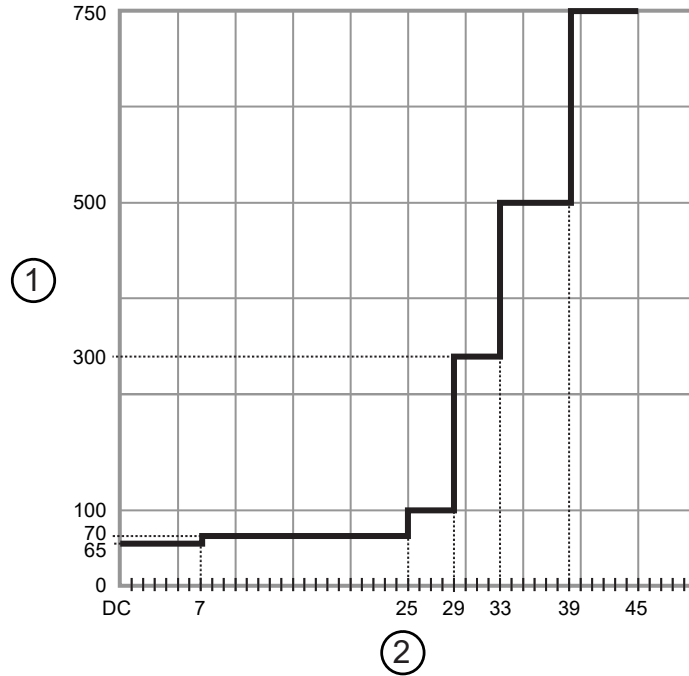
### 3.2.3 Vibration Requirements



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 for UA magnet on page 68](#) and [Figure 3-3 Magnet Steady State Vibration Specifications for AR magnet on page 69](#)). 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 151](#).
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 151](#) 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.

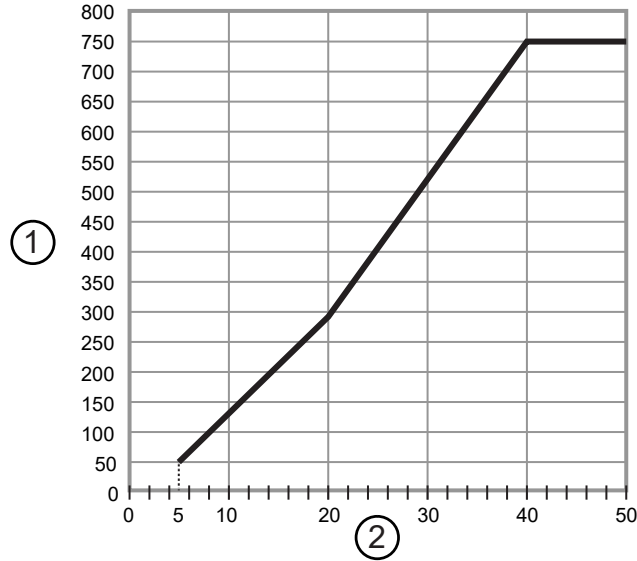
**Figure 3-2 Magnet Steady State Vibration Specifications for UA magnet**



Item	Description
1	Acceleration ( $g \times 10^{-6}$ ) (RMS) above ambient baseline
2	Excitation frequency (Hz)

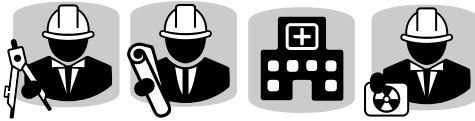
Acceleration ( $g \times 10^{-6}$ ) (RMS) above ambient baseline	Excitation frequency (Hz)
65	0 – 7
70	7 – 25
100	25 – 29
300	29 – 33
500	33 – 39
750	39 – 45

**Figure 3-3 Magnet Steady State Vibration Specifications for AR magnet**



Item	Description
1	Acceleration (g x 10 <sup>-6</sup> ) (RMS) above ambient baseline
2	Excitation frequency (Hz)

## 3.3 Shielding Requirements and Radiation Sources



(Applies to all subsections within this section)

### 3.3.1 Shielding Requirements

1. A qualified Radiological Health Physicist must review the Magnet Room shielding requirements and consider the following:
  - Scatter radiation levels within the Magnet Room
  - Equipment placement
  - Weekly projected workloads (number of patients per day)
  - Materials used for construction of walls, floors, ceiling, doors, and windows
  - Access to surrounding Magnet Room areas
  - Equipment in surrounding Magnet Room areas (such as film developer, film storage)
2. Appropriate barriers such as walls, lead-shielded glass, lead shields, and so on, must be installed to protect staff from unnecessary exposure to radiation. You must consult a qualified Radiological Health Physicist to design walls and safety barriers to assure correct attenuation.
3. Patients become significant sources of radioactivity, thus, the room design should keep the patient as far away from the operator as possible during the uptake and acquisition phase of scan procedures.

**NOTE**

PET images are generated by measuring radiation resulting from electron positron annihilation events within the patient. No external radiation source is required to generate this data. None of the phantoms are used during a patient scan.

### 3.3.2 Radioactive Phantoms and PET Spheres

Three phantoms and PET spheres are used for calibrations (listed below) performed on the PET/MR System. During normal operation, they should remain in a customer-provided storage area. Phantom half life is 271 days; each should be replaced every two years.

**Table 3-2 Phantom Specifications**

Phantom	Use	Dimensions	Dose Rate	GE Part Number	Frequency
Annulus	PET Detectors, Normalization Correction, and Daily Quality Assurance Calibrations	Diameter: 137 mm (5.4 in.) Length: 300 mm (11.8 in.)	Germanium-68 (Ge-68) 55 MBq	5476930	Daily by Customer
Volumetric Quality Control (VQC)	MR and PET Image Alignment Calibration	Dimension: 300 x 300 x 300 mm (11.8 x 11.8 x 11.8 in.)	Ge-68 5 x 0.7 MBq	5450562	Quarterly
Flood	3D Well Counter Correction Calculation	Fillable Portion Diameter: 200 mm (7.87 in.) Length: 180 mm (7.09 in.)	Fluoro-deoxyglucose F18 (FDG) 20 MBq <b>Note:</b> Only radioactive after Customer fills before test.	5312567	Quarterly
PET Spheres	HNU Coil, CMA Coil and Filler Position Calibration (3 pieces for each site)	Diameter: 19 mm (0.75 in.)	Ge-68 3 x 0.7 MBq	5308766	Quarterly

**IMPORTANT**

Contact GE HealthCare Accessories or your Project Manager to order the Annulus Phantom, VQC Phantom, or PET Spheres.

**NOTE**

In addition to PET detector calibrations, the Annulus Phantom is used to assess the relative performance of the detector channels, so differences in individual detector efficiency can be accommodated during image reconstruction.

### 3.3.3 Radiation Survey

**WARNING****POSSIBLE PERSONAL INJURY OR EQUIPMENT DAMAGE**

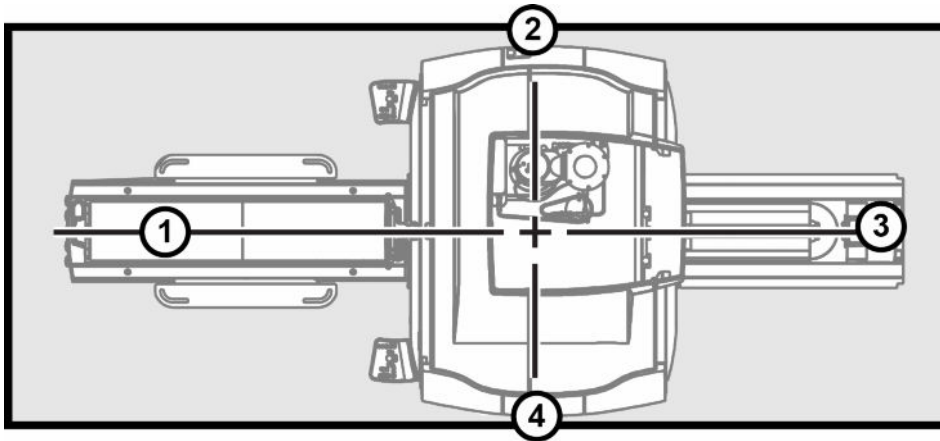
The radiation survey meter is ferrous and will be attracted to the magnet.

To prevent injury or equipment damage, do not bring the meter into the Magnet Room WHEN THE MAGNET IS RAMPED.

The dose rates described here are estimates based on measurements taken under specific conditions. Since the measurement conditions vary at every scanner installation (due to differing room geometrics, the presence of other equipment or shielding material, and so on), use these measurements as guidelines **only**. The following illustration shows a sampling of measurement points for radiation from a 75.35 MBq Phantom containing Ge-68.

**NOTE** Both the VQC and Annulus Phantoms as well as the PET Spheres are much less radioactive than the source used for this radiation survey.

**Figure 3-4 Measurement Points**



**Table 3-3 Survey Data**

Location of Measurement	Distance from Source, m (ft.)	Dose Rate, mR/hr.
1 – At Table	3.00 (9.84)	0.05
2 – At Cover	1.20 (3.94)	0.01
3 – At Rear Pedestal	2.50 (8.20)	0.07
4 – At Cover	1.20 (3.94)	0.01

### 3.3.4 Storage

1. Radioactive phantoms and PET spheres should be stored in a way to prevent unintended exposure.
2. The site is responsible for providing a location that is sized and shielded appropriately for them.
3. The storage location should minimize exposure to personnel when transporting a phantom to the scanner and back again.
4. The storage location should be accessible by GE Field Engineers for servicing the system. For calibration procedures, the field engineer typically positions the phantom at the rear of the scanner.

### 3.3.5 Other Sources of Radiation

A number of common radionuclides are used with the PET/MR System. These radionuclides are either produced at the site or brought to the site from an outside source. They have a relatively short half life (2 to 110 minutes) and, as such, decay to benign levels fairly quickly. Typical positron-emitting isotopes include: Carbon-11, Nitrogen-13, Oxygen-15, and Fluorine-18.

### 3.3.6 Gamma Ray Protection

A number of radioactive substances, of various levels of stability, are used by the PET unit of the system. This material is necessary in imaging procedures. Before the suite is operational, unstable material may be on the premises. It is important to recognize that clear and significant hazards from ionizing radiation may exist at the site as it is undergoing preparation. Other equipment may be in place and operational at this time. The calibration source may be on the site at some time during the preparation process, as well as after the imager is put into operation. A cyclotron may be operational at the site. Keep aware of these hazards and take necessary precautions to ensure the safety of workers, patients, and visitors during all phases of the construction, installation, and operation of the facility.

**NOTE**

The licensing process for the site must be completed before radioactive material can be brought in.

### 3.3.7 Radiation Protection for Equipment

1. Radiation shields must keep background radiation in the Equipment Room to a minimum. The Equipment Room should have an area dose rate of less than 0.2 mR/hr.

**NOTE**

The coincidence detection used in a PET/MR System allows a moderate amount of external singles events. The PET/MR System has less than 1% dead time if the external field is below 1 mR/hr from a single source. Area background can be more general than a single source, thus, a lower limit is appropriate. If the area dose rate stays at less than 0.2 mR/hr (due to 511 or lower energy gamma rays) at the covers, detector dead time usually does not exceed 1%.

2. Radioactive sources must be stored in approved shielded containers. It is recommended that any radioactive source be stored in a separate room (hot lab) adjacent to, and accessible from, the Magnet Room. This hot lab should be near the cyclotron (if used). Doses should be prepared in the same area.
3. The radiation shield must keep radioactive gases out of the Equipment Room.

**NOTE**

Some procedures involve the use of radioactive carbon dioxide and other radioactive gases. This can compromise image quality if the gasses are not controlled.

### 3.3.8 Radiation Protection for Personnel

The escape of radioactive gases, if not correctly confined, can cause unnecessary exposure to clinical staff. All sources must be correctly stored in appropriate radiation-approved enclosures to provide adequate protection to all in the suite.

## 3.4 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 25](#) 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.

## 3.5 Penetration Panel Wall Opening Requirements



1. The Equipment Room and the Magnet Room must share at least one common wall to mount the PEN panel and SPW.
2. The penetration panel opening requirements are shown in [Figure 3-5 Penetration Wall Openings on page 74](#).
3. Two GE HealthCare-supplied penetration panel adaptor frames are used to connect the PEN panel and SPW to the wall openings. Connection details are shown in [Figure 3-5 Penetration Wall Openings on page 74](#).
4. The RF vendor must supply 40 fasteners for hole size of  $\varnothing 7.25$  mm (0.285 in) (total quantity for both panels) and install each penetration panel adaptor frame to the wall through the outer ring of holes in the plate.



### NOTE

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

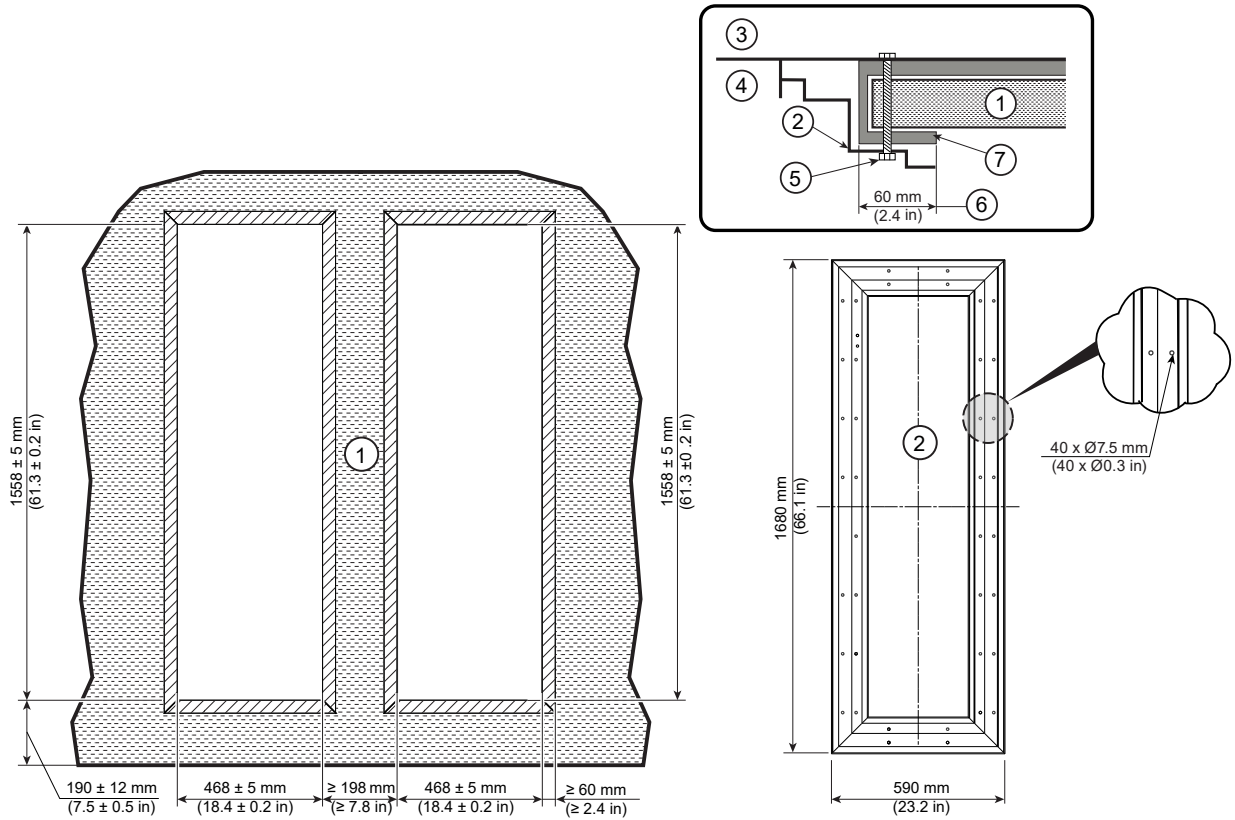



### NOTE

GE HealthCare-supplied bolts connect the penetration panels to each adaptor frame through the inner ring of holes in the plate.

5. 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 adaptor frame. The minimum overlay in the Equipment Room is 60 mm (2.4 in.).
6. 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 adaptor frame.
7. The maximum distance between the penetration panels is determined by the available length of the cables between the RF common ground stud and pen panels. Refer to [7.1.2 Available Cable Lengths on page 131](#).
8. Refer to [3.6.4 Penetration Panel Closet on page 79](#) for service hatch requirements.

Figure 3-5 Penetration Wall Openings



**NOTE**  
 The wall detail cross section is not to scale.

Item	Description	Item	Description
1	RF shield supporting structure (wall or double-sided galvanized panels, and so on)	5	Bolts are provided by screen room vendor and bolt holes are drilled at installation. Bolt length varies by wall thickness.
2	PEN Frame	6	Minimum exposed RF shield material (all around)
3	Magnet Room	7	RF Shield Material
4	Equipment 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.



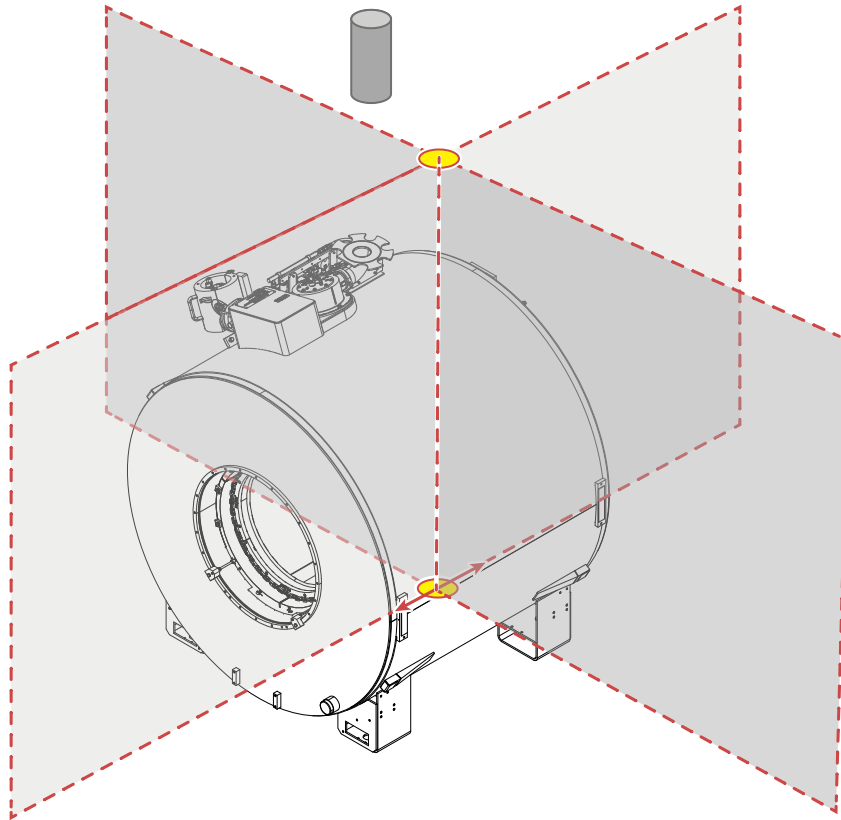
#### NOTE

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.

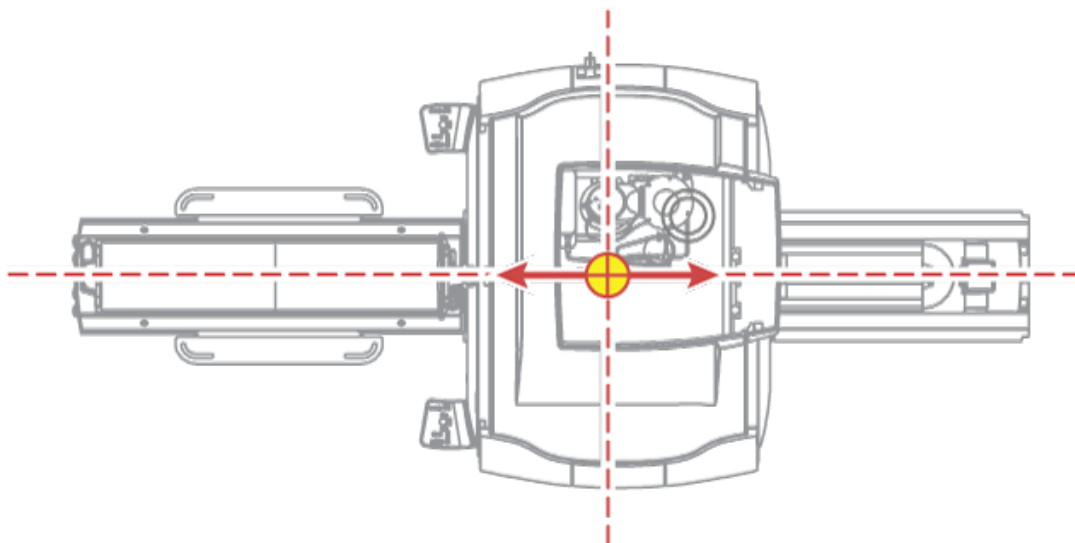
Refer to *Magnet Room Venting Requirements*, 5850263-1EN for the location of the magnet vent.

2. 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 3-6 Marking Magnet Isocenter (in a Room Without a Vent Pipe)**



**Figure 3-7 Marking the Magnet Isocenter and the Z-Axis Orientation on the Floor**



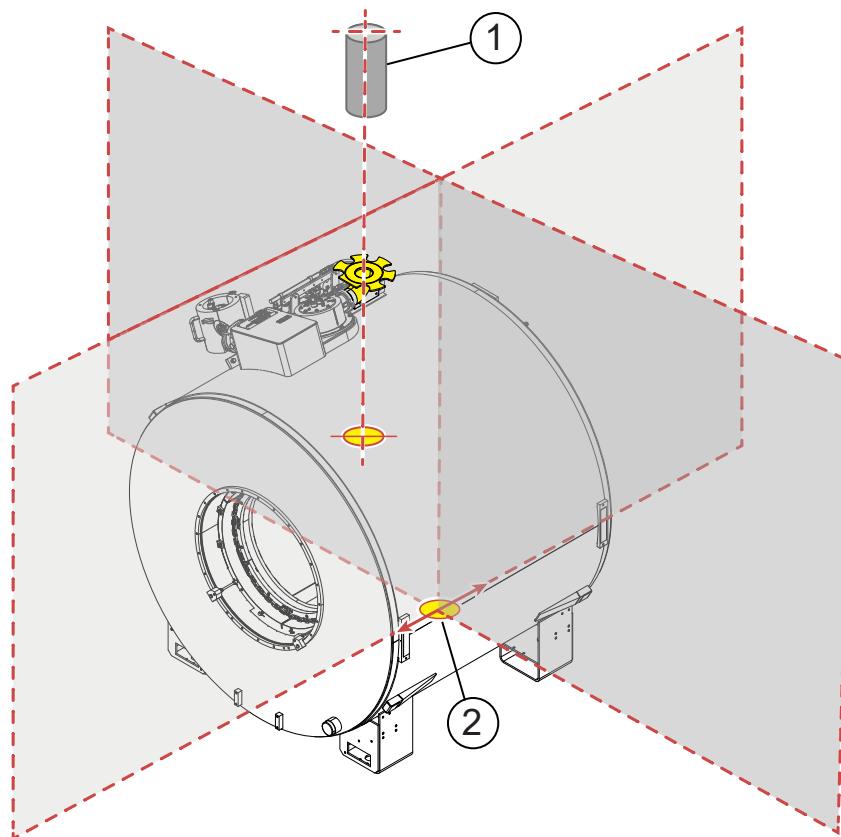
3. If a ceiling vent pipe already exists at the start of construction, the magnet isocenter marking must be correctly aligned relative to the position of the vent pipe. Refer to *Magnet Room Venting Requirements*, 5850263-1EN for the location of the magnet vent.

 **NOTE**

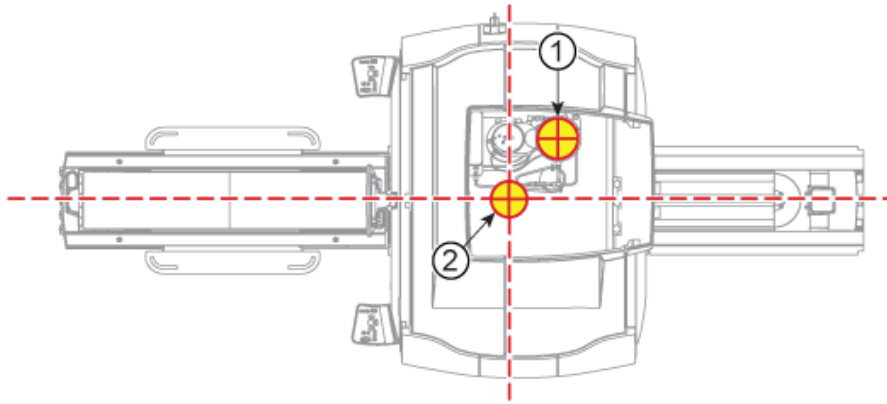
We recommend:

- 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 3-8 Marking the Center of the Vent Pipe**



Item	Description
1	Vent center
2	Magnet isocenter

**Figure 3-9 Marking the Vent Pipe and Magnet Isocenter on the Floor**

Item	Description
1	Vent center
2	Magnet isocenter

## 3.6.4 Penetration Panel Closet



1. An enclosure (that is, the penetration panel closet) must be provided to restrict access to the penetration panel(s) and for storage of excess interconnections.
  - 1.1. The penetration panel closet must meet the minimum penetration panel closet outline as shown in [3.6.5 Penetration Panel Closet Specifications on page 81](#).
  - 1.2. The penetration panel closet must have a mechanical locking mechanism to restrict access to the penetration panels.
  - 1.3. The penetration panel closet may be expanded to provide an area for excess cable storage with the following requirements:
    - 1.3.1. Excess cable must not be stored within the minimum closet service area.
    - 1.3.2. Excess cable must not interfere with access or servicing of the Penetration Panel (PP) or SPW.
    - 1.3.3. The area within the penetration panel closet to store the cable should be sized to accept a 711 mm (28 in.) cable loop (2x the minimum bend radius of the largest cable).
    - 1.3.4. Refer to [7.1.6 Storage Requirements for Excess Gradient Cable on page 135](#) for additional excess cable storage requirements.
  - 1.4. The penetration panel closet must allow free air exchange of 680 m<sup>3</sup>/hour (400 cfm) between the Magnet Room and penetration panel closet for MR System blowers. Airflow may be achieved through door louvers or other openings in the penetration panel closet that meet all other penetration panel closet requirements.
  - 1.5. 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.
  - 1.6. The penetration walls may be enclosed by separate closets with the following requirements:
    - 1.6.1. The maximum distance between the penetration panels is determined by the available length of the cables between the RF common ground stud and pen panels. Refer to [7.1.2 Available Cable Lengths on page 131](#).
    - 1.6.2. The separate closets must meet all other service area requirements for each penetration panel.
    - 1.6.3. Airflow as listed above must be provided for both closets.
    - 1.6.4. Both closets must have mechanical locks.
2. A closet service hatch must be provided if the room does not allow the PP blower box removal path to remain completely outside the 20 mT (200 G) line. The closet service hatch must meet the following requirements:
  - 2.1. Must be located within the penetration panel closet on the RF wall allowing access to the Equipment Room.
  - 2.2. May be located anywhere within the penetration panel closet with unobstructed pass-through.

- 2.3. Must be minimum 508 mm x 508 mm (20 in. x 20 in.).
- 2.4. Must maintain RF shield integrity for all service access.
- 2.5. May use any design (quick disconnect RF panel, blanker panel, hinged door, and so on) as long as all other requirements are met.
- 2.6. The closet service hatch removal must take less than 15 minutes (replacement must also take less than 15 minutes).
- 2.7. If two penetration panel closets are used, the closet with the PP must contain a closet service hatch.
- 2.8. Refer to [Figure 3-10 Minimum dimensions of closet in the Magnet Room on page 81](#) and [Figure 3-11 Example of service hatch location inside closet in the Magnet Room on page 82](#) for closet service hatch location.
- 2.9. Refer to [Penetration Panel Cabinet \(PEN\) Specifications on page 104](#) for detailed service area clearance dimensions of the PEN cabinet.

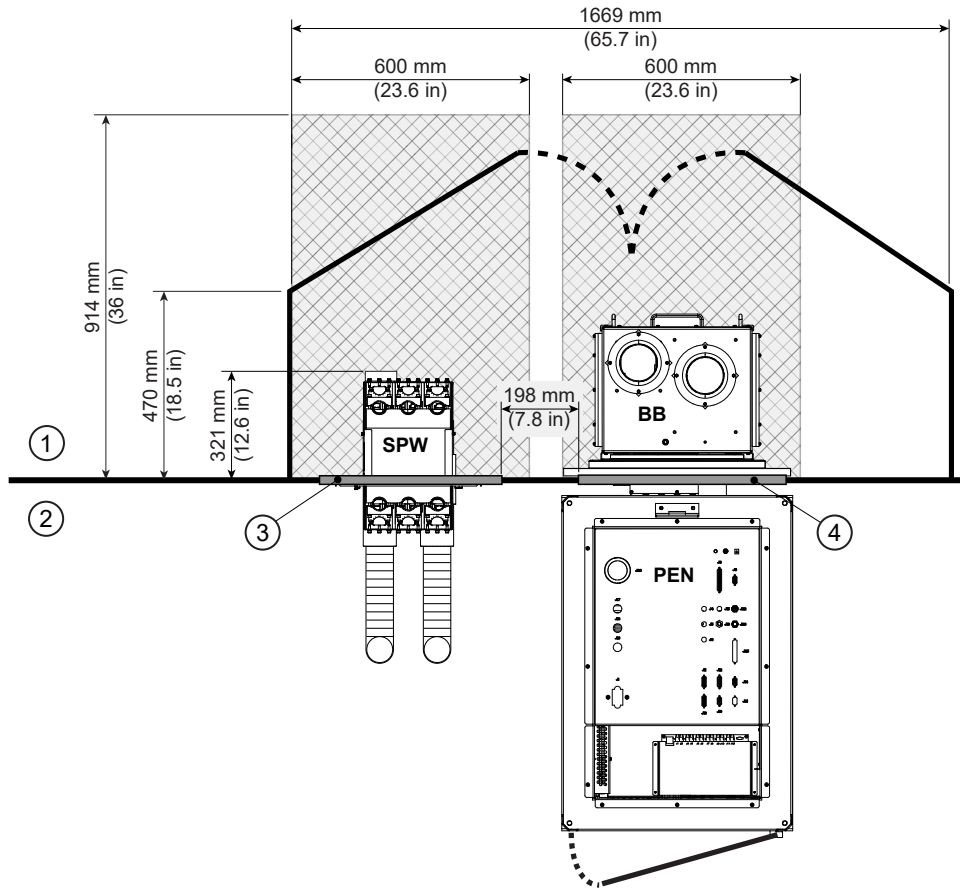
### 3.6.5 Penetration Panel Closet Specifications

- Minimum Closet Depth: 470 mm (18.5 in)
- Minimum Closet Width: 1669 mm (65.7 in)
- Minimum Closet Height: 2007 mm (79 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.

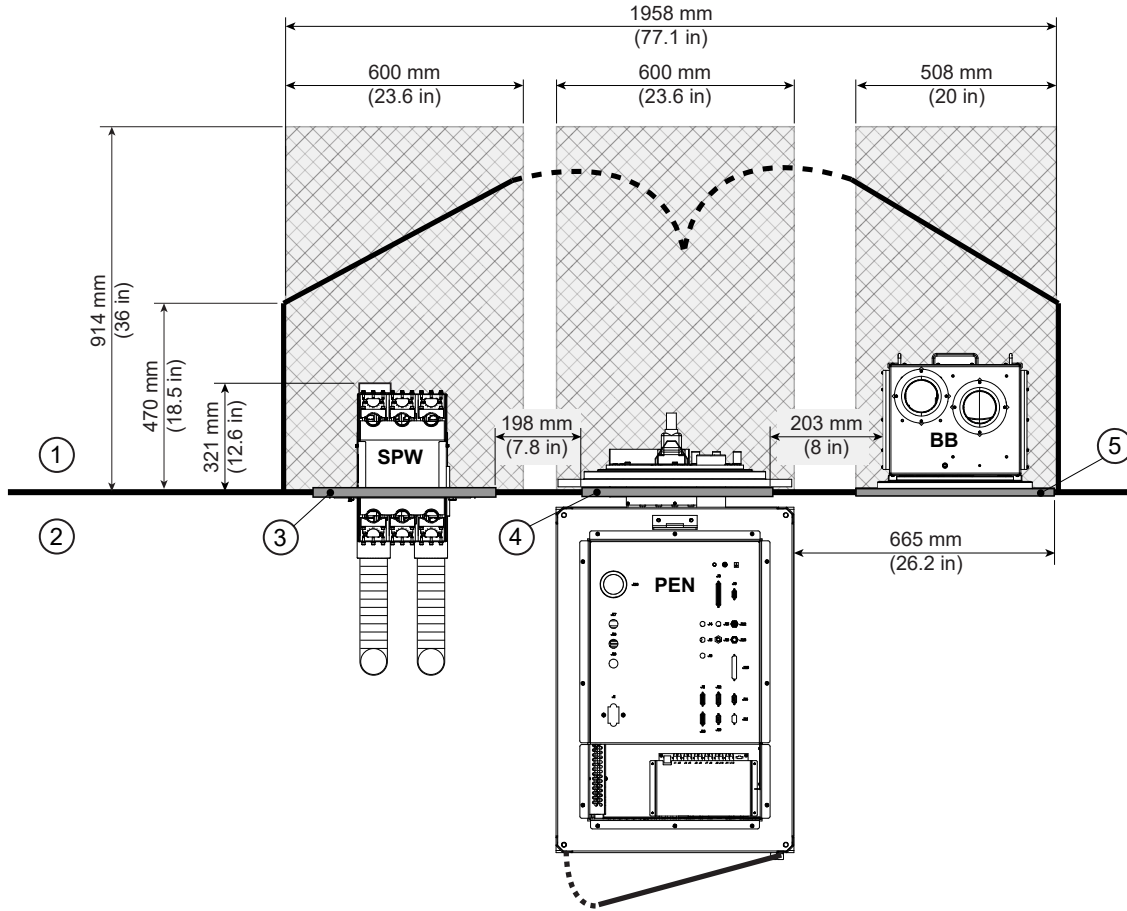
**NOTE**  
 Minimum closet specifications do not account for storage space for excess gradient cable. Refer to [7.1.6 Storage Requirements for Excess Gradient Cable](#) on page 135 for additional excess cable storage requirements.

**Figure 3-10 Minimum dimensions of closet in the Magnet Room**



Item	Description		
1	Magnet Room	3	SPW Wall Opening
2	Equipment Room	4	PEN Wall Opening

**Figure 3-11 Example of service hatch location inside closet in the Magnet Room**



Item	Description		
1	Magnet Room	4	PEN with Blower Box removed
2	Equipment Room	5	Blower Box removed through hatch
3	SPW Wall Opening	-	-

## 3.6.6 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

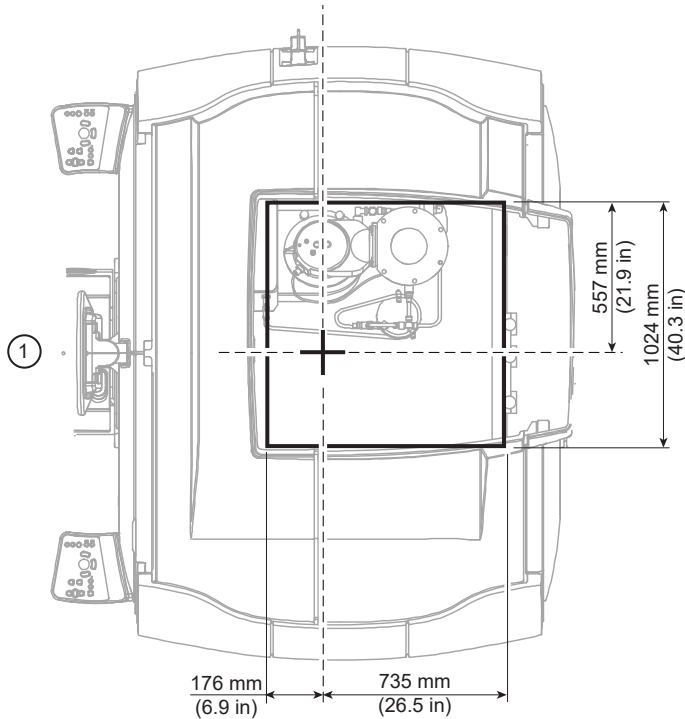
- GE HealthCare recommends using a window, although other means (for example, camera and video display) may be used as long as all IEC requirements are met.
  - The recommended dimensions for the patient viewing windows are 1219 mm wide x 762 mm high (48 in. wide x 30 in. high).
  - The recommended distance 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.

## 3.6.7 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.
4. Ceiling preparation should be completed prior to magnet delivery. See [Figure 3-12 Cable Concealment Kit Ceiling Opening Dimensions \(Top View\)](#) on page 84 for ceiling opening dimensions.

**Figure 3-12 Cable Concealment Kit Ceiling Opening Dimensions (Top View)**



Item	Description
1	Front of magnet

### 3.6.8 Magnet Room Floors



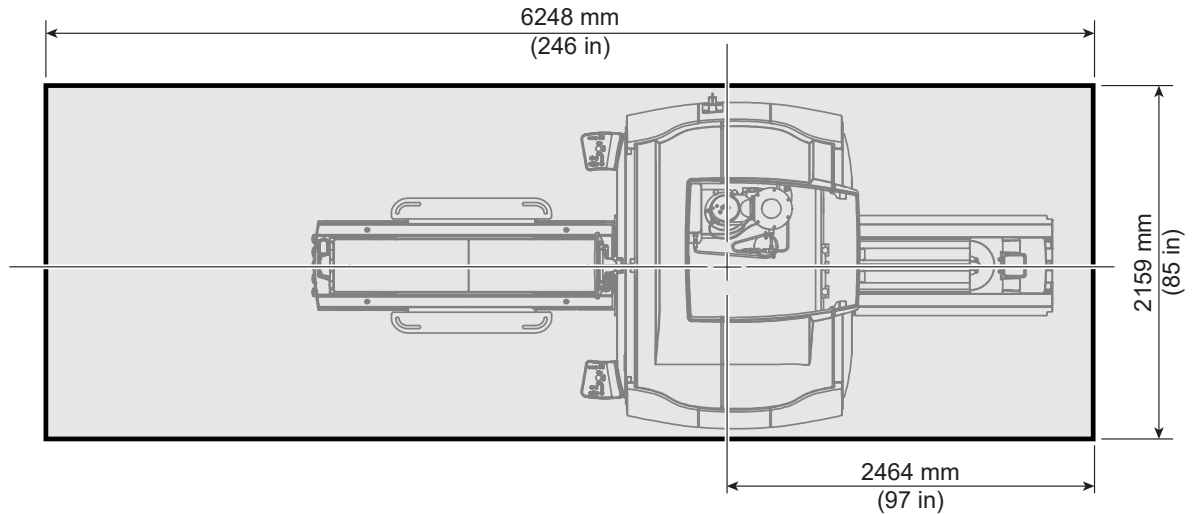
1. The finished floor must support the weight of all components throughout operation and service life. This includes the magnet, patient table, and gradient coil replacement cart.



**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 3-13 Magnet Room Floor Levelness Area on page 85](#).

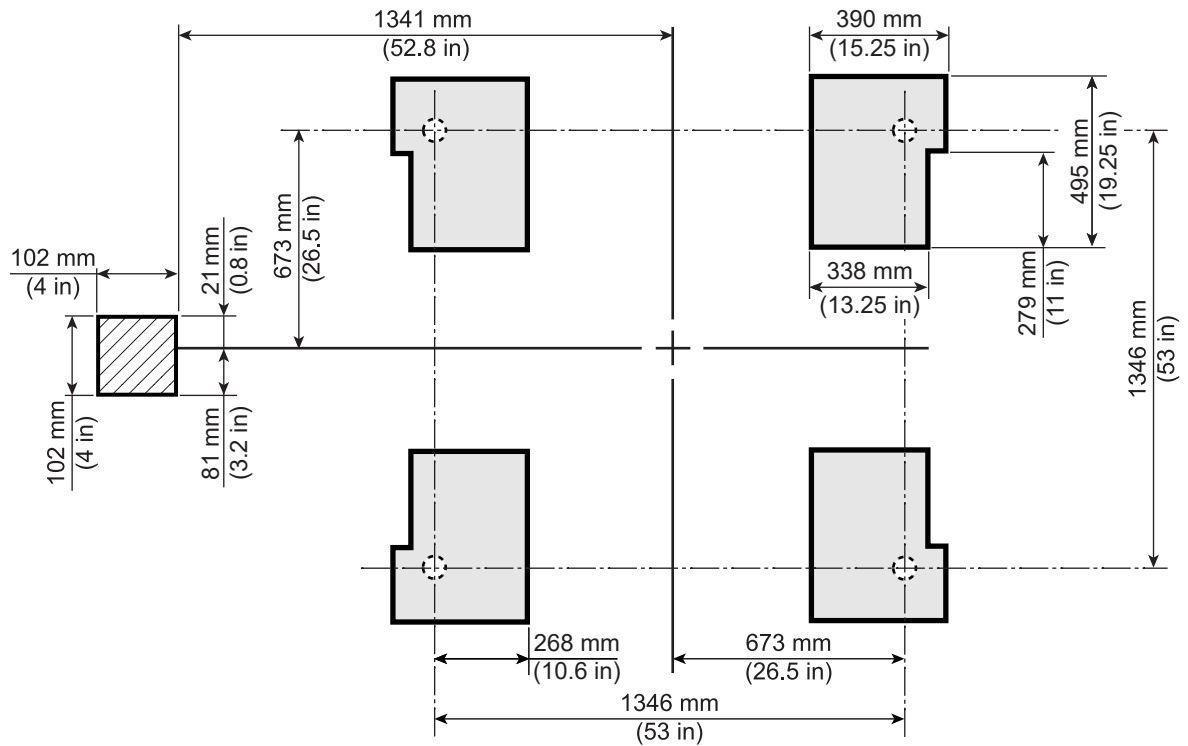
**Figure 3-13 Magnet Room Floor Levelness Area**

5. **For UA series magnet only:** 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 3-14 For UA series magnet only: Magnet Mounting Detail for M7000VA \(non-seismic\)—Patient End is on the Left Side on page 86](#) for details.
  - Weight: 8 kg (17 lb.) each
  - Size: 390 x 495 mm (15.25 x 19.25 in.) each
  - A 102 mm x 102 mm (4 in. x 4 in.) rebar-free area is necessary under the table dock anchor, in the position shown in the figure below.

**IMPORTANT**

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

**Figure 3-14 For UA series magnet only: Magnet Mounting Detail for M7000VA (non-seismic)— Patient End is on the Left Side**



6. **For UA series magnet only:** 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 3-15 For UA series magnet only: Magnet Mounting Detail for M7000VM \(seismic\)— Patient End is on the Left Side on page 87](#) for details.

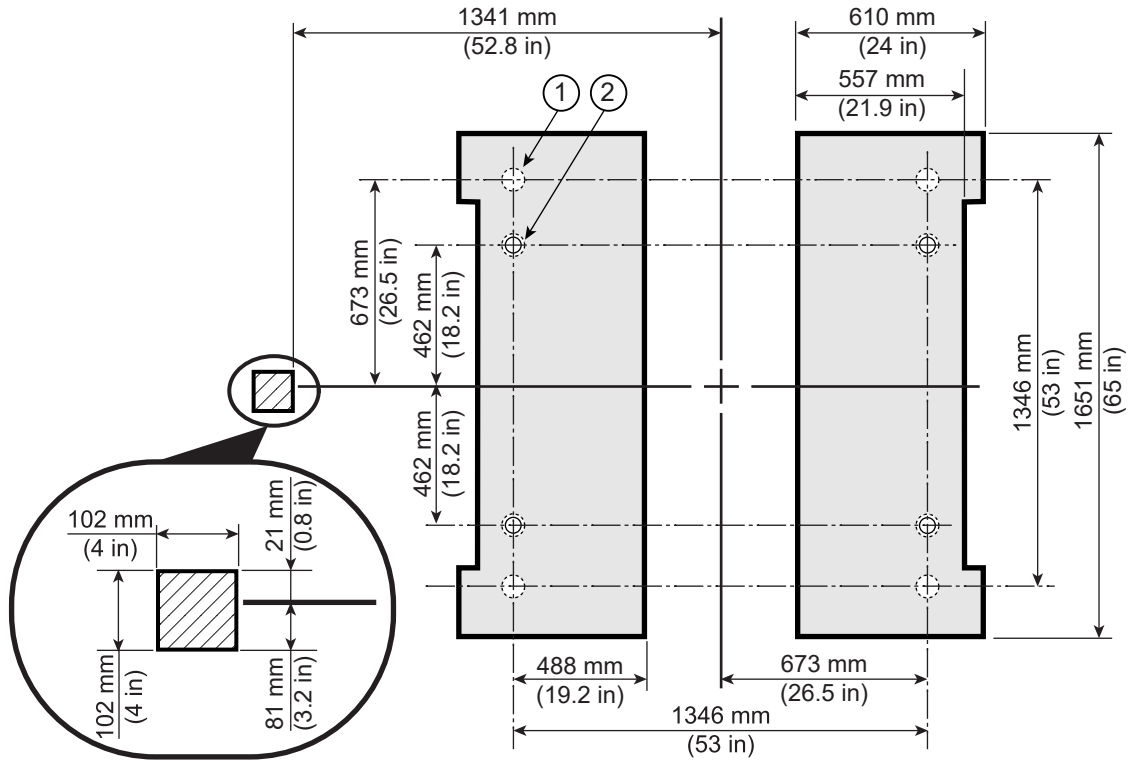
- 2 pads per magnet, 116 kg (255 lb.) each
- Nominal size: 610 x 1651 mm (24 x 65 in.) each
- Magnet anchor option 1: Corner seismic anchor points (x4)
- Magnet anchor option 2: Seismic anchor holes (x4) 38 mm (1.5 in.)
- Seismic anchors must be isolated from rebar.
- A 102 mm x 102 mm (4 in. x 4 in.) rebar-free area is necessary under the table dock anchor, in the position shown in the figure below.



**IMPORTANT**

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


**Figure 3-15 For UA series magnet only: Magnet Mounting Detail for M7000VM (seismic)— Patient End is on the Left Side**



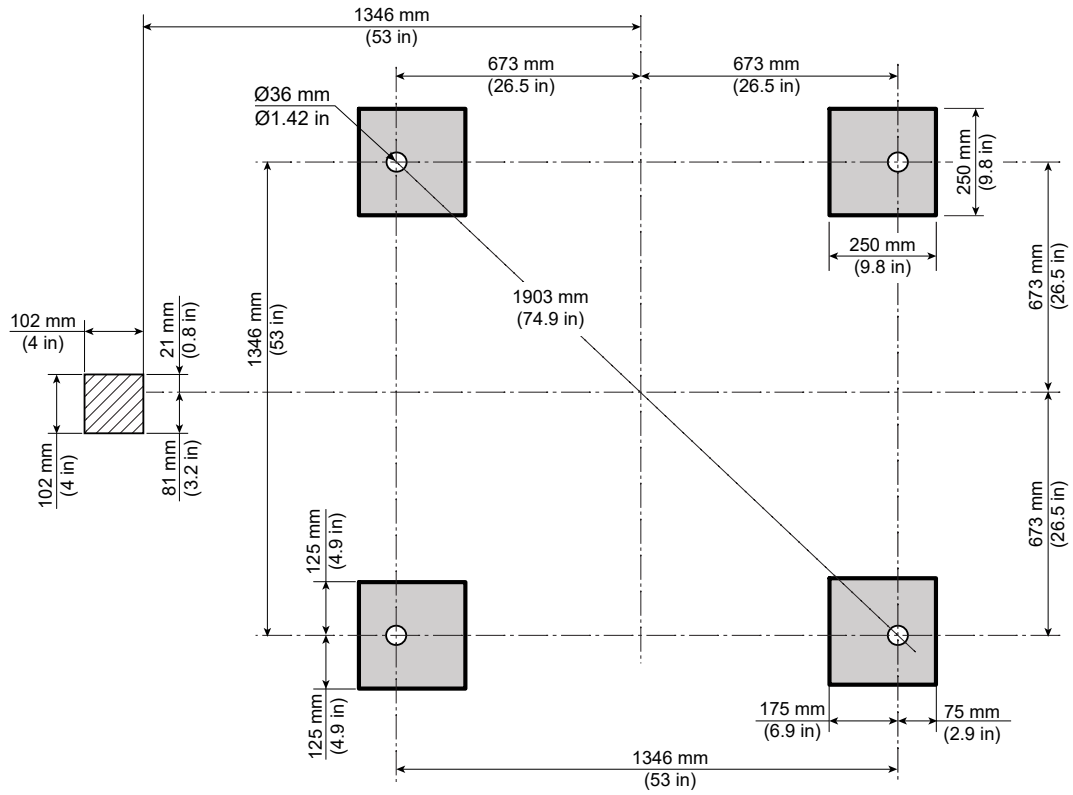
Item	Description	Item	Description
1	Magnet mounting holes	2	Seismic mounting holes

- For AR series magnet only:** The VibroAcoustic Dampening kit for both seismic and non-seismic mounting is included with the magnet shipment. See [Figure 3-16 For AR series magnet only: Magnet Mounting Detail— Patient End is on the Left Side](#) on page 88 for details.

  - Seismic anchors shall have a 76.2 mm (3 in) rebar-free area around the anchor and shall be installed with the assistance of the RF shield vendor.
  - A 102 mm x 102 mm (4 in. x 4 in.) rebar-free area is necessary under the table dock anchor, in the position shown in the illustration below.
  - Seismic anchors must be isolated from rebar.
  - For seismic installations, a mounting hardware kit for the magnet feet (M6001AH) is available from GE HealthCare.

**IMPORTANT**  The table dock anchor hole is drilled only after magnet installation.

**Figure 3-16 For AR series magnet only: Magnet Mounting Detail— Patient End is on the Left Side**



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

## 3.6.9 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

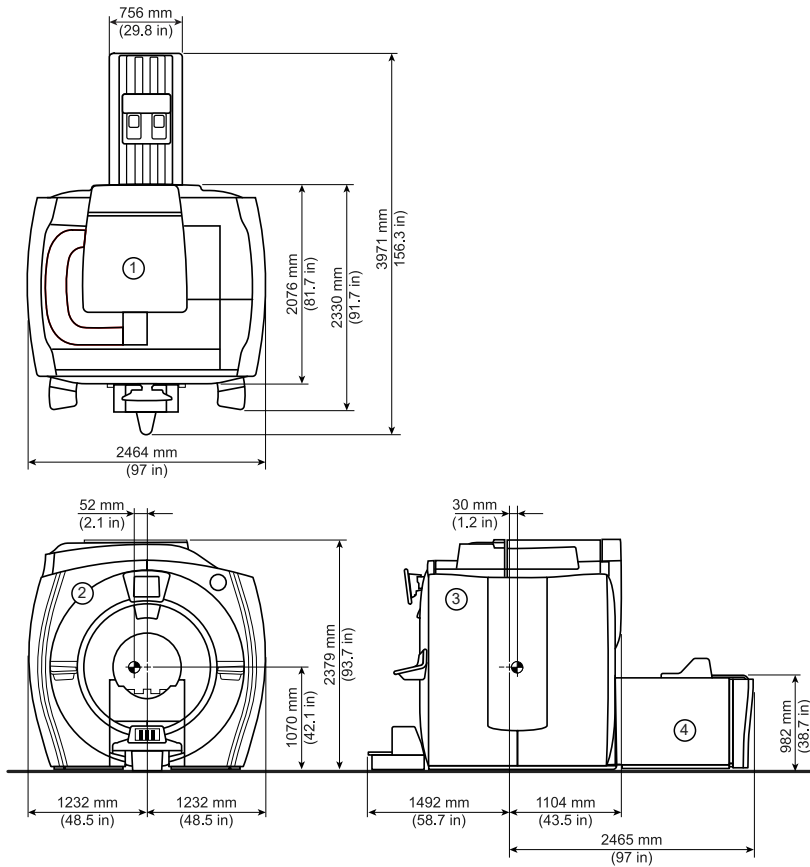


(Applies to all subsections within this section)

## 3.7.1 Magnet (MAG) Assembly Specifications

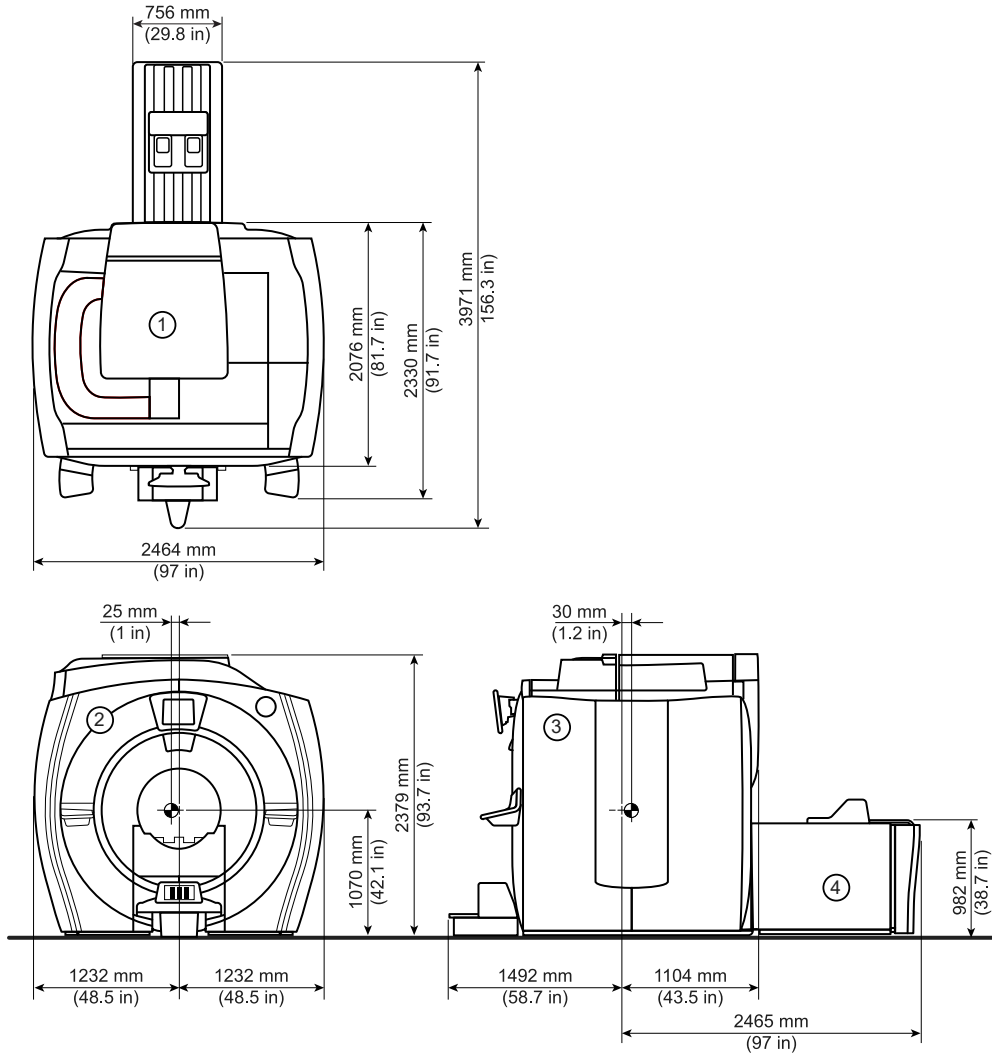
1. Rear Pedestal weight: 96 kg (212 lb.)
2. UA Magnet weight, with cryogenics at maximum capacity: 7443 kg (16410 lb.)
3. AR Magnet weight, with cryogenics at maximum capacity: 5665 kg (12489 lb.)

**Figure 3-17 Magnet (MAG) Dimensions and Rear Pedestal for UA Magnet**



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

**Figure 3-18 Magnet (MAG) Dimensions and Rear Pedestal for AR Magnet**



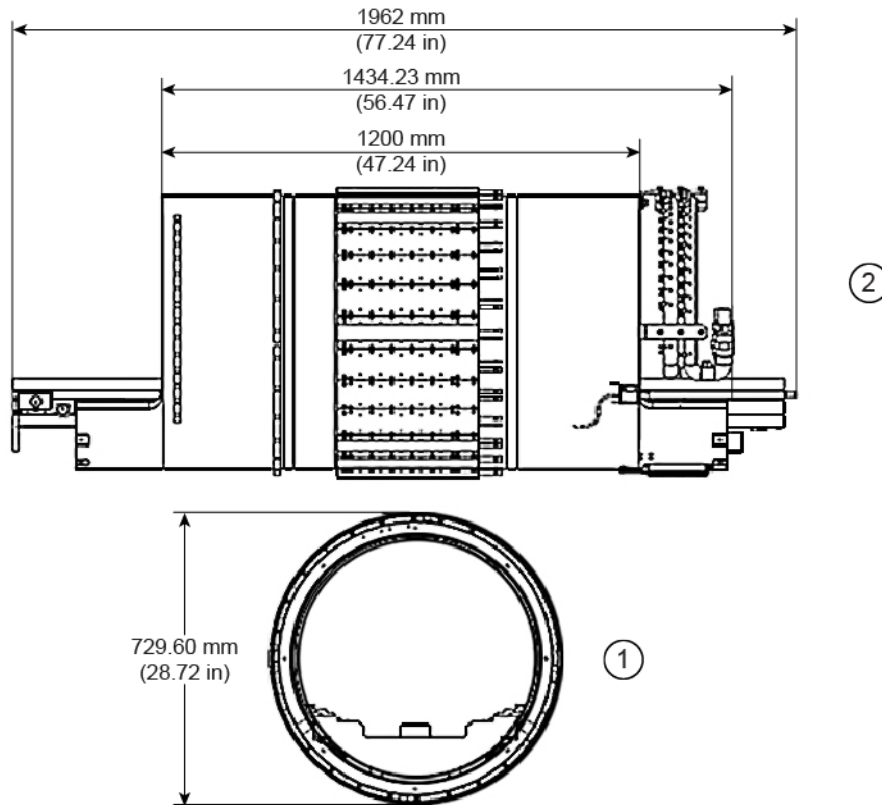
Item	Description	Item	Description
1	Top view	3	Side view
2	Front view	4	Rear Bridge

### 3.7.2 PET/MR Insert

Weight of Insert:

1. Without PET Detectors: 90.7 kg (200 lb.)
2. With PET Detectors installed: 247.8 kg (544 lb.)
3. With PET Detectors and Bridge: 287.5 kg (634 lb.)

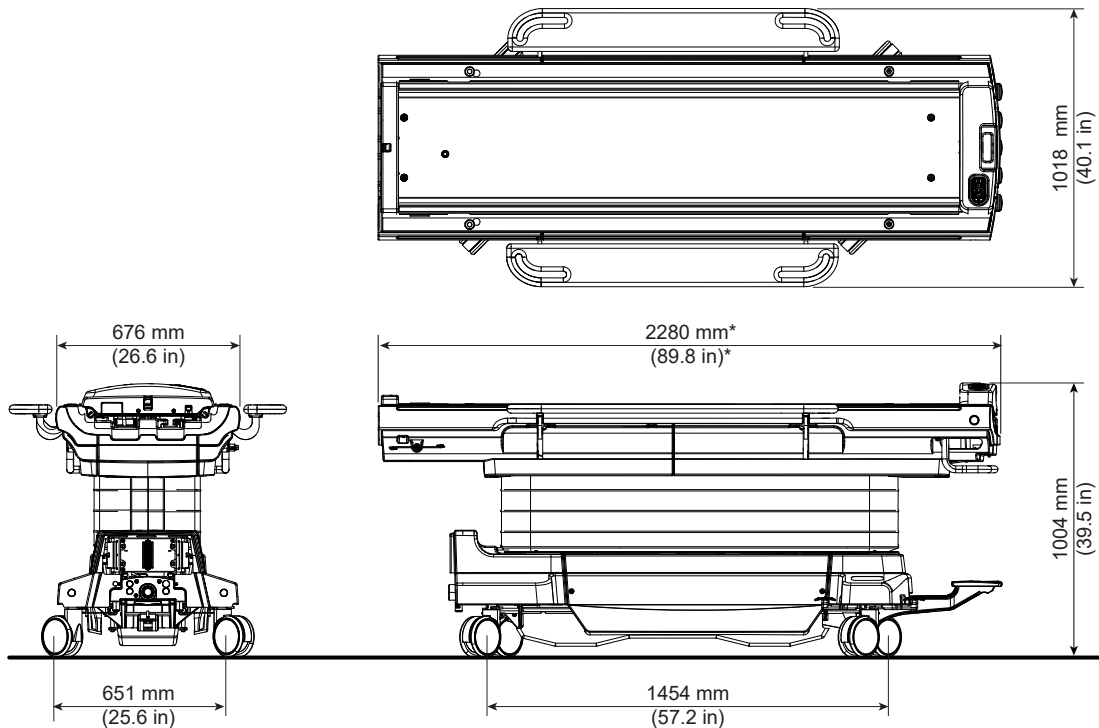
**Figure 3-19 PET/MR Insert**



Item	Description
1	Front view
2	Side view (with PET Detectors, Manifold and Bridge)

### 3.7.3 Patient Table (PT) Specifications

1. Table weight, empty: 190 kg (418 lb.)
2. Table weight, including maximum patient weight of 227 kg (500 lb.): 416 kg (918 lb.)

**Figure 3-20 Patient Table (PT)**

\* When the table handle is rotated into its extended position, the length of the table is 2370 mm (93.3 in.)

### 3.7.4 Magnet Rundown Unit (MRU) Specifications and Requirements

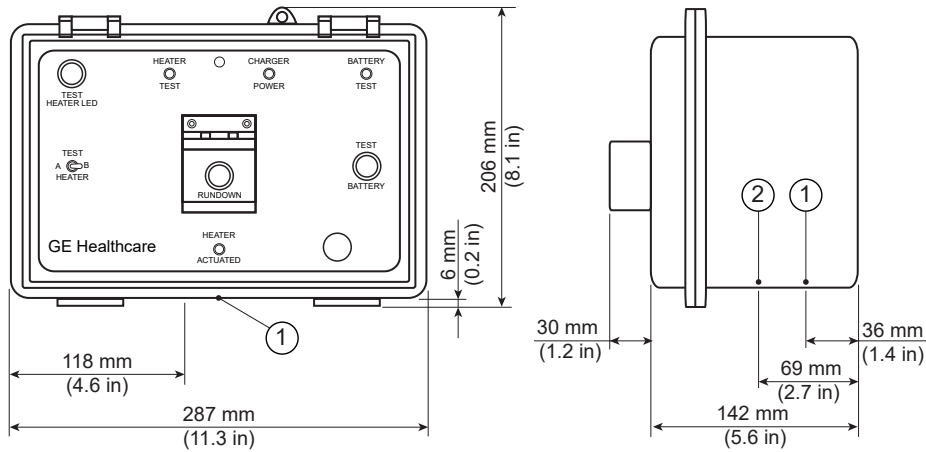
1. Location: The bottom edge of the MRU must be mounted  $1524 \pm 25$  mm ( $60 \pm 1$  in.) above the Magnet Room floor near the front of the magnet enclosure.
2. Weight: 3.2 kg (7 lb.)
3. Magnetic Field Limit: 20 mT (200 G)
4. The MRU is installed by the facility contractor.



#### NOTE

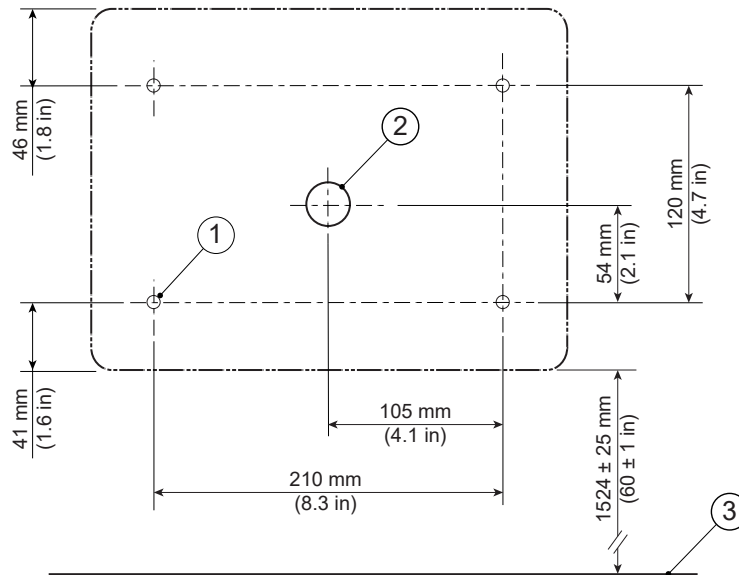
An optional remote MRU may be installed outside the Magnet Room. The remote MRU does not require facility power. For more information, refer to MRU vendor manual.

**Figure 3-21 Magnet Rundown Unit (MRU)**



Item	Description
1	Cable access
2	Power access

**Figure 3-22 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	-	-

### 3.7.5 Oxygen Monitor Option Sensor Specifications

See [Oxygen Monitor \(OXY\) Option](#) on page 127.

## 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.



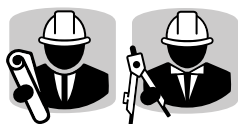
### NOTE

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 HEC and the Gradient Coil must be less than 5 meters (196.8 in.).
2. The vertical distance between the coolant connection points of the PET chiller and the PET insert manifold must be less than 4.8 meters (189 in.).
3. The HEC, CRY and PGR Cabinets must be located on the same floor.

The following illustration shows minimum equipment room service clearances. Refer to [MR Suite Minimum Room Size Requirements on page 19](#) 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 HEC. Optional equipment is not shown; additional space may be required for options.



#### NOTE

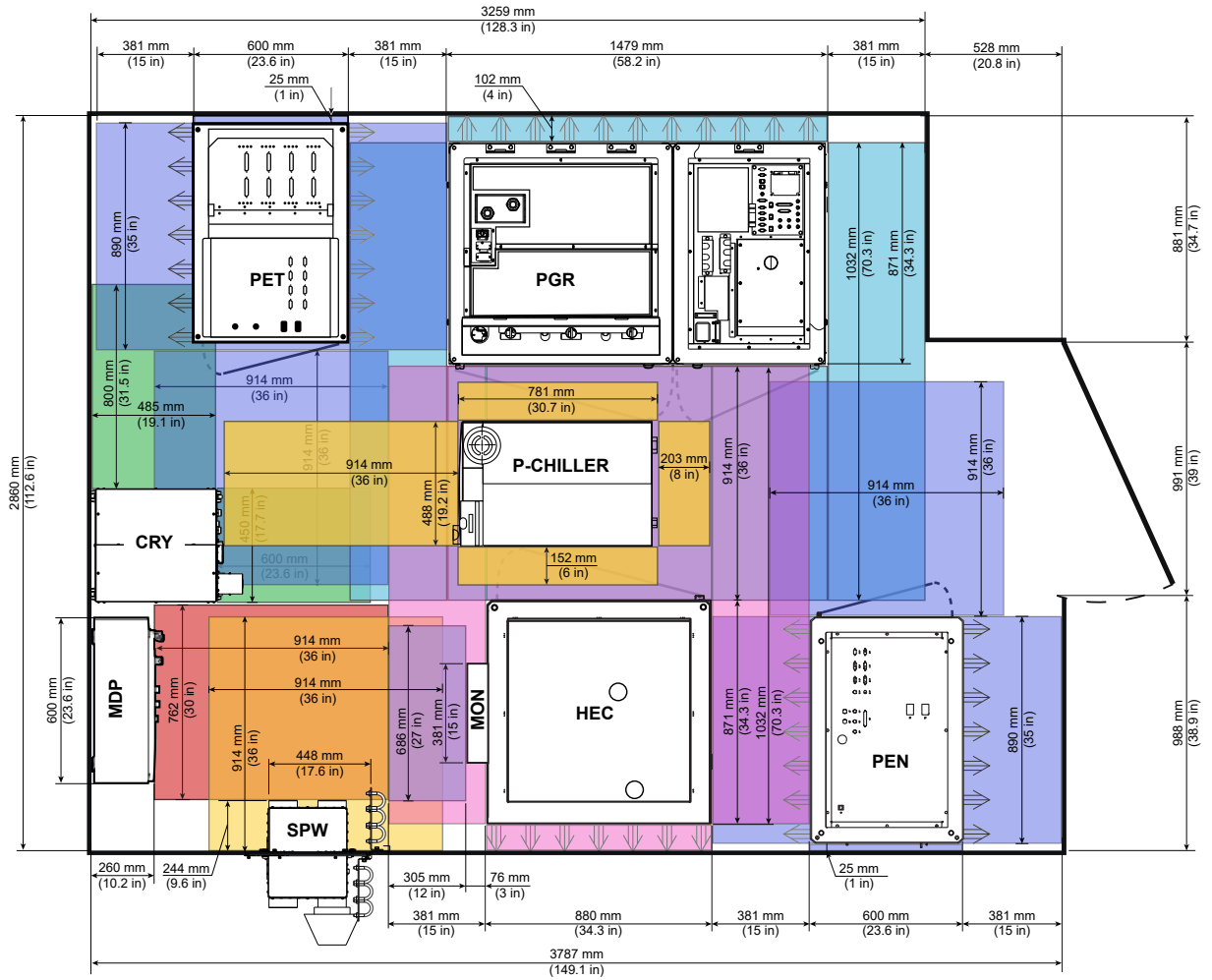
A 381 mm (15 in.) clearance on the cabinet sides for PGR, HEC, PEN, PET is needed for cabinet dolly removal. This clearance must extend from the cabinet front for dolly removal if the adjacent cabinet or wall is fixed.



#### NOTE

Refer to [Table 2-20 MR System Component Replacement Shipping Specifications on page 62](#) 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



## 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:
  - 1.1. A T100 network connection with RJ45 connector near the MDP
  - 1.2. 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).

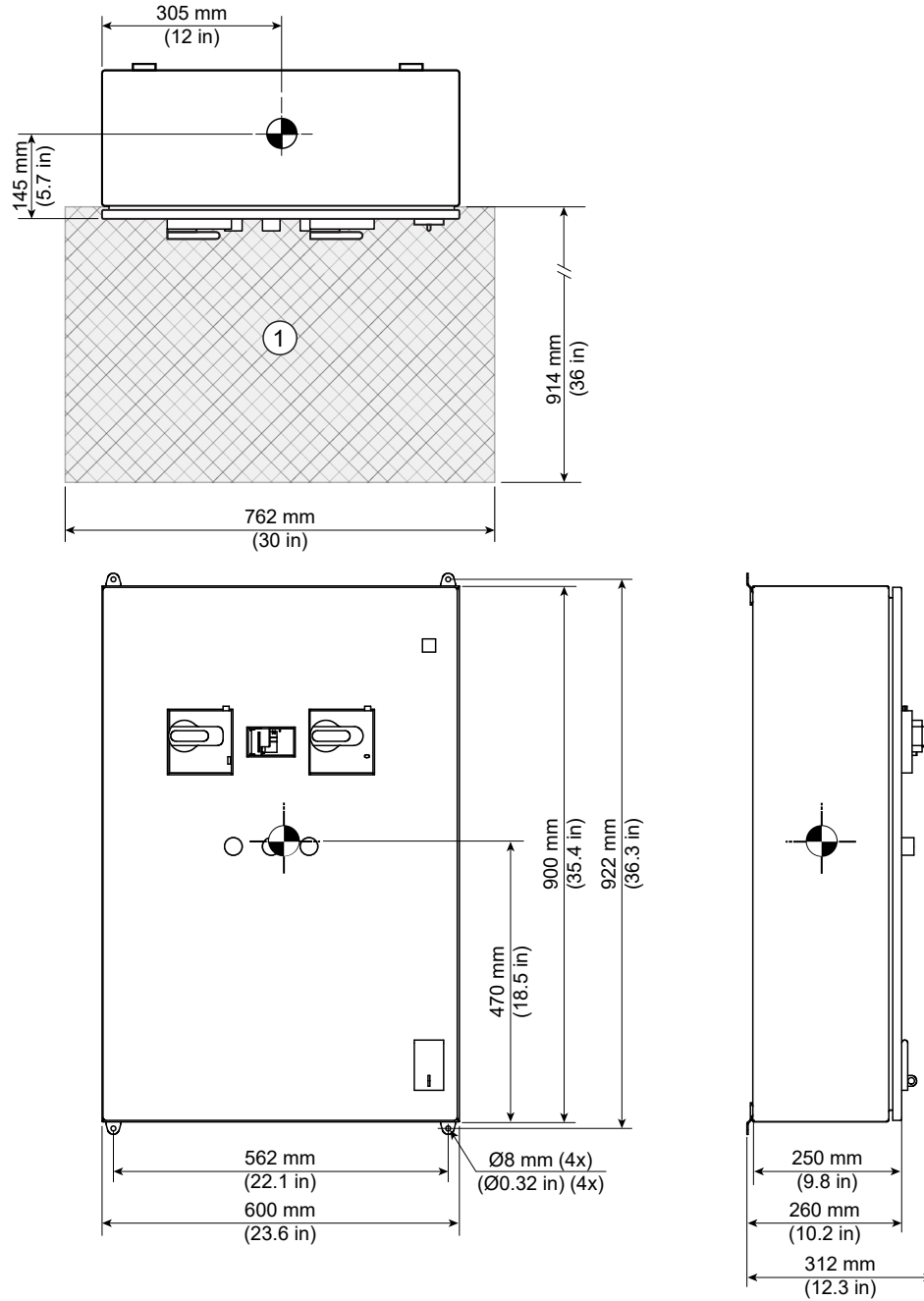
### 4.2.2 Specifications

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 54).

#### **M8000PH**

1. Weight: 59 kg (130 lb.)
2. Magnetic Field Limit: 5 mT (50 G)

**Figure 4-2 GE HealthCare supplied Main Disconnect Panel (MDP) M8000PH**

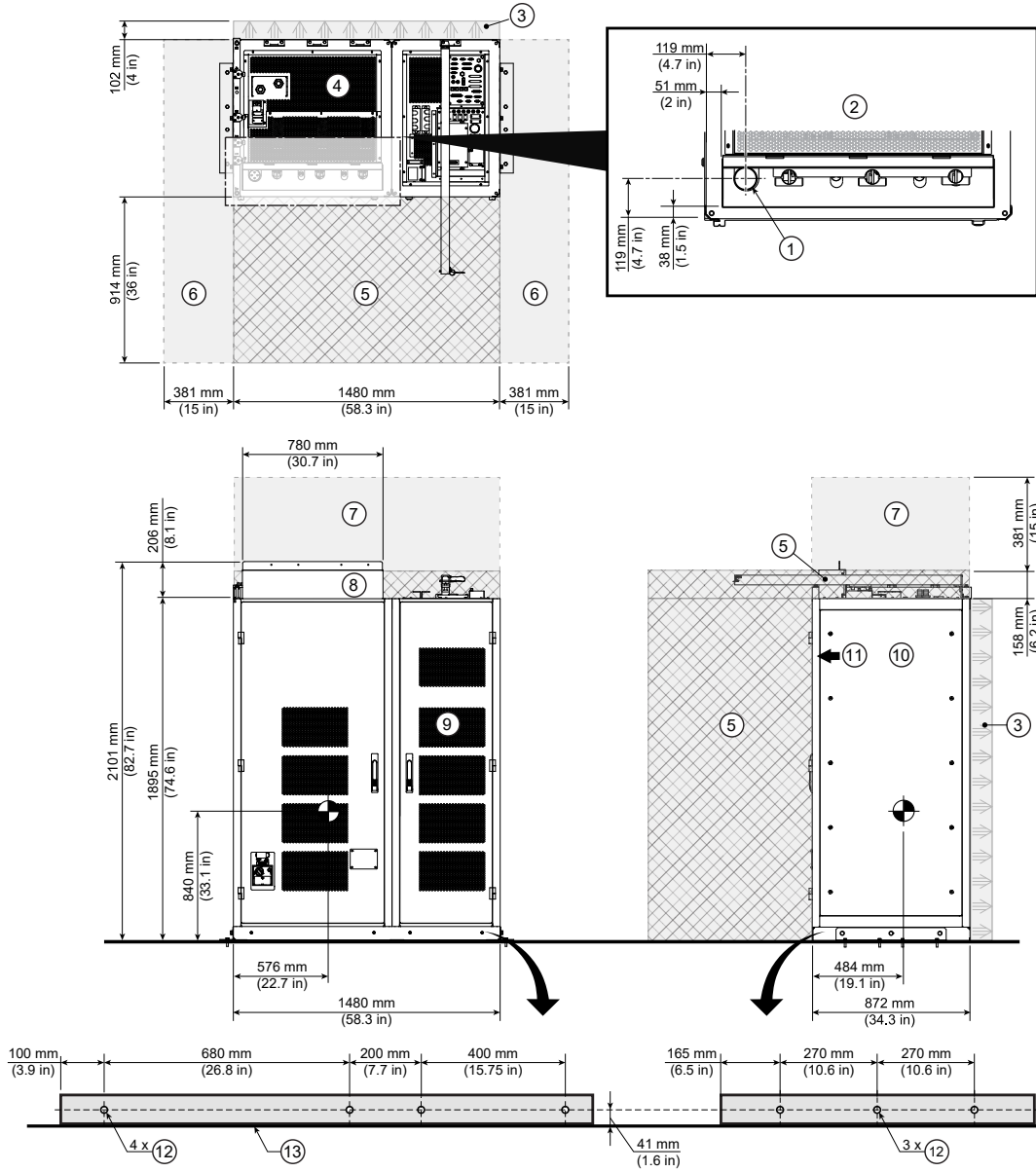


Item	Description
1	Service Clearance

## 4.3 Power, Gradient, RF Cabinet (PGR) Specifications

1. Weight: 1510 kg (3329 lb.)
2. Magnetic Field Limit: 5 mT (50 G)

Figure 4-3 Power, Gradient, RF (PGR) Cabinet



Item	Description	Item	Description
1	Conduit Hole for Incoming Power from MDP	8	Cable Strain Relief
2	Strain Relief Detail (Top View)	9	Front View
3	Airflow Clearance	10	Side View
4	Top View	11	Cabinet Front
5	Service Clearance	12	Seismic Anchor Mounting Holes to accommodate M12 fasteners (Same on front and both sides of cabinet)
6	Dolly Installation Clearance	13	Finished floor
7	Cable Clearance		

## 4.4 Heat Exchanger Cabinet (HEC) Specifications

Facility coolant is supplied to the Heat Exchanger Cabinet (HEC). The HEC provides closed loop chilled water circuits for the Power, Gradient, RF (PGR) Cabinet in the equipment room and the Gradient Coil inside the Magnet Enclosure. The HEC also routes facility chilled coolant to the Cryocooler Compressor (CRY).

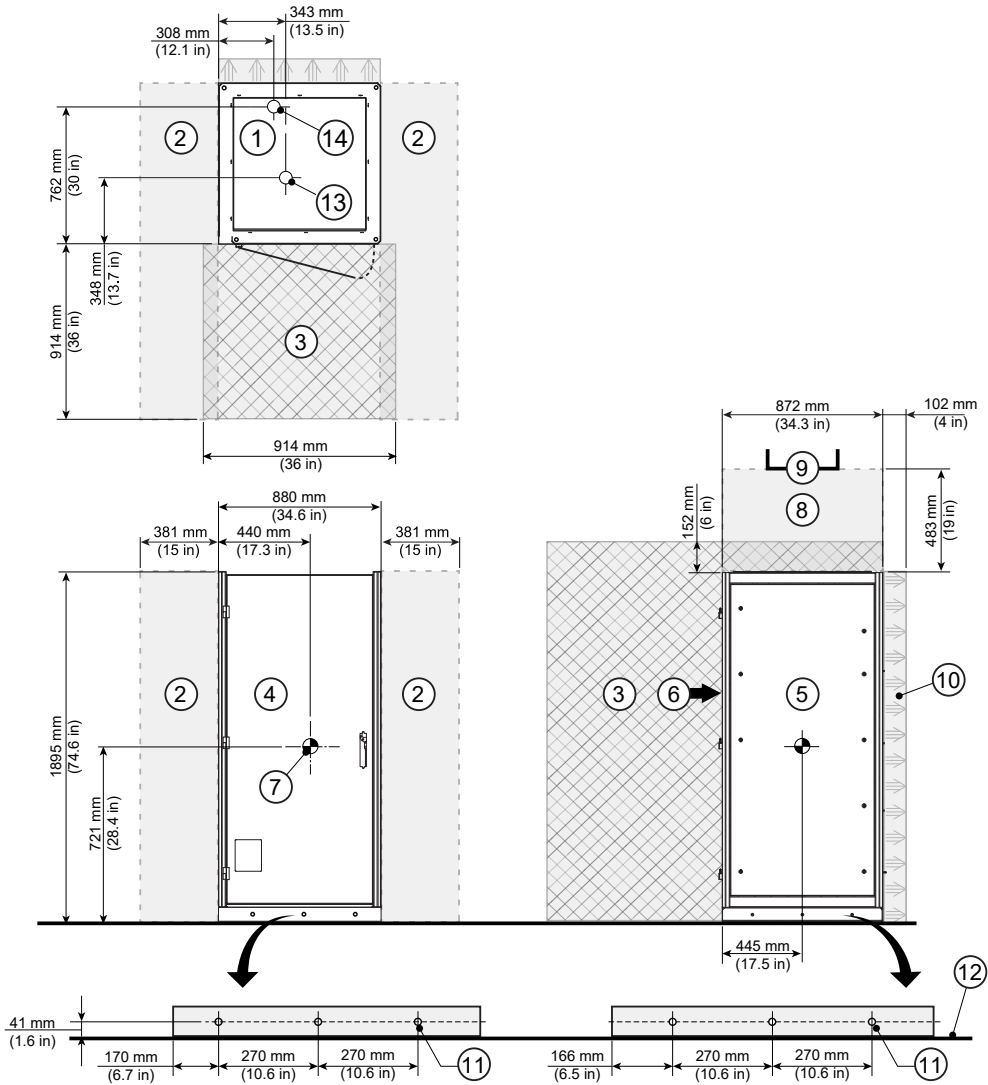
1. Weight (approximate):
  - 1.1. Dry (shipping – no fluid): 431 kg (950 lb.)
  - 1.2. Wet (with cooling fluid): 612 kg (1350 lb.)
2. Magnetic Field Limit: 5 mT (50 G)



### NOTE

- The Magnet Monitor may be installed on either side of the HEC. Service clearance is required on the mounting side.
- The bottom of the cable tray must be at least 483 mm (19 in.) above cabinet.

**Figure 4-4 Heat Exchanger Cabinet (HEC)**



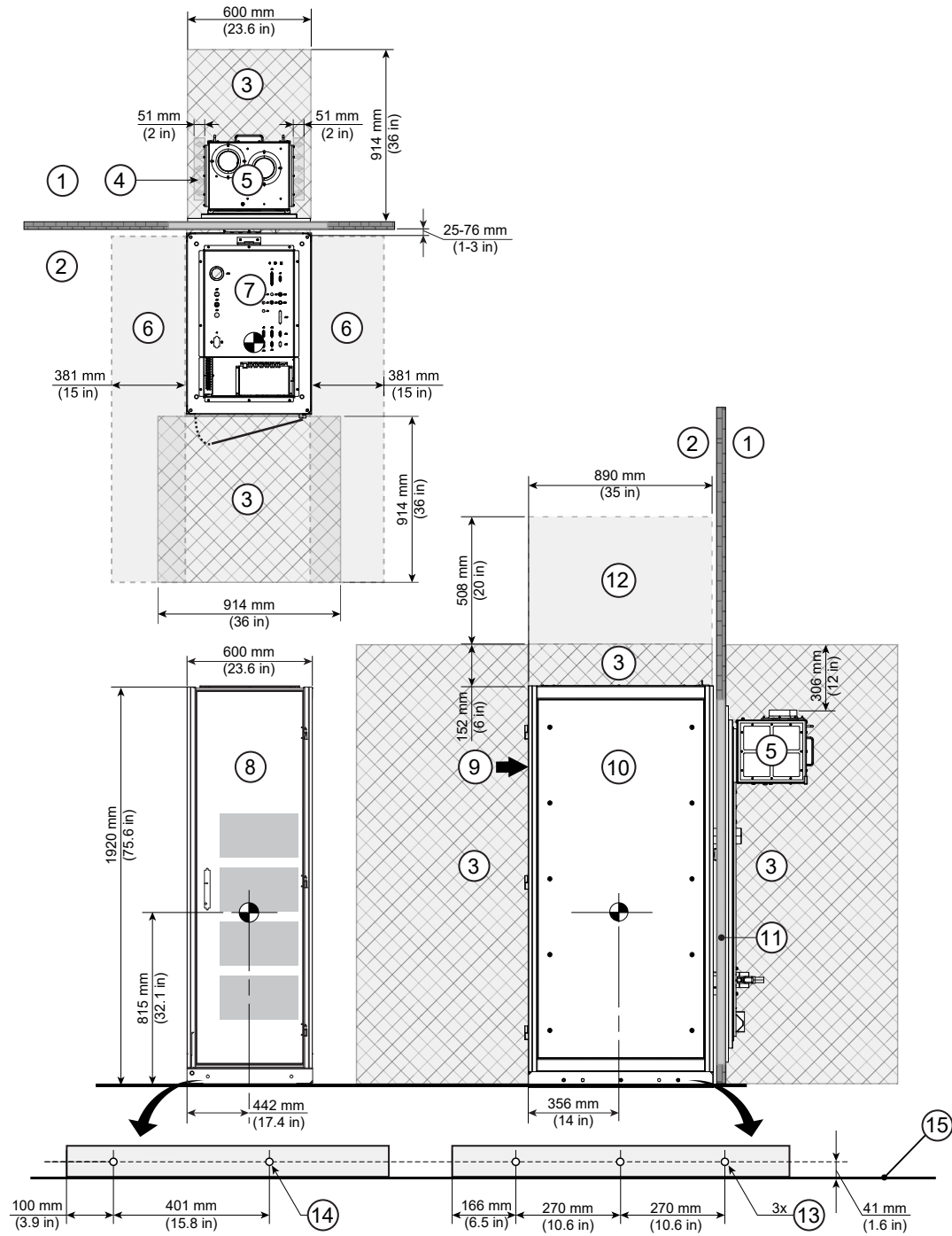
Item	Description	Item	Description
1	Top View	8	Cable Clearance
2	Dolly Installation Clearance	9	Cable Tray
3	Service Clearance	10	Airflow Clearance
4	Front View	11	M12 Seismic Anchor Mounting Holes (Same on both sides of cabinet)
5	Side View	12	Finished Floor
6	Cabinet Front	13	Facility Coolant Return
7	Center of Gravity	14	Facility Coolant Supply

## 4.5 Penetration Cabinet (PEN) Specifications

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

1. Weight: 313 kg (691 lb.)
2. PEN Panel Magnetic Field Limit: 20 mT (200 G) for the entire PEN Panel (the blower box must be outside the 20 mT (200 G) line)  
PEN Cabinet Magnetic Field Limit: 5 mT (50 G)
3. The PEN cabinet must be positioned directly in front of the PEN Panel. Refer to [3.5 Penetration Panel Wall Opening Requirements on page 73](#) for PEN panel mounting and location requirements.

Figure 4-5 PEN Cabinet



Item	Description	Item	Description
1	Magnet Room	9	Cabinet Front
2	Equipment Room	10	Side View
3	Service Clearance	11	Penetration Panel (See 3.5 Penetration Panel Wall Opening Requirements on page 73)
4	Airflow clearance required on both sides of Blower Box	12	Cable Drop Area

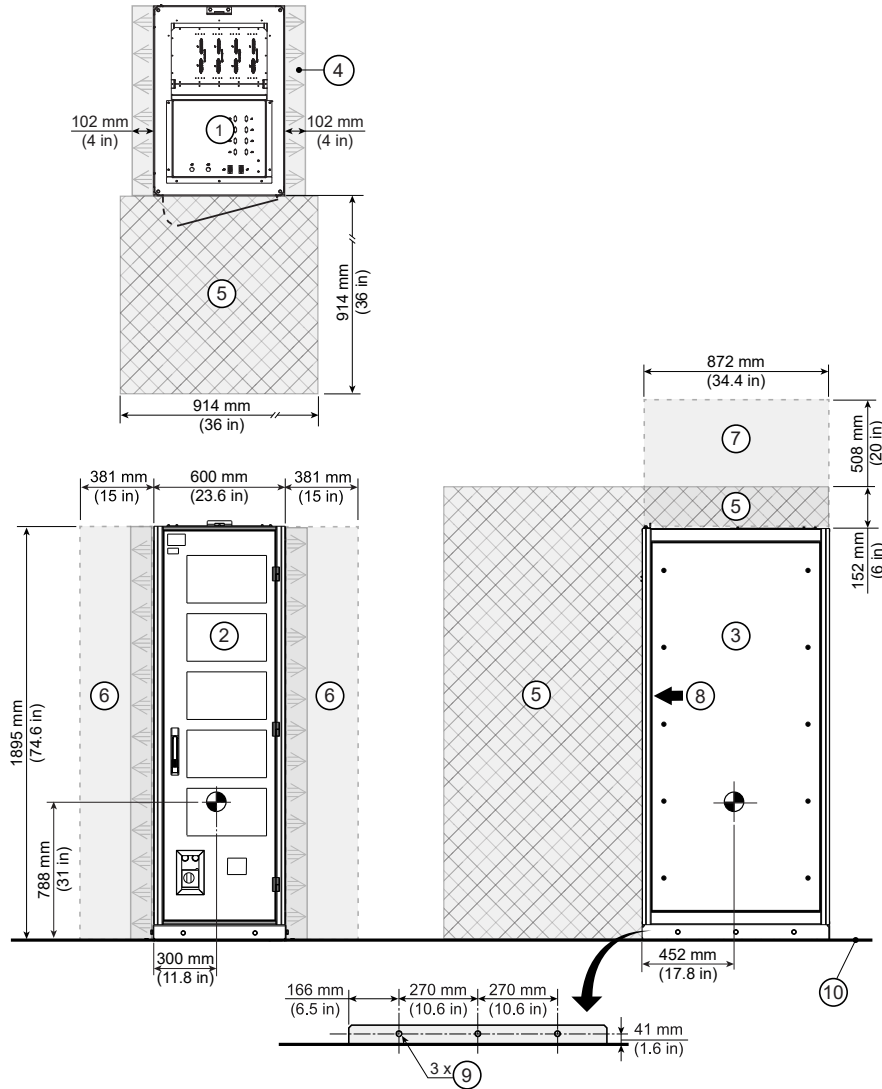
<b>Item</b>	<b>Description</b>	<b>Item</b>	<b>Description</b>
5	Blower Box	13	Seismic Anchor Mounting Holes (Same on both sides of cabinet)
6	Dolly Installation Clearance	14	All M12 x 1.75 mm Front Mounting Holes
7	Top View	15	Finished floor
8	Front View	-	-

## 4.6 PET Electronics Cabinet (PET) Specifications

The PET Electronics Cabinet (PET) provides power to the detectors, performs PET Reconstruction, and supplies power to the PET Chiller (P-CHILL).

1. Weight: 371 kg (817 lb.)
2. PET Cabinet Magnet Field Limit: 5 mT (50 G)

**Figure 4-6 PET Cabinet**



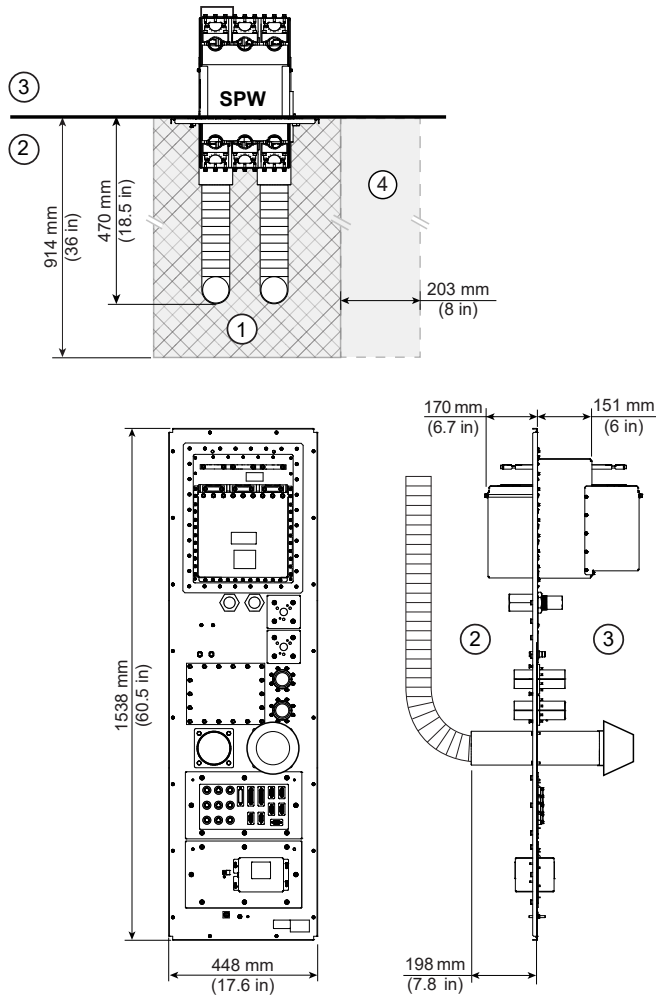
Item	Description	Item	Description
1	Top View	6	Dolly Installation clearance required on both sides of the PET cabinet
2	Front View	7	Cable Drop Area
3	Side View	8	Cabinet Front
4	Airflow clearance required on both sides of the PET cabinet	9	Seismic Anchor Holes, M12 x 1.75 mm (Same on both sides of cabinet)
5	Service Clearance	10	Floor

## 4.7 Secondary Penetration Wall (SPW) Specifications

The Secondary Penetration Wall (SPW) 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 on page 73](#) for PEN panel mounting and location requirements.
3. The service area for the SPW is 914 mm (36 in.) from both sides the RF wall, and from floor to cable trays.

**Figure 4-7 Secondary Penetration Wall (SPW)**



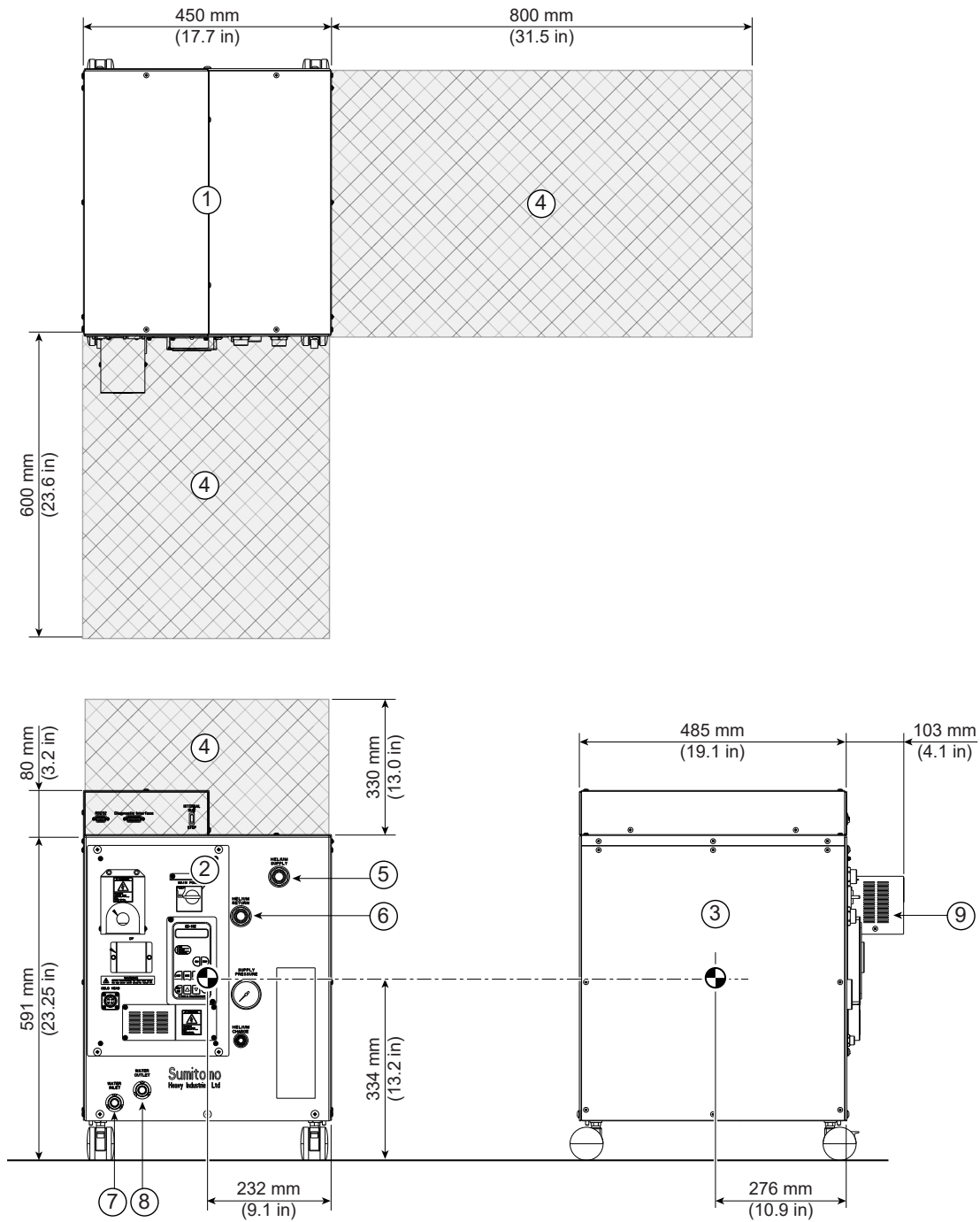
Item	Description		
1	Service clearance (shaded area)	3	Magnet Room
2	Equipment Room	4	Additional service clearance needed. The clearance can be on either side of the SPW.

## 4.8 Cryocooler Compressor (CRY) Specifications

Water cooling for the F-50SH Cryocooler Compressor (CRY) is provided from the Heat Exchanger Cabinet (HEC) or facility supplied emergency backup water supply.

1. F-50SH Cryocooler Compressor Weight: Approx 120 kg (264 lb.)
2. Magnetic Field Limit: 10 mT (100 G)

**Figure 4-8 Cryocooler Compressor F-50SH (Water Cooled)**



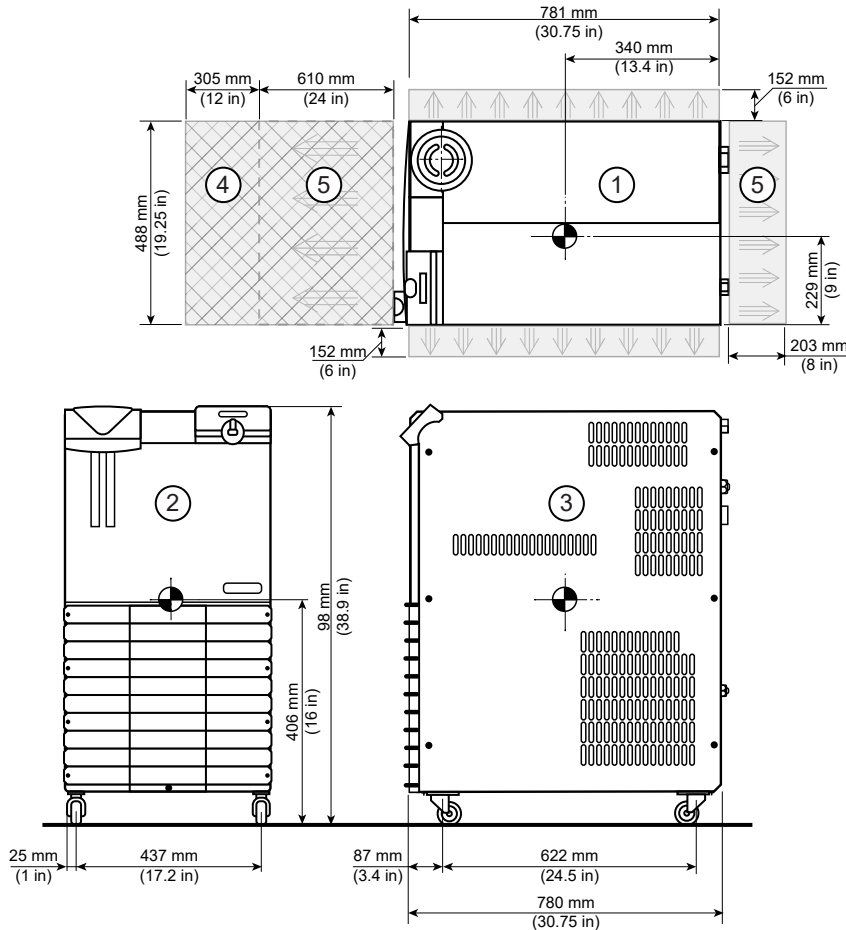
Item	Description	Item	Description
1	Top view	6	Helium return
2	Front view	7	Water supply
3	Side view	8	Water return
4	Service clearance	9	Input power terminal
5	Helium supply	-	-

## 4.9 PET Chiller (P-CHILL) Specifications

The PET detectors in the Magnet Room are water cooled via a Thermo Scientific NESLAB ThermoFlex Recirculating Chiller, Model 5000.

1. Weight: 138 kg (303 lb.)
2. Magnetic Field Limit: 5 mT (50 Gauss)
3. PET Chiller seismic specifications are available in the chiller technical manual (DOC1806882)

Figure 4-9 PET Chiller



Item	Description	Item	Description
1	Top View	4	Service Clearance
2	Rear View	5	Airflow clearance
3	Side View		

## 4.10 Magnet Monitor (MON) Requirements and Specifications

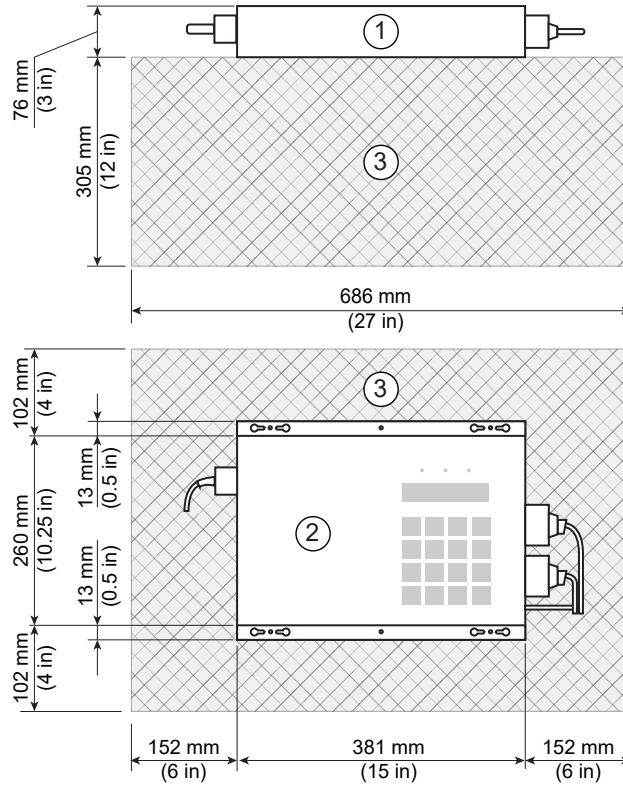
### 4.10.1 Requirements

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).

### 4.10.2 Specifications

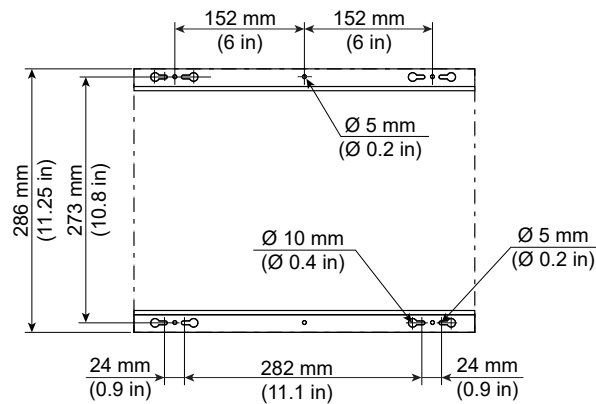
1. Mounting location: On either side of the Heat Exchanger Cabinet (HEC) or on a wall that is close to the HEC
2. Weight: 4.5 kg (10 lb.)
3. Magnetic Field Limit: 20 mT (200 gauss)
4. Power cord length: 1829 mm (72 in.)

**Figure 4-10 Magnet Monitor (MON)**



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

**Figure 4-11 Magnet Monitor (MON) Mounting Patterns**



## 4.11 Magnetic Resonance Elastography (MRE) Specifications (Optional Equipment)

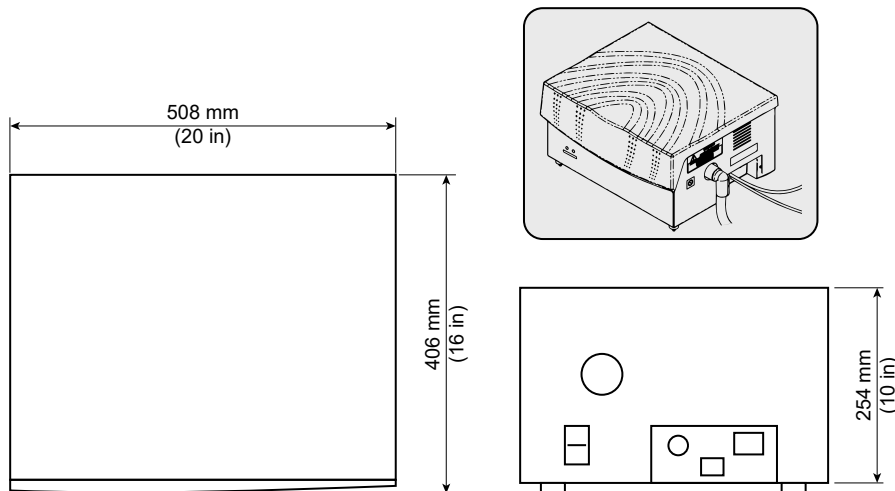
### 4.11.1 Requirements

1. The customer must work with the RF shield vendor to provide a waveguide for the 25 mm (1 in.) diameter tube.
2. MRE Resoundant 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 135](#)).

### 4.11.2 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.)

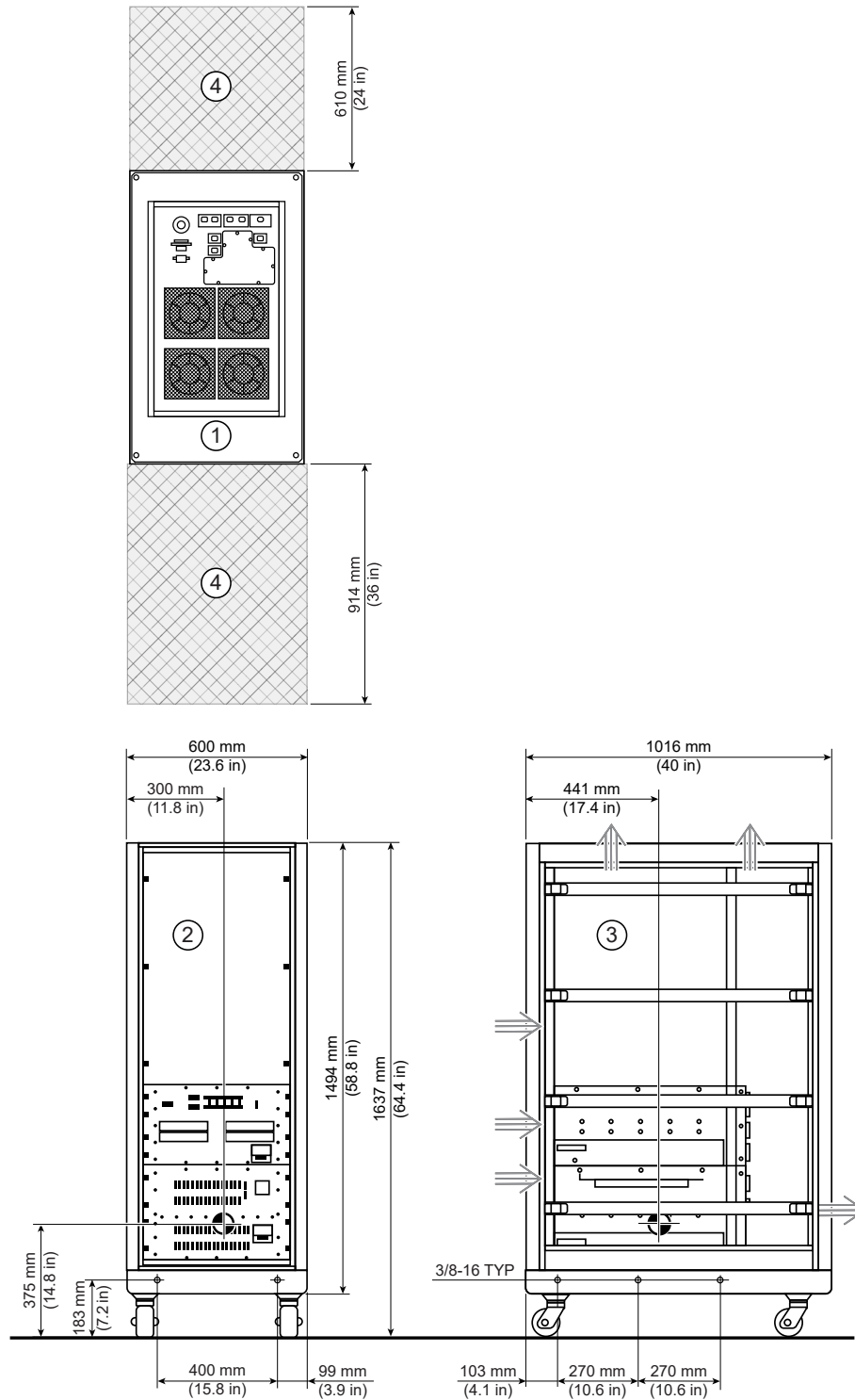
**Figure 4-12 Magnetic Resonance Elastography (MRE) Resoundant Acoustic Driver**



## 4.12 Multi-Nuclear Spectroscopy (MNS) Specifications (Optional Equipment)

1. Weight: 295 kg (650 lb.)
2. Magnetic Field Limit: 20 mT (200 G)
3. The threaded seismic anchor mounting holes accommodate 3/8"-16 bolts.

**Figure 4-13 Seismic Mounting Detail for MNS Amplifier Cabinet for 8 kW MNS Option**



Item	Description	Item	Description
1	Top View	3	Side View
2	Front View	4	Service area

# 5 Control Room

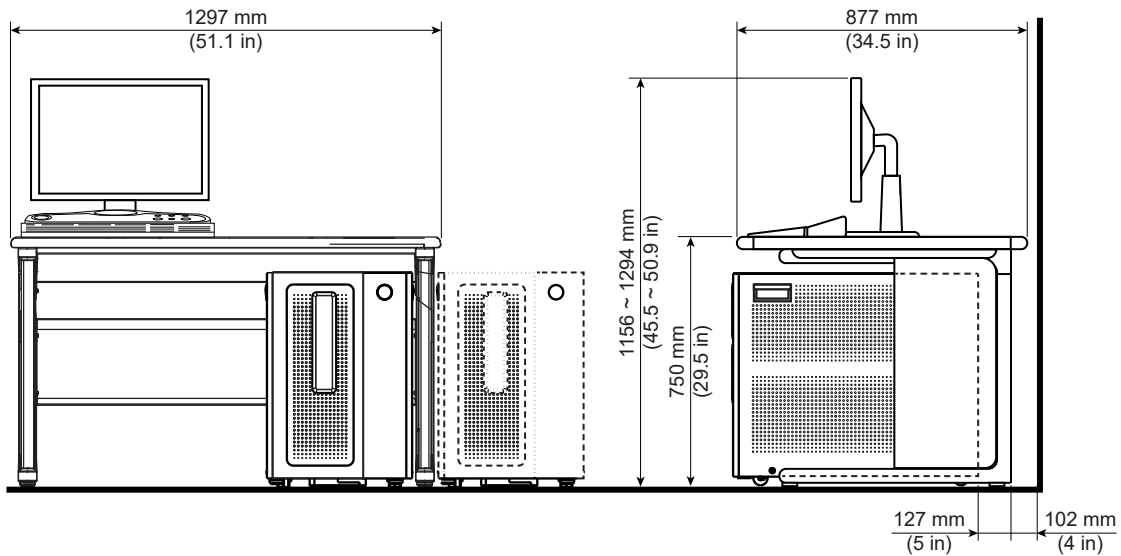
## 5.1 Operator Workspace Equipment Specifications



(Applies to all sections within this chapter)

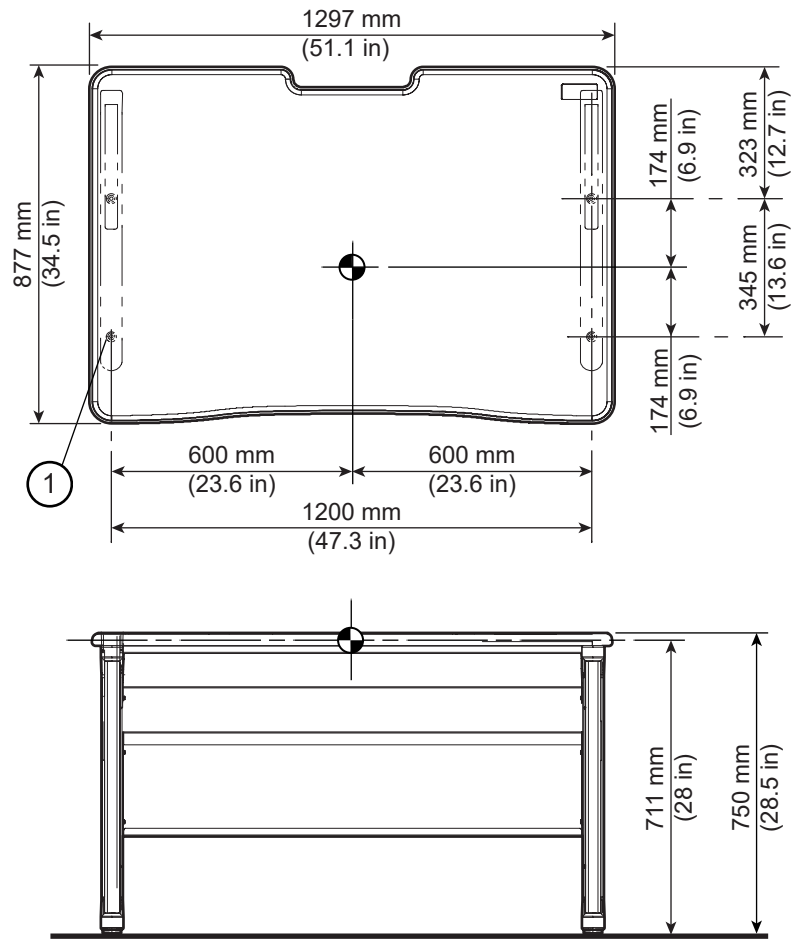
### 5.1.1 Operator Workspace Assembly

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)

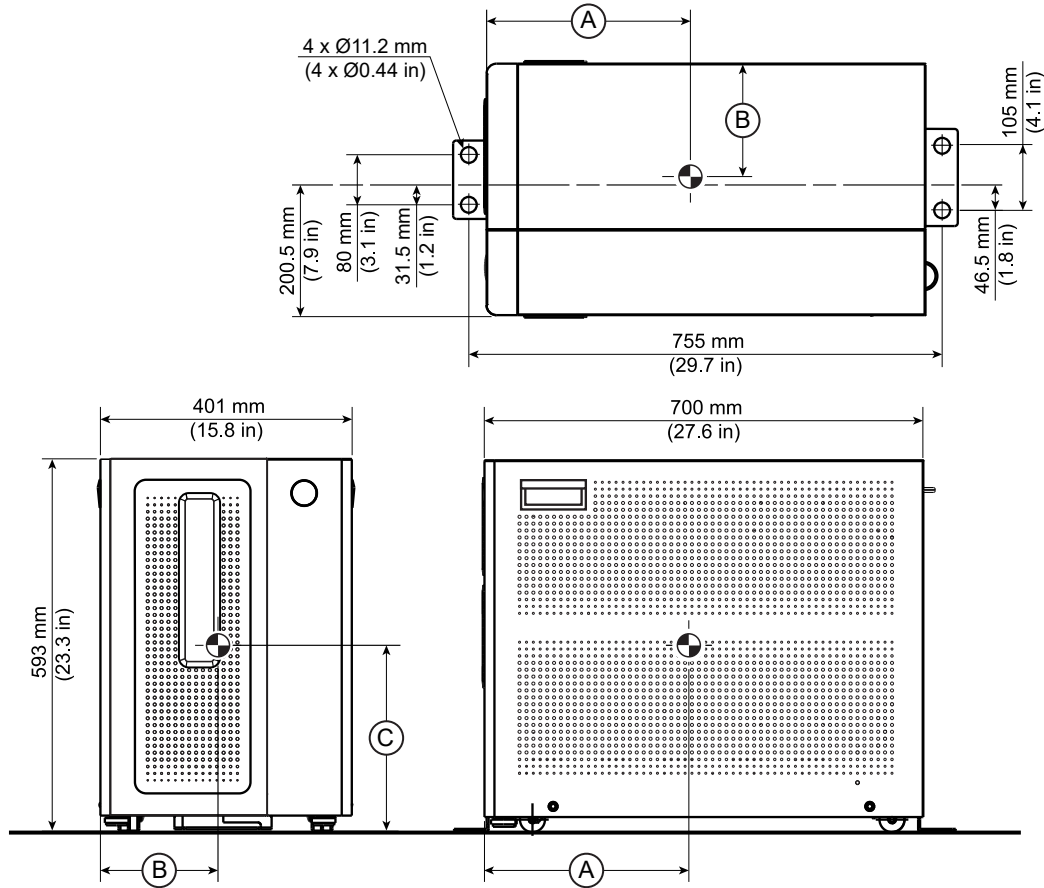


Item	Description
1	Four (4) 15.9 mm (5/8 in.) thru mounting holes for 9.5 mm (3/8 in.) seismic anchors

### 5.1.3 Global Operator Cabinet (GOC)

1. Weight:
  - For Dell T5820:** 60.4 kg (133.1 lb.)
  - For HP Z4G5:** 55.0 kg (121.3 lb.)
2. Magnetic Field Limit: 5 mT (50 G)
3. Anchor size: M10 (3/8 in.)

Figure 5-3 Global Operator Cabinet (GOC)



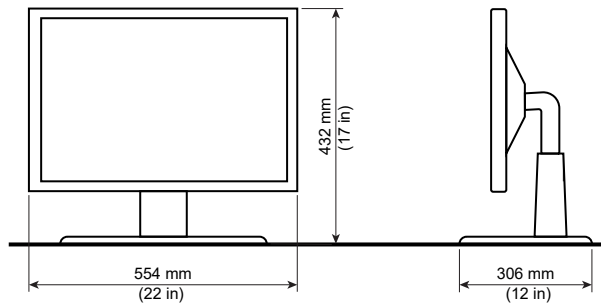
	A	B	C
Dell T5820	324 mm (12.7 in.)	192 mm (7.6 in.)	279 mm (11 in.)
HP Z4G5	375 mm (14.8 in.)	205 mm (8.1 in.)	328 mm (12.9 in.)

## 5.1.4 Host Display

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

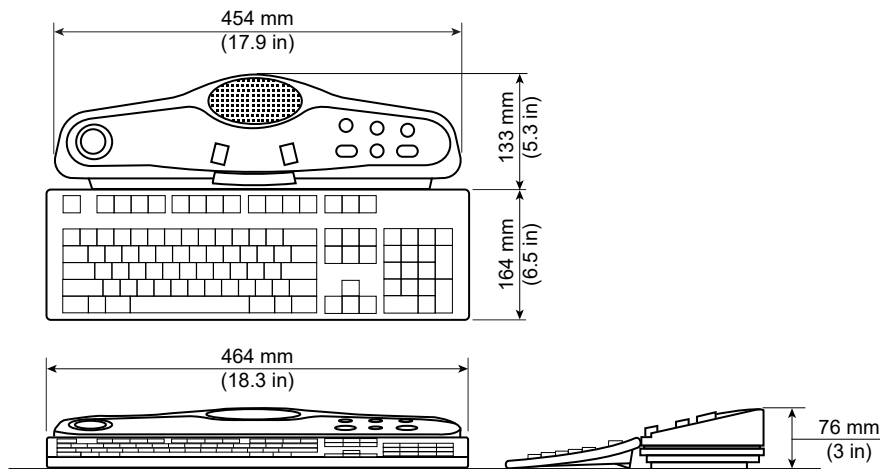
1. Weight: 6.7kg (14.8 lb.)
2. Magnetic Field Limit: 5 mT (50 G)

**Figure 5-4 Host Display**



## 5.1.5 Host Keyboard

**Figure 5-5 Host Keyboard**

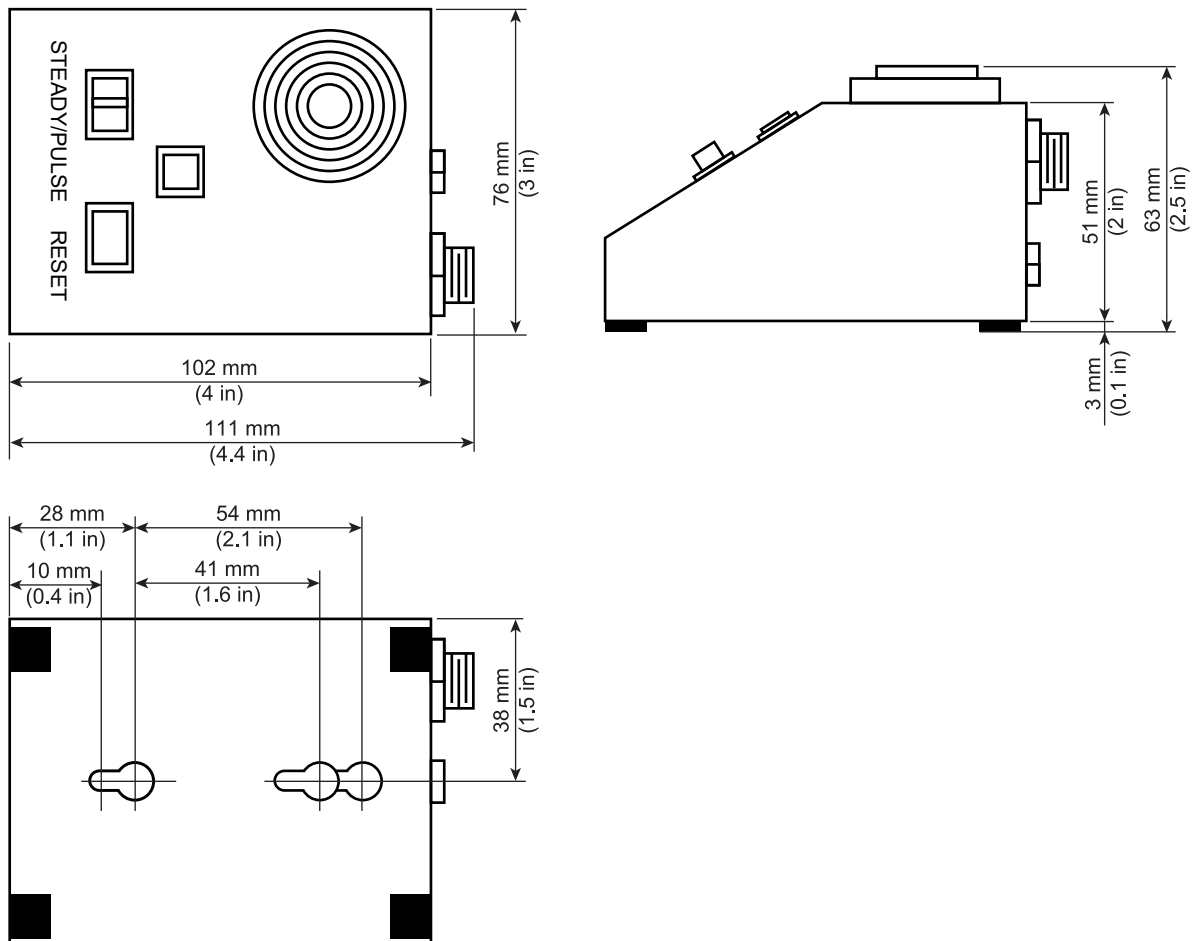


### 5.1.6 Pneumatic Patient Alert

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 SPiCE Workstation (SW) Equipment Specifications (Optional Equipment)



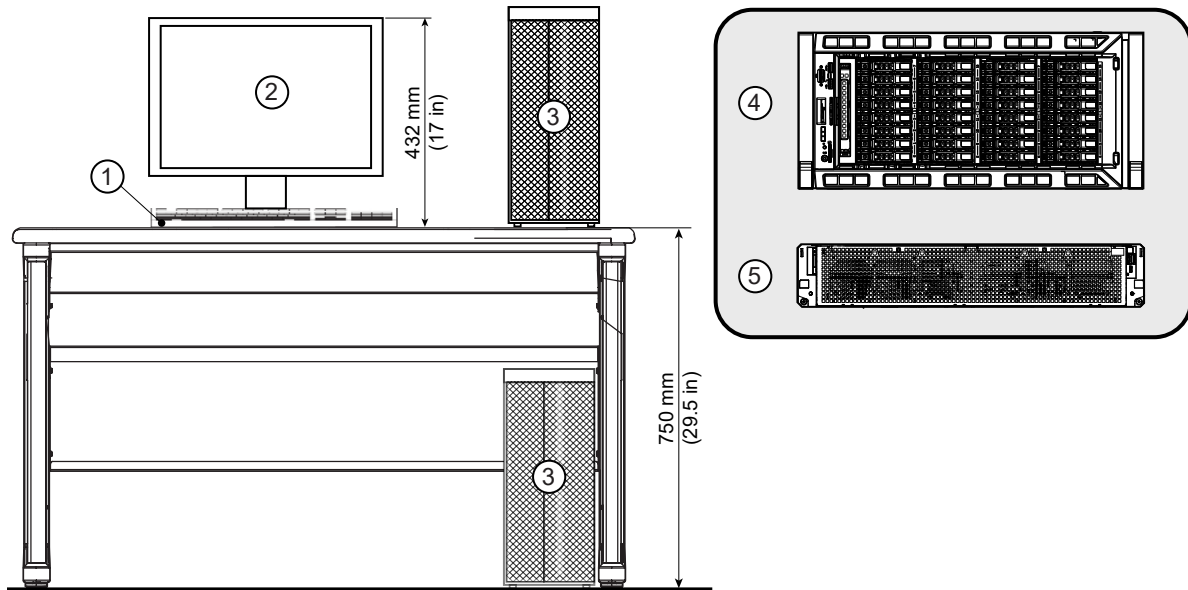
(Applies to all sections within this chapter)

### 5.2.1 SPiCE Workstation (SW) Assembly

The optional SPiCE Workstation assembly consists of a display, keyboard, SPiCE Workstation host computer, SPiCE computer, and ethernet switch. The SPiCE Workstation can be installed in a location that is separate from the control room, but cannot be installed in the magnet room or equipment room. The installation location needs to have a T100 network connection with an RJ45 connector.

Figure 5-7 SPiCE Workstation Assembly on page 123 shows possible placement options of the SPiCE Workstation host computer and SPiCE Computer.

Figure 5-7 SPiCE Workstation Assembly

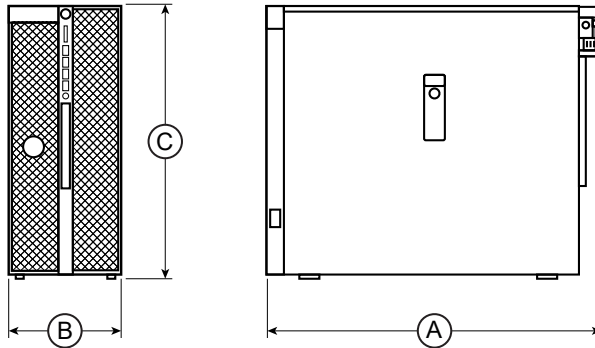


Item	Description	Item	Description
1	Keyboard	4	SPiCE 2 Computer
2	Display	5	SPiCE 3 Computer
3	SPiCE Workstation Host Computer	-	-

## 5.2.2 SPiCE Workstation (SW) Host Computer

- Weight:
  - For Dell T5820:** 15.4 kg (34 lb.)
  - For HP Z4G5:** 10.5 kg (23.1 lb.)
- Magnetic Field Limit: 5 mT (50 G)

**Figure 5-8 SPiCE Workstation (SW) Host Computer**



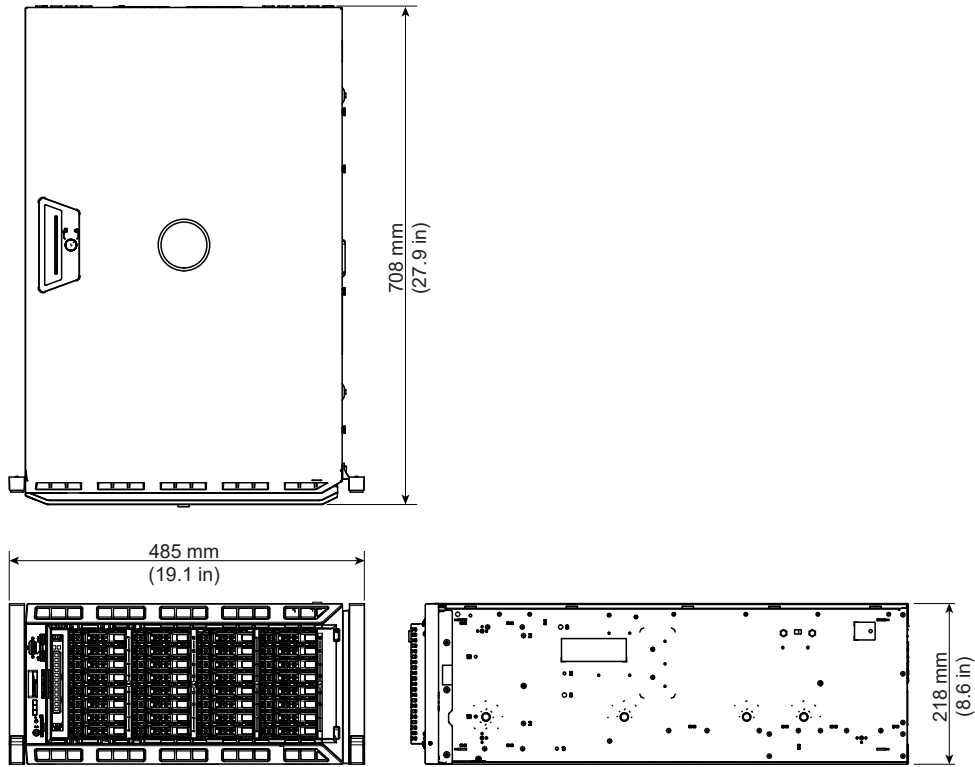
	A	B	C
Dell T5820	518 mm (20.4 in.)	177 mm (7 in.)	418 mm (16.5 in.)
HP Z4G5	445 mm (17.5 in.)	169 mm (6.7 in.)	386 mm (15.2 in.)

## 5.2.3 SPiCE Computer

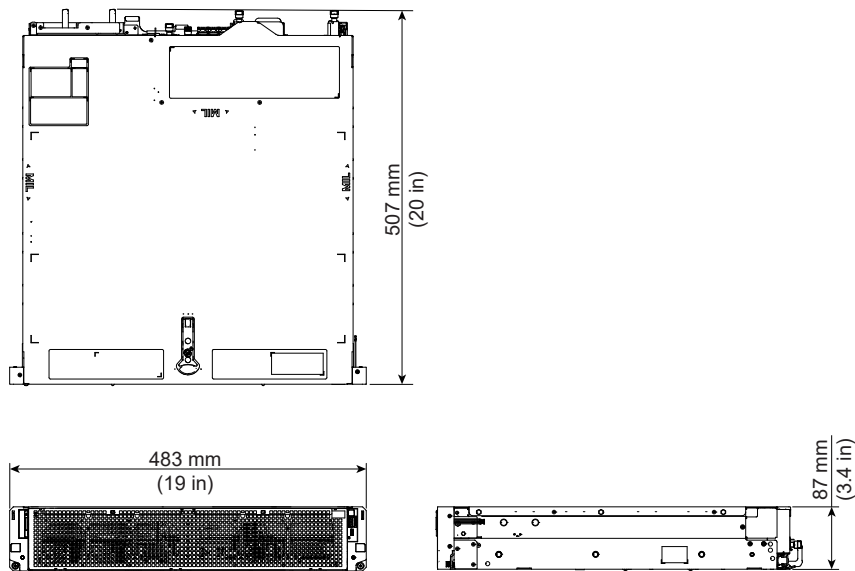
- Weight:
  - For SPiCE 2:** 42.4 kg (93.4 lb)
  - For SPiCE 3:** 19.5 kg (43 lb.)
- Magnetic Field Limit: 5 mT (50 G)

The SPiCE computer can be installed in a location that is separate from the SPiCE Workstation. It cannot be mounted in the magnet room or system equipment cabinets. The SPiCE computer is rack mountable. Refer to the Dell documentation for mounting requirements and dimensions. A T100 network connection with an RJ45 connector is required between the SPiCE Workstation location and the SPiCE computer location.

**Figure 5-9 SPiCE 2 Computer**



**Figure 5-10 SPiCE 3 Computer**



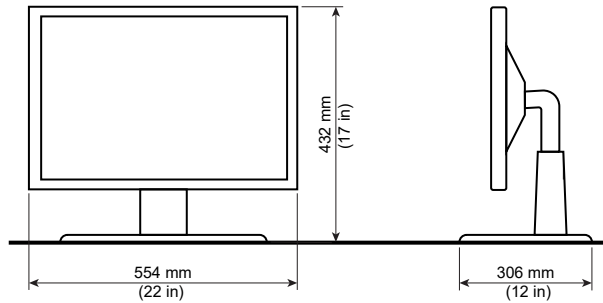
## 5.2.4 SPiCE Display

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

1. Weight: 6.7kg (14.8 lb.)

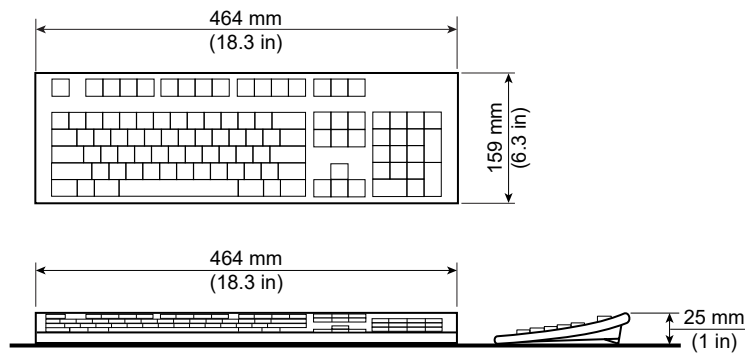
2. Magnetic Field Limit: 5 mT (50 G)

Figure 5-11 Host Display



### 5.2.5 SPiCE Keyboard

Figure 5-12 SPiCE Keyboard

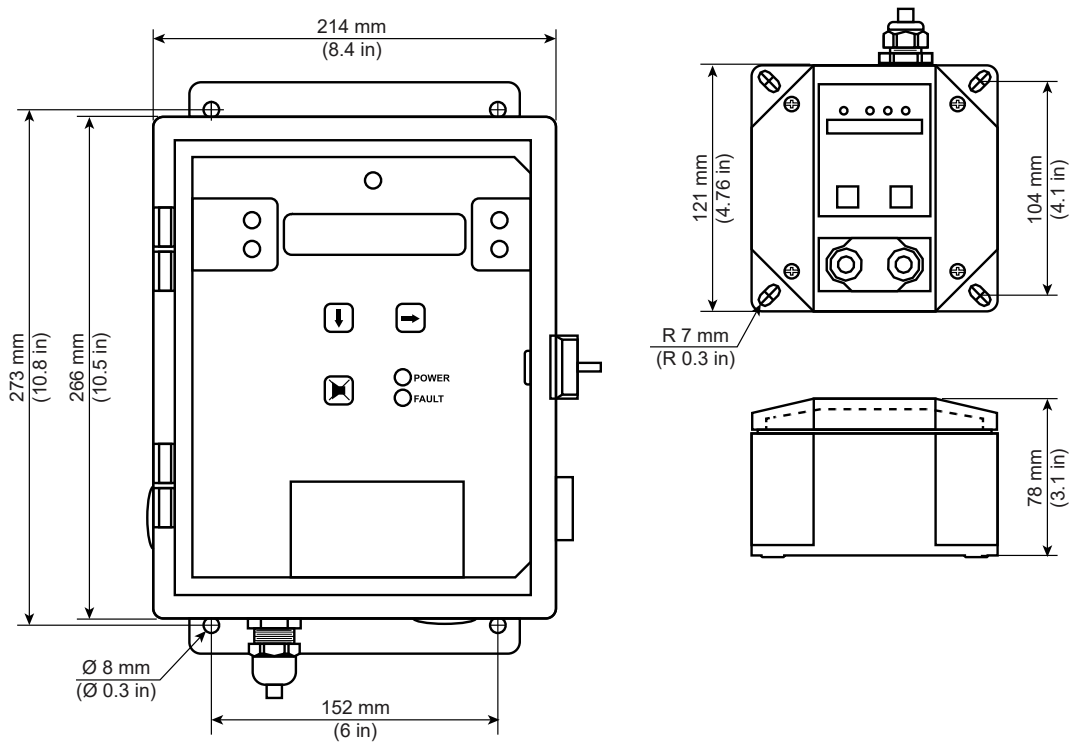


## 5.3 Oxygen Monitor (OXY) Specifications (Optional Equipment)

The optional Oxygen Monitor system consists of the Oxygen Monitor, the Remote Oxygen Sensor Module, and interconnects through the Secondary Penetration Wall (SPW). 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 5-13 Oxygen Monitor and Remote Sensor**

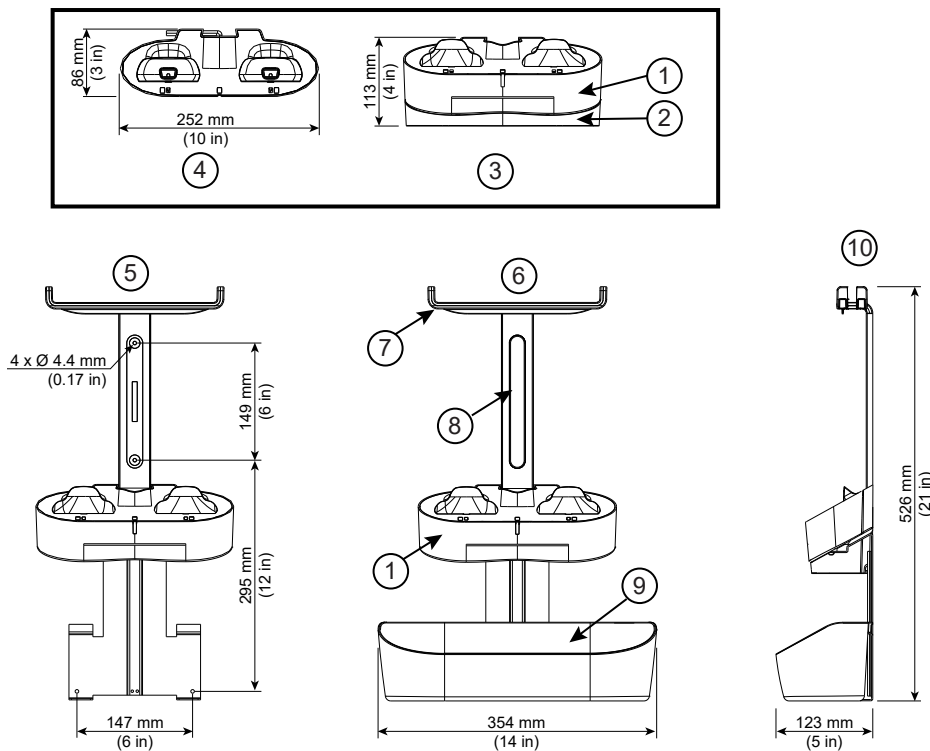


## 5.4 Physiological Acquisition Transceiver (PAT) Charging Station Specification (Optional Equipment)

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 5-14 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
HEC	Heat Exchanger 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 PGR cabinet
PED	Magnet Rear Pedestal
PEN	Penetration Cabinet
PET	PET Electronics and PET PDU
P-CHILL	PET Chiller
PGR	Power Gradient RF Cabinet
PT	Patient Transport Table
SPW	Secondary Pen Wall

**Table 7-2 MR System Options Component Designators**

Component Designator	Description
MNS	MNS Cabinet

**Table 7-2 MR System Options Component Designators** (Table continued)

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

## 7.1.2 Available Cable Lengths

Three configurations of cable lengths are available for order, and multiple selections for gradient cables. Gradient cables are no longer field terminated, and it is critical to select an appropriate length to avoid too much excess. 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 and Hose Lengths on page 131](#). 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 and Hose Lengths**

Length Identifier (shown in the figure below)	Point A	Point B	Site Option: Short	Site Option: Long
			mm (in.)	
<b>Equipment Room</b>				
L1	CRY	MON	10000 (393.7)	
L2	MON	SPW, top edge	16800 (661.4)	
L3	HEC, top panel	CRY	9000 (354.3)	
Not shown	HEC, top panel	Customer-Supplier Network	28000 (1102.4)	
L4	PEN, top panel	OW, rear panel	29000 (1141.7)	
L5	PEN, top panel	MON	16400 (645.7)	
Not shown	PEN, top edge	RF common ground stud	2673 (105.2)	
Not shown	SPW, top edge	RF common ground stud	1276 (50.2)	

**Table 7-4 Available Cable and Hose Lengths** (Table continued)

Length Identifier (shown in the figure below)	Point A	Point B	Site Option: Short	Site Option: Long
			mm (in.)	
L6	PGR, top panel	OW, rear panel	28800 (1133.9)	
L7	PGR, top panel	HEC, top panel	8800 (346.5)	
L8	PGR, top panel	Magnet Room door switch	24400 (960.6)	
L9	PGR, top panel	PEN, top panel	9400 (370.1)	16400 (645.7)
L10 (This length is for all cables and hoses <b>except</b> for gradient cables. For gradient cable available lengths, see <a href="#">Table 7-5 Available Cable Lengths for Gradient Cable (Equipment Room, SPW I/O Panel to Top of PGR)</a> on page 133.)	PGR, top panel	SPW, top edge	9200 (362.2)	16200 (637.8)
Not shown	PGR, top panel	RF common ground stud	9200 (362.2)	16200 (637.8)
L11	SPW, top edge	CRY	14000 (551.2)	
Not shown	SPW, top edge	E-Off switch, Control Room or Equipment Room	9800 (385.8)	16800 (661.4)
L12	SPW, top edge	OW, rear panel	29200 (1149.6)	
L17	PET Cabinet, top panel	PET Chiller	15000 (591)	
L18	PET Cabinet, top panel	SPW	14000 (551)	21000 (826)
L19	PET Cabinet, top panel	PEN, top panel	14000 (551)	21000 (826)
L20	PET Cabinet, top panel	PGR, top panel	14000 (551)	21000 (826)
L21	PET Cabinet, top panel	OW, rear panel	29000 (1141.7)	
Not shown	PET Chiller	MAG, gradient cable clamp block	32918 (1296)	
<b>Magnet Room</b>				
L13	PEN (magnet room side) top edge	MAG, gradient cable clamp block	9000 (354.3)	13000 (511.8)

**Table 7-4 Available Cable and Hose Lengths** (Table continued)

Length Identifier (shown in the figure below)	Point A	Point B	Site Option: Short	Site Option: Long
			mm (in.)	
L14 (This length is for all cables and hoses except for gradient cables. For gradient cable available lengths, refer to <a href="#">Table 7-6 Available Cable Lengths for Gradient Cable (Magnet Room, Magnet Gradient Cable Strain Relief Plate to Top of SPW I/O Panel)</a> on page 133.)	SPW, top edge	MAG, gradient cable clamp block	7700 (303.2)	11700 (460.6)
Not shown	SPW, top edge	E-Off switch, Magnet Room	29800 (1173.2)	
L15	OW, rear panel	MAG, gradient cable clamp block	38000 (1496.1)	42000 (1653.5)
L16	MRU	MAG, gradient cable clamp block	24700 (972.4)	
Not shown	RF common ground stud	MAG, gradient cable clamp block	10000 (393.7)	14000 (551.2)

**Table 7-5 Available Cable Lengths for Gradient Cable (Equipment Room, SPW I/O Panel to Top of PGR)**

Length Identifier (shown in the figure below)	Available lengths mm (in.)
L10	3700 (145.7)
	5700 (224.4)
	7700 (303.1)
	9700 (381.9)
	11700 (460.6)
	13700 (539.4)
	15700 (618.1)

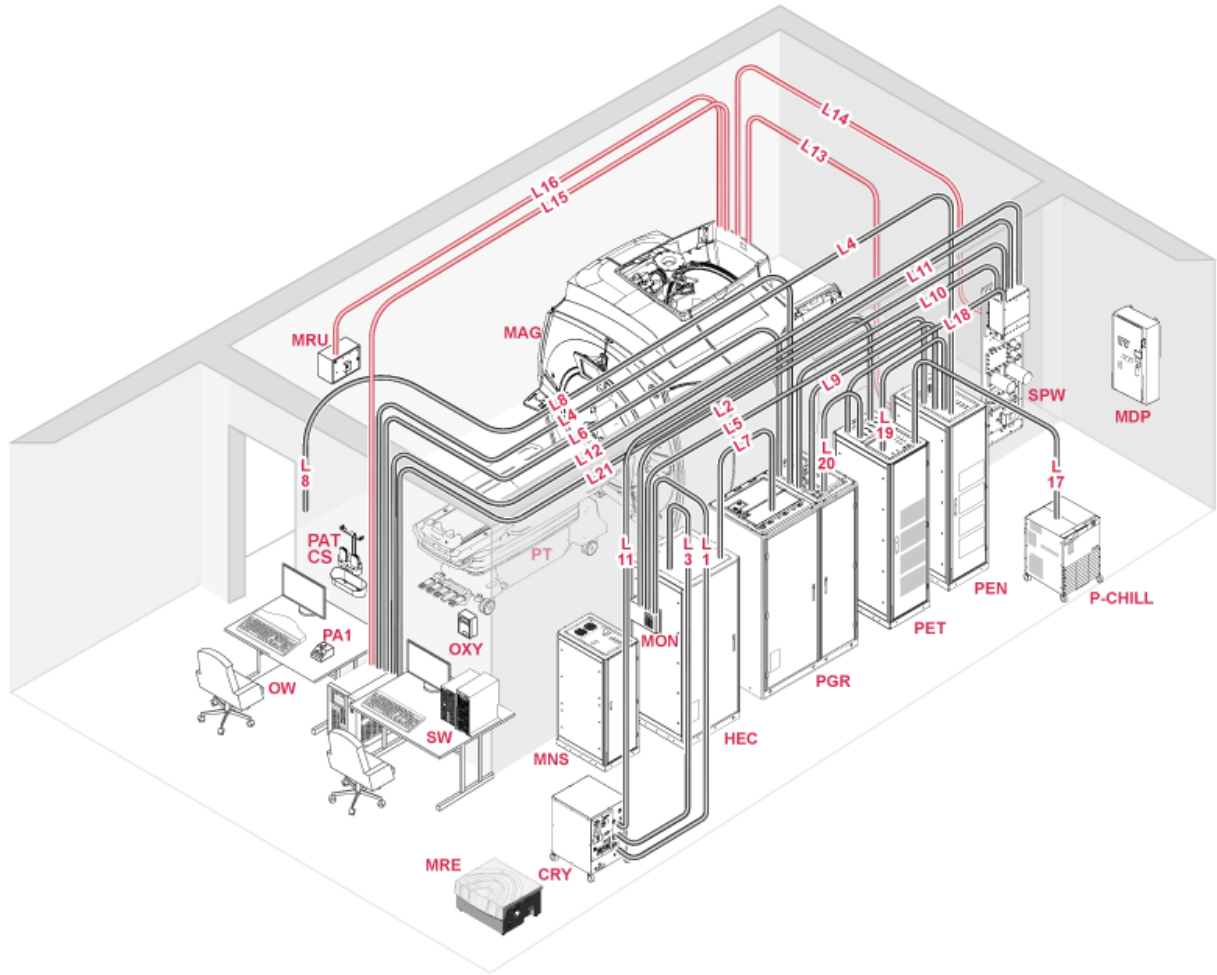
**Table 7-6 Available Cable Lengths for Gradient Cable (Magnet Room, Magnet Gradient Cable Strain Relief Plate to Top of SPW I/O Panel)**

Length Identifier (shown in the figure below)	Available lengths mm (in.)
L14	4000 (157.5)
	6000 (236.2)
	8000 (315.0)
	10000 (393.7)

**Table 7-6 Available Cable Lengths for Gradient Cable (Magnet Room, Magnet Gradient Cable Strain Relief Plate to Top of SPW I/O Panel)**

Length Identifier (shown in the figure below)	Available lengths mm (in.)
	12000 (472.4)

**Figure 7-1 Available Cable/Hose Lengths**




**NOTE**

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

## 7.1.3 Multi-Nuclear Spectroscopy (MNS) Option

Table 7-7 MNS Option Available Cable Lengths

Point A	Point B	Site Option A: Short ER, Short SR	Site Option B: Long ER, Short SR	Site Option C: Short ER, Long SR
		mm (in.)		
PGR, top panel	MNS Cabinet, top panel	9750 (383.9)		
PEN cabinet, top panel	MNS Cabinet, top panel	15800 (622)		
MNS cabinet, top panel	SPW, top edge	8618 (339.3)	14748 (580.6)	8618 (339.3)

 **NOTE**  
All cable lengths include a 600 mm (24 in.) service loop.

## 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	SPW, top edge	Top of GOC	34187 (1346)
9-pin D-sub to BNC	PEN, top edge	Top of GOC	27432 (1080)
9-pin D-sub to Coax	SPW, top edge	MAG, gradient cable clamp block	13867 (546)

## 7.1.5 Magnetic Resonance Elastography (MRE) Option

Table 7-9 MRE Option Available Cable Lengths

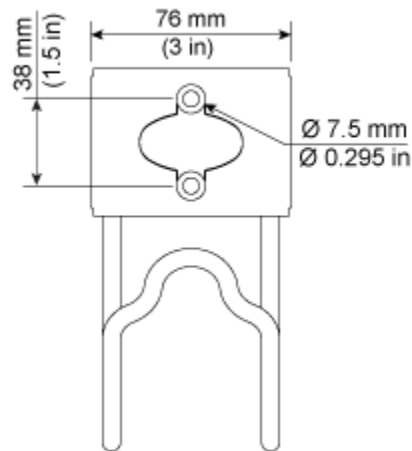
Cable	Point A	Point B	mm (in.)
25 mm (1 in.) Tubing	Resoundant Active Driver	Magnet (Isocenter)	Nominal 7315 (288) Maximum 10058 (396)
BNC	Resoundant Active Driver	Penetration Panel	15240 (600)
Ethernet	Resoundant Active Driver	Ethernet Hub in PGR	15240 (600)
Power	Resoundant Active Driver	Customer-Supplied Outlet	60 Hz: 6096 (240) 50 Hz: 7620 (300)

## 7.1.6 Storage Requirements for Excess Gradient Cable

1. Excess gradient cable must be stored on a wall hook inside the penetration panel closet in the Magnet Room and on a hook anchored into the Equipment Room wall. GE HealthCare 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 330 mm (13 in.).
4. Supports for the 1 AWG (X and Y axis) cables shall be anchored no more than 2591 mm (102 in.) above the floor and no more than 2133 mm (84 in.) above the floor for the 2/0 AWG (Z axis) cable.
5. The Z-gradient cable is heavier than the X or Y gradient cable and must be positioned lower, as shown in [Figure 7-4 Gradient Cable Storage Horizontal Layout \(Example\)](#) on page 138.

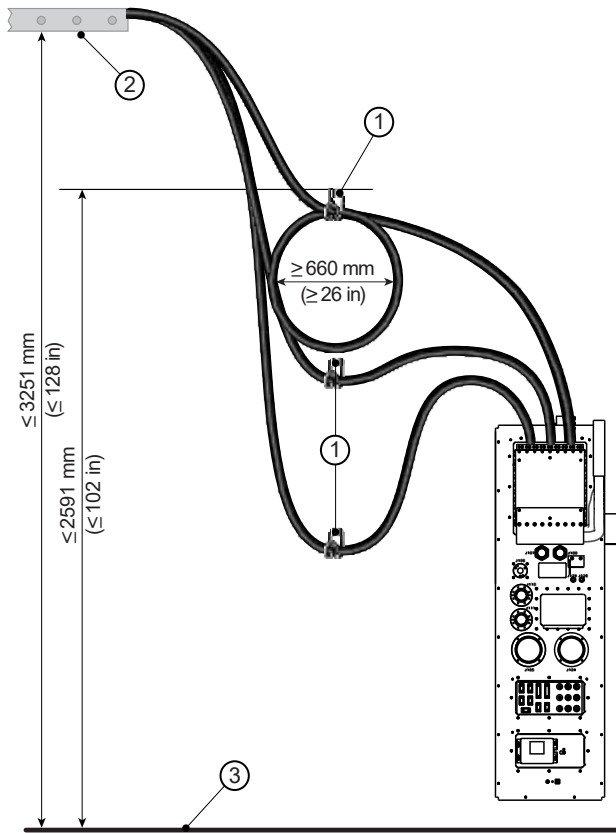
**Figure 7-2 Gradient Cable Mounting Hook Mounting Detail**



**NOTE**

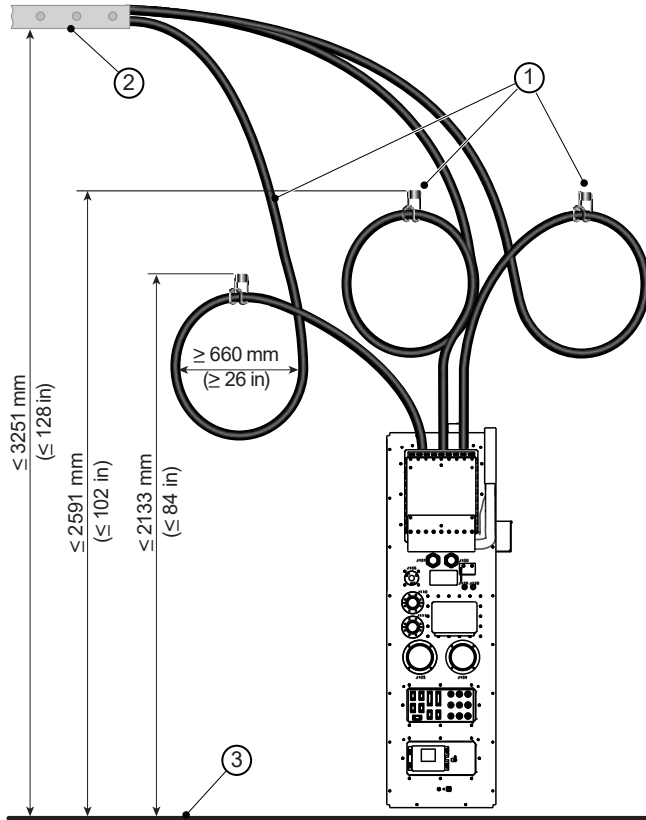
The examples below are representative of possible cable layout or configuration. Layout may vary depending on size, shape and configuration of the penetration panel closet. Configure cables to best suit the install configuration without violating the requirements above.

**Figure 7-3 Gradient Cable Storage Vertical Layout (Example)**



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

**Figure 7-4 Gradient Cable Storage Horizontal Layout (Example)**



Item	Description	Item	Description
1	GE HealthCare-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 the 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 330 mm (13 in.).
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 7-6 Cable Groupings on page 141](#)).
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 7-7 Cable Tray Requirements Example \(Side-By-Side\) on page 142](#) or [Figure 7-8 Cable Tray Requirements Example \(Stacked\) on page 143](#).) 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).

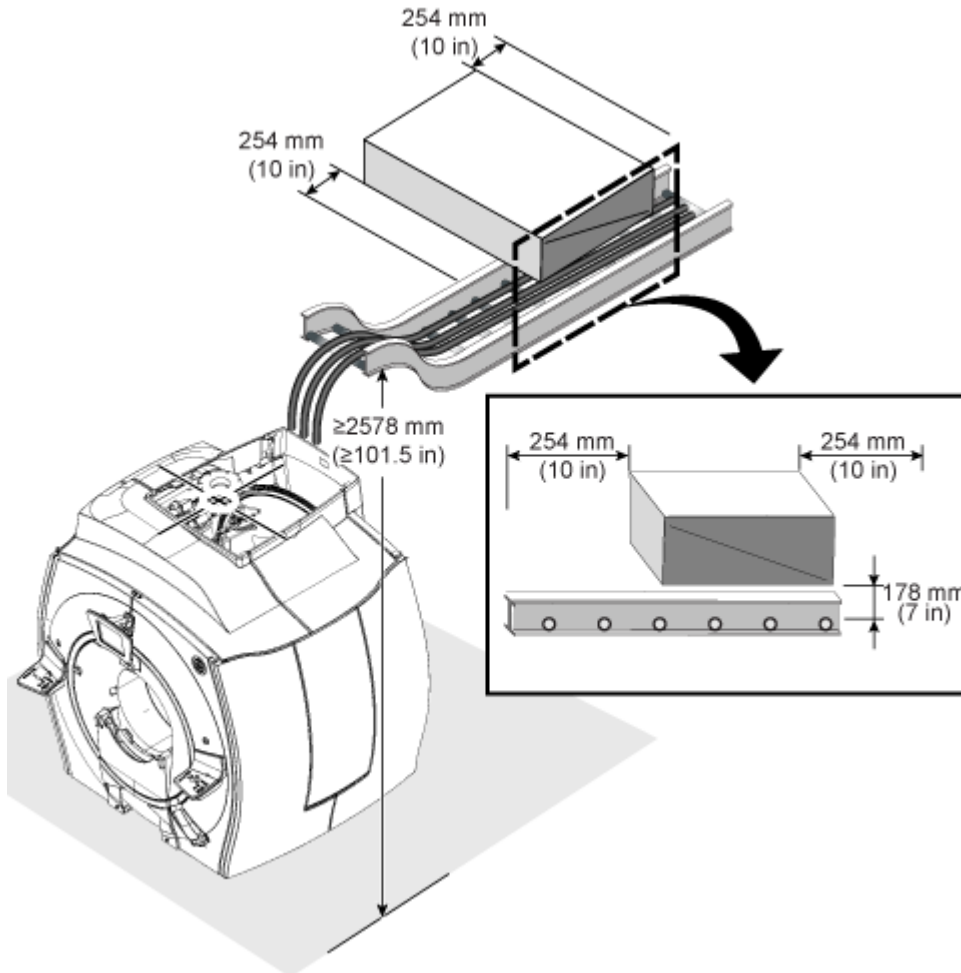
#### Exceptions for Obstructions:

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 7-5 Obstruction Example on page 140](#).
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 7-5 Obstruction Example**



## 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:
  - 5.1. 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.).

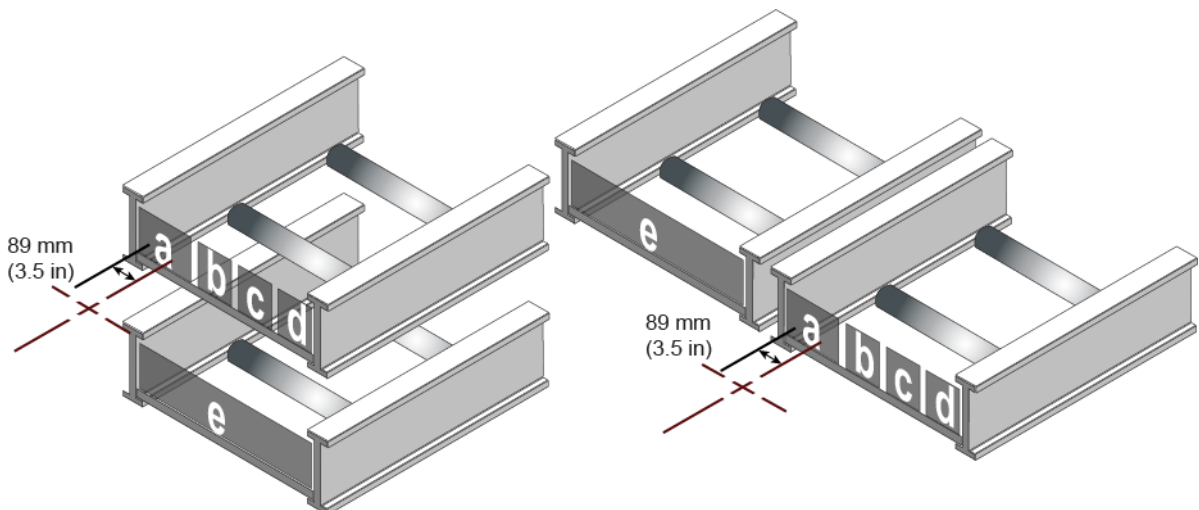
- 5.2. Magnet Room cable trays (excess cable must be at least 915 mm (36 in.) from the magnet end of the tray)

### 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 7-6 Cable Groupings on page 141](#).
- 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, and PET Detector Module Power Cables
- Group e — Air, water, and cryogen lines

**Figure 7-6 Cable Groupings**



### 7.2.4 Cable Tray Requirements and Examples

1. The gradient cable support must end at the back of the magnet  $1245 \pm 12$  mm ( $49 \pm 0.5$  in.) from the geometric isocenter, and must be parallel to the rear face of the magnet. See [Figure 7-7 Cable Tray Requirements Example \(Side-By-Side\) on page 142](#), [Figure 7-8 Cable Tray Requirements Example \(Stacked\) on page 143](#), and [Figure 7-9 Cable Tray Requirements Example \(90° Magnet Interface\) on page 144](#).
2. Supports for all other cables and hoses must end at the back of the magnet  $864 \pm 12$  mm ( $34 \pm 0.5$  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 2578 mm (101.5 in.) at the back of the magnet measured from the floor. See [Figure 7-7 Cable Tray Requirements Example \(Side-By-Side\) on page 142](#).



**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 7-7 Cable Tray Requirements Example \(Side-By-Side\)](#) on page 142 .

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

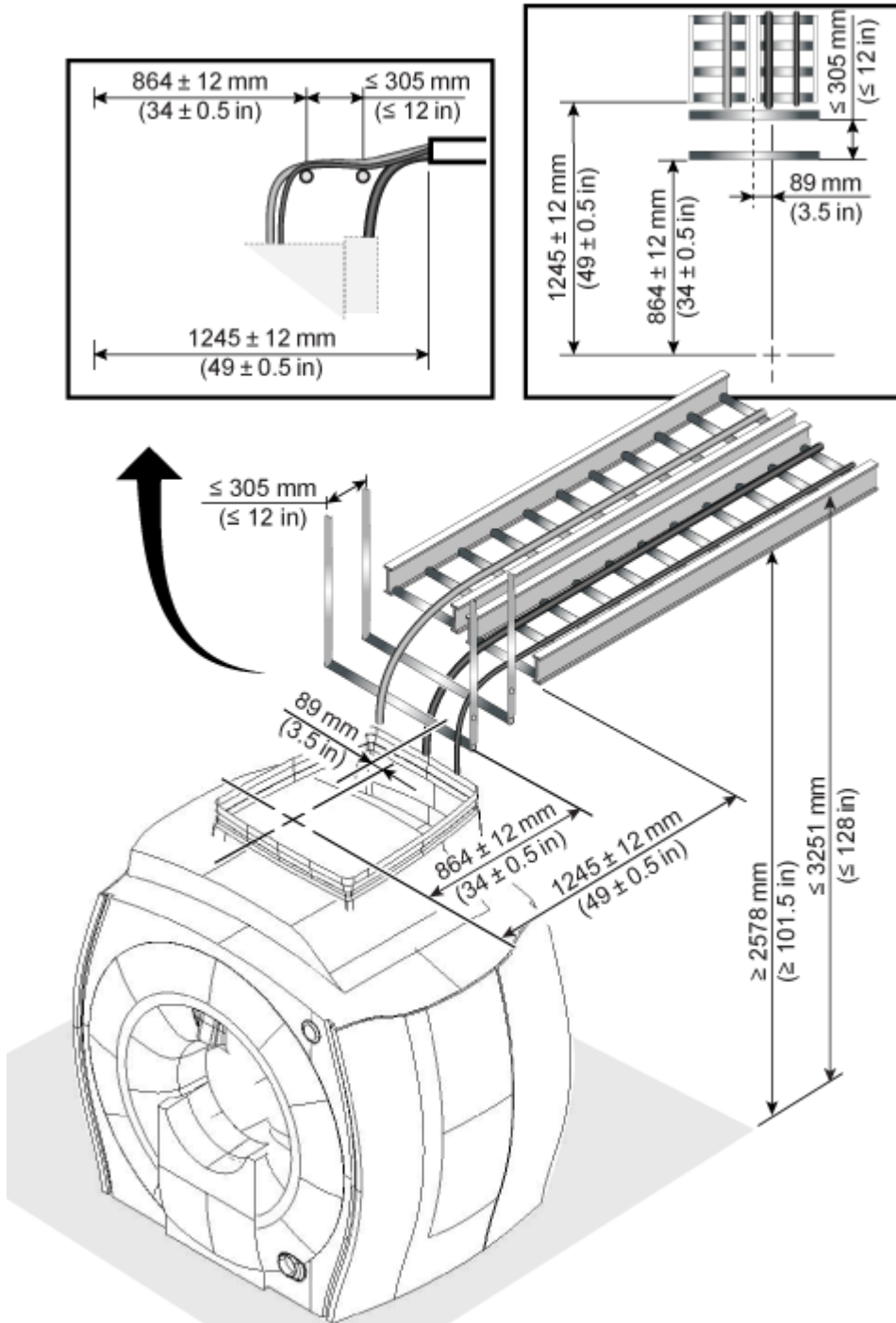
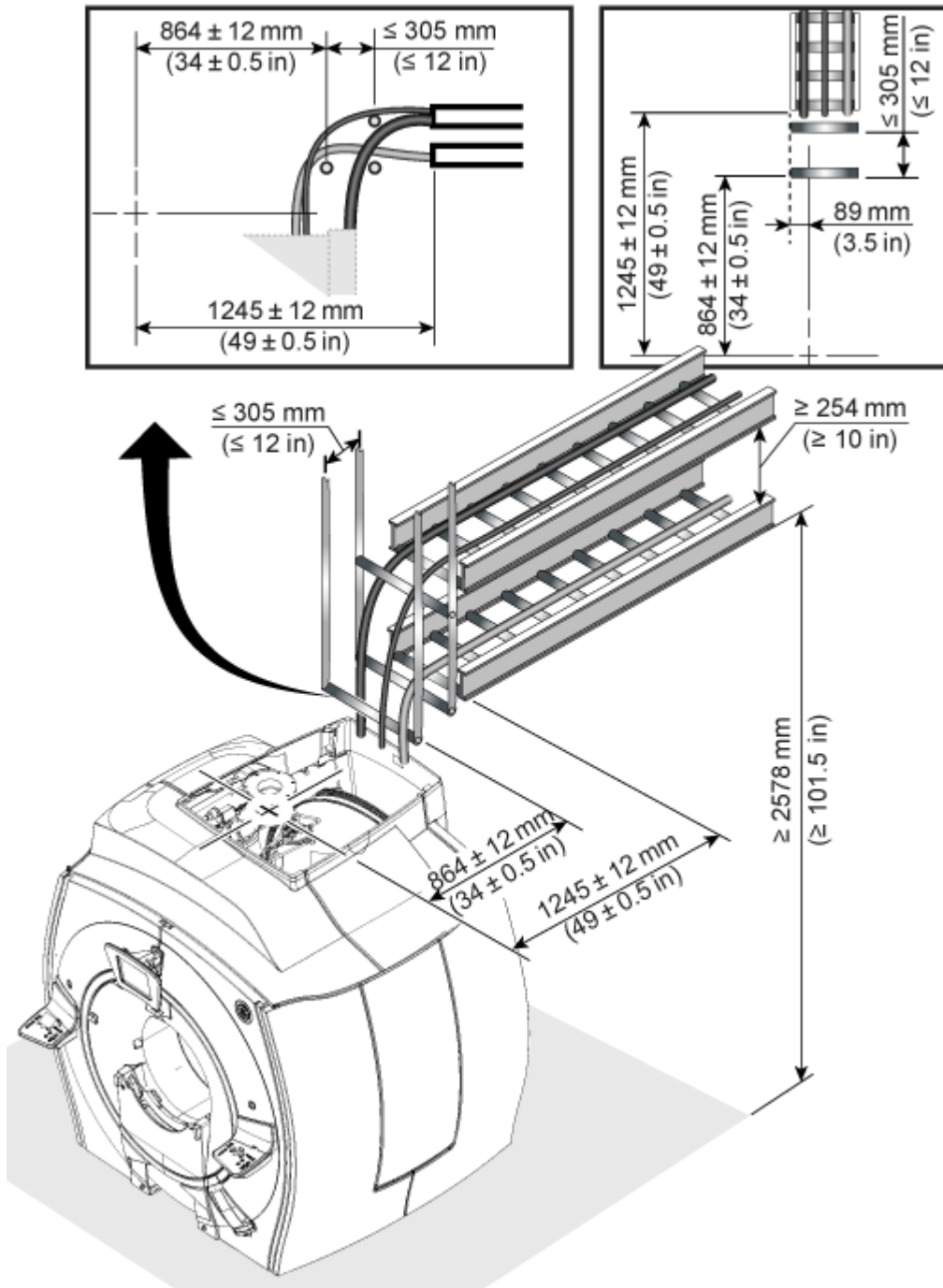
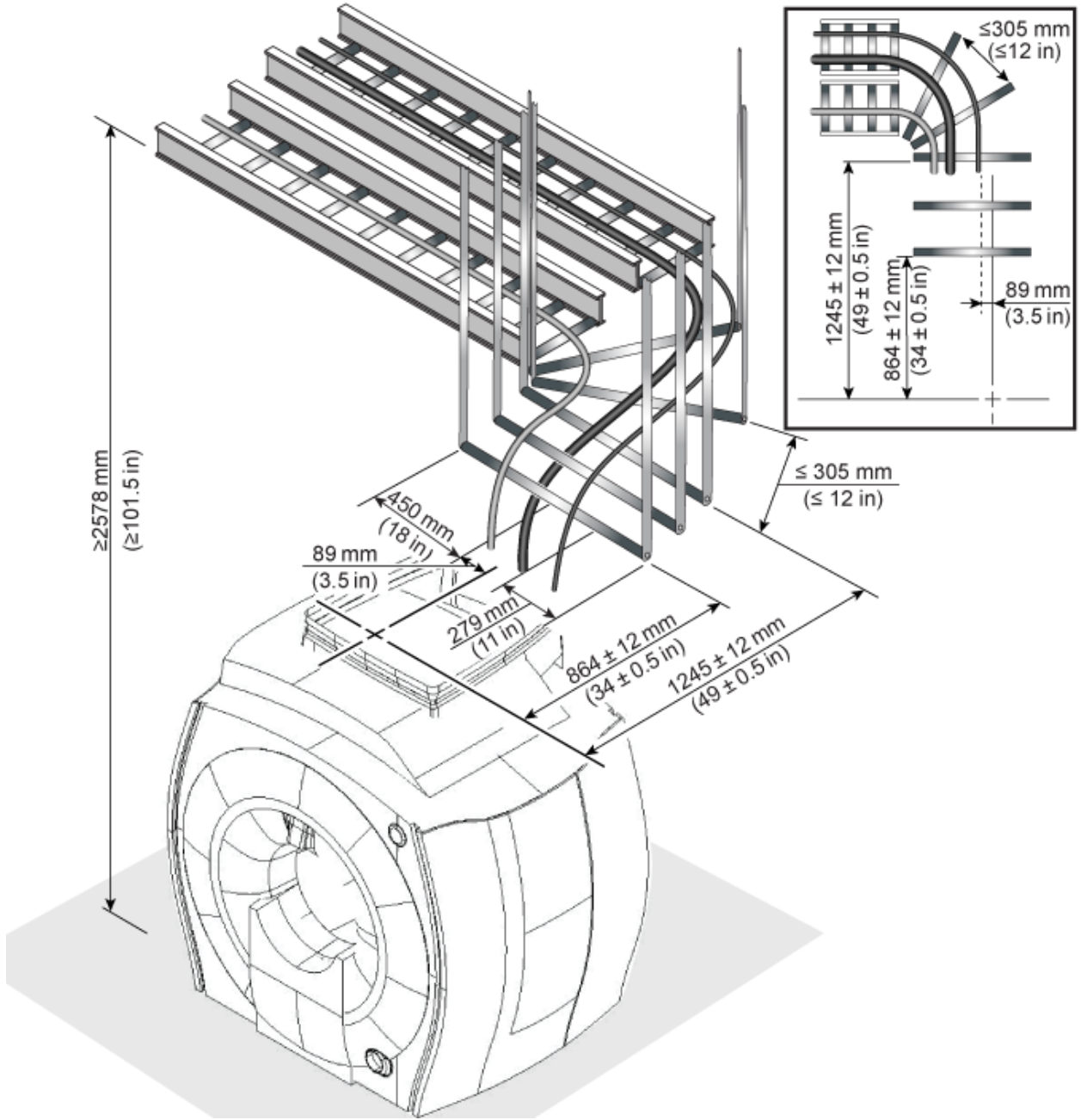


Figure 7-8 Cable Tray Requirements Example (Stacked)



**Figure 7-9 Cable Tray Requirements Example (90° Magnet Interface)**



### 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 support must end 560 mm (22 in.) in front of the Penetration Panel.
2. The gradient cable support height and distance from the SPW must support a minimum cable bend radius of 330 mm (13 in.) to accommodate gradient cables.

## 7.2.6 Equipment Room Requirements

1. All equipment interconnects must route overhead, except for helium hoses.
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 (to maintain the 330 mm (13 in.) bend radius drop to the PGR cabinet).
4. The end of the gradient cable support must be parallel to the Secondary Penetration Wall (SPW).
5. The gradient cable support height and distance from the SPW must support a minimum cable bend radius of 330 mm (13 in.) to accommodate the gradient cable bend radius.
6. Excess cable length must be stored in the Equipment Room.
7. For multiple MR System installations, cables from different MR Systems must not share the same cable support.
8. The table below lists the minimum width for cable trays between Equipment Room (and Operator Workspace) components.

**Table 7-10 Minimum Cable Tray Width**

	<b>PEN</b>	<b>SPW</b>	<b>PGR</b>	<b>HEC</b>	<b>OW</b>	<b>PET</b>
PEN		N/A	150 mm (6 in.) Electrical	150 mm (6 in.) Electrical	150 mm (6 in.) Electrical	N/A
SPW	N/A		300 mm (12 in.) Electrical	150 mm (6 in.) Electrical	150 mm (6 in.) Electrical	N/A
PGR	150 mm (6 in.) Air and Water	N/A		150 mm (6 in.) Electrical	150 mm (6 in.) Electrical	N/A
HEC	450 mm (18 in.) Air and Water	N/A	150 mm (6 in.) Air and Water		N/A	N/A
OW	N/A	N/A	N/A	N/A		N/A
PET Cabinet (PET)	N/A	200 mm (8 in.) Electrical	50 mm (2 in.) Electrical	N/A	N/A	
PET Chiller (PET Chill)	N/A	150 mm (6 in.) Water	N/A	N/A	N/A	50 mm (2 in.) Electrical

## 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 7-10 Facility-Supplied System Interconnects](#) on page 147 for additional information.

**Table 7-11 Facility-Supplied System Interconnects**

Group	Between Units		Comments	Requirements
	From	To		
C01	Facility Power	MDP	Facility Power and Ground	<a href="#">MR Suite Electrical Requirements on page 49</a>
C02	MDP	HEC	HEC Power	
C03	MDP	PGR	PDU Power	
	Facility Cooling Water	HEC	Cooling Water Supply	<a href="#">MR System Facility Water Requirements on page 43</a>
	Facility Cooling Water	HEC	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.	<a href="#">Magnet Monitor (MON) Requirements and Specifications on page 113</a>
	Facility Network	GOC		
	Facility Network	Receptacle near MDP		<a href="#">4.2 Main Disconnect Panel (MDP) Requirements and Specifications on page 98</a>
C05	MDP	E-Off Switch	Facility must supply cable from MDP to the E-Off Switch in the Equipment Room.	<a href="#">MR Suite Electrical Requirements on page 49</a>
	Facility Power	Outlet near MON	Facility outlet for MON power	<a href="#">Magnet Monitor (MON) Requirements and Specifications on page 113</a>
C06	GE HealthCare supplied Cable from SPW	E-Off Switch in Control Room or Equipment Room	Facility must supply additional wiring between the GE HealthCare supplied cable and the E-Off switch if the length needed is greater than the available length listed in <a href="#">MR System Interconnects Specifications on page 130</a> .	<a href="#">MR Suite Electrical Requirements on page 49</a>
C07	MDP	PET PDU	PET Power	<a href="#">MR Suite Electrical Requirements on page 49</a>
	Facility Power	MRU	Facility power to MRU	<a href="#">Magnet Room Equipment Specifications on page 90</a>

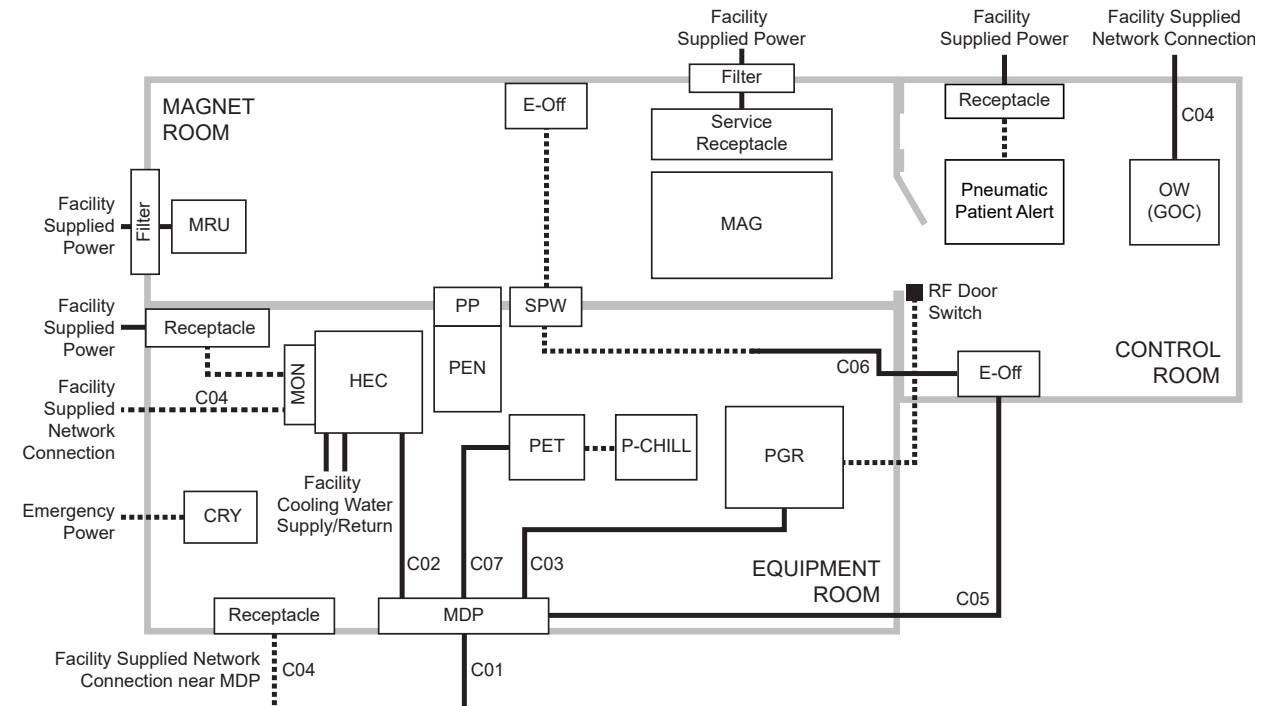
**Table 7-11 Facility-Supplied System Interconnects** (Table continued)

Group	Between Units		Comments	Requirements
	From	To		
	Facility Power	Service Receptacle	Receptacle to be installed in Magnet Room, using appropriate filter.	<a href="#">MR Suite Electrical Requirements on page 49</a>
	Facility Power	Pneumatic Patient Alert	Facility Power to Pneumatic Patient Alert	<a href="#">MR Suite Electrical Requirements on page 49</a>

**Table 7-12 Optional Facility-Supplied System Interconnects**

Group	Between Units	Comments	Requirements	
C01	Facility Power	Outlet near MRE	Facility outlet for MRE power (optional, not shown)	<a href="#">2.10 MR Suite Electrical Requirements on page 49</a>
C01	Facility Power	Control room	Hardwired connection for OXY power (optional, not shown)	<a href="#">2.10 MR Suite Electrical Requirements on page 49</a>
C01	Facility Power	Outlet near SPiCE Workstation	Facility outlet for SPiCE Workstation power strip	<a href="#">2.10 MR Suite Electrical Requirements on page 49</a>
C04	Facility Network	Secondary Host Computer	Facility must provide separate network access for the secondary host computer	
C01	Facility Power	Outlet near PAT Charging Station	Facility outlet for PAT Charging Station (optional, not shown)	<a href="#">2.10 MR Suite Electrical Requirements on page 49</a>

**Figure 7-10 Facility-Supplied System Interconnects**



Legend			
	Facility supplied interconnect		GE HealthCare 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 49](#) 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.

**PET**

Abbreviation for Positron Emission Tomography.

**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.

**SPiCE**

Scalable PET image Reconstruction Engine

**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 151](#).
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 66](#), 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 66](#).

## 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 153](#), [Figure 8-3 Acceleration Time History on page 154](#), and [Figure 8-4 Acceleration Time History \(Zoomed In on Transient Event\) on page 155](#). 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:
  - 2.1. Instrumentation setup including number of averages, frequency resolution, and so on
  - 2.2. Test location
  - 2.3. Test conditions:
    - 2.3.1. Steady state
    - 2.3.2. Transient
    - 2.3.3. Heel drop
    - 2.3.4. Normal environment
    - 2.3.5. Typical traffic
    - 2.3.6. 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:
  - 4.1. Determine the source of the vibration
  - 4.2. Propose a solution to the problem
  - 4.3. 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**

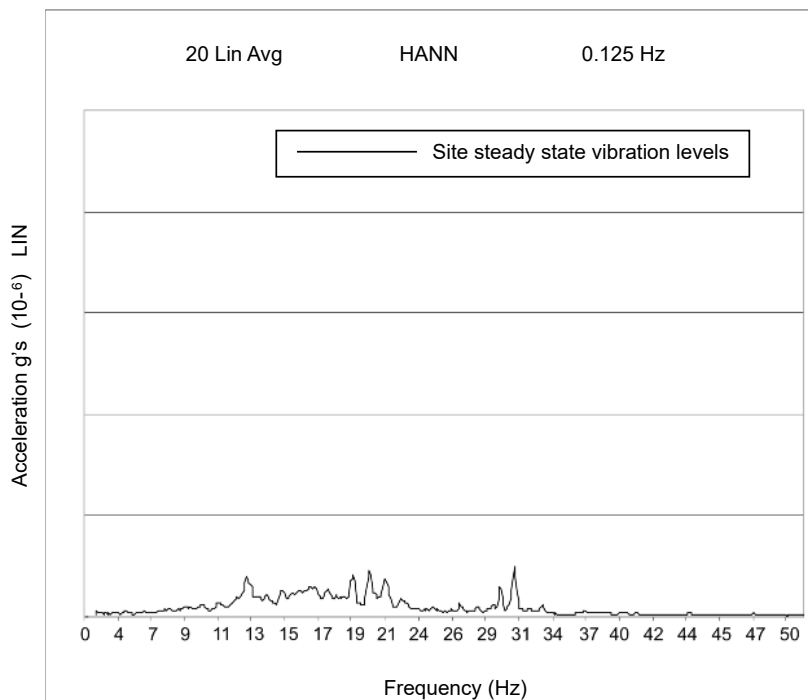


Figure 8-2 Example Site Environmental Vibration

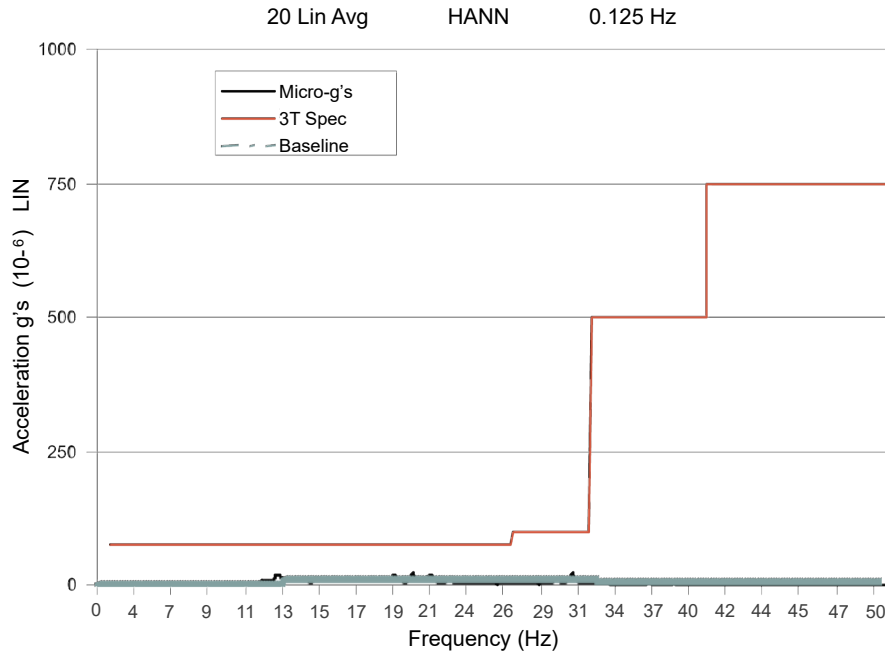
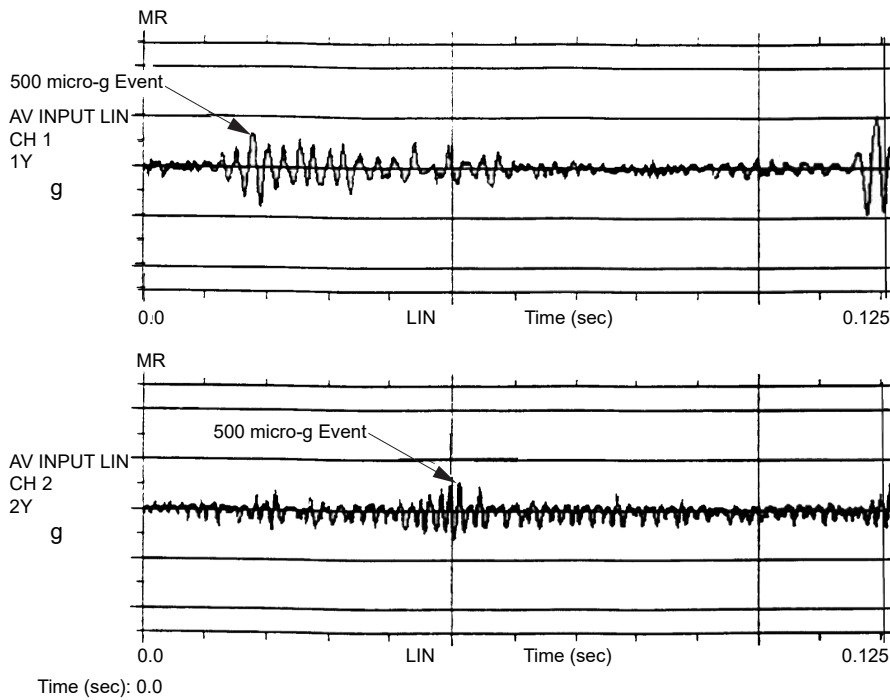
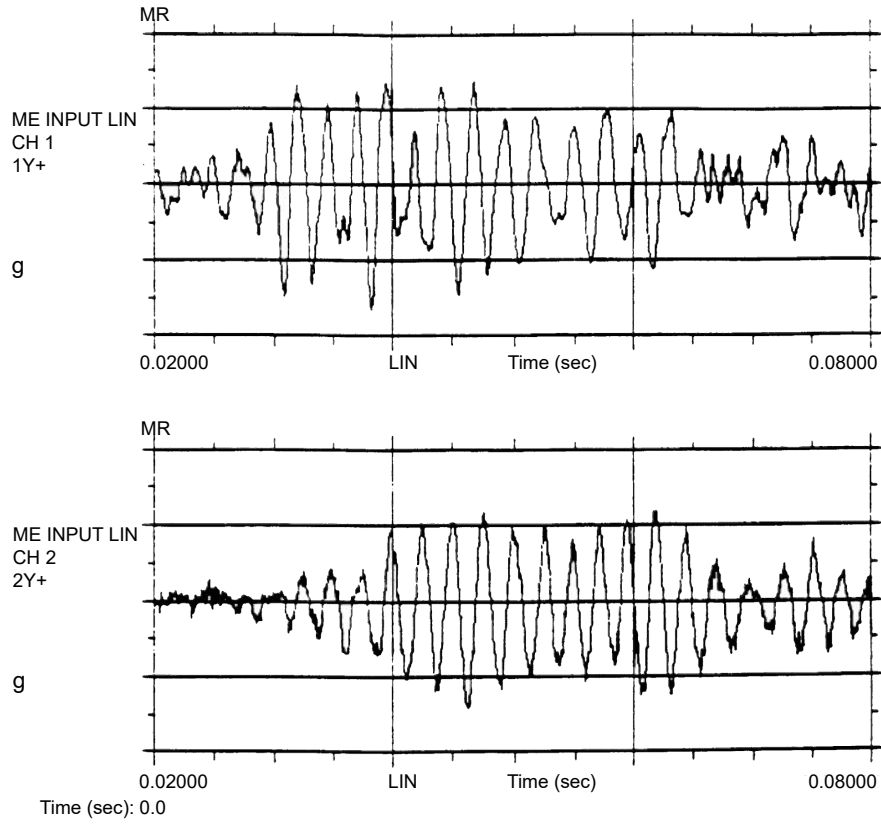


Figure 8-3 Acceleration Time History



**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 36 to determine minimum distance from a feeder, transformer, or other AC electrical source.

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

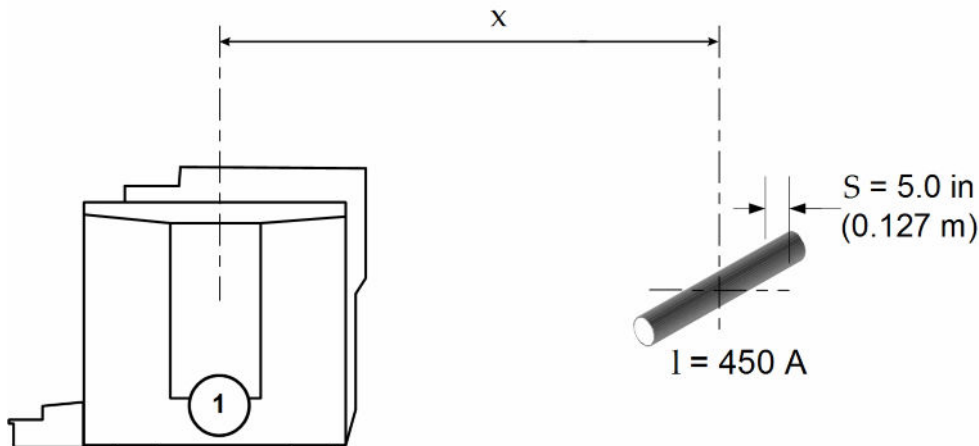
Note that the formula has three variables. If you have two of them, you can calculate the third. In this example, we calculate the minimum distance **x** from the source—in this case, a main electrical feeder carrying 450 amps of current in a 127 mm (5 in.) conduit.

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

where:	
<b>x</b>	Minimum distance (in meters) from the feeder lines to isocenter of the magnet
<b>I</b>	Maximum allowable RMS single phase current (in amps) or maximum allowable RMS line current (in amps) in three phase feeder lines
<b>S</b>	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.

$$S = 5 \text{ inches} = 0.127 \text{ meters}$$



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 :  $\geq 15.875$  mm (0.625 in.)  $\leq 31.75$  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)	<b>5.6</b> <b>(1250)</b>	<b>12.5</b> <b>(2800)</b>	<b>7.1</b> <b>(1600)</b>	<b>13.7</b> <b>(3070)</b>	<b>8.1</b> <b>(1810)</b>	<b>14.8</b> <b>(3300)</b>	<b>8.5</b> <b>(1920)</b>	<b>12.5</b> <b>(3330)</b>
	102 (4)	<b>8.3</b> <b>(1870)</b>	<b>14.8</b> <b>(3330)</b>	<b>10.7</b> <b>(2400)</b>	<b>14.8</b> <b>(3330)</b>	13.0 (2930)	14.8 (3330)	14.2 (3200)	12.5 (3330)
	178 (7)	<b>11.2</b> <b>(2500)</b>	<b>14.8</b> <b>(3330)</b>	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)	<b>6.9</b> <b>(1550)</b>	<b>12.8</b> <b>(2880)</b>	<b>8.7</b> <b>(1950)</b>	<b>14.7</b> <b>(3310)</b>	<b>10.5</b> <b>(2350)</b>	<b>16.6</b> <b>(3730)</b>	<b>11.6</b> <b>(2610)</b>	<b>21.4</b> <b>(4800)</b>
	121 (4 3/4)	<b>11.2</b> <b>(2510)</b>	<b>20.1</b> <b>(4510)</b>	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)	<b>11.2 (2500)</b>	<b>25.1 (5650)</b>	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)

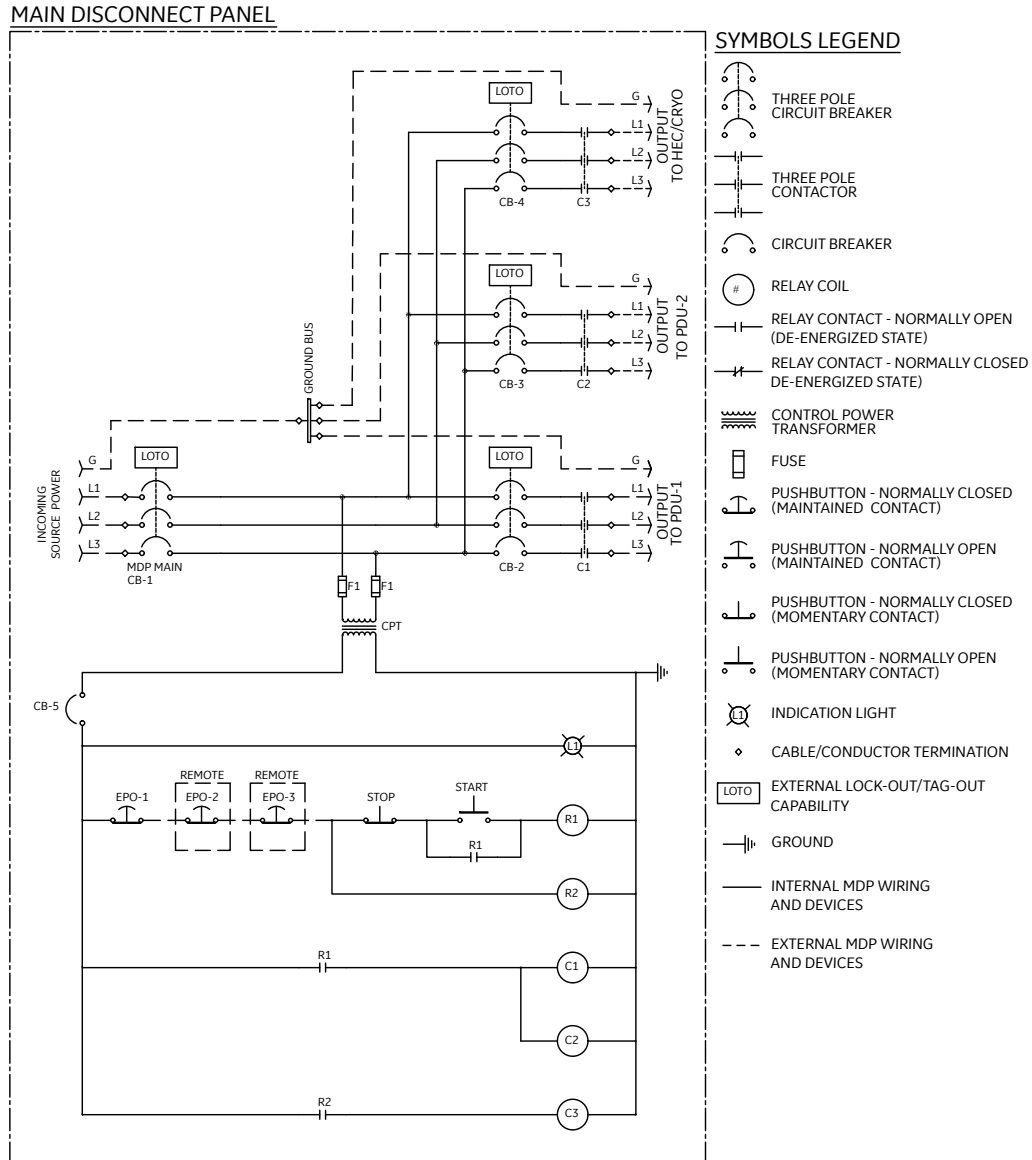
**NOTE**  All bolded values in this table fail to meet the clamping force (tension), and are therefore not acceptable anchors.

## 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

Rev	Date	Description
<b>English Document review and approval per DOC1555600</b>		
8	October 2024	<p>Added SIGNA™ PET/MR AIR to title of manual</p> <p><b>Throughout manual:</b></p> <ul style="list-style-type: none"> <li>Added information for AR magnet</li> </ul> <p><b>Chapter 2:</b></p> <ul style="list-style-type: none"> <li>Section 2.2.3: Added Physiological Acquisition Transceiver (PAT) Charging Station</li> <li>Figure 2-1: Added PAT CS</li> <li>Table 2-9: Added Physiological Acquisition Transceiver (PAT) Charging Station</li> <li>Table 2-10: Updated power draw values</li> <li>Table 2-16: Updated weight for PGR and PEN</li> <li>Table 2-17: Updated weight for PGR and PEN</li> <li>Table 2-19: Added SPiCE 3</li> </ul> <p><b>Chapter 3:</b></p> <ul style="list-style-type: none"> <li>Figure 3-10: Removed service area on equipment room side</li> <li>Figure 3-11: Removed service area on equipment room side</li> </ul> <p><b>Chapter 4:</b></p> <ul style="list-style-type: none"> <li>Section 4.3: Updated weight</li> <li>Figure 4-4: Updated CoG dimensions</li> <li>Section 4.5: Updated weight</li> <li>Figure 4.5: Updated CoG dimensions</li> <li>Figure 4-6: Added front cabinet service area to side view</li> </ul> <p><b>Chapter 5:</b></p> <ul style="list-style-type: none"> <li>Section 5.1.3 Added weight for HP Z4G5</li> <li>Figure 5-3: Added callouts and callout table</li> <li>Figure 5-5: Updated dimensions</li> <li>Figure 5-7: Added callouts and callout table</li> <li>Section 5.2.2 Added weight for HP Z4G5</li> <li>Figure 5-8: Added callouts and callout table</li> <li>Section 5.2.3 Added SPiCE 3 weight and installation requirements</li> <li>Figure 5-9: Updated figure layout</li> <li>Figure 5-10: Added figure</li> <li>Section 5-4: Added section</li> </ul> <p><b>Chapter 7:</b></p> <ul style="list-style-type: none"> <li>Table 7-2: Added Physiological Acquisition Transceiver Charging Station</li> <li>Figure 7-1: Added PAT CS</li> <li>Table 7-12: Added row for Facility Power to outlet near PAT Charging Station</li> <li>Figure 7-10: Added filter to MRU</li> </ul>

Rev	Date	Description
<b>English Document review and approval per DOC1555600</b>		
7	July 2023	<p><b>Chapter 1:</b> Table 1-2: Updated manual numbers</p> <p><b>Chapter 2:</b></p> <ul style="list-style-type: none"> <li>• Section 2.2.3: Added PET/MR SPiCE Workstation (SW)</li> <li>• Figure 2-1: Added SW</li> <li>• Table 2-1: Updated Equipment Room dimensions and area</li> <li>• Figure 2-2: Updated dimensions</li> <li>• Figure 2-3: Updated dimensions</li> <li>• Table 2-6: Added SPiCE Workstation</li> <li>• Section 2.9.2: Added step 3</li> <li>• Section 2.10.1: Added step 2 and step 7</li> <li>• Table 2-9: Added PET/MR SPiCE Workstation</li> <li>• Table 2-10: Removed "Standby Consumption"</li> <li>• Section 2.10.3: Added note to explain exempt countries; added step 6</li> <li>• Table 2-17: Updated height of Magnet (as shipped); updated weight of PGR cabinet, PEN Cabinet, and Operator Workspace Display; updated dimensions and weight of Operator Workspace Table</li> <li>• Figure 2-23: Updated height</li> <li>• Table 2-20: Updated entire table</li> </ul> <p><b>Chapter 3:</b></p> <ul style="list-style-type: none"> <li>• Section 3.5: Updated steps 3 through 8</li> <li>• Section 3.6.4, Step 1.f.i: Updated sentence for clarity</li> <li>• Section 3.6.6: Changed dimension in step 2 to 15 mm (0.6 in.)</li> <li>• Section 3.6.7: Added step 4</li> <li>• Section 3.6.8: Added step 5 and Figure 3-13</li> <li>• Section 3.6.9: Added entire section</li> <li>• Figure 3-15: Updated dimensions</li> <li>• Section 3.8: Updated step 10</li> </ul> <p><b>Chapter 4:</b></p> <ul style="list-style-type: none"> <li>• Section 4.1: Added two notes before Figure 4-1, updated Figure 4-1</li> <li>• Section 4.2.1: Added requirement for an electrical outlet</li> <li>• Section 4.2.2: Added sentence that only exempt countries can supply their own MDP</li> <li>• Section 4.3, Step 1: Updated weight (SPR HCSDM00714302)</li> <li>• Figure 4-3: Updated CoG dimensions (SPR HCSDM00714302)</li> <li>• Section 4.5, Step 1: updated weight (SPR HCSDM00714305)</li> <li>• Figure 4-5: Updated CoG dimensions (SPR HCSDM00714305)</li> <li>• Section 4.6, Step 1: Updated weight</li> <li>• Section 4.8, Step 1: Updated weight (SPR HCSDM00714309)</li> <li>• Section 4.10.1: Added step 2</li> <li>• Section 4.12, Step 1: Updated weight</li> </ul> <p><b>Chapter 5:</b></p> <ul style="list-style-type: none"> <li>• Section 5.1.3: Updated weight (SPR HCSDM00700931); Changed anchor size from 9.5mm to M10</li> <li>• Figure 5-3: Updated CoG dimensions (SPR HCSDM00700931)</li> <li>• Section 5.1.4: Changed weight from 11.8 kg to 6.7 kg</li> </ul>

Rev	Date	Description
<b>English Document review and approval per DOC1555600</b>		
		<ul style="list-style-type: none"> <li>• Section 5.2: Added entire section</li> <li><b>Chapter 6:</b> Added entire chapter</li> <li><b>Chapter 7:</b> <ul style="list-style-type: none"> <li>• Table 7-2: Added SPiCE Workstation</li> <li>• Table 7-4: updated cable lengths for "PEN, top edge to RF common ground stud" and "SPW, top edge to RF common ground stud"</li> <li>• Table 7-7: Updated Point A and Point B and cable lengths</li> <li>• Table 7-8: Updated "From" "To" entries and cable lengths</li> <li>• Section 7.2.5, Step 1: Updated sentence for clarity</li> <li>• Table 7-12: Added rows 2, 3 and 4</li> </ul> </li> <li><b>Chapter 8:</b> Section 8.1: Removed definitions "Exclusion Zone", "Gradient" and "Security Zone"</li> </ul>
6	November 2020	<p><b>All chapters:</b></p> <ul style="list-style-type: none"> <li>• 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.</li> <li>• New personnel matrix and icons added throughout the manual to help contractors and customers locate the content they need for their respective project work.</li> </ul> <p><b>Chapter 2:</b></p> <ul style="list-style-type: none"> <li>• MDP updates</li> <li>• IEC requirements moved to a separate document</li> <li>• Acoustic requirements moved to a separate document</li> <li>• Grounding requirements related to RF shielding moved to a separate document</li> <li>• Emergency Backup Facility Coolant Requirements updates</li> <li>• General Electrical Requirements updates</li> </ul> <p><b>Chapter 3:</b></p> <ul style="list-style-type: none"> <li>• Magnet Room venting requirements moved to a separate document</li> <li>• RF shielded room requirements moved to a separate document</li> </ul> <p><b>Chapter 4:</b> MDP updates</p> <p><b>Chapter 6:</b></p> <ul style="list-style-type: none"> <li>• New specifications for available lengths</li> <li>• Added available gradient cable lengths</li> <li>• Removed list of system cable specifications from the PIM</li> </ul> <p><b>Appendix:</b></p> <ul style="list-style-type: none"> <li>• Updated sample customer-supplied MDP schematic</li> <li>• RF shielded room testing requirements moved to a separate document</li> </ul>

Rev	Date	Description
<b>English Document review and approval per DOC1555600</b>		
5	June 2020	<ul style="list-style-type: none"> <li>• 2.4 IEC EMC Compliance: Statements added to be consistent with Premier OM safety section.</li> <li>• 2.11.1 General Electrical Requirements: Clarification in Facility Power Requirements table to emphasize that emergency-off buttons are required, even if supplied by the customer.</li> <li>• 2.12.3 MR System Component Shipping Specifications: Added SPiCE workstation shipping specifications.</li> <li>• 3.6.7 RF Shielding Integrity (Shielding Effectiveness) Reliability Requirements: Updated door switch requirements.</li> <li>• 3.9.3.1 Emergency Exhaust Vent Requirements: Updating requirements for fire dampers.</li> <li>• 3.9.6.4 Cryogen Vent Support: Added requirement.</li> <li>• 3.9.7.1 Cryogen Vent Support: Added requirements.</li> <li>• 3.9.7.3 Vent Exit: Added clarification for rooftop exits and Cryogenic Exterior Venting Volume figure.</li> <li>• 7.1 Glossary: Added SPiCE definition.</li> <li>• 7.3.6 RF Shield Test Requirements and Test Setup: Combined the Test Set-Up for RF Shielded Room section with the RF Shield Test Requirements section.</li> <li>• 7.3.17 RF Shield Test Report: Added Recommended Additional Information.</li> <li>• 7.4.1 Acoustic Background: Clarification added.</li> <li>• 7.4.4 Acoustic Design Guidelines for the Magnet Room: Clarification added.</li> </ul>
4	May 21, 2018	<ul style="list-style-type: none"> <li>• 2.11 MR Suite Electrical Requirements: Updated MDP catalog number to M8000PH.</li> <li>• 2.12 MR System Shipping and Receiving: Updated magnet shipping width to account for the installed CPDAs.</li> <li>• 4.2 Main Disconnect Panel (MDP) Specifications: Corrected width of MDP in specification drawing.</li> </ul>
3	Oct 17, 2016	<ul style="list-style-type: none"> <li>• Updated cryogen venting section per CAPA PR #17064234.</li> <li>• Added cable length/size specifications.</li> <li>• Reformatted graphics for clarity, and fixed other minor defects.</li> </ul>
2	March 31, 2015	<p>Per SPR HCSM00323742, made updates to these procedures for M4:</p> <ul style="list-style-type: none"> <li>• Removed from the bottom of every page in manual: '510k pending at FDA ...' disclaimer.</li> <li>• System Shipping and Receiving, VSID 1163703</li> <li>• Shielding Requirements and Radiation Sources, VSID 1167948</li> <li>• System Cable Specifications, VSID 1163626</li> <li>• Site Pre-Installation Checklist, VSID 1165152</li> <li>• Facility Coolant Requirements, VSID 1163709</li> <li>• System Interconnect Specifications, VSID 1163625</li> <li>• Suite Electrical Requirements, VSID 1163707</li> <li>• PET Electronics Cabinet Specifications, VSID 1180925</li> <li>• Facility-Supplied System Interconnect Specifications, VSID 1163623</li> </ul>
1	July 25, 2014	Initial release of approved manual.



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