GE Medical Systems

Technical Publications

Direction 2241391

Revision 5

Signa® Open*Speed*

Pre–Installation

Architectural/Installation Planning Use Only

Operating Documentation

GE Medical Systems

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WARNING

- **THIS SERVICE MANUAL IS AVAILABLE IN ENGLISH ONLY.**
- **IF A CUSTOMER'S SERVICE PROVIDER REQUIRES A LANGUAGE OTHER THAN ENGLISH, IT IS THE CUSTOMER'S RESPONSIBILITY TO PROVIDE TRANSLATION SERVICES.**
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- **NE PAS TENTER D'INTERVENTION SUR LES ÉQUIPEMENTS TANT QUE LE MANUEL SERVICE N'A PAS ÉTÉ CONSULTÉ ET COMPRIS.**
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WARNUNG

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- **FALLS EIN FREMDER KUNDENDIENST EINE ANDERE SPRACHE BENÖTIGT, IST ES AUFGABE DES KUNDEN FÜR EINE ENTSPRECHENDE ÜBERSETZUNG ZU SORGEN.**
- **VERSUCHEN SIE NICHT, DAS GERÄT ZU REPARIEREN, BEVOR DIESES KUNDENDIENST–HANDBUCH ZU RATE GEZOGEN UND VERSTANDEN WURDE.**
- **WIRD DIESE WARNUNG NICHT BEACHTET, SO KANN ES ZU VERLETZUNGEN DES KUNDENDIENSTTECHNIKERS, DES BEDIENERS ODER DES PATIENTEN DURCH ELEKTRISCHE SCHLÄGE, MECHANISCHE ODER SONSTIGE GEFAHREN KOMMEN.**

AVISO

- **ESTE MANUAL DE SERVICIO SÓLO EXISTE EN INGLÉS.**
- **SI ALGÚN PROVEEDOR DE SERVICIOS AJENO A GEMS SOLICITA UN IDIOMA QUE NO SEA EL INGLÉS, ES RESPONSABILIDAD DEL CLIENTE OFRECER UN SERVICIO DE TRADUCCIÓN.**
- **NO SE DEBERÁ DAR SERVICIO TÉCNICO AL EQUIPO, SIN HABER CONSULTADO Y COMPRENDIDO ESTE MANUAL DE SERVICIO.**
- **LA NO OBSERVANCIA DEL PRESENTE AVISO PUEDE DAR LUGAR A QUE EL PROVEEDOR DE SERVICIOS, EL OPERADOR O EL PACIENTE SUFRAN LESIONES PROVOCADAS POR CAUSAS ELÉCTRICAS, MECÁNICAS O DE OTRA NATURALEZA.**

ATENÇÃO

- **ESTE MANUAL DE ASSISTÊNCIA TÉCNICA SÓ SE ENCONTRA DISPONÍVEL EM INGLÊS.**
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- **NÃO TENTE REPARAR O EQUIPAMENTO SEM TER CONSULTADO E COMPREENDIDO ESTE MANUAL DE ASSISTÊNCIA TÉCNICA.**
- **O NÃO CUMPRIMENTO DESTE AVISO PODE POR EM PERIGO A SEGURANÇA DO TÉCNICO, OPERADOR OU PACIENTE DEVIDO A‘ CHOQUES ELÉTRICOS, MECÂNICOS OU OUTROS.**

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- **IL PRESENTE MANUALE DI MANUTENZIONE È DISPONIBILE SOLTANTO IN INGLESE.**
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- **SI PROCEDA ALLA MANUTENZIONE DELL’APPARECCHIATURA SOLO DOPO AVER CONSULTATO IL PRESENTE MANUALE ED AVERNE COMPRESO IL CONTENUTO.**
- **NON TENERE CONTO DELLA PRESENTE AVVERTENZA POTREBBE FAR COMPIERE OPERAZIONI DA CUI DERIVINO LESIONI ALL’ADDETTO ALLA MANUTENZIONE, ALL’UTILIZZATORE ED AL PAZIENTE PER FOLGORAZIONE ELETTRICA, PER URTI MECCANICI OD ALTRI RISCHI.**

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注意:

- 本维修手册仅存有英文本。
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REVISION HISTORY

REV	DATE	PRIMARY REASON FOR CHANGE
0	Dec 17, 1999	Initial Product document release.
1	May 16, 2000	Section 1: Updated catalog numbers & descriptions for product changes; Changed Water Chiller info to new System Cooling Subsystem; Added Magnet Monitor UPS infoUpdated MR InSite Interactive Platform Global Modem. Section 2: Added System Cooling Cabinet & System Cooling Auxiliary Cabinet; Deleted Water Chiller (WC1) for Gradient Coil Cooling; Updated Minimum Room Inside Clear Dimensions; Updated Main Disconnect Panel information; Updated Magnet Monitor info, added UPS for Magnet Monitor; Update Telephone RequirementsRevised equipment dimension illustrations. Section 3: Updated magnetic field expansion conditions. Section 4: Added System Cooling Cabinet & System Cooling Auxiliary Cabinet; Deleted Water Chiller (WC1) for Gradient Coil Cooling; Updated Magnet Monitor info, added UPS for Magnet Monitor; Revised backup water cooling specifications; Updated Changing Magnetic field; Updated Magnet Room floor materials; Vibration measurements method added & specification revised. Section 5: Eliminated requirement for Essential Power feed in addition to Facility power feed; Added System Cooling Cabinet & System Cooling Auxiliary Cabinet; Updated Magnet Monitor info, added UPS for Magnet Monitor; Updated Main Disconnect Panel design, requirements, & function information. Section 6: Added System Cooling Cabinet & System Cooling Auxiliary Cabinet; Deleted Water Chiller (WC1) for Gradient Coil Cooling; Updated Magnet Monitor info, added UPS for Magnet Monitor. Section 7: Revised magnet mounting plate RF Shield Room interactions. Section 8:Added System Cooling Cabinet & System Cooling Auxiliary Cabinet; Deleted Water Chiller (WC1) for Gradient Coil Cooling; Updated Magnet Monitor info, added UPS for Magnet Monitor; Updated Magnet moving dimensions. Section 9: Update for Pre–Installation Kit power requirements Magnet Mounting Plate installation; Revised Vibration study reference. Section 10: Revised for new part number information. Appendix A: Vibration Test Guidelines info moved to Section 4–14 Vibration. Appendix B: Renamed Appendix A due to changes in Appendix A.
2	Oct 24, 2000	Throughout document: updated System Cooling equipment info & added Remote Condenser Unit option config, clarified Cryo Cooler Compressor & Shield Cooler Compress cabinets naming. Section 1: Updated catalog numbers & descriptions for product changes. Section 2: Updated proximity limits information. Updated Main Disconnect Panel information, updated Magnet Monitor & Telephone Requirements. Revised equipment dimension illustrations. Section 3: Updated floor levels on isogauss line plots. Section 4: Added Temperature And Humidity Specs for Remote Condenser Unit. Updated Air Cooling & Water Cooling Requirements for the various. System Cooling equipment. Revised Magnet Room Air Flow requirements. Updated DC Lighting requirement & light fixtures gauss limit. Revised Magnetized Metal Sensitivity Line Plot magnet axis & floor levels. Section 5: Updated Main Disconnect Panel design & function information. Section 6: Updated System Cooling Cabinet equipment interconnect information. Added Remote Condenser Unit option customer supplied interconnect information. Updated miscellaneous system interconnects. Updated Contractor Furnished Components. Deleted Oxygen Monitor information. Section 7: Consolidated Magnet Mounting Plate information in Section 7–7. Revised Magnet Mounting Plate RF Shield Room interactions & floor requirements. Section 8: Updated System Cooling Cabinet cabinet information. Section 9: Updated Preparations Required in Advance of Magnet Delivery. Revised Typical Project Schedule for MDP & SCC requirements. Section 10: Revised for new part number information.
3	Mar 27, 2001	**Throughout manual:** Revised information for Magnet info for Slab On Grade Sites, Suspension Foundation Sites, & Relocatable Mobile system; Added Low Voltage Step–Up Transformer Options; Deleted SCC & MDP low voltage catalogs. S**ection 1:** Added Relocatable Van Manufacturer contact information; Updated ReFlex and BAM Memory catalogs. **Section 2:** Updated SCC & RCU separation distances. Added System Cooling equipment installation tasks responsibility lists; Updated SCC & RCU mounting information; Revised Magnet, Enclosure, & Patient Table minimum service area; **Section 4:** Water Cooling requirement minor corrections. **Section 5:** Clarified MDP circuit breaker short–circuit current interruption rating; Added RCU to Main Disconnect Panel Set–up illustration. **Section 6:** Added note for groups that contain water line shall be routed separate from electrical lines; Updated Remote Condenser Unit option customer supplied interconnect information; Updated miscellaneous system interconnectsUpdated Contractor Furnished Components. **Section 7:** Updated Ventglass contacts information; Updated door opening dimensions for moving magnet into room; Revised floors & Magnet mounting in RF Shielded Room for Magnet & Pre–Install Kits for Slab On Grade sites & Suspension Foundation sites. **Section 8:** Updated final moving dimension dependent on rigger equipment requirements. **Section 10:** Updated 0.7T ECMT Kit & 0.7T HSS / SST Coil Kit for part number information

REVISION HISTORY (Continued)

REV	DATE	PRIMARY REASON FOR CHANGE
4	Apr. 5, 2002	**Section 1:** Updated catalogs for system electronics, Patient Swing Table, Head Coil, & Body Coil. **Section 2:** Equipment Room minimum clear space dimensions revised for SCC increase service clearance; Revised System Cooling Subsystem information for SCC2 installed on top of SCC; Updated Equipment Room minimum clear space for SCC2 installed on top of SCC; Revised Telephone Requirements to System Monitoring & Support Connectivity Requirements; Added NEC 2002 Article references for MDP information; Updated suggestion for accessories & supplies storage shelf/cabinet; Revised Magnet, Enclosure, & Patient Table minimum service area; Updated SCC & RCU mounting informationAdded Penetration Panel service clearance dimensions. **Section 3:** Corrected 200 G (20mT) callout. **Section 4:** Updated Magnet Room temperature & humidity specs; Revised Remote Condenser Unit operating ambient temperature; Updated Water Cooled SCC water requirements; Updated Magnet Room exhaust fan requirements/recommendations; Revised Changing Magnetic Environment (moving metal) specifications; Added Distance for AC fields sample calculation. **Section 5:** Clarified MDP Emergency Off circuit function & Magnet Monitor UPS output; Added NEC 2002 Article references; Updated Facility Ground Wire measurement techniques. **Section 6:** Minor corrections. **Section 7:** Updated Slab On Grade sites Magnet Support Ring Mounting Template dimension. **Section 8:** Revised System Cooling Subsystem information for SCC2 installed on top of SCC. **Section 9:** Added SAFETY subsection; Updated all others subsections for safety changes. **Section 10:** Updated Magnet Service Tool Power Supply GE part number; Updated Shim Camera Kit & Field Shim Kit GE part numbers; Added alternate GE part number for 0.7T Eddy Current Measurement Test Kit. **Appendix B:** Added Ellis & Watts “Prerequisites for Scheduled Start–up of Chillers For Signa Open Speed” document.
5	Dec. 5, 2002	Direction 2128126 updated to Rev 1. **Sec 1:** Corrected Air Cooled TSCC & Water Cooled TSCC catalogs in Major Equiment illustration. **Sec 2:** Added Multiple MR System Sites shared Equipment Room requirements; Revised System Monitoring & Support Connectivity Requirments for Magnet Monitor; Mounting requirements clarified for MDP top breaker highest position. **Sec 3:** Magnetic Isogauss line plots added 40mT & 200mT required by IEC 60601–2–33 6.8.3 bb. **Sec 4:** Revised hearing protectiion requirement in the Magnet Room; Added metric value for recommend Magnet Room ventilation; Exhaust Fan illustrations added Room Ventilation Requirements/Recommendations reference; Added Cryogenic Vent inspection CAUTION; Typical Cryogenic Vent Detail added height requirement for RF Shielded Room Contractor supplied vent pipe/waveguide in Magnet Room. **Sec 5:** Revised Voltage Transient specificiation; Updated Common Ground Stud location dimension in Magnet Room Grounding Requirements illustration. **Sec 6:** Added notes to identified RF Transmit & RF Receive cables; Updated Oxygen Monitor plug pull information. **Sec 7:** Revised floor Coldhead mounting area clearances for Slab on Grade and Seismic Zone & Suspension Foundation sites. **Sec 8:** Added Transportation Environmental Conditions. **Sec 9:** Added Cryogenic Vent connected to magnet prior to magnet ramp–up. **Sec 10:** Added Resistance Meter to table of Rigger/Customer Supplied Equipment; Updated software release for ECMT kit. **Appendix C:** Added REQUIREMENTS FOR EQUIPMENT ROOM SHARED BY MULTIPLE MR SYSTEMS.

* This revision number/letter corresponds to the indicated document’s revision control system.

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GLOSSARY

CRYO COOLER COLDHEAD – An external refrigeration device which is used as a recondenser to change gaseous helium to liquid within the magnet helium vessel.

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

CRYOSTAT – An apparatus maintaining a very low constant temperature. The cryostat consists of one concentric, cylindrical container housed in an outer vacuum tight vessel. The magnet and shim coils are mounted in the inner container. The container is filled with liquid helium. The shields surrounding the inner container are kept cold by a refrigeration device.

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.

EXCLUSION ZONE – Area where the magnetic flux density is greater than five gauss. Personnel with cardiac pacemakers, neurostimulators and other biostimulation devices must NOT enter this zone. Signs are posted outside the five gauss line alerting personnel of this requirement. Since the magnetic field is three–dimensional, signs are also posted on floors above and below the Magnet Room in which the five gauss line exists.

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 = 10,000G and 1 milli Tesla = 10G).

GRADIENT – The amount and direction of the rate of change in space of the magnetic field strength. In the magnetic resonance system, gradient amplifiers and coils are used to vary the magnetic field strength in the x, y, and z planes.

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 – An imaginary line or a line on a field plot connecting identical magnetic field strength points.

MAGNETIC FIELD (H) – The space around a magnet (or current carrying conductor) which 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 (e.g. steel) to redistribute a magnetic field , usually to reduce the magnetic field strength in a desired radius from the magnet.

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 to resonance. Typical frequency range for magnetic resonance systems is 5–80 Mhz.

GLOSSARY (Continued)

RADIO FREQUENCY SHIELDING – Using material (e.g. copper, aluminium, 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.

SECURITY ZONE – Area within the Magnet Room where the magnet is located. Signs are posted outside the Magnet Room warning personnel of the high magnetic field existing in the Magnet Room and the possibility of ferrous objects becoming dangerous projectiles within this zone.

SEISMIC ZONE – Any area where local building codes require special seismic anchoring of equipment.

SHIELD COOLER COLDHEAD – An external refrigeration device which maintains the shields inside the cryostat at a constant temperature.

SHIM COILS – Shim coils are used to provide auxiliary magnetic fields in order to compensate for inhomogeneities in the main magnetic field due to imperfections in the manufacturing of the magnet or affects of steel in the surrounding environment.

SHIMMING – Correction of inhomogeneity of the main magnetic field due to imperfections in the magnet or to the presence of external ferromagnetic objects.

SLAB ON GRADE – A magnet room's concrete foundation which is uniformly supported directly on the earth.

SUSPENSION FOUNDATION – A magnet room's concrete foundation which is suspended (i.e. on air springs) to reduce environmental vibration.

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 (T) – The internationally accepted unit of magnetic flux density. One tesla is equal to 10,000 gauss. One milli Tesla is equal to 10 gauss.

INTRODUCTION

This document contains the physical, magnetic, cryogenic, plumbing and electrical data necessary for planning and preparing a site for a magnetic resonance system. “Preinstallation work” is done to prepare the customer’s premises for the installation of the products sold. It is the responsibility of the purchaser to arrange for performance of this work. Such work includes:

- Installation of the electrical conduit, junction boxes, ducts, surface raceways, outlets and line safety switches.
- Installation of wires not supplied by GE Medical System such as: the facility input power line to the Main Disconnect Panel (MDP) and from the MDP to Power Distribution Unit (PDU), as well as emergency power lines and facility power lines to the the Magnet Room. The electrical contractor shall ring out and tag all wires at both ends. Color–coded wires are recommended for easier identification. Wires shall be continuous without splices. Insulation on all equipment ground wires must be green with a yellow stripe.
- Installation of non–electrical lines such as: water plumbing, helium venting systems and air conditioning equipment. Also, installation of recommended air, vacuum and oxygen lines into the Magnet Room. All lines must be clearly labeled.
- Installation of RF shielding in Magnet Room, installation of magnet mounting plate and equipment anchors.
- RF Screen Room including all openings (i.e. windows, doors, vents, etc.) need acoustic properties to meet local regulations and customer requirements.
- Site construction or renovation.
- Installation of structural reinforcements as required.
- Installation of selected magnetic shielding as required.
- Installation of water treatment equipment if necessary.
- Scheduling of riggers to move magnet (under GE Medical Systems direction) into its final location within the Magnet Room and moving the System Cooling Cabinet (SCC) equipment to final location(s) at the customer site.

All work MUST be in compliance with national and local building and safety codes.

A structural steel analysis may be necessary during site evaluation for a magnetic resonance system. All site plans and preliminary concepts should be reviewed by GE Medical Systems MR Siting group prior to construction.

Unless specifically mentioned, GE Medical Systems does not provide or install: the facility input power lines to the Main Disconnect Panel (MDP) and from the MDP to Power Distribution Unit (PDU) or the power lines required in the Magnet Room, nor raised flooring, conduit, junction boxes, ducts, plumbing, water treatment equipment, cryogenic venting outside the Magnet Room, non standard cryogenic venting inside the Magnet Room, acoustic treatment to contain acoustic noise to the RF shielded room, or the RF shielded room illustrated in this document.

INTRODUCTION (Continued)

All electrical installations that are preliminary to positioning of the equipment at the site prepared for the equipment shall be performed by licensed electrical contractors. In addition, electrical feeds into the Main Disconnect Panel and Power Distribution Unit shall be performed by licensed electrical contractors. Other connections between pieces of electrical equipment, calibrations, and testing shall be performed by qualified GE Medical Systems personnel or third–party service companies with equivalent training. The products involved (and the accompanying electrical installations) are highly sophisticated, and special engineering competence is required. In performing all electrical work on these products, GE will use its own specially trained field engineers. All of GE's electrical work on these products will comply with the requirements of the applicable electrical codes. The purchaser of GE equipment shall only utilize qualified personnel (i.e. GE's field engineers, personnel of third–party service companies with equivalent training, or licensed electricians) to perform electrical servicing on the equipment.

Pre–installation information is continually changing due to the evolution of the product. GE will make every reasonable effort to maintain accuracy of pre–installation information.

Note

The contents of this document do not support site plans for interventional procedures.

SECTION 1 – SYSTEM CONFIGURATION

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1–1 INTRODUCTION

Magnetic Resonance (MR) system 0.7T Signa® Open*Speed* is documented throughout this publication.

1–2 BASIC SYSTEM

The following tables list the major equipment which comprise the Signa Open*Speed* system. Illustration 1–1 shows the major equipment of the Signa Open*Speed* system.

Note

The Pre–install Kit must be delivered and equipment installed at site prior to Magnet delivery to site. See Table 1–3 information.

TABLE 1–1
0.7T SIGNA Open*Speed* SYSTEM ELECTRONICS MAJOR EQUIPMENT

CATALOG	DESCRIPTION
M2000AB System with Phased Array	●Power Cabinet containing the RF Amplifier, RF Power Monitor, power supplies for the Magnet Enclosure system components, Gradient Amplifiers, and Power Distribution Unit module with unregulated transformer (200/208/380/400/415/480Volt, 50/60 Hz) with power filter. ●System Cabinet consisting of Integrated Systems Electronics subsystem and Universal Combined Exciter/Receiver (UCERD). ●Operator Workspace equipment: Octane II Computer, Workspace Cabinet, Mouse and Mouse Pad, LCD panel, and chair. Note, refer to Tables 1–11, 1–12, and 1–13 for catalog choices required to complete Operator Workspace equipment. ●Pneumatic Patient Alert System. ●Standard Surface Coils including CTL coil, shoulder coil, 1 large body flex coil, and 1 medium body flex coil. ●Patient accessories such as: a phantom kit, patient log book, table pads, head cushion and sponges, chin and forehead straps, body wedges, knee cushions, and security/restraint straps. ●Gating accessories which include: patient cardiac leads, peripheral gating probe, and respiratory bellows.

1–2 BASIC SYSTEM (Continued)

TABLE 1–2
MAGNET SUBSYSTEM (SELECT ONE)

CATALOG *See Note 1*	DESCRIPTION
M2060LA	●Slab On Grade Site compatible 0.7T Active Shield Open Magnet Configuration with Gradient Coil and Enclosure. The following equipment is shipped with the magnet: – Magnet Mounting Kit used with Floor Preparation Kit (See Table 1–3) – Magnet Rundown Unit – Magnet Monitor and UPS for Magnet Monitor – Patient Swing Table installation kit (swing rails & rear wheel floor plate) – Penetration Panel with Magnet Temperature Control Unit and Penetration Panel Covers.
M2060LB	●Suspension Foundation site compatible 0.7T Active Shield Open Magnet Configuration with Gradient Coil and Enclosure. The following equipment is shipped with the magnet: – Magnet Mounting Kit for use with magnet mounting plate (See Table 1–3) – Magnet Rundown Unit – Magnet Monitor and UPS for Magnet Monitor – Patient Swing Table installation kit (swing rails & rear wheel floor plate) – Penetration Panel with Magnet Temperature Control Unit and Penetration Panel Covers.
M2060LC	●Relocatable Mobile with Suspension Foundation compatible 0.7T Active Shield Open Magnet Configuration with Gradient Coil and Enclosure. ***See Note 2*** The following equipment is shipped with the magnet: – Magnet Mounting Kit for use with magnet mounting plate (See Table 1–3) – Magnet Rundown Unit – Magnet Monitor and UPS for Magnet Monitor with Relocatable Mobile length cables – Patient Swing Table installation kit (swing rails & rear wheel floor plate) – Penetration Panel with Magnet Temperature Control Unit and Penetration Panel Covers.
M2060LD	●Seismic Slab On Grade Site compatible 0.7T Active Shield Open Magnet Configuration with Gradient Coil and Enclosure. The following equipment is shipped with the magnet: – Magnet Seismic Mounting Kit for use with magnet mounting plate (See Table 1–3) – Magnet Rundown Unit – Magnet Monitor and UPS for Magnet Monitor – Patient Swing Table installation kit (swing rails & rear wheel floor plate) – Penetration Panel with Magnet Temperature Control Unit and Penetration Panel Covers.
Note 1 A Magnet Air Transport Crate (M2060SC) is required if shipped by air, air transport crate is not required within continental USA.	
Note 2 For Relocatable Mobile: Contact the Van Manufacturer for site pre–installation, refer to Section 1–5, VAN MANUFACTURER CONTACT INFORMATION.	

TABLE 1–3
PRE–INSTALL KIT (SELECT ONE)

CATALOG	DESCRIPTION
M2060PJ	●Slab on Grade Site compatible 0.7T Open Magnet floor preparation kit ***See Note 1***
M2060PP	●Suspension foundation site compatible 0.7T Open Magnet mounting plate, epoxy, and mounting hardware ***See Note 2***
Note 1 Installation of Magnet Floor Preparation Kit 2 weeks prior to Magnet delivery is required.	
2 Installation of Magnet Mounting Plate 2 weeks prior to Magnet delivery is required. Magnet Mounting Plate must be installed by the customer/contractor in site floor and epoxy cured prior to 0.7T Magnet delivery. At least 3 days needed to allow for the epoxy to cure.	

1–2 BASIC SYSTEM (Continued)

TABLE 1–4
SHIELD & CRYO COOLER COMPRESSORS

CATALOG *See Notes 1 & 2*	**DESCRIPTION**
M2060JW	●Contains 2 Water Cooled High Voltage Shield/Cryo Cooler Compressors (380/400/415 VAC 50 Hz or 460/480 VAC 60Hz) with power cords for installation in System Cooling Cabinet.

Note 1 The 0.7T Magnet utilizes two Shield/Cryo Cooler Compressors: one unit functions as a Cryo Cooler Compressor (MS5) in two–stage operation and the other unit (MS8) functions as a Shield Cooler Compressor in single–stage operation.

2 The Shield & Cryo Cooler Compressors are not part of the Magnet Catalog but are required at magnet delivery. Refer to Table 1–5 for installation timing requirements.

TABLE 1–5
SYSTEM COOLING SUBSYSTEM & MAIN DISCONNECT PANEL (SELECT ONE)

CATALOG *See Notes 1, 2, 3 & 4*	**DESCRIPTION**
M2085KC	●High Voltage System Cooling subsystem air cooled configuration ●Main Disconnect Panel (MDP) for Signa Open*Speed* Systems: 480Y/277 VAC, 400Y/230 VAC, 50/60 Hz, Surface mounted enclosure with 2 remote emergency off pushbuttons.
M2085KE	●High Voltage System Cooling subsystem air cooled configuration with Remote Condenser Unit *See Note 5.* ●Main Disconnect Panel (MDP) for Signa Open*Speed* Systems: 480Y/277 VAC, 400Y/230 VAC, 50/60 Hz, Surface mounted enclosure with 2 remote emergency off pushbuttons.
M2085KG	●High Voltage System Cooling subsystem water cooled configuration *See Note 6* ●Main Disconnect Panel (MDP) for Signa Open*Speed* Systems: 480Y/277 VAC, 400Y/230 VAC, 50/60 Hz, Surface mounted enclosure with 2 remote emergency off pushbuttons.

Note 1 These catalogs include the System Cooling Cabinet (SCC), the System Cooling Auxiliary Cabinet(SCC2), and the Main Disconnect Panel (MDP). The MDP contains input power control circuits for the following equipment:
– Power Distribution Unit (PDU) which distributes power to system electronics
– System Cooling Cabinet subsystem with circuit auto restart
– Magnet Temperature Control Unit (TCU), Magnet Monitor, Modem for Magnet Monitor, and UPS for Magnet Monitor with circuit auto restart.

2 The system Main Disconnect Panel (MDP) & System Cooling Cabinet (SCC) configurations require high voltage for input voltage. A step–up transformer is required if the site input voltage for the system is 200 V or 208V, refer to Table 1–6 offerings.

3 **The MDP and System Cooling Cabinet equipment (Shield & Cryo Cooler Compressor Cabinets) must be installed by the customer/contractor at site with power available prior to 0.7T Magnet delivery.**

4 Backup temporary water cooling is recommended for the Cryo Cooler Compressor in the System Cooling Cabinet (all configurations), refer to **Section 4–4–1 Cryo Cooler Compressor Backup Temporary Water Cooling Requirement**.

5 These catalogs include the System Cooling Cabinet, the System Cooling Auxiliary Cabinet, and the Remote Condenser Unit (RCU). The RCU is designed to be located external to the building. Refer to **Section 2–7–1 System Cooling Cabinet & System Cooling Auxiliary Cabinet** for additional information.

6 The water cooled configuration System Cooling Cabinets require customer supplied water for cooling. Refer to **Section 4–4–2 Water Cooled System Cooling Cabinet Configuration Requirements** for water cooling specifications.

1–2 BASIC SYSTEM (Continued)

TABLE 1–6
LOW VOLTAGE (200 or 208 VOLTS) STEP UP TRANSFORMER OPTIONS

CATALOG See Note 1	DESCRIPTION
E4500AS	●150 KVA 208 to 480Y277 Volt, 60 Hz transformer
R4500BD	●150 KVA 200 to 400Y230 Volt, 50/60 Hz transformer
Note 1 A step–up transformer is required if the site input voltage for the system is 200 V or 208V. The system Main Disconnect Panel (MDP) & System Cooling Cabinet (SCC) configurations require high voltage for input voltage.	

TABLE 1–7
SITE COLLECTOR KIT (REQUIRE ONE)

CATALOG	DESCRIPTION
M2043PS	●Penetration Panel Covers. ●Fixed Site system interconnect cables ●Fixed Site Power Distribution Unit cables ●Patient Comfort Compressor ●SPT Phantom Set with Shipping/Storage Cart
M2043PR	●Penetration Panel Covers. ●Relocatable Mobile Site system interconnect cables ●Relocatable Mobile Site Power Distribution Unit cables ●Patient Comfort Compressor ●SPT Phantom Set with Shipping/Storage Cart

TABLE 1–8
PATIENT SWING TABLE (REQUIRE ONE)

CATALOG	DESCRIPTION
M2000TL	●Patient Swing Table for Signa Open*Speed* System (not detachable) Note, the Patient Swing Table operates in one of three positions: 0°, –25°, or +25°. Refer to Illustration 2–8.

TABLE 1–9
HEAD COIL

CATALOG	DESCRIPTION
M2087HA	●0.7T Head Coil

TABLE 1–10
0.7T INTEGRATED BODY COIL

CATALOG	DESCRIPTION
M2085BH	●Signa Open*Speed* integrated transmit/receive Body Coil Assembly

1–2 BASIC SYSTEM (Continued)

TABLE 1–11
OPERATOR WORKSPACE MONITOR (ONE REQUIRED)

CATALOG	DESCRIPTION
M1000NZ	●LCD Color Monitor

TABLE 1–12
OPERATOR WORKSPACE TABLE (ONE REQUIRED)

CATALOG	DESCRIPTION
M1000MW	●Table for Operator Workspace *See Note 1*
Note 1 OW Table is an integral part of the regulatory approved system. OW Table provides mounting for several assemblies (e.g. OW Interface Module, OW Power Distribution Box, Modem, DASM) and cable routing for OW interconnects.	

TABLE 1–13
COUNTRY KITS (SELECT ONE)

CATALOG	DESCRIPTION
M1000MN	●English Keyboard
M1000MP	●French Keyboard
M1000MR	●German Keyboard
M1000MS	●Scandinavian Keyboard
M1000NH	●Italian Keyboard
M1000NJ	●Portuguese Keyboard
M1000NK	●Spanish Keyboard

TABLE 1–14
RECON PROCESSOR WITH BAM MEMORY (SELECT ONE)
SEE NOTE 1 IN TABLE

CATALOG	DESCRIPTION
M3000RA	●ReFlex100 – Hex Power PC Processor with four 128 MB Bulk Acquisition Memory (BAM) boards (512 MB)
M3000RB	●ReFlex50 – Dual Power PC Processor with four 128 MB Bulk Acquisition Memory (BAM) boards (512 MB)
M3000RC	●ReFlex50 – Dual Power PC Processor with two 128 MB Bulk Acquisition Memory (BAM) boards (256 MB)
Note 1 BAM memory is now included with the ReFlex Array Processor and is not ordered separately.	

1–2 BASIC SYSTEM (Continued)

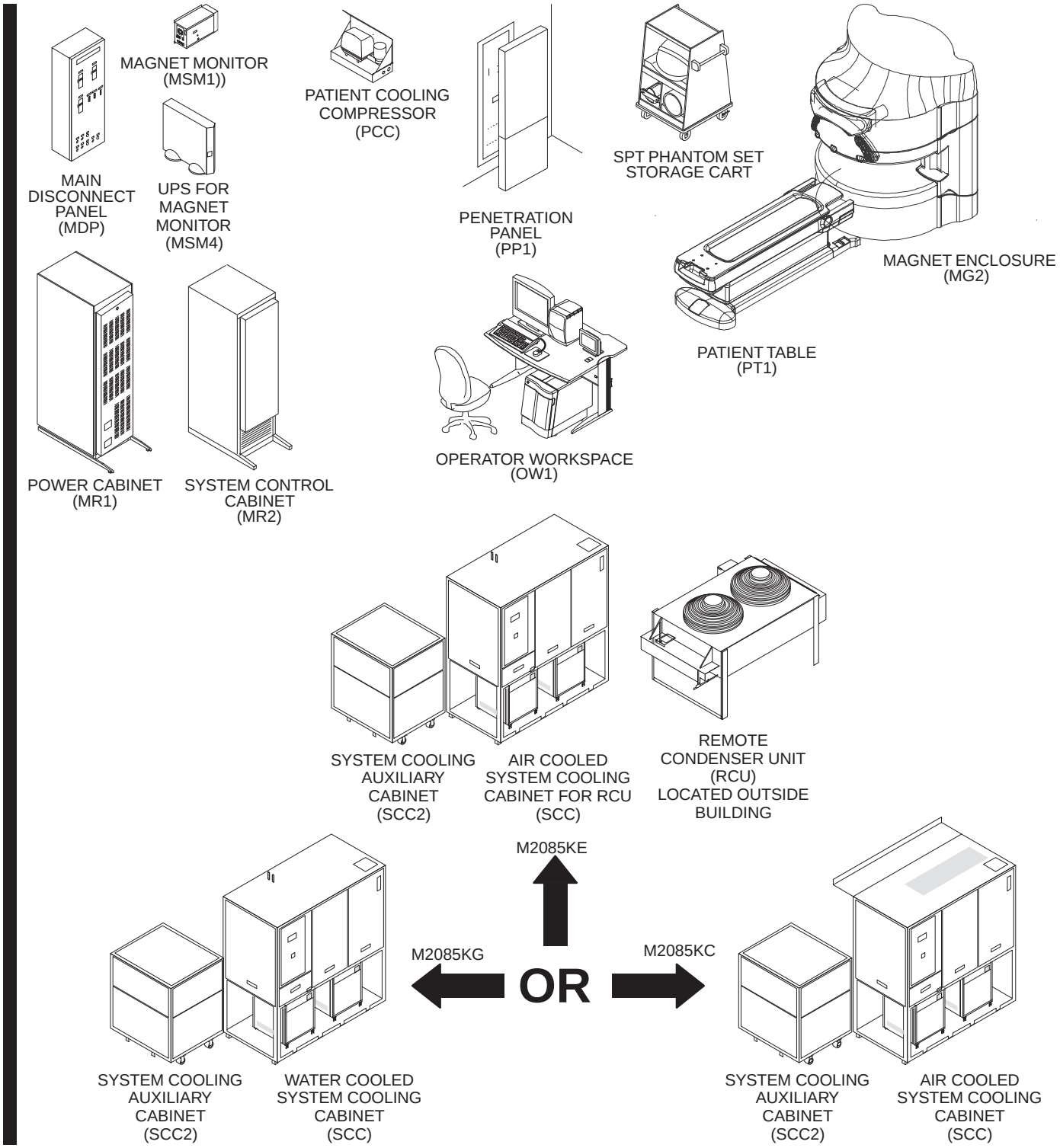
TABLE 1–15
FILMING INTERFACE (SEE NOTE 1 IN TABLE)

CATALOG	DESCRIPTION
M1000MJ	●Analog DASM
M1000MK	●Digital DASM
Note 1 Must choose one Filming DASM Board unless DICOM Print will be used exclusively for software filming to DICOM print peripheral devices.	

TABLE 1–16
IIP GLOBAL MODEM (ONE REQUIRED)

CATALOG	DESCRIPTION
M1000NW	●MR InSite Interactive Platform Global Modem; An external InSite modem is required to be available during system installation and warranty time.

1–2 Basic System (Continued)



SIGNA Open*Speed* SYSTEM MAJOR EQUIPMENT
ILLUSTRATION 1–1

1–3 SYSTEM OPTIONS

This section lists options for Signa Open*Speed* system which have site preparation impact.

- Octane Computer 256MB BAM Memory Board (M3090RW)
- Refer to the vendor pre–installation guides for the optional cameras and hard copy imagers.
- VCR Interface Kit for Octane Computer (M1090TZ)
- Bar Code Reader (M1090PM) for use in conjunction with HIS/RIS software option.
- Other hard copy devices and patient accessories.
- Cryogen refill service.
- Various GE Medical Systems Group service contracts.

1–4 FACILITY OPTIONS

- Direct current (DC) lighting controller for the magnet room:
  - E4503AD 20 Amp Maximum Constant Lighting Level System, surface/semi–flush mount
  - E4503AF 20 Amp Maximum Variable Lighting Level System, surface/semi–flush mount
  - E4503AW 28 Amp Maximum Constant Lighting Level System, surface/semi–flush mount
  - E4503AY 28 Amp Maximum Variable Lighting Level System, surface/semi–flush mount. 50 Hz designs are available by special order.

Note

DC powered lighting is required in the Magnet Room per Section 4–6 LIGHTING. For details of GE available options of DC light controllers and DC lighting controller system refer to Section 2–10 COMPONENT DIMENSIONS and Section 5–8 DC LIGHTING CONTROLLER.

- Signa System Seismic Anchorage Service (R4390JA) for system electronics.

Note

Magnet Seismic anchoring is the customer's responsibility. Coordinate magnet mounting methods with the RF shielded room vendor to prevent RF leaks and secondary grounding problems. Refer to Section 7–7 MAGNET MOUNTING REQUIREMENTS INSIDE RF SHIELDED ROOM for details**.**

- Oxygen Monitor Kit (M1060KM) which includes Oxygen Monitor and Remote Oxygen Monitor Module.

Note

The Oxygen Monitor does not bear a CE monogram and therefore may not be acceptable in all European countries.

1–5 VAN MANUFACTURER CONTACT INFORMATION

Pre–Installation requirement for Relocatable configuration are defined by the Van Manufacturer. Listed below is contact information for GE Van Manufacturer.

- PDC Facilities
  700 Walnut Ridge Drive, PO Box 900 Telephone: 262–367–7700
  Hartland, WI 53029–0900 FAX: 262–367–7744
  USA

SECTION 2 – ROOM LAYOUTS

TABLE OF CONTENTS

2–1 INTRODUCTION

When laying out a floor plan there are special considerations that must be taken into account due to the magnetic field effect on certain medical implants (including cardiac pacemakers, neurostimulators, and biostimulation devices) and the environmental effect (motors,steel, etc.) on the field homogeneity. The maximum magnetic field in which the equipment can be located is listed in Table 2–1. Selected magnetic shielding of some devices and equipment is possible but must be handled on an individual basis. Refer to Section 6, INTERCONNECTION DATA, for cable length considerations.

The RF shielded room (Magnet Room) is unique in that the room must be shielded from outside radio frequency interference. This is done by enclosing the room with metal walls, floors and ceiling. These shielding requirements impose special considerations which are addressed in Section 7, RF SHIELDED ROOM.

The Magnet Room can be magnetically shielded to reduce the magnet fringe field or to shield the magnet from the effects of the external environment. Refer to Section 3–4, MAGNETIC SHIELDING, for magnet shielding considerations.

Note

The contents of this document do not support site plans for interventional procedures.

2–2 ROOM SIZES

Table 2–2 contains minimum room dimensions necessary for an MR suite. Table 2–2 also contains issues which are created by reduction in service access, operator access, and equipment space.

TABLE 2–1
PROXIMITY LIMITS

GAUSS (mT) LIMIT See Notes 1 & 2	EQUIPMENT	
0.5 GAUSS (0.05mT) OR LESS See Note 4	• Nuclear cameras	
1 GAUSS (0.1mT) OR LESS See Note 4	• Positron Emission Tomography scanner • Linear Accelerator • Cyclotrons • Accurate Measuring scale • Image intensifiers • Color TV	• Video display (color, B/W, monochrome) • CT scanner • Ultrasound • Lithotriptor • Electron microscope • Advantage Workstation with CRT Monitor
3 GAUSS (0.3mT) OR LESS See Note 4	• Power transformers • Main electrical distribution transformers • 150 KVA 208 to 480Y277 Volt, 60 Hz transformer (option) • 150 KVA 200 to 400Y230 Volt, 50/60 Hz transformer (option)	• Moving steel equipment such as: – Fork lift trucks – Dumb waiters – Electric transport carts – Loading dock (truck traffic) – Elevators – Escalators – Helicopters (See Note 3)
5 GAUSS (0.5mT) OR LESS	• Cardiac pacemakers • Neurostimulators	• Biostimulation devices
10 GAUSS (1mT) OR LESS	• Magnetic tapes and floppy discs • Hard copy imagers • Line printers • Video Cassette Recorder (VCR) • Film processor • Credit cards, watches, and clocks • Telephone switching station • Water cooling equipment	• HVAC equipment • Major mechanical equipment room • Large steel equipment such as: – Emergency generators – Commercial laundry equipment – Food preparation area – Air conditioning chiller – Fuel storage tanks – Motors greater than 5 horsepower • X–ray tubes
30 GAUSS (3mT) OR LESS	• System Cabinet (MR2) • System Cooling Cabinet (SCC)	• System Cooling Auxiliary Cabinet (SCC2) • Remote Condenser Unit (RCU) for SCC
50 GAUSS (5mT) OR LESS	• Operator Workspace Cabinet (OW1A2) • LCD Color Monitor (OW1A6) (See note 5) • Main Disconnect Panel (MDP) • Magnet Monitor (MSM1)	• UPS for Magnet Monitor (MSM4) • Patient Comfort Compressor (PCC) • Telephones • Metal detector for screening
100 GAUSS (10mT) OR LESS	• Cryo Cooler Compressor Cabinet (MS5) • Shield Cooler Compressor Cabinet (MS8)	• Magnet Service Tool Power Supply Cabinet • Pneumatic Patient Alert Control Box (PA1)
200 GAUSS (20mT) OR LESS	• Penetration Panel (PP1) • Power Cabinet (MR1)	• Magnet Rundown Unit (MS4)

Note 1 Refer to SECTION 3, MAGNETIC FIELD CONSIDERATIONS, for magnet field plots.

2 Recommended limits given above are based on general MR site planning guidelines. Actual susceptibility of specific devices may vary significantly depending on electrical design orientation of the device relative to the magnetic field and the degree of interference considered unacceptable.

3 Verify operating limits with provider of helicopter service

4 Refer to **Section 4–13 CHANGING MAGNETIC ENVIRONMENT SPECIFICATIONS** for additional Active Shield magnet proximity limits.

5 If gauss limit is more than indicated for OW with LCD Color Monitor then contact GE to determine impacts on OW equipment.

TABLE 2–2
MINIMUM ROOM INSIDE CLEAR SPACE DIMENSIONS
(VALUES DO NOT INCLUDE MAGNETIC AND/OR RF SHIELDING OR FINISHED WALL)

ROOM	0.7T SYSTEM CONFIGURATION MINIMUM VALUES
MAGNET ROOM See Note 1	
Width X Depth: ft–in. (m)	13.12 x 19.68 (4 x 6) See Note 3
Area: ft^2 (m^2)	258.20 (24.00)
Ceiling Height: ft–in. (m) See Note 4	8–7 (2.62)
EQUIPMENT ROOM See Note 2	
Width X Depth: ft–in. (m)	14 x 9 (4.27 x 2.74)
Area: ft^2 (m^2)	126 (11.70)
CONTROL ROOM	
Width X Depth: ft–in. (m)	5* x 7 (1.52* x 2.13)
Area: ft^2 (m^2)	35 (3.24)
TOTAL SYSTEM AREA: ft^2 (m^2)	419.2 (38.94)

Note 1 Absolute Minimum Magnet Room dimensions will result in limited operator clearances and increased Magnet Service time.

2 Absolute Minimum Equipment Room and Control Room dimensions do not permit placement of air conditioning in room. Nor do they permit space for any optional equipment such as Laser Camera, etc.

3 Magnet Room dimensions do not contain 5 gauss line to room.

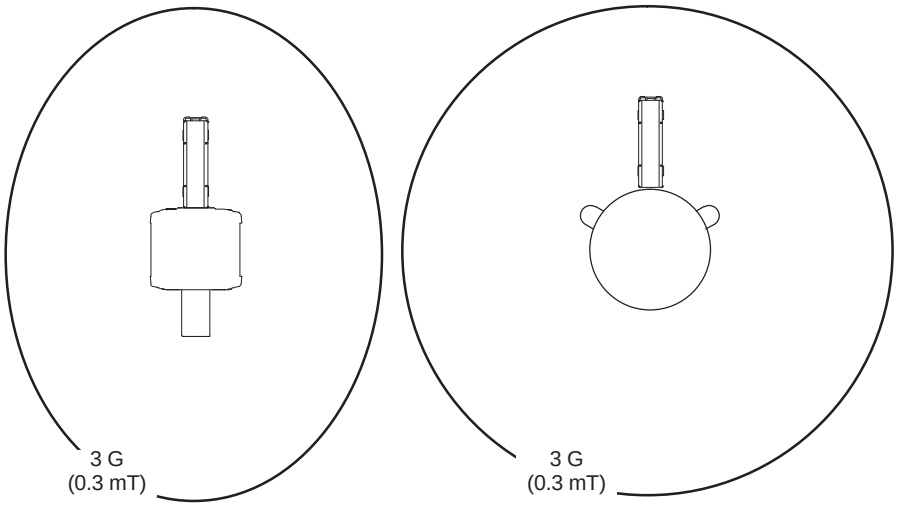
4 For Slab On Grade Sites the 0.7T magnet is limited to minimum of 18 inch (457 mm) thick concrete slab on grade installation as required in **Section 7–6–4 Floors.**
For Suspension Foundation Sites the magnet requires a 2 inch (51 mm) thick Magnet Mounting Plate be recessed into the floor, refer to **Section 7–7 MAGNET MOUNTING REQUIREMENTS INSIDE RF SHIELDED ROOM** for additional floor requirements

* Width is dependent on Magnet Room door location and customer's approval of limited space available for operator.

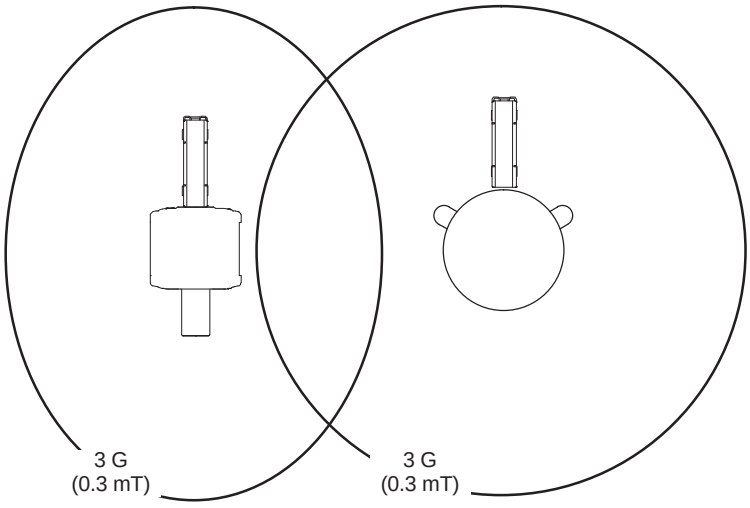
2–3 MULTIPLE MR SYSTEMS SITE

2–3–1 TWO MAGNET SITE LAYOUT

For two magnet installations interaction can occur between the magnetic fields. For 2 magnets not to interact at all (including when bringing magnet to field) the 3 gauss lines of each magnet must not intersect. If the 3 gauss lines intersect but remain outside each magnet's cryostat there will be interaction between the magnets when bringing to field. The orientation of the magnets is irrelevant. Consult the MR Siting & Shielding group for closer proximity of magnets.



NO INTERACTION



INTERACTION WHEN BRINGING MAGNET TO FIELD

TWO MAGNET INSTALLATION
ILLUSTRATION 2–1

2–3–2 Equipment Room Shared By Multiple MR Systems

When the Equipment Room is shared by two or more MR systems of the same field strength there is a potential for cross–talk of RF energy between the MR systems. RF cross–talk may cause noise artifacts in images. Proper planning and installation of the multiple systems in the shared Equipment Room can reduce the potential for cross–talk.

- The RF Screen of the Magnet Room for each system needs to meet the RF Attenuation specifications in **Section 7–1 RF SHIELDED ROOM SPECIFICATION**.
- The Equipment Room design, layout, and installation must meet the requirements of **APPENDIX C – REQUIREMENTS FOR EQUIPMENT ROOM SHARED BY MULTIPLE MR SYSTEMS** for:
  - Relative location of certain equipment cabinets of one MR system relative to other MR system(s) equipment cabinets.
  - Separation of the Penetration Panel of one MR system relative to the Penetration Panel of other MR system(s).
  - Separation of interconnects of one MR system relative to interconnects other system(s) and the managing of any excess RF Receive and RF Transmit cables for each MR System.

2–4 MINIMUM DOOR/HALLWAY SIZES

Table 2–3 lists minimum actual clearance opening dimensions for doors and hallways required by Signa equipment. Installation or replacement of components listed in Table 2–4 must be taken into consideration when determining hallway and door dimensions. Clearance for maneuvering around corners or turns must also be taken into consideration. Refer to SECTION 8, SHIPPING AND DELIVERY DATA, for Signa Component shipping dimensions.

TABLE 2–3
MINIMUM HALLWAY/DOOR DIMENSIONS

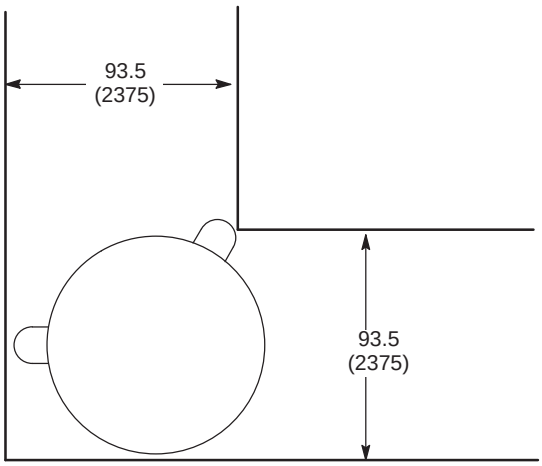
COMPONENT	MINIMUM HALLWAY/ DOOR WIDTH* in. (mm)	MINIMUM HALLWAY/ DOOR HEIGHT* in. (mm)	COMMENTS
Operator Workspace Table	32 (813)	80 (2032)	
System Cooling Cabinet	40 (1016) See Comments	76 (1930)	Minimum Hallway/Door width for 90° turn is 50 inches (1270 mm).
Equipment Cabinets	36 (914)	80 (2032)	
Cryogen delivery route and Storage Room	43 (1092)	80 (2032)	Width requirements due to size of 500 liter dewars. Width and height requirements vary dependent on the dewars used. Check with cryogen supplier.
Magnet	Refer to Note 1	Refer to Note 2	Refer to Section 8, SHIPPING AND DELIVERY DATA, for dimensions, illustrations and weights.
RF Room Door	Refer to Section 7, RF SHIELDED ROOM	Refer to Section 7, RF SHIELDED ROOM	

Note * Minimum hallway and door dimensions are actual clearance openings inside of the door casing. Width and height of rigging equipment is not included in above dimension.

1 Minimum width depends on access route to removable panels of RF shielded room wall. For straight path (i.e. no bends or turns) recommended to allow 6 in. (153 mm) on both sides of magnet. Appropriate calculations must be performed if turns exist along proposed magnet delivery route. Illustration 2–2 shows dimensions for 90° turn.

2 Final dimension is dependent on rigger equipment used, refer to SECTION 8, SHIPPING AND DELIVERY DATA.

2–4 MINIMUM DOOR/HALLWAY SIZES (continued)



NOTE:

- ALL DIMENSIONS ARE IN INCHES ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.

MAGNET MINIMUM DOOR/HALLWAY DIMENSIONS 90° TURN
ILLUSTRATION 2–2

TABLE 2–4
COMPONENT DIMENSIONS FOR INSTALLATION/REPLACEMENT

COMPONENT	APPROXIMATE WEIGHT lbs (kg)	OVERALL DIMENSIONS W x D x H in. (mm)	COMMENTS
Magnet (uncrated)	Refer to comments.	Refer to comments.	Refer to Section 8, SHIPPING AND DELIVERY DATA, for dimensions, illustrations and weights.
System Cooling Cabinet (SCC)	1350 (614) dry	65 x 32.5 x 75.44 (1600 x 825.5 x 1916)	Cryo Cooler Compressor Cabinet & Shield Cooler Compressor Cabinet are installed in lower portion of System Cooling Cabinet at site.
System Cooling Auxiliary Cabinet (SCC2)	550 (250) dry	34.12 x 40.5 x 42.12 (867 x 1029 x 1070)	SCC2 must be located immediately next to SCC. SCC2 can be positioned on either side of SCC.
High Pressure Blower (SCC2)	150 (69) dry	32 x 40.5 x 20 (813 x 1016 x 508)	SCC2 will be installed on top of the SCC.
RF Coil	160 (73)	12 x 36 x 42 (305 x 914 x 1067)	The RF Coil (upper & lower) are shipped separate from the magnet and installed at site.
Replacement Gradient Coil in Shipping Box	350 (159)	42 x 42 x 12 (1067 x 1067 x 305)	Initial Gradient Coil Assembly is shipped installed in the Magnet. Shipping box is used for replacement coil assembly only.
Gradient Coil Replacement Tool Kit Crate	250 (114)	30 x 86 x 28 (762 x 2184 x 711)	The Gradient Coil Replacement Tool Kit is shipped in a wooden crate on casters.

2–5 CABLING CONSIDERATIONS

Several different methods for running cables are listed below and the customer should carefully consider the advantages and disadvantages of each.

Note

Customer current and future system utilization should be considered when determining method of running cables, i.e. surface floor duct or access floor behind magnet may not be acceptable if customer access is desired around the entire magnet.

Care must be taken to protect interconnecting cords and cables from physical damage (including water). Branch circuit conductors must be enclosed in metal raceway or metal wireway when concealed or when installed under raised flooring.

Consult local/national code for interconnects separation requirements (i.e. signal, power, water, etc.).

Note

Only non–magnetic metal material (e.g. aluminum) can be used when routing cables in the Magnet Room.

2–5–1 Floor Duct

Recessed floor duct has advantages when used within a single room or two adjacent rooms. Floor duct combines a neat functional appearance with accessibility and room for expansion. The disadvantage is the amount of work required to install it, which is generally prohibitive in old installations. Floor ducts can be used in the Magnet Room, however, they must meet the requirements in **Section 7, RF SHIELDED ROOM**.

2–5–2 Raceway

Raceways offer some unique advantages when routing cables. It is very practical to use in existing structures since it is surface–mounted. There is no problem with pre–terminated cables since the entire raceway system can be opened. Raceway systems are relatively easy to expand as compared to other means of routing cables. However, surface–mounted raceways are not recommended for routing cables within the Magnet Room due to the number/size of cables and the trip hazard of the raceway.

2–5–3 Raised Flooring

Raised flooring is recommended for use in both the Equipment and Magnet Rooms due to the number and size of cables in the system. Cable accessibility and ease of alteration are just a few advantages of using raised flooring. Floor duct with dividers placed above the Magnet Room floor but beneath the raised flooring is a convenient method of separating electrical lines from water lines. However, if the area under the raised flooring is used for an air plenum, cables may have to be in raceway depending on local and national codes. **Note**, the Signa system interconnecting cables in the Equipment room are FT4 rated, not air plenum rated.

2–5–4 Conduit

Conduit has some important restrictions when used with a MR system. The primary problem is that the majority of cables used are pre–terminated, which greatly simplifies interconnection, but makes cabling difficult because of the added dimensions of the connectors. As a consequence, conduit size must allow for the dimension of the connectors and the possibility of additional cables being added as the system is upgraded in the future. Always size the conduit to allow the cable to pass through with all other cables already in the conduit. Conduit should not be used for running the main GE MR system cables in the Magnet Room due to the number and size of conduits needed.

Note

MR personnel must have an unobstructed path from the patient table to the area directly behind the Magnet. Therefore cable routing methods must not interfere with this pathway.

Cable runs in the Magnet Room as well as throughout the system must be in accordance with local and national codes.

2–6 FLOORING

2–6–1 Cable Routing Areas

Use of a raised floor with covering to minimize static discharge is recommended in the Equipment Room and the portion of the Magnet Room for cable routing. For safety purposes in the Magnet Room, it is required that the raised flooring be made of aluminum. Depending on local and national codes, the area under the raised floor may possibly be used as an air conditioning plenum. If the area under the raised floor is to be used as an air plenum and for cable routing, 10 in. (254mm) of clear space from the underside of the raised floor to the permanent floor is recommended. Cabling, plumbing (water lines), etc. routed under the raised floor may affect air flow and needs to be considered if used as an air conditioning plenum. Also check local and national codes for fire protection requirements under raised floor.

Note

The Signa system interconnecting cables in the Equipment room are FT4 rated, not air plenum rated.

Ensure that the raised flooring, if used, can support the equipment and any transport device needed to move the equipment.

2–6–2 Finished Floor

The finished floor in the Magnet Room should be waterproof and be a conductive type flooring to reduce the possibility of a static discharge. Hard surface finished flooring is required in the Magnet Room for operation of the Swing Patient Table. Information on RF shielded room floor requirements can be found in Section 7, RF SHIELDED ROOM.

If carpeting is used in the Control Room, it should either be anti–static carpeting or treated with an anti–static solution. Carpeting is not recommended in cryogen storage area as well as along the dewar delivery route due to possible problems with moving the dewars.

2–7 SPECIAL SITING CONSIDERATIONS

The following system equipment have special siting concerns which need to be considered.

2–7–1 System Cooling Cabinet Subsystem Equipment

The System Cooling Cabinet (SCC) is a dedicated chiller system providing water cooling for

- Cryo Cooler Compressor Cabinet (MS5)
- Shield Cooler Compressor Cabinet (MS8)
- Gradient Coils
- System Cooling Auxiliary Cabinet (SCC2) which provides compressed cooled air to the RF Coil. The SCC and SCC2 **must** be located side–by–side.

The SCC is available in the 3 configuration options: 1) Air Cooled SCC with Remote Condenser Unit (RCU), 2) Water Cooled SCC, or 3) Air Cooled SCC. Each configuration is available configured for high voltage power (480Y/277 VAC, 400Y/230 VAC, 50/60 Hz). Low voltage (200 or 208 VAC) sites will need to provide a step–up transformer as described in **Section 2–7–6 Step–Up Transformers for 200/208 V Sites**. See Illustration 2–16 for System Cooling Cabinet (SCC), Illustration 2–18 for System Cooling Auxiliary Cabinet (SCC2), and Illustration 2–13 for Remote Condenser Unit (RCU).

Note

The system interconnects are designed for the Cryo Cooler Compressor Cabinet (MS5) and the Shield Cooler Compressor Cabinet (MS8) are to be installed in the lower portion of the System Cooling Cabinet (SCC) as shown in Illustrations 2–12, 2–15, and 2–16.

CAUTION

Continuous water cooling is critical for the Shield/Cryo Cooler Compressors and therefore MUST be available 24 hours per day / 7 days per week to maximize proper uninterrupted magnet operation. Water cooling is required immediately upon magnet arrival. The System Cooling Cabinet (SCC) and Main Disconnect Panel (MDP) must be installed and operational prior to magnet arrival.

Note

Customer provided temporary backup water cooling is highly recommended for the Cryo Cooler Compressor Cabinet located in the lower portion of the System Cooling Cabinet (SCC). Backup temporary water cooling can be connected directly to the Cryo Cooler Compressor Cabinet via the by–pass connection located inside the SCC. Refer to Section 4–4–1 Cryo Cooler Compressor Backup Temporary Water Cooling Requirement.

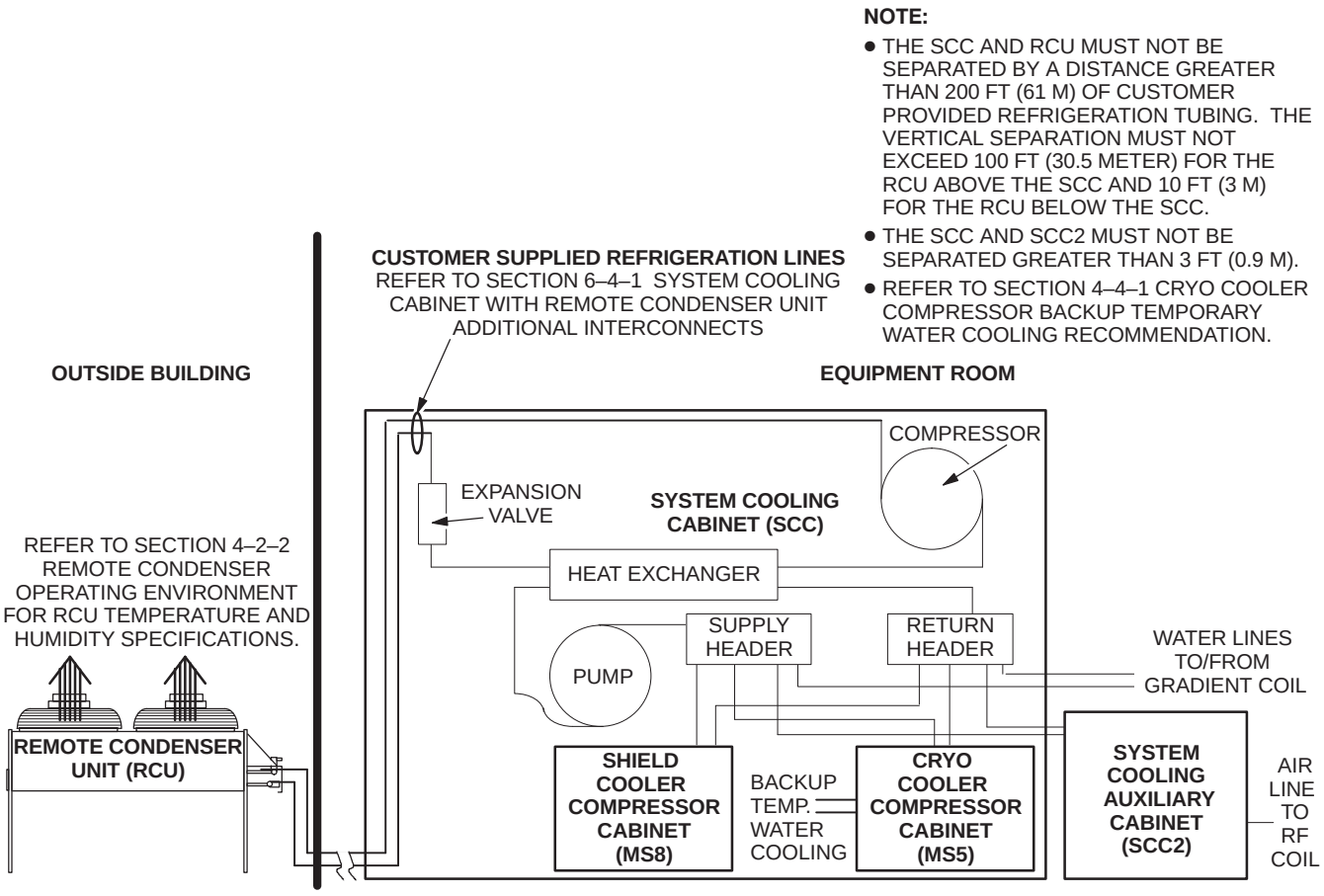
Note

The SCC and system Body Coil located inside the Magnet Enclosure must be located within a maximum of 15 ft (4.6 m) vertical elevation difference and total length. Refer to Section 6, INTERCONNECT DATA, for interconnects length between SCC and Magnet Enclosure.

The SCC is powered from the Main Disconnect Panel (MDP) via customer supplied wiring. The SCC2 is powered from SCC via a supplied power cord. For an SCC with a RCU, the RCU is powered from the SCC via customer supplied power wiring with a Lock Out/Tag Out capable disconnect box located on the RCU. Refer to Section 6, INTERCONNECT DATA, for additional interconnects information and requirements.

2–7–1 System Cooling Cabinet Subsystem Equipment (Continued)

Air Cooled SCC with Remote Condenser Unit (RCU) has the SCC installed in the Equipment Room and the RCU installed external to the building which exhausts the majority of heat to outside air. The SCC in this configuration contains the water chiller compressor and heat exchanger which requires air cooling. See Illustration 2–3.



SYSTEM COOLING CABINET WITH REMOTE CONDENSER UNIT MODEL LC20M/RAC OVERVIEW SKETCH
ILLUSTRATION 2–3

2–7–1 System Cooling Cabinet Subsystem Equipment (Continued)

RCU Location and Mounting

Provisions for a supply of ambient air to the RCU and removal of heated air from the condenser area must taken into account when determining the location of the air cooled RCU. Failure to adhere to these essential requirements will result in higher head pressures which cause poor operation and possible eventual failure of the equipment. The RCU must not be located in the vicinity of steam, hot or fume exhausts. The RCU must be mounted with the airflow in the vertical direction and can not be mounted with the airflow in a horizontal direction.

The RCU should be mounted away from noise sensitive spaces and must have adequate support to avoid vibration and noise transmission into the building. Sound and structural consultants should be retained for recommendations.

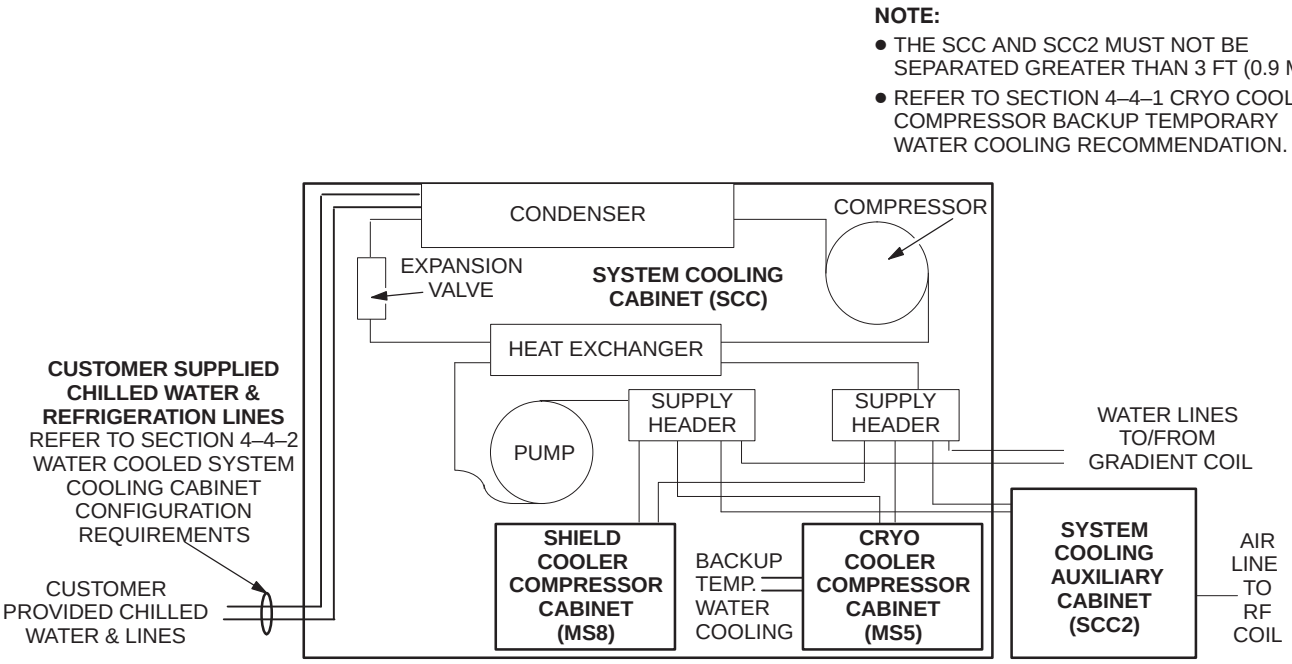
The RCU is designed for outdoor application and may be mounted on a roof or above ground support, or a concrete slab for ground level installation.

- Roof or support mounted units should be level on steel channels or an I–beam frame to support the unit above the roof or other mounting surface. These mounts must be strong enough to support the weight of the unit. Due to the various details involved with roof or support mounting structure, Ellis and Watts International cannot determine the details for this type of mounting without the necessary engineering and site data. It is the responsibility of the installer to have the necessary resources to determine framework for roof or support mounting of the RCU.
- Ground level installation of the RCU requires a concrete pad be used. The concrete pad should be installed level and be properly supported to prevent settling. See Illustration 2–14 for concrete pad dimensions and concrete requirements. The concrete footing should meet or exceed the local code requirements.

Installation of the RCU must be in accordance with local and national codes for electrical and according to standard accepted refrigeration practices i.e. proper traps in line.

2–7–1 System Cooling Cabinet Subsystem Equipment (Continued)

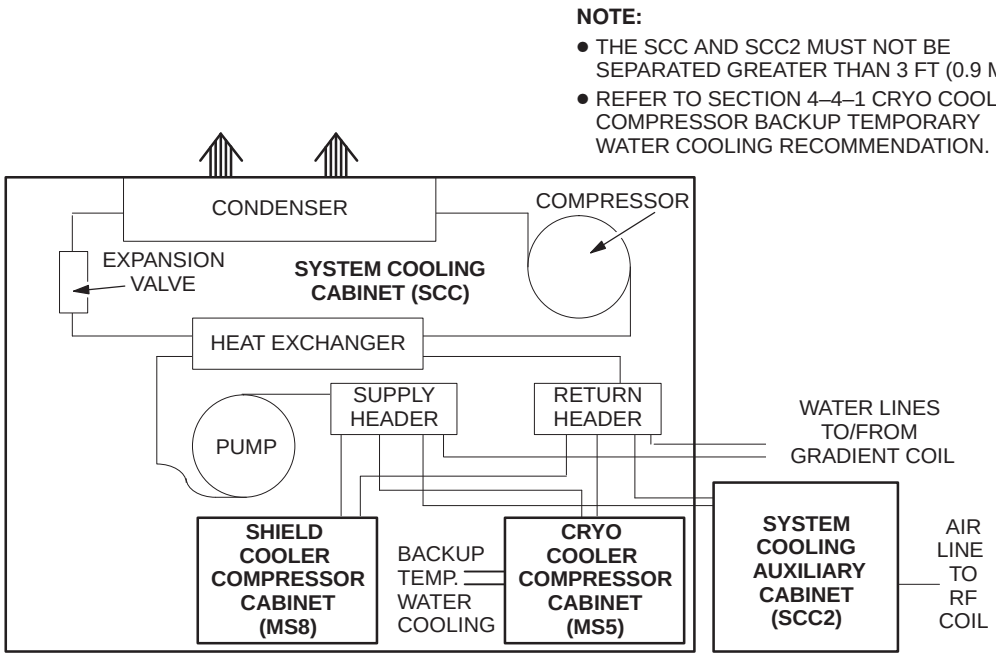
Water Cooled SCC with recondenser inside the cabinet is a dedicated, closed loop, liquid–to–liquid water chiller system. The water cooled SCC is installed in the Equipment Room with some heat output to room air and the majority of heat output to customer supplied chilled cooling water. Refer to Sections 4–3 AIR COOLING REQUIREMENTS and 4–4–2 Water Cooled System Cooling Cabinet Configuration Requirements. See Illustration 2–4.



WATER COOLED SYSTEM COOLING CABINET MODEL LC20M/WC OVERVIEW SKETCH
ILLUSTRATION 2–4

2–7–1 System Cooling Cabinet Subsystem Equipment (Continued)

Air Cooled System Cooling Cabinet (SCC) with condenser in the cabinet is a dedicated, closed loop, water–to–air chiller system installed in the Equipment Room. The SCC heat output to air must be managed by the Equipment Room cooling system, refer to **Section 4–3 AIR COOLING REQUIREMENTS** for specifics. See Illustration 2–5.



AIR COOLED SYSTEM COOLING CABINET MODEL LC20M1 OVERVIEW SKETCH
ILLUSTRATION 2–5

2–7–1 System Cooling Cabinet Subsystem Equipment (Continued)

Responsibility For Installation Tasks For SCC Equipment

The SCC subsystem equipment installation requires specific tasks to be performed by the Customer Contractors (riggers, plumbers, electrician and HVAC contractor), GE Service, and Ellis & Watts Service Provider (vendor of the SCC equipment). Refer to Table 2–5 for the list of the responsibility for the specific tasks. Refer to vendor manual for additional information concerning tasks.

TABLE 2–5
SCC EQUIPMENT RESPONSIBILITY FOR INSTALLATION TASKS PRIOR TO MAGNET DELIVERY & WHEN MAGNET IS DELIVERED/INSTALLED

COOLING CABINET TYPE				RESPONSIBILITY		
INDOOR WITH RCU See Note 1	**INDOOR WATER COOLED** See Note 2	**INDOOR AIR COOLED** See Note 3	**INSTALLATION TASKS FOR SCC EQUIPMENT** See Notes 1, 2, & 3	**CUSTOMER CONTRACTORS**	**GE SERVICE**	**E&W SERVICE PROVIDER**
WHEN SCC EQUIPMENT IS AT SITE & PRIOR TO MAGNET DELIVERY						
X	X	X	Unload SCC and SCC2 and accessories from truck, uncrate and deliver to equipment installation location. (Remote Condenser Units are generally installed outside of the building.) **Note: Lifting equipment such as forklift or crane must be available to perform unloading / move to final location for equipment installation.**	X		
X	X	X	Install SCC2 next to SCC.	X		
X	X	X	Install SCC and mount on Vibration Isolators. (Use seismic Tie Down Brackets where required by law).	X		
X	X	X	Inflate Vibration Isolators with air or dry nitrogen.	X		
X	X	X	Install Main Disconnect Panel (MDP).	X		
X	X	X	Install customer supplied power wiring from MDP to SCC. Make final electrical connections at both ends.	X		
X			Assemble and mount Remote Condenser Unit (RCU)	X		
X			Install electric conduit and wiring between SCC and RCU. Make final electrical connections at both ends.	X		
X			Install customer supplied refrigeration piping from SCC to RCU. Make final connections; fill lines with dry nitrogen and leak test. Repair leaks. Evacuate nitrogen from lines, pull vacuum to 500 microns and fill with a holding charge of 10 pounds of R–134a refrigerant. Must be performed by qualified HVAC contractor.	X		
	X		Install water filter, water supply and water return lines from customer's chilled water supply to SCC Water Cooled Condenser.	X		
X	X	X	Install Facility Backup Chilled water supply and returns lines to SCC (Optional) (Emergency Water Back–up). Refer to **Section 4–4–1 Cryo Cooler Compressor Backup Temporary Water Cooling Recommendation**. **Note: This feature allows service to switch over the cooling water supply from the SCC to the Facility Backup thereby allowing the 2 stage Cryo Cooler Compressor to run in the event the SCC stops working. For LC20M1/WC units – Do not use the customer's chilled water supply as the Facility Backup supply.**	X		

Note 1 Refer to Ellis & Watts *Technical Publication 468 Pre installation/Installation/Operating LC 20M/RAC Chilled Water System for GE Signa OpenSpeed MRI Equipment* for additional SCC with RCU information and details.

2 Refer to Ellis & Watts *Technical Publication 467 Pre installation/Installation/Operating LC 20M/WC Chilled Water System for GE Signa OpenSpeed MRI Equipment* for additional Indoor Water Cooled SCC information and details.

3 Refer to Ellis & Watts *Technical Publication 460 Pre installation/Installation/Operating LC 20M Chilled Water System for GE Signa OpenSpeed MRI Equipment* for additional Indoor Air Cooled SCC information and details.

(Continued)

2–7–1 System Cooling Cabinet Subsystem Equipment (Continued)

TABLE 2–5 (Continued)
SCC EQUIPMENT RESPONSIBILITY FOR INSTALLATION TASKS
PRIOR TO MAGNET DELIVERY & WHEN MAGNET IS DELIVERED/INSTALLED

COOLING CABINET TYPE				RESPONSIBILITY		
INDOOR WITH RCU See Note 1	**INDOOR WATER COOLED** See Note 2	**INDOOR AIR COOLED** See Note 3	**INSTALLATION TASKS FOR SCC EQUIPMENT** See Notes 1, 2, & 3	**CUSTOMER CONTRACTORS**	**GE SERVICE**	**E&W SERVICE PROVIDER**
X			See **APPENDIX B Prerequisites for Scheduled Start–up Or Performance Verification of Chillers For Signa Open Speed** and review for completeness. Send email request for initial start up of RCU to service@elliswatts.com. Email to include: System ID, Magnet Monitor System ID, Model and Serial Number of the SCC unit, and Customer location.		X	
X			Install power, control and water lines from SCC to SCC2, short loop the Gradient Coil water supply and return lines, start up, operate and add final refrigerant charge of R–134a and check fluid levels / operation. Must be completed 1 week prior to magnet arrival.	X		
WHEN MAGNET IS DELIVERED/INSTALLED						
X	X	X	Install Cryo Cooler and Shield Cooler compressors into position inside the lower deck of SCC.		X	
X	X	X	Install water supply and return lines from SCC to: 1) Gradient Coil* via system Penetration Panel (PP1) 2) Cryo Cooler Compressor 3) Shield Cooler Compressor Refer to **Section 6 – INTERCONNECT DATA** for details of interconnects.		X	
X	X	X	Install power, control and water return lines from SCC to SCC2. Note: SCC2 and Gradient Coil water lines must be connected or short looped in order for SCC to start. Refer to **Section 6 – INTERCONNECT DATA** for details of interconnects.		X	
X	X	X	Install 2 inch air hose from SCC2 to RF Coil duct at back of Magnet. Note: If the Gradient Coil or SCC2 are not connected then must be short looped on the SCC for proper operation. SCC will not function without the four loops. Refer to **Section 6 – INTERCONNECT DATA** for details of interconnects.		X	
X	X	X	Fill SCC with Propylene Glycol per service manual.		X	
X	X	X	Start up SCC, SCC2, and RCU if present and verify operation per service manual.		X	
X	X	X	See **APPENDIX B Prerequisites for Scheduled Start–up Or Performance Verification of Chillers For Signa Open Speed** and review for completeness. Send email request for initial performance verification to service@elliswatts.com. Note: For RCU type units this will be the 2nd visit made by the E&W Service Provider. Email to include: System ID, Magnet Monitor System ID, Model and Serial Number of the SCC unit, and Customer location.		X	
X	X	X	Write the System ID and Magnet Monitor System ID onto the label located on the System Cooling Cabinet.		X	
X	X	X	Verify proper installation and operation with all thermal loads active per E&W Startup Checklist.			X

Note 1 Refer to Ellis & Watts *Technical Publication 468 Pre installation/Installation/Operating LC 20M/RAC Chilled Water System for GE Signa OpenSpeed MRI Equipment* for additional SCC with RCU information and details.

2 Refer to Ellis & Watts *Technical Publication 467 Pre installation/Installation/Operating LC 20M/WC Chilled Water System for GE Signa OpenSpeed MRI Equipment* for additional Indoor Water Cooled SCC information and details.

3 Refer to Ellis & Watts *Technical Publication 460 Pre installation/Installation/Operating LC 20M Chilled Water System for GE Signa OpenSpeed MRI Equipment* for additional Indoor Air Cooled SCC information and details.

2–7–2 Pneumatic Patient Alert (PA1)

The Pneumatic Patient Alert system is a stand alone system that will allow the Patient to contact the Operator even when the intercom volume is turned down. The Control Box is to be located near the Operator Workspace. 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. The Control Box should be mounted with consideration for ease of use by operator, remaining within sight of operator and within 5 ft (1.5 m) of an electrical outlet. The Control Box can be powered from an outlet on the Operator Workspace. Refer to Illustration 2–32 for Control Box mounting dimensions.

2–7–3 SPT Phantom Set Shipping/Storage Cabinet

System Performance Test provides the customer and GE Service with a means to quickly verify whether critical parameters affecting image quality are within specifications. The test uses a set of phantoms and a nesting plate for proper positioning of the phantoms on the Patient Table. The phantom set and nesting plate are provided in a cabinet which protects the pieces during shipment and storage at site. The cabinet is not magnetic therefore it can be stored inside the Magnet Room if so desired and moved to the Patient Table for ease of positioning the phantoms. See Illustration 2–34 for dimensions information.

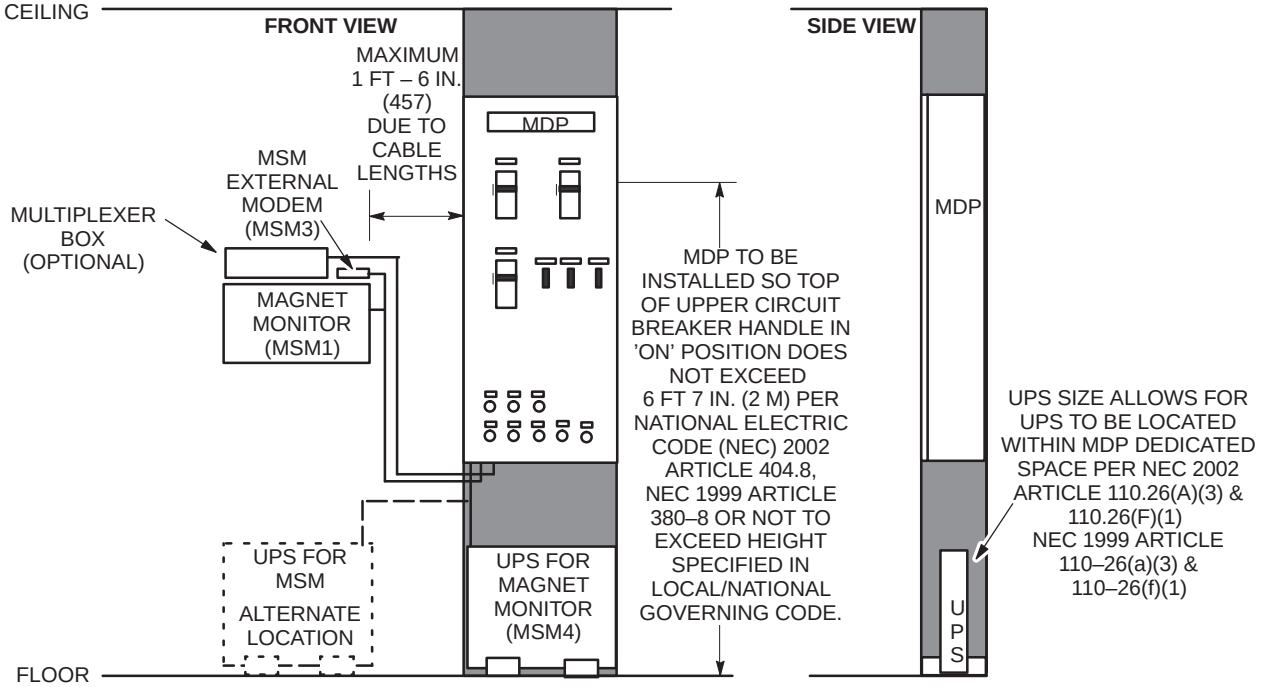
2–7–4 Magnet Monitor Equipment

The Magnet Monitor (MSM1) performs the functions of a cryogen meter and magnet pressure control with readout display capability on the unit. Also the Magnet Monitor with its modem allows for remote monitoring during system warranty period or available as part of a GE Service Contract. A dedicated direct–distance–dialing voice–grade telephone line with access located near the Magnet Monitor in the Equipment Room for remote monitoring is required, refer to **Section 2–7–5 System Monitoring & Support Connectivity Requirements** for additional information. The Signa Open*Speed* includes a Remote Alarm Box to be located on or near the Operator Workspace that has visual and audible alerts if the Magnet Monitor detects a major alarm condition.

Magnet Monitor remote monitoring operation is critical to maximize proper uninterrupted 0.7T magnet operation. A small Uninterruptible Power System (UPS) is provided with the Magnet Monitor for the 0.7T Magnet. In the event of facility power outage, the UPS will maintain Magnet Monitor operation for sufficient time to communicate status via the remote monitoring.

The Magnet Monitor and its UPS are powered from the Main Disconnect Panel (MDP) and must be mounted near the MDP, see Illustration 2–6 The Magnet Monitor should be mounted approximately 60 in. (1524 mm) above the floor in the Equipment Room. Refer to **Section 6 – INTERCONNECT DATA** for details of Magnet Monitor, UPS, and system interconnects.

NOTE:
SPACE ABOUT ELECTRICAL EQUIPMENT PER NATIONAL ELECTRICAL CODE (NEC) 2002 ARTICLE 110.26 OR NEC 1999 ARTICLE 110–26.



MAGNET MONITOR (MSM) & ASSOCIATED EQUIPMENT, UPS FOR MAGNET MONITOR, AND MDP LOCATIONS
ILLUSTRATION 2–6

2–7–5 System Monitoring & Support Connectivity Requirements

One of the system monitoring and support connectivity configurations listed in Table 2–6 must be provided for system installation and serviceability purposes. The network connection (if selected configuration) and telephone lines are to be provided and paid for by the customer.

Note

Telephone line and network connection (if planned configuration) requirements listed in Table 2–6 must be available and functioning prior to magnet delivery and for duration of installation for communication with Magnet Monitor equipment.

TABLE 2–6
SYSTEM MONITORING & SUPPORT CONNECTIVITY REQUIREMENTS

CONFIGURATION	PHONE LINE	USE/LOCATION
Network connection & telephone lines	One voice–grade telephone line (voice line)	Available for Service Personnel use, located in the Control Room
	Two Network connection with a static IP Addresses **See Note 1**	One access located near the Operator Workspace (OW) in the Control Room.
		One access located near the Magnet Monitor (MSM) in the Equipment Room for remote monitoring. This Ethernet connection must not loose power when the MR system is shutdown.
Multiple telephone lines	One voice–grade telephone line (voice line)	Available for Service Personnel use, located in the Control Room
	One line must be a dedicated direct–distance–dialing voice–grade line (data line)	Access located near the Operator Workspace (OW) in the Control Room. **See Note 2 & 3**
	One line must be a dedicated direct–distance–dialing voice–grade line (data line)	Access located near the Magnet Monitor (MSM) in the Equipment Room for remote monitoring. **See Note 2 & 3**

Note 1 **For North America & South America:** One Internet accesible Virtual Private Network Connection with a static IP Address is requred.
For Europe: One ISDN Network Connection with a static IP Address is required.

2 A dedicated direct–distance–dialing voice–grade telephone line can be shared for Operator Workspace (OW) and Magnet Monitor (MSM) requirement through the use of a multiplexer box. The following multiplexer boxes are available for customer purchase.
46–328475P1 4 Line Phone Multiplexer box; 115 VAC input power
46–328475P3 4 Line Phone Multiplexer box; 220 VAC input power
If the customer chooses not to purchase the multiplexer box then the customer must provide an additional line for each requirement as stated in this table.

3 If a Multiplexer Box is used then the Magnet Monitor **MUST** be Channel 1 to allow for call out after a power outage.

2–7–6 Step–Up Transformers for 200/208 V Sites

A step–up transformer is required if the site input voltage for the system is 200V or 208V. The system Main Disconnect Panel (MDP) & System Cooling Cabinet (SCC) configurations require high voltage for input voltage. For transformer options available from GE refer to Section 1–2 BASIC SYSTEM, Table 1–6.

2–8 ARCHITECTURAL REMINDERS

1. Pay attention to isogauss limits, not only for placement of equipment in rooms, but also for isogauss limits with respect to outside environment.

2. The customer is responsible for establishing protocols to warn persons with cardiac pacemakers, neurostimulators, and biostimulation devices of the potential danger of entering magnetic fields greater than 5 gauss (exclusion zone).

3. Due to the periodic cryogen servicing of the magnet, consideration must be given to the delivery route of the cryogens to the Magnet Room. The service route should be level and therefore steps or steep ramps must be avoided. Maximum acceptable incline along dewar delivery route is 1:12 (5°).

3A. Cryogen dewars must not be stored within the Magnet Room due to the safety issues of seismic considerations, spillage effects, fire hazards and explosive effects of compressed gas. Also the magnetic field inhomogeneity is affected by the physical shape of the non–magnetic dewars. If the magnet is shimmed with no dewars in the Magnet Room, the magnetic field inhomogeneity will slightly change once dewars are moved into the room (or vise versa). All dewars must be stored outside of the Magnet Room and more than 10 ft (3.05 m) from isocenter of the magnet in all directions.

3B. Means must be provided to secure gas cylinders used for cryogen transfills in an upright position using a removable chain or strap. This is to prevent the cylinders from falling, which may cause injury or damage.

4. If elevators are to be used along cryogen delivery route, verify that elevator dimensions and weight capacity is sufficient to handle the cryogen dewars. Also, elevator must be dedicated with restricted access during cryogen transport (will not allow stops between initial start and final floor destination).

5. The operator seated at the Operator Workspace should have an unobstructed view of the patient on the Patient Table. A typical height of 42 inches (1067 mm) to the bottom of the Magnet Room viewing window should allow viewing of the patient on the Patient Table.

6. It is recommended that the Magnet Room viewing window be of fine mesh screening material (as opposed to a “honeycomb–type pattern”) for better visibility of the patient from the Operator Workspace.

7. Operators in Magnet Room must have easy access to the scan control switches located on both sides of front top panel of the magnet enclosure.

8. A patient preparation/emergency area should be located near the Magnet Room and direct patient access must be available from the Magnet Room to a patient preparation/emergency area.

9. Customer provided and paid for telephone lines must be supplied for system installation and serviceability purposes per **Section 2–7–5 System Monitoring & Support Connectivity Requirements**.

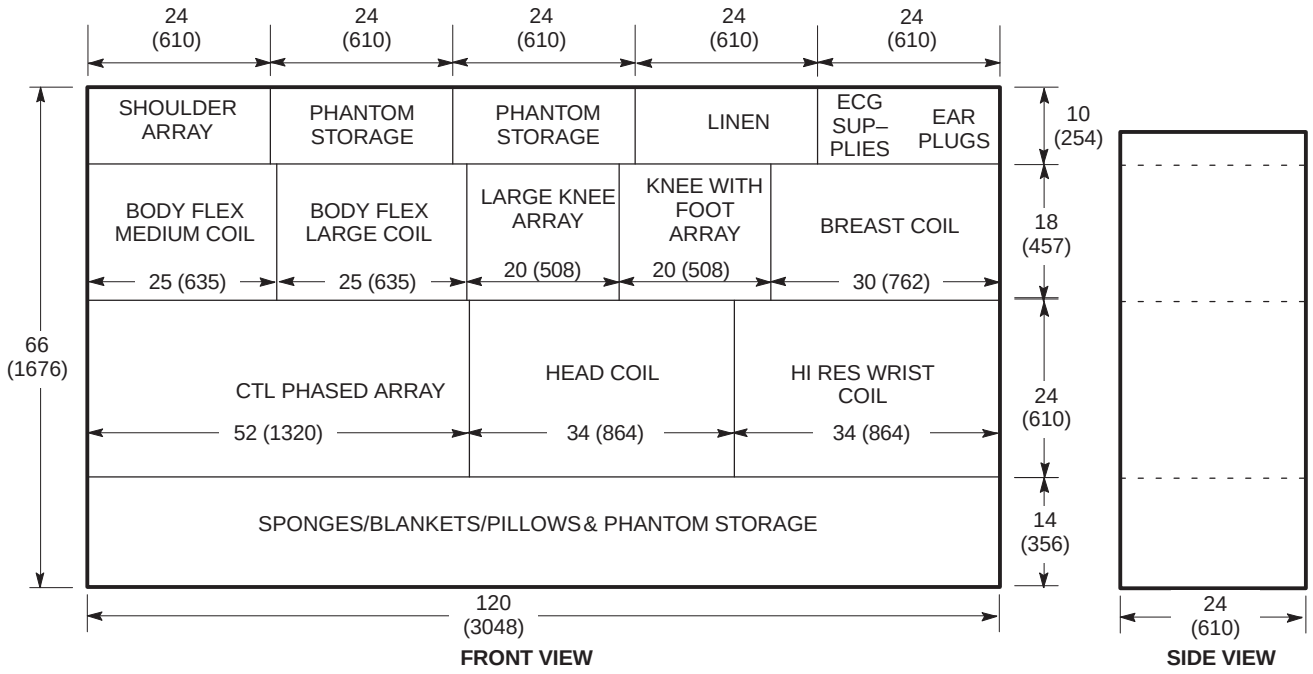
10. A lockable storage cabinet can be provided and maintained by GE Medical Systems Service for storage of GE Medical Systems service documentation/tools. Cabinet to be approximately 36 in. (914 mm) wide, 18 in. (457 mm) depth, and 72 in. (1829 mm) high.

2–8 ARCHITECTURAL REMINDERS (Continued)

11. Corrosive chemicals must not be stored or used in the Equipment Room. These include chemicals used for film processor storage tanks, processor chemical recovery systems, etc. Such chemicals can contribute to increased equipment failures, increased system downtime, and decreased reliability. Film processor equipment installation must meet the manufacturer's requirements (e.g. ventilation specifications) and all applicable national and local codes. Also, consideration should be given to the location of this equipment and chemical fumes relative to human contact as it relates to locating this equipment and chemicals in the control area.

12. Storage space for system accessories and supplies should be planned for and included in room layout drawings. Illustration 2–7 shows one suggestion for a shelf/cabinet arrangement developed by several MR Application Specialists and MR System Operators.

NOTE:
- ALL DIMENSIONS ARE IN INCHES. ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.



SUGGESTION FOR ACCESSORIES & SUPPLIES STORAGE SHELF/CABINET
ILLUSTRATION 2–7

2–9 FLOOR LOADING AND WEIGHTS

This section contains loading considerations for the MR system. Listed in Table 2–7 are the weights, floor loading, and normal mounting methods for MR components.

TABLE 2–7
FLOOR LOADING

COMPONENT	NET WT lbs (kg)	OVERALL DIMENSIONS W x D x H in. (mm)	LOAD PATTERN in. (mm)	NORMAL MOUNTING METHOD
FOR SLAB ON GRADE SITE: Magnet, Enclosure, and Coils	See Notes 1 & 4 & Refer to Section 2–9–1	81.5 x 81.5 x 95.8 (2070 x 2070 x 2434)	See Illustration 7–15 through 7–19	Magnet & Table Rail Assembly anchor/bolted to floor with supplied materials.
FOR SUSPENSION SITE: Magnet, Magnet Mounting Plate, Enclosure, and Coils	See Notes 2 & 4 & Refer to Section 2–9–1	81.5 x 81.5 x 95.8 (2070 x 2070 x 2434)	See Illustration 7–15 through 7–19	Magnet & Table Rail Assembly bolted to magnet mounting plate. Plate is installed with epoxy & anchor/bolted to floor with supplied materials.
Patient Swing Table (See Note 5)	1300 (591)	36 x 97 x 36 (914 x 2464 x 914)	See Illustrations 2–8 & 2–9	Magnet end of Patient Swing Table connects to arc rail attached to magnet mounting plate.
Air Cooled System Cooling Cabinet utilize with RCU (See Note 6 & 7)	1720 (782)	65 x 32.5 x 75.44 (1651 x 826 x 1916)	Rectangular base 65 x 32.5 (1651 x 816). Six vibration isolators 3.88 (98.5) dia. See Illustration 2–12.	Casters for location. Set on floor on vibration isolators. Tie down brackets also used for seismic zones.
Remote Condenser Unit (RCU)	470 (214)	48 x 75 x 44 (1219 x 1905 x 1118)	See to Illustration 2–13 for mounting pattern.	Installed on vibration isolation pads.
Water Cooled System Cooling Cabinet (See Note 6 & 7)	1750 (795)	65 x 32.5 x 75.44 (1651 x 826 x 1916)	Rectangular base 65 x 32.5 (1651 x 816). Six vibration isolators 3.88 (98.5) dia. See Illustration 2–16.	Casters for location. Set on floor on vibration isolators. Tie down brackets also used for seismic zones.
Air Cooled System Cooling Cabinet (See Note 6 & 7)	1870 (850)	65 x 32.5 x 75.44 (1651 x 826 x 1916)	Rectangular base 65 x 32.5 (1651 x 816). Six vibration isolators 3.88 (98.5) dia. See Illustration 2–16.	Casters for location. Set on floor on vibration isolators. Tie down brackets also used for seismic zones.
System Cooling Auxiliary Cabinet (See Note 8)	550 (250)	34.12 x 40.5 x 42.12 (869 x 1029 x 1070)	Rectangular base 31.13 x 35.12 (790 x 829).	Set on floor on casters.

Note
1 Weight of magnet, enclosure, RF/Gradient Body Coil, and cryogens is 20,180 lbs (9173 kg).
2 Weight of magnet with magnet mounting plate, enclosure, RF/Gradient Body Coil, and cryogens is 23,180 lbs (10,536 kg).
3 Consult a structural engineer on method of calculating proper weight/unit area for floor loading.
4 Refer to Section 2–4 MINIMUM DOOR/HALLWAY SIZES for Gradient Coil Assembly replacement weight and dimension requirements.
5 Patient Table weight includes 500 lbs (227 kg) patient.
6 The System Cooling Cabinet (SCC) provides water cooling for the Cryo Cooler Compressor Cabinet, the Shield Cooler Compressor Cabinet, Gradient Coils, and System Cooling Auxiliary Cabinet. Both the Cryo Cooler Compressor Cabinet & the Shield Cooler Compressor Cabinet are physically located inside the lower portion of the System Cooling Cabinet.
7 System Cooling Cabinet is available in 3 configuration options (must choose one):
- Air Cooled SCC utilized with outdoor Remote Condenser Unit (RCU)
- Indoor Water Cooled SCC
- Indoor Air Cooled SCC

8 The System Cooling Cabinet and the System Cooling Auxiliary Cabinet must be located side–by–side.

(Continued)

2–9 FLOOR LOADING AND WEIGHTS (Continued)

TABLE 2–7 (Continued)
FLOOR LOADING

COMPONENT	NET WT lbs (kg)	OVERALL DIMENSIONS W x D x H in. (mm)	LOAD PATTERN in. (mm)	NORMAL MOUNTING METHOD
UPS for Magnet Monitor	34 (15)	19.4 x 3.5 x 17 (494 x 89 x 432)	See Illustration 2–23	Set on floor on 2 mounting brackets.
Power Cabinet	1200 (545)	23.312 x 40 x 76.13 (592 x 1016 x 1933)	Rectangular base 22 x 33 (584 x 838). Four leveling pads each 1.5 (38) dia.	Casters for location. Set on floor on leveling pads.
System Cabinet	494 (225)	23.25 x 42 x 76.5 (591 x 1067 x 1943)	Rectangular base 22 x 30 (584 x 762). Four leveling pads each 1.5 (38) dia.	Casters for location. Set on floor on four leveling pads.
Operator Workspace Table with LCD Color Monitor (See Note 9)	175 (80)	54 x 43 x 52 (1372 x 1092 x 1321)	See Illustration 2–26.	Set on floor: Table on leveling pads & Cabinet rest on casters. Anchor Table to floor per Section 2–9–3.
Patient Comfort Compressor	45 (20)	19.68 x9.60 x 17.16 (500 x 244 x 436)	Wall hanger key holes on back of unit or four rubber feet on bottom. See Illustration 2–21.	Hang on wall, set on floor or other horizontal surface.
Operator Workspace Cabinet (See Note 9)	192 (87)	18.5 x 29 x 26 (470 x 737 x 660)	See Illustration 2–27.	Set on floor and rest on casters.
R4500AS – 150 KVA 208–480Y277 Volt, 60 Hz GE transformer *	875 (397)	35 x 23 x 46 (885 x 589 x 1168)	See Illustration 2–38.	Set on floor
R4500BD – 150 KVA 200–400Y230 Volt, 50/60 Hz GE transformer *	1160 (526.3)	38 x 28 x 48 (972 x 722 x1219)	See Illustration 2–39.	Set on floor
500 Liter Helium Dewar**	812 (369)	42 dia. x 67.5 high (1067 x 1715)	Mobile.	Four casters.
250 Liter Helium Dewar**	519 (236)	36 dia. x 64.0 high (914 x 1626)	Mobile.	Four casters.

Note * Optional Equipment.

** Dewar specifications may vary. Check with cryogen supplier for exact weight and dimensions.

9 The Operator Workspace Cabinet minimum area location is under the Workspace Table, see in Illustration 2–26. An alternate location is possible with the Operator Workspace Cabinet located against the right side of the Workspace Table.

2–9–1 Magnet Loading Considerations

In addition to the weight of the riggers equipment, special consideration must be given to the weight of the magnet along the delivery route. Refer to **Section 9 SHIPPING AND DELIVERY DATA**, for the shipping weight of the magnet (i.e. magnet shipped with liquid cryogens and RF/Gradient coil inside magnet bore and without an enclosure). Structural reinforcement may be required along the magnet delivery route. It is required that a structural engineering analysis be performed on the Magnet Room floor and delivery route to determine its load bearing capacity.

Refer to **Section 7–6–4 FLOORS** for magnet room levelness requirements and **Section 7–7–4 Physical Requirments** for magnet mounting plate floor requirements.

2–9–2 Anchoring And Seismic Considerations

The center of gravity for MR system components are given for use in seismic calculations. If the MR cabinets are required by code to be anchored, refer to seismic drawings available on request from your local GEMS Installation Specialist.

Slab On Grade sites, excepting those in seismic zones, require the magnet to be mounted to the concrete foundation. The magnet support ring is bolted to the concrete foundation through foam isolation pads. The lower coldhead is bolted to the concrete floor through a bracket to minimize image artifacts generated by coldhead vibration. Refer to **Section 7–7–3 Slab On Grade Sites Physical Requirments** particularly Table 7–5 and Illustrations 7–12 through 7–14, for description of the site physical requirements.

For Seismic Zones and Suspension Foundation sites the 0.7T Magnet requires the magnet mounting plate be installed into the Magnet Room floor so the top of the plate will be flush with the concrete subfloor and will allow installation of the room finished floor such that the finished floor elevation is 0.25 ± 0.04 inches (6.4 ± 1.0 mm) higher than the top of the mounting plate, refer to Illustrations 7–15 through 7–19. The plate must be recessed into an existing floor. The magnet mounting plate must be utilized as the RF Shield under the Magnet and the magnet mounting plate must be mounted to the concrete. In cases where the RF Shield is located well below the magnet, i.e. in a combined RF and Magnetic shield design, then the magnet mounting plate will not be utilized as part of the RF Shield. Refer to **Section 7–7 MAGNET MOUNTING REQUIREMENTS INSIDE RF SHIELDED ROOM** for magnet mounting information.

Note

It is the customer's responsibility to coordinate and install magnet mounting plate connection and mounting methods with the RF shielded room vendor to prevent RF leaks and secondary grounding problems.

It is the responsibility of the customer to obtain any and all approvals necessary for the construction of equipment support and seismic anchoring.

2–9–3 Operator Workspace Mounting Requirements

The Operator Workspace Table sets on the floor with the Workspace Cabinet positioned under the Table towards the right side, see Illustration 2–26. Note, the Workspace Table must be bolted to the floor for safe use of the table and equipment positioned on the table.

2–10 COMPONENT DIMENSIONS

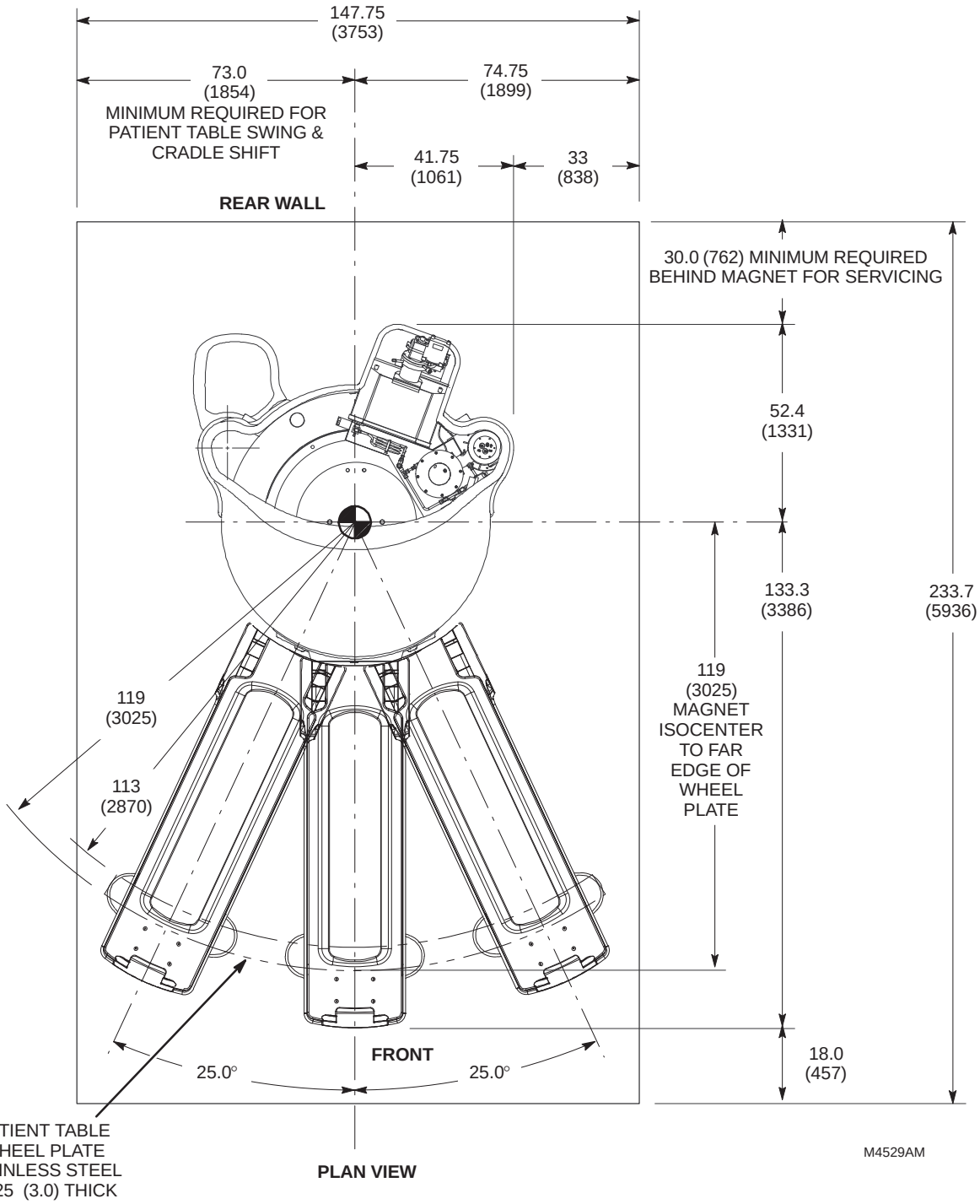
To assist in completing your room layout, refer to Table 2–8 for list of component Illustrations.

TABLE 2–8
MR SYSTEM COMPONENT ILLUSTRATIONS LIST

ILLUSTRATION NAME	ILLUSTRATION NUMBER
0.7T MAGNET, ENCLOSURE, & PATIENT TABLE (MINIMUM SERVICE AREA)	2–8
0.7T MAGNET, ENCLOSURE, & PATIENT TABLE (FRONT AND REAR VIEWS)	2–9
0.7T MAGNET, ENCLOSURE, & PATIENT TABLE CABLE ACCESS	2–10
MAIN DISCONNECT PANEL (MDP)	2–11
AIR COOLED SYSTEM COOLING CABINET [LC–20M/RAC] (SCC) UTILIZED WITH RCU	2–12
REMOTE CONDENSER UNIT [LC–20M/RAC] (RCU) FOR SCC	2–13
REMOTE CONDENSER UNIT [LC–20M/RAC] (RCU) GROUND LEVEL MOUNTING	2–14
WATER COOLED SYSTEM COOLING CABINET [LC–20M/WC] (SCC)	2–15
AIR COOLED SYSTEM COOLING CABINET [MODEL LC–20M] (SCC)	2–16
SYSTEM COOLING CABINET (SCC) MOUNTING	2–17
POWER CABINET (MR3)	2–19
SYSTEM CONTROL CABINET (MR2)	2–20
PATIENT COOLING COMPRESSOR	2–21
MAGNET MONITOR (MSM)	2–22
UPS FOR MAGNET MONITOR	2–23
PENETRATION PANEL (PP1)	2–24
PENETRATION PANEL COVER	2–25
OPERATOR WORKSPACE (OW1)	2–26
OPERATOR WORKSPACE CABINET (OW1 A2)	2–27
OPERATOR WORKSPACE COMPONENTS POSITIONED ON TABLE TOP – LCD COLOR MONITOR	2–28
OPERATOR WORKSPACE COMPONENTS POSITIONED ON TABLE TOP – OCTANE COMPUTER	2–29
OPERATOR WORKSPACE COMPONENTS POSITIONED ON TABLE TOP – KEYBOARD	2–30
MAGNET MONITOR REMOTE ALARM BOX (MSM2) POSITIONED ON OW TABLE TOP	2–31
PNEUMATIC PATIENT ALERT CONTROL BOX (PA1)	2–32
MAGNET RUNDOWN UNIT (MS4)	2–33
SPT PHANTOM SET SHIPPING/STORAGE CART	2–34
DC LIGHTING CONTROLLER – GE FACILITY OPTION	2–35
OXYGEN MONITOR (OM1) – OPTIONAL	2–36
REMOTE OXYGEN SENSOR MODULE (OM3) – OPTIONAL	2–37
150 KVA 208 – 480Y277 VOLT, 60 Hz GE TRANSFORMER – E4500AS	2–38
150 KVA 200 – 400Y230 VOLT, 50/60 Hz GE TRANSFORMER – R4500BD	2–39

NOTE:

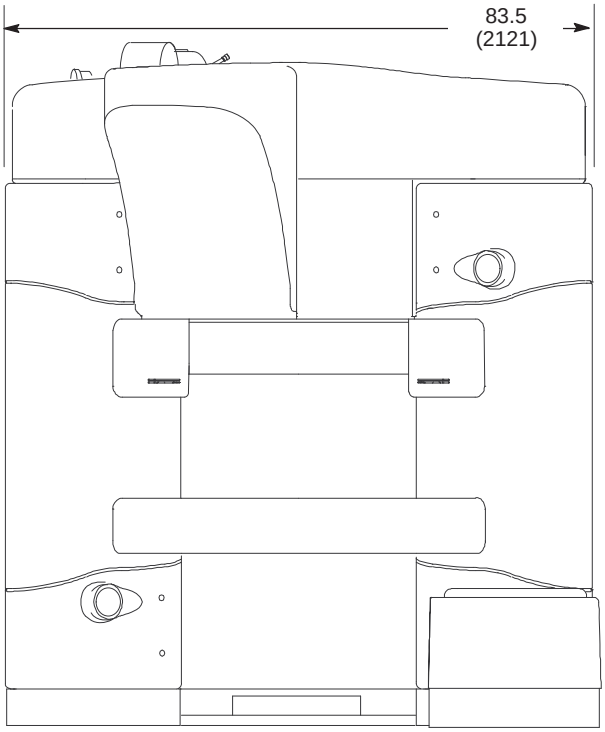
- ALL DIMENSIONS ARE IN INCHES.
  ALL BRACKETED ( ) DIMENSIONS ARE IN MILLIMETERS.



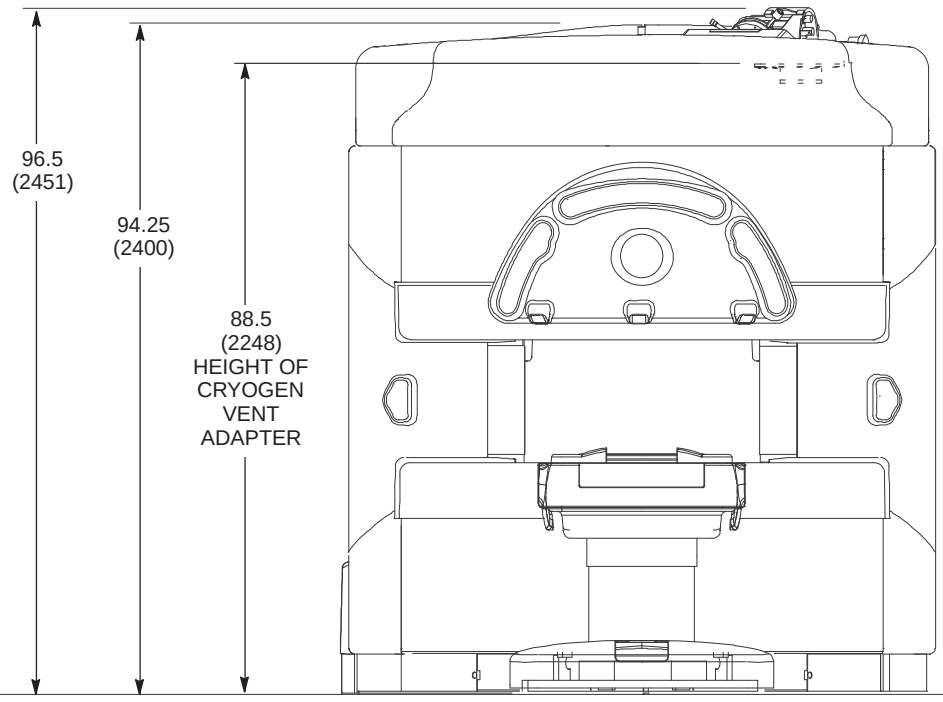
0.7T MAGNET, ENCLOSURE, & PATIENT TABLE (MINIMUM SERVICE AREA)
ILLUSTRATION 2–8

NOTE:

- ALL DIMENSIONS ARE IN INCHES. ALL BRACKETED ( ) DIMENSIONS ARE IN MILLIMETERS.



REAR VIEW



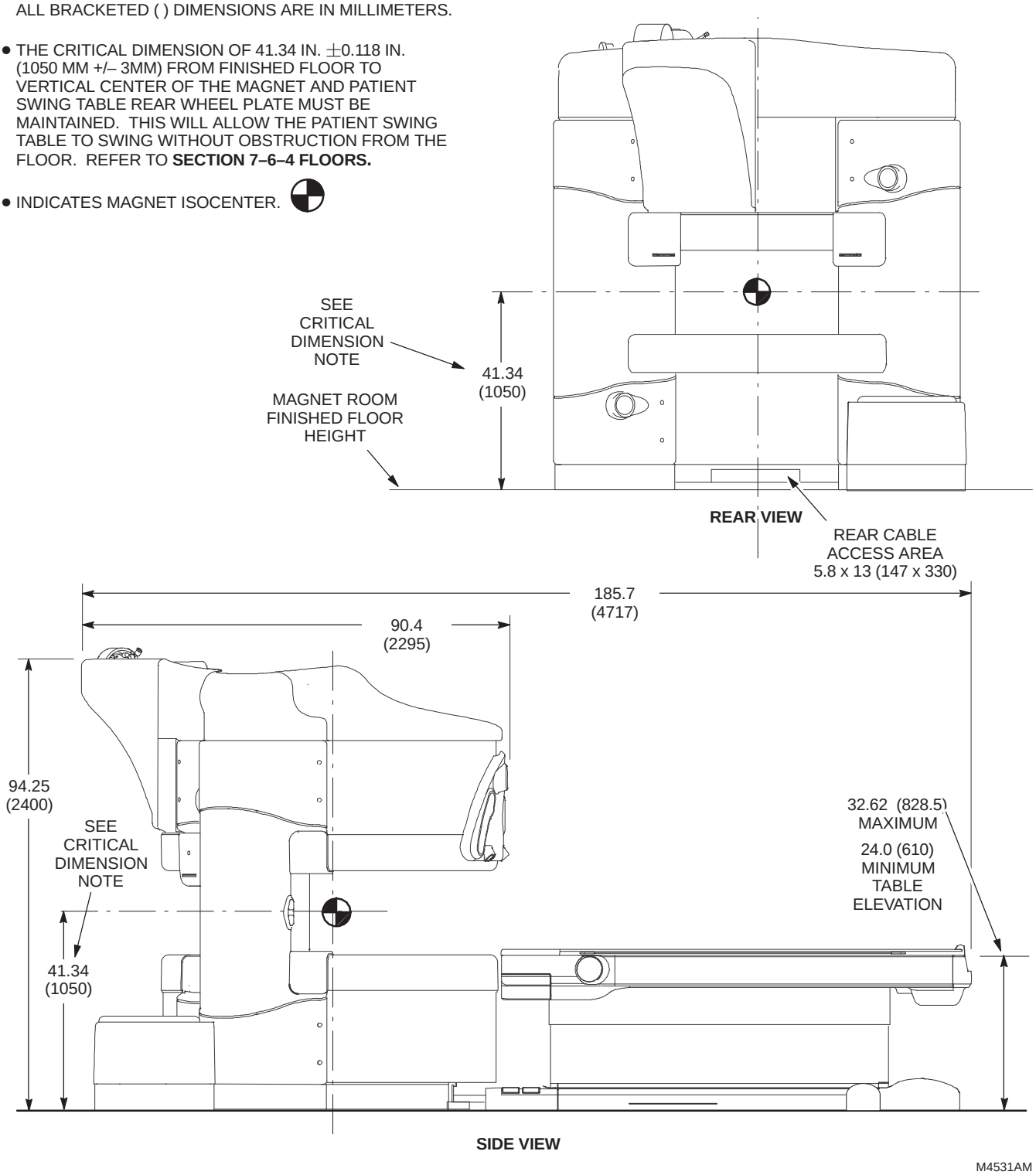
FRONT VIEW

M4530AM

0.7T MAGNET, ENCLOSURE, & PATIENT TABLE (FRONT AND REAR VIEWS)
ILLUSTRATION 2–9

NOTE:

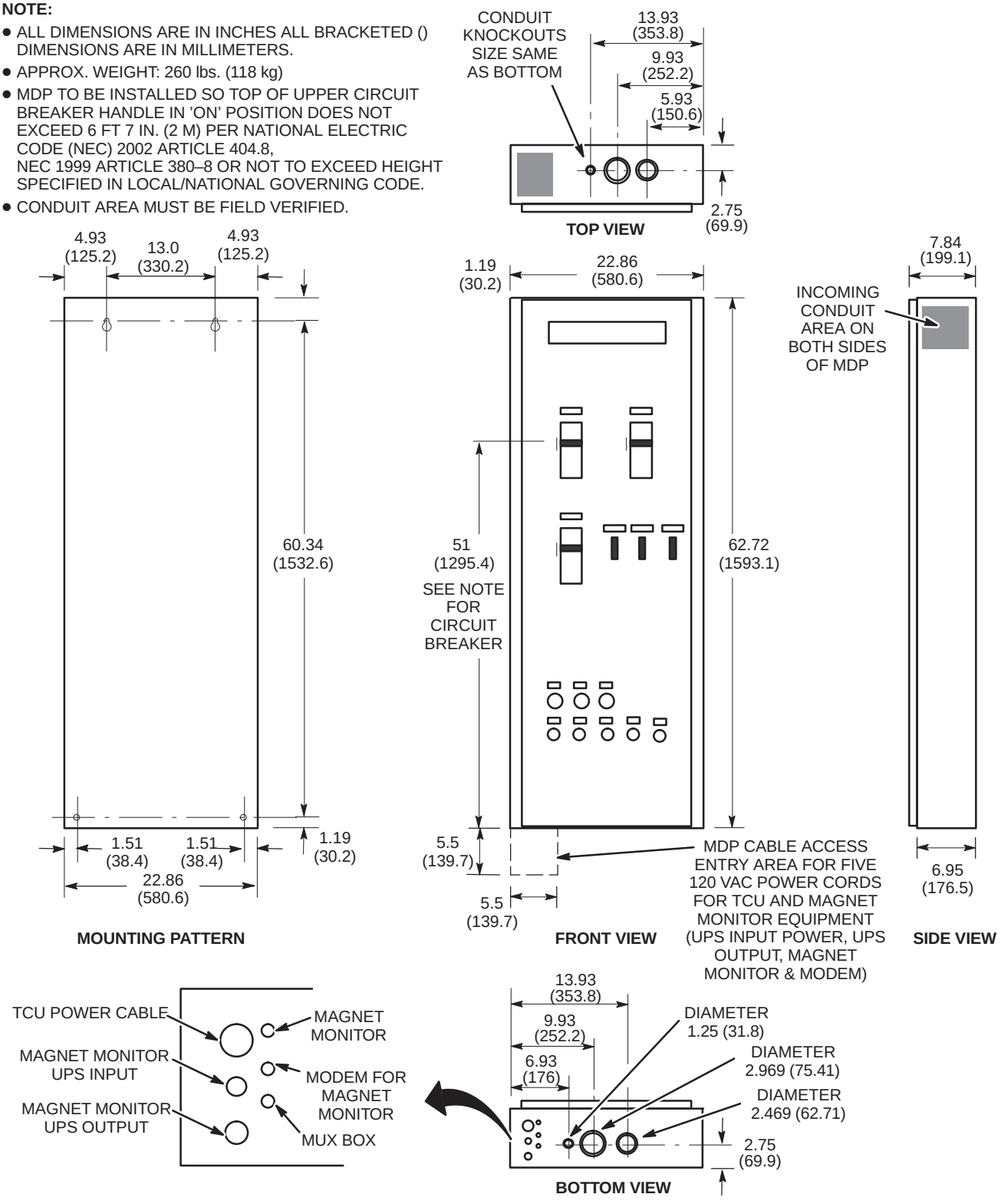
- ALL DIMENSIONS ARE IN INCHES.
  ALL BRACKETED ( ) DIMENSIONS ARE IN MILLIMETERS.
- THE CRITICAL DIMENSION OF 41.34 IN. ±0.118 IN. (1050 MM +/– 3MM) FROM FINISHED FLOOR TO VERTICAL CENTER OF THE MAGNET AND PATIENT SWING TABLE REAR WHEEL PLATE MUST BE MAINTAINED. THIS WILL ALLOW THE PATIENT SWING TABLE TO SWING WITHOUT OBSTRUCTION FROM THE FLOOR. REFER TO **SECTION 7–6–4 FLOORS.**
- INDICATES MAGNET ISOCENTER.



0.7T MAGNET, ENCLOSURE, & PATIENT TABLE CABLE ACCESS
ILLUSTRATION 2–10

NOTE:

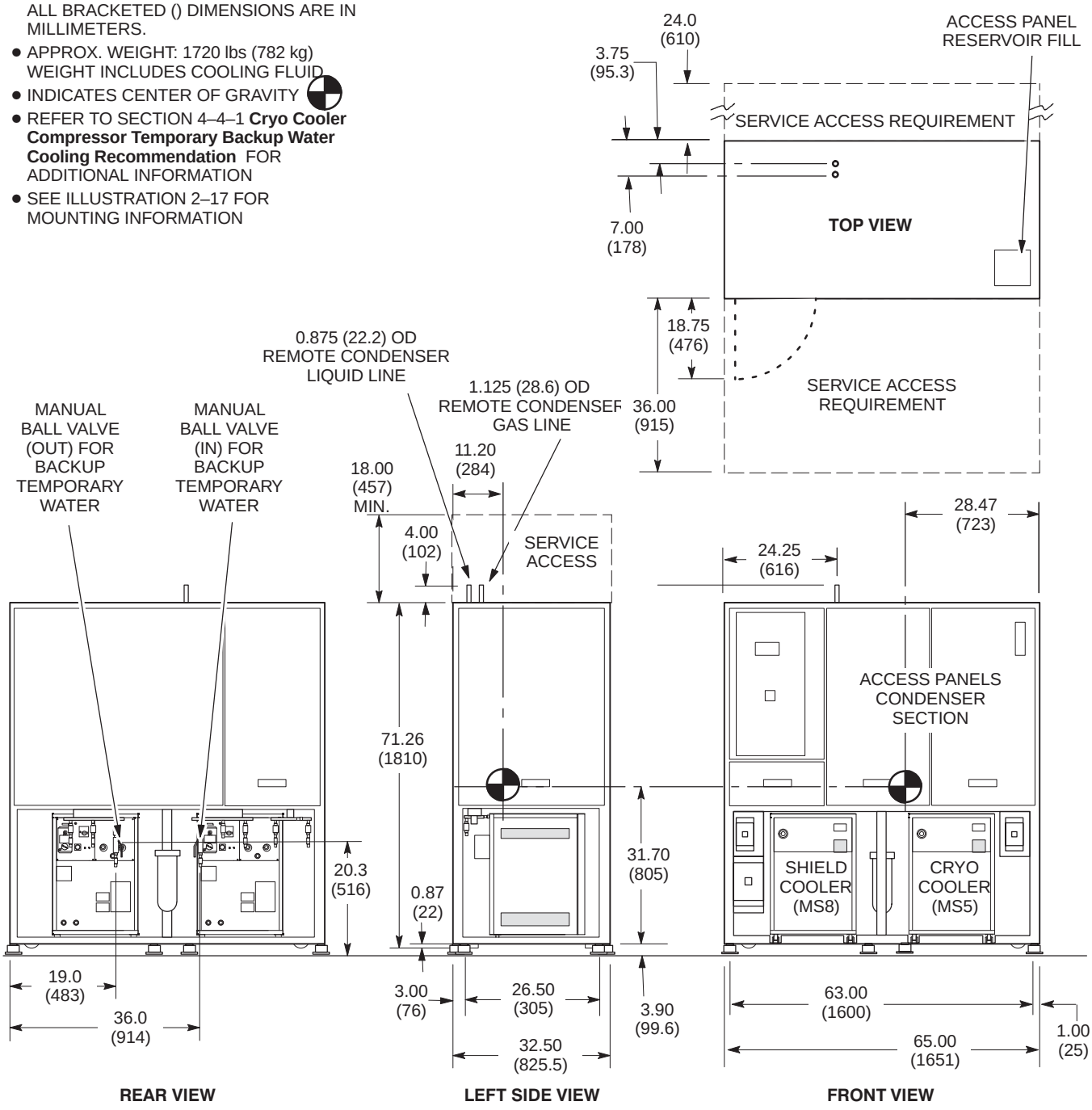
- ALL DIMENSIONS ARE IN INCHES ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.
- APPROX. WEIGHT: 260 lbs. (118 kg)
- MDP TO BE INSTALLED SO TOP OF UPPER CIRCUIT BREAKER HANDLE IN 'ON' POSITION DOES NOT EXCEED 6 FT 7 IN. (2 M) PER NATIONAL ELECTRIC CODE (NEC) 2002 ARTICLE 404.8, NEC 1999 ARTICLE 380–8 OR NOT TO EXCEED HEIGHT SPECIFIED IN LOCAL/NATIONAL GOVERNING CODE.
- CONDUIT AREA MUST BE FIELD VERIFIED.



MAIN DISCONNECT PANEL (MDP)
ILLUSTRATION 2–11

NOTE:

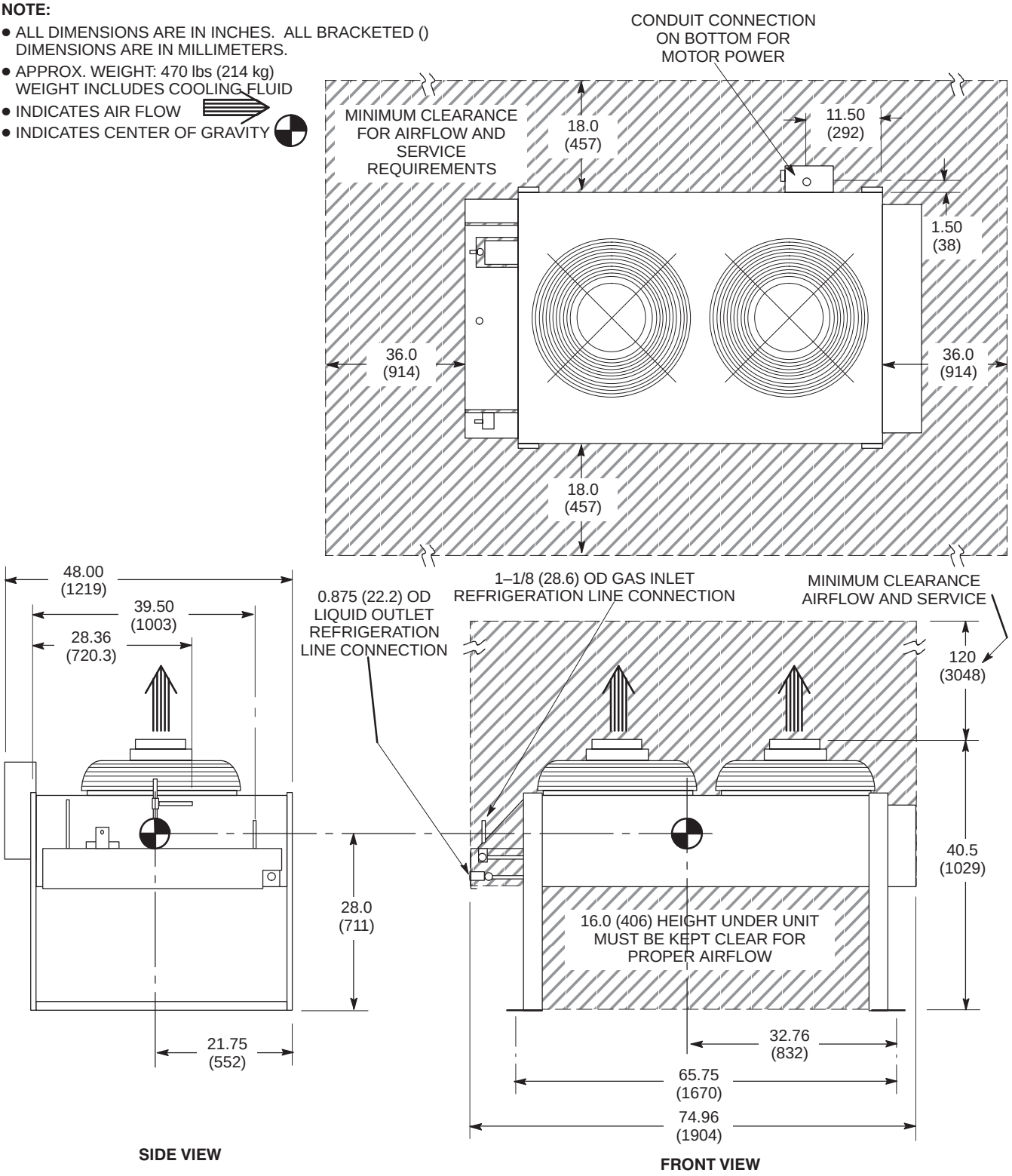
- ALL DIMENSIONS ARE IN INCHES ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.
- APPROX. WEIGHT: 1720 lbs (782 kg) WEIGHT INCLUDES COOLING FLUID
- INDICATES CENTER OF GRAVITY
- REFER TO SECTION 4–4–1 **Cryo Cooler Compressor Temporary Backup Water Cooling Recommendation** FOR ADDITIONAL INFORMATION
- SEE ILLUSTRATION 2–17 FOR MOUNTING INFORMATION



AIR COOLED SYSTEM COOLING CABINET [MODEL LC20M1/RAC] (SCC) UTILIZED WITH RCU
ILLUSTRATION 2–12

NOTE:

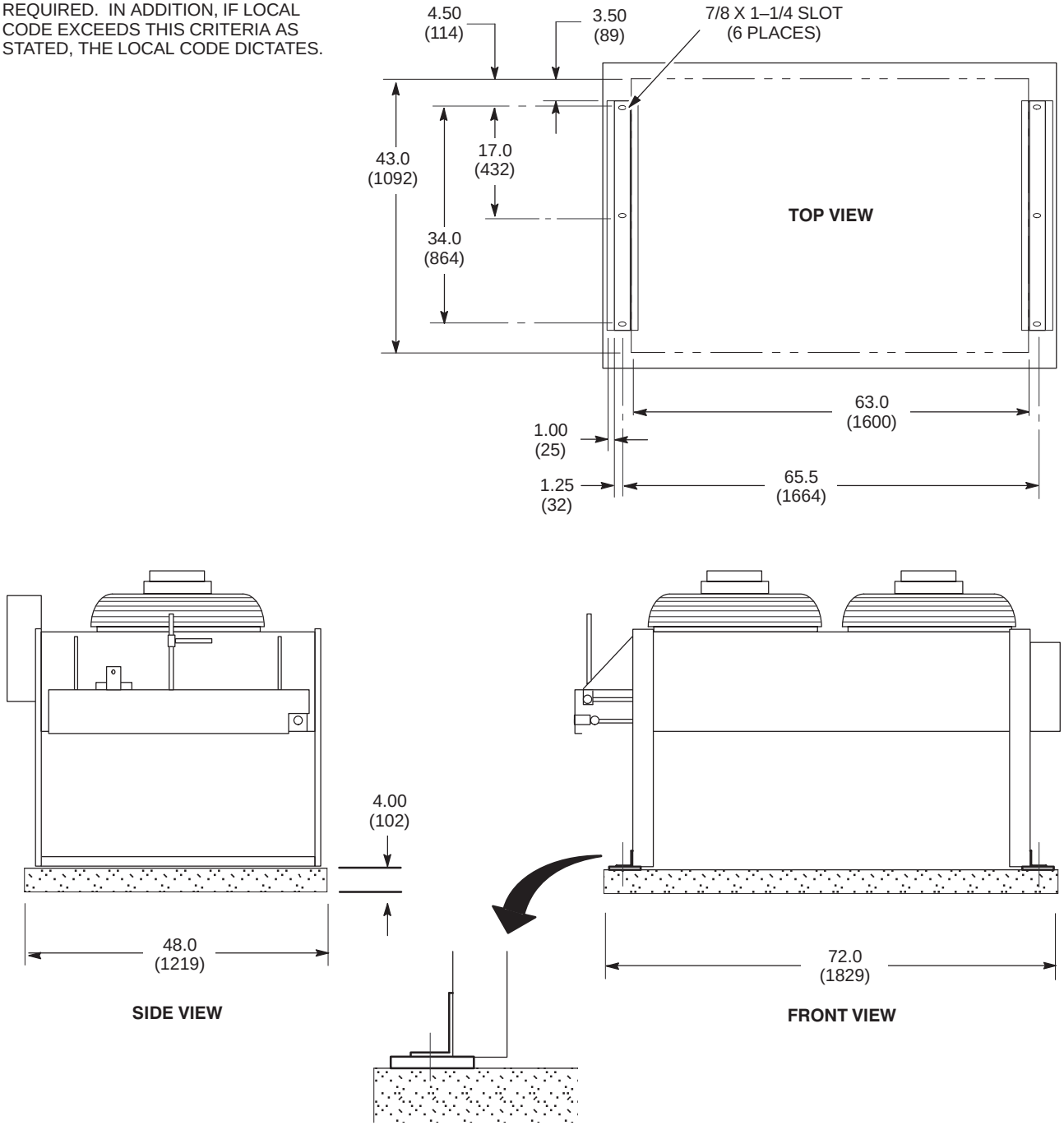
- ALL DIMENSIONS ARE IN INCHES. ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.
- APPROX. WEIGHT: 470 lbs (214 kg) WEIGHT INCLUDES COOLING FLUID
- INDICATES AIR FLOW
- INDICATES CENTER OF GRAVITY



REMOTE CONDENSER UNIT [MODEL LC20M1/RAC] (RCU) FOR SCC
ILLUSTRATION 2–13

NOTE:

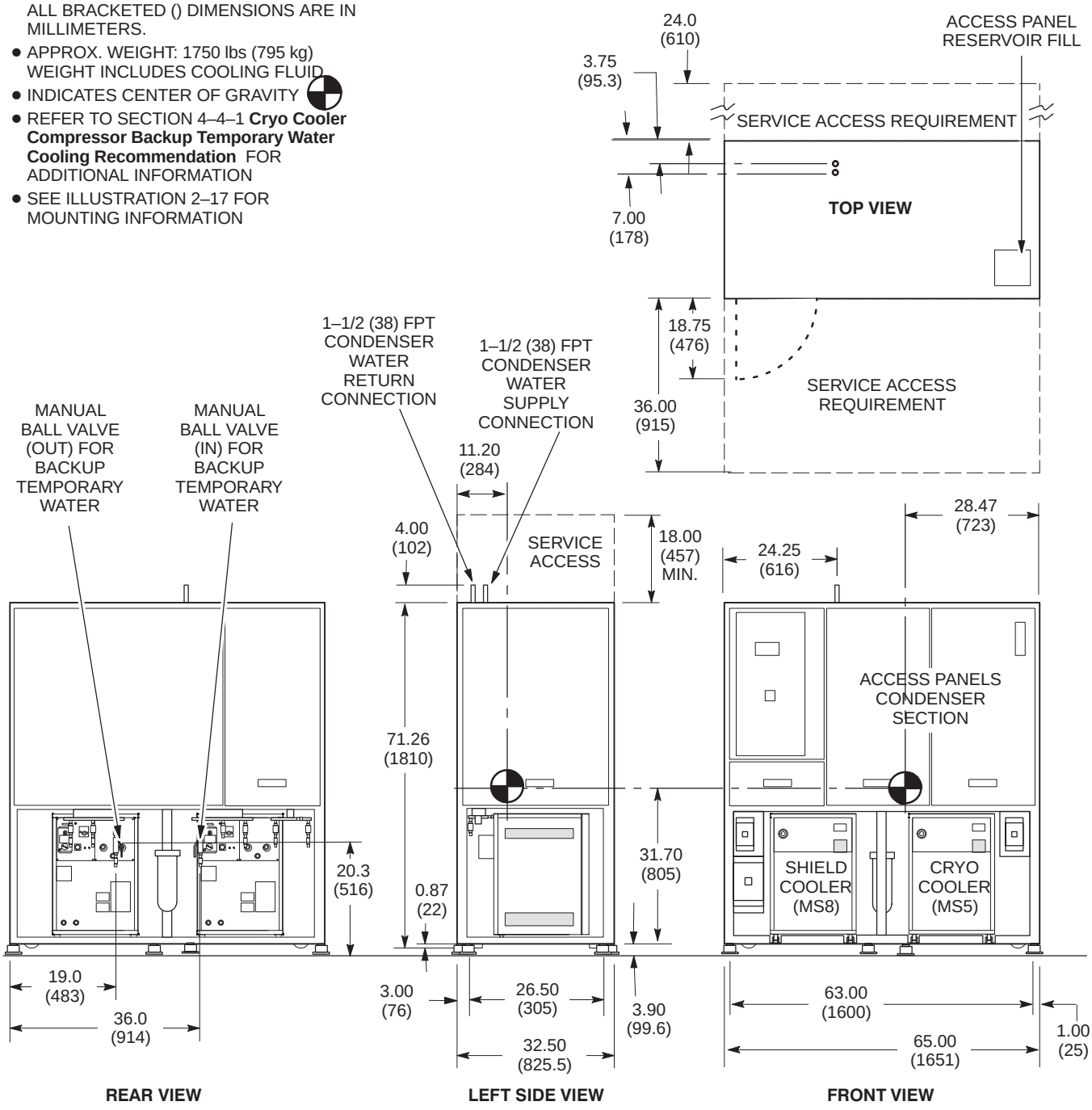
- ALL DIMENSIONS ARE IN INCHES. ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.
- MINIMUM 4 INCH (102 MM) DEEP CONCRETE PAD OF 2500 PSI CONCRETE REQUIRED. IN ADDITION, IF LOCAL CODE EXCEEDS THIS CRITERIA AS STATED, THE LOCAL CODE DICTATES.



REMOTE CONDENSER UNIT [MODEL LC20M1/RAC] (RCU) GROUND LEVEL MOUNTING
ILLUSTRATION 2–14

NOTE:

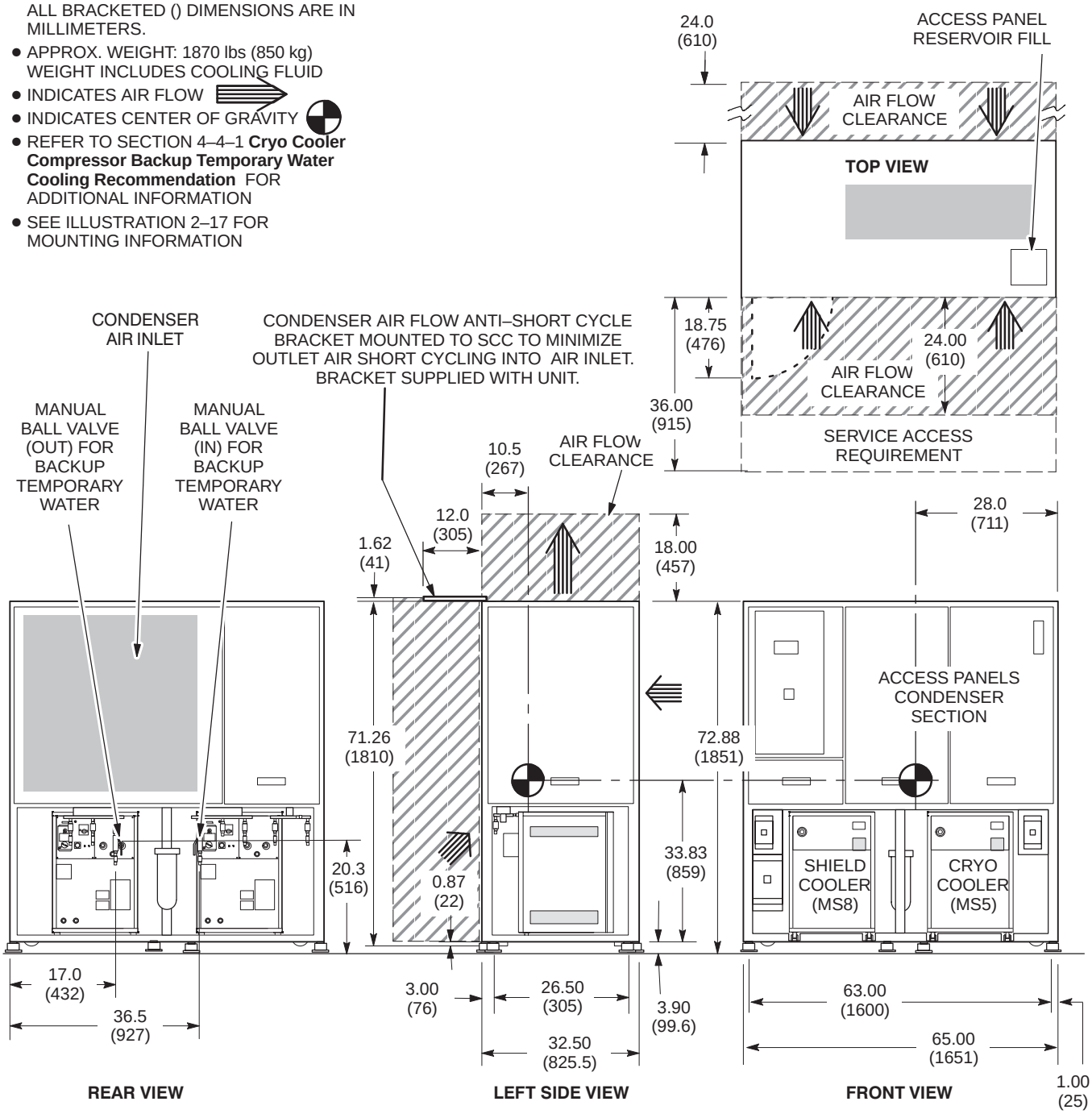
- ALL DIMENSIONS ARE IN INCHES ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.
- APPROX. WEIGHT: 1750 lbs (795 kg) WEIGHT INCLUDES COOLING FLUID
- INDICATES CENTER OF GRAVITY
- REFER TO SECTION 4–4–1 **Cryo Cooler Compressor Backup Temporary Water Cooling Recommendation** FOR ADDITIONAL INFORMATION
- SEE ILLUSTRATION 2–17 FOR MOUNTING INFORMATION



WATER COOLED SYSTEM COOLING CABINET [MODEL LC20M1/WC] (SCC)
ILLUSTRATION 2–15

NOTE:

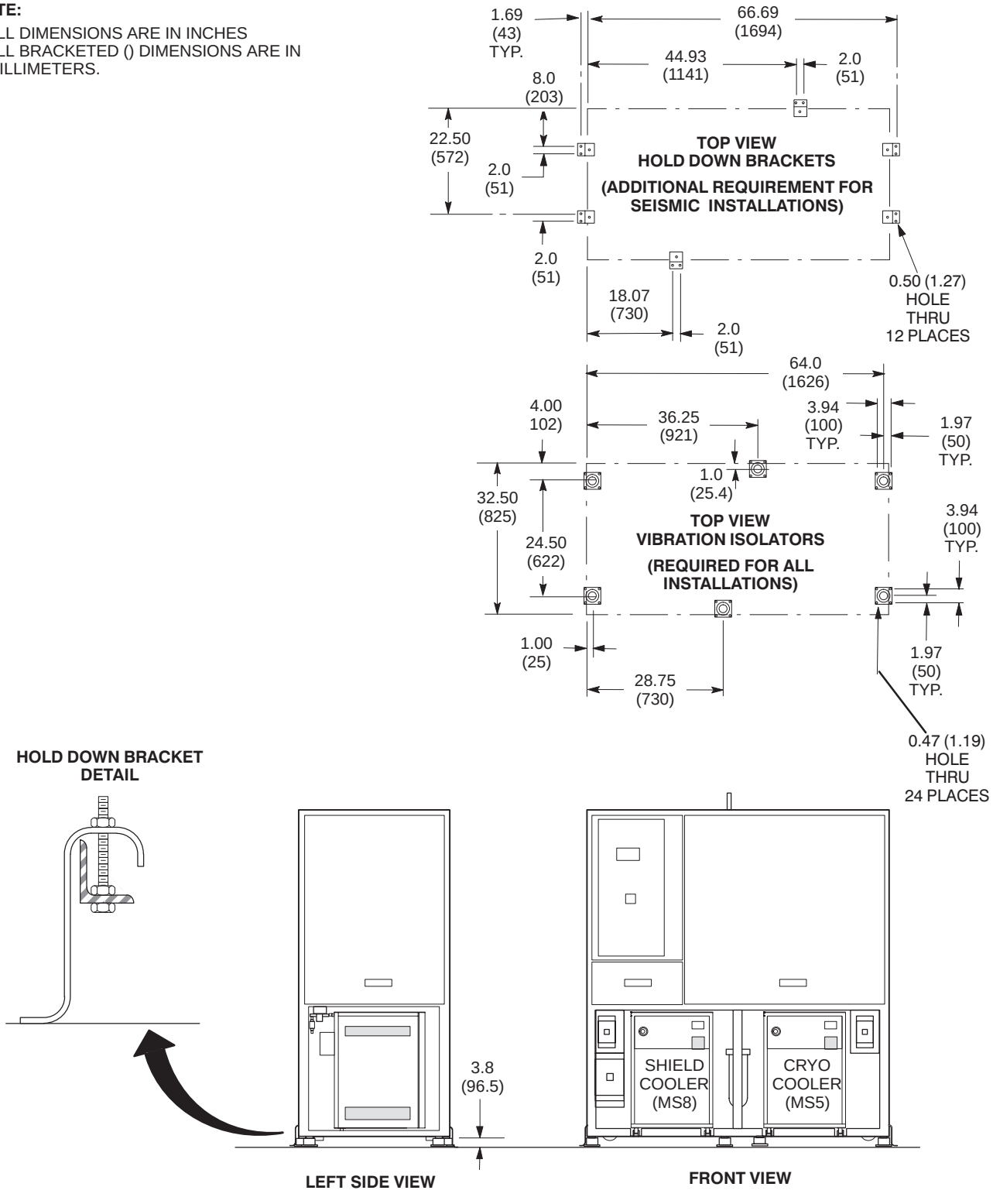
- ALL DIMENSIONS ARE IN INCHES ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.
- APPROX. WEIGHT: 1870 lbs (850 kg) WEIGHT INCLUDES COOLING FLUID
- INDICATES AIR FLOW
- INDICATES CENTER OF GRAVITY
- REFER TO SECTION 4–4–1 **Cryo Cooler Compressor Backup Temporary Water Cooling Recommendation** FOR ADDITIONAL INFORMATION
- SEE ILLUSTRATION 2–17 FOR MOUNTING INFORMATION



AIR COOLED SYSTEM COOLING CABINET [MODEL LC20M1] (SCC)
ILLUSTRATION 2–16

NOTE:

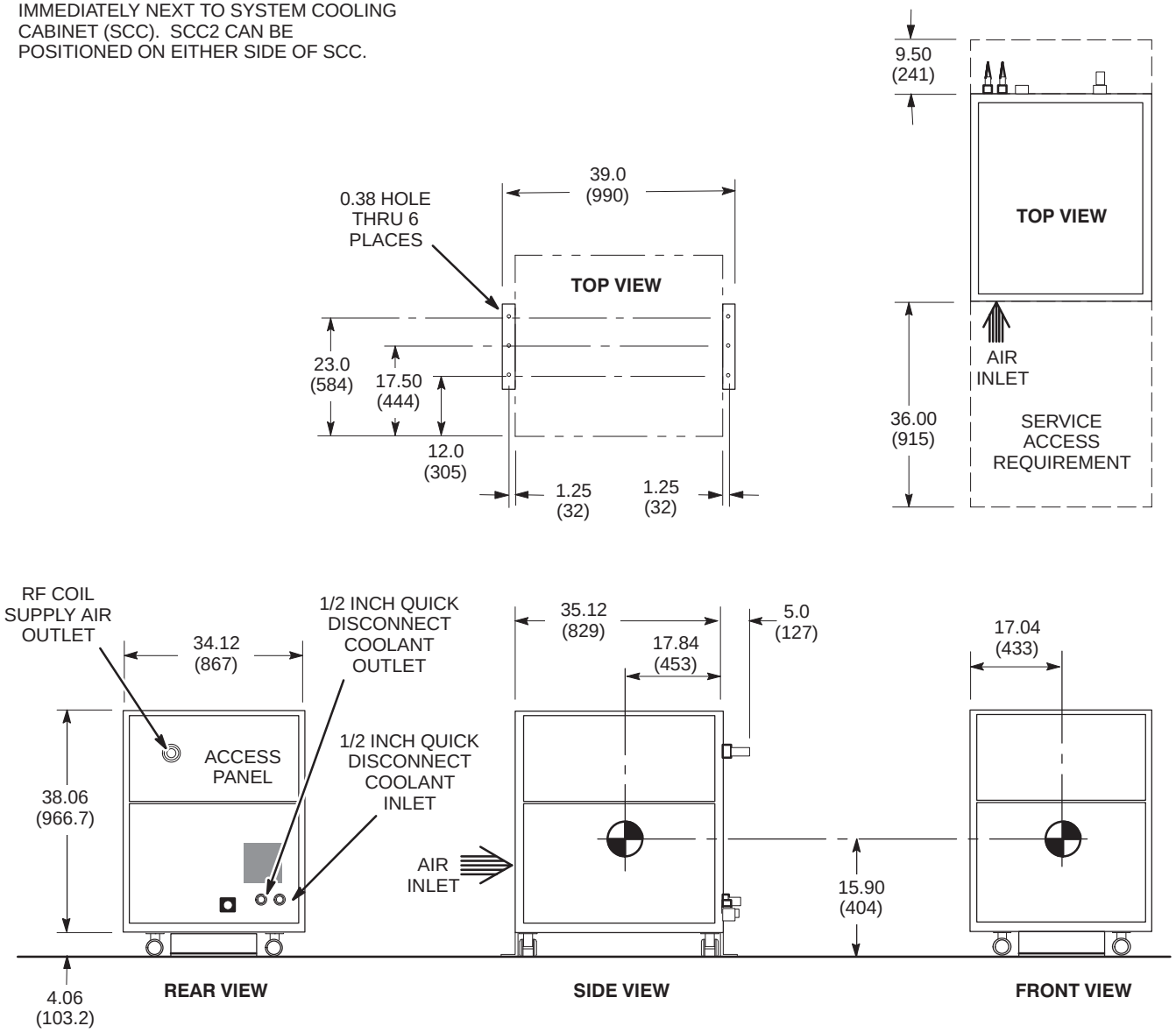
- ALL DIMENSIONS ARE IN INCHES ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.



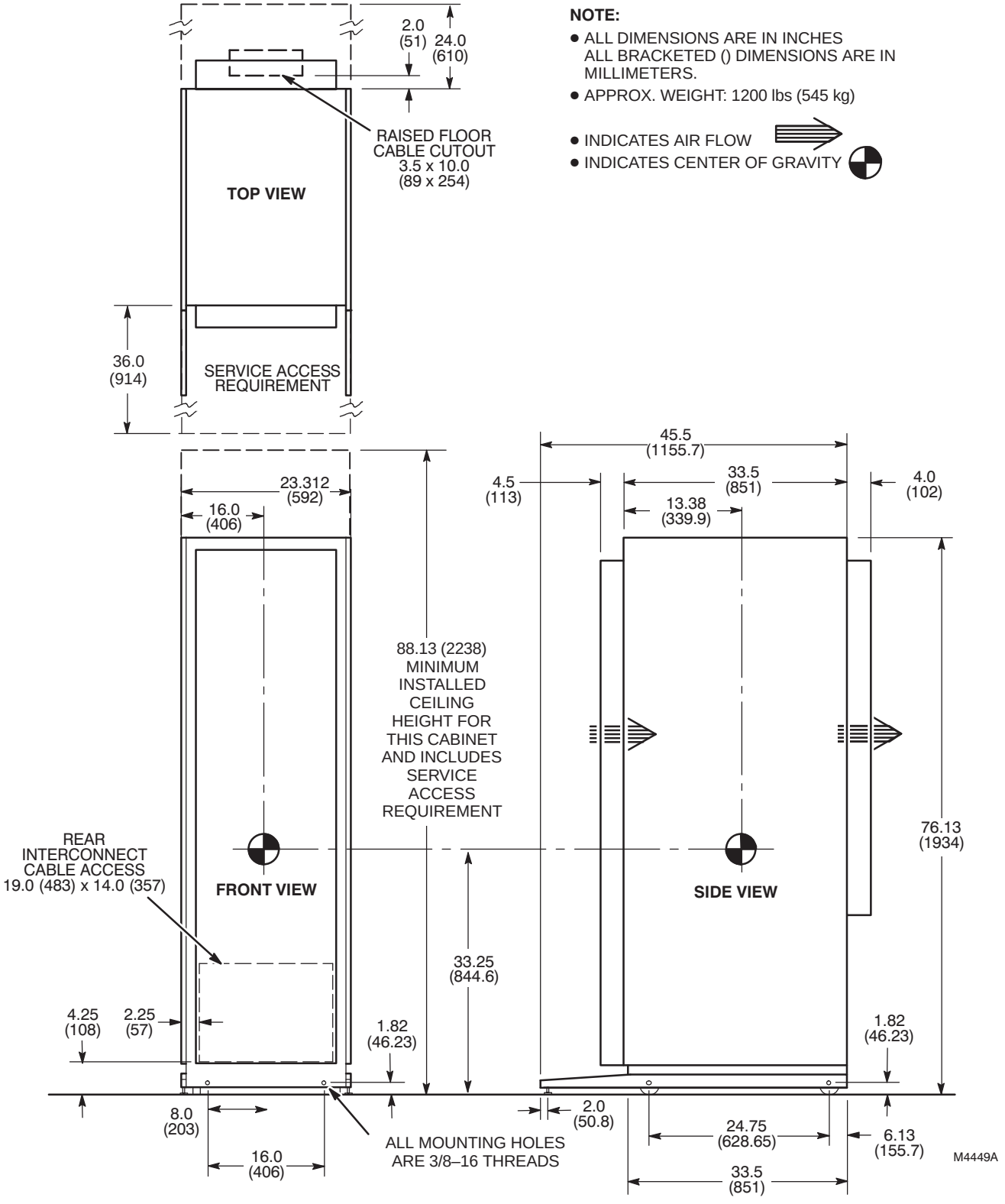
SYSTEM COOLING CABINET (SCC) MOUNTING
ILLUSTRATION 2–17

NOTE:

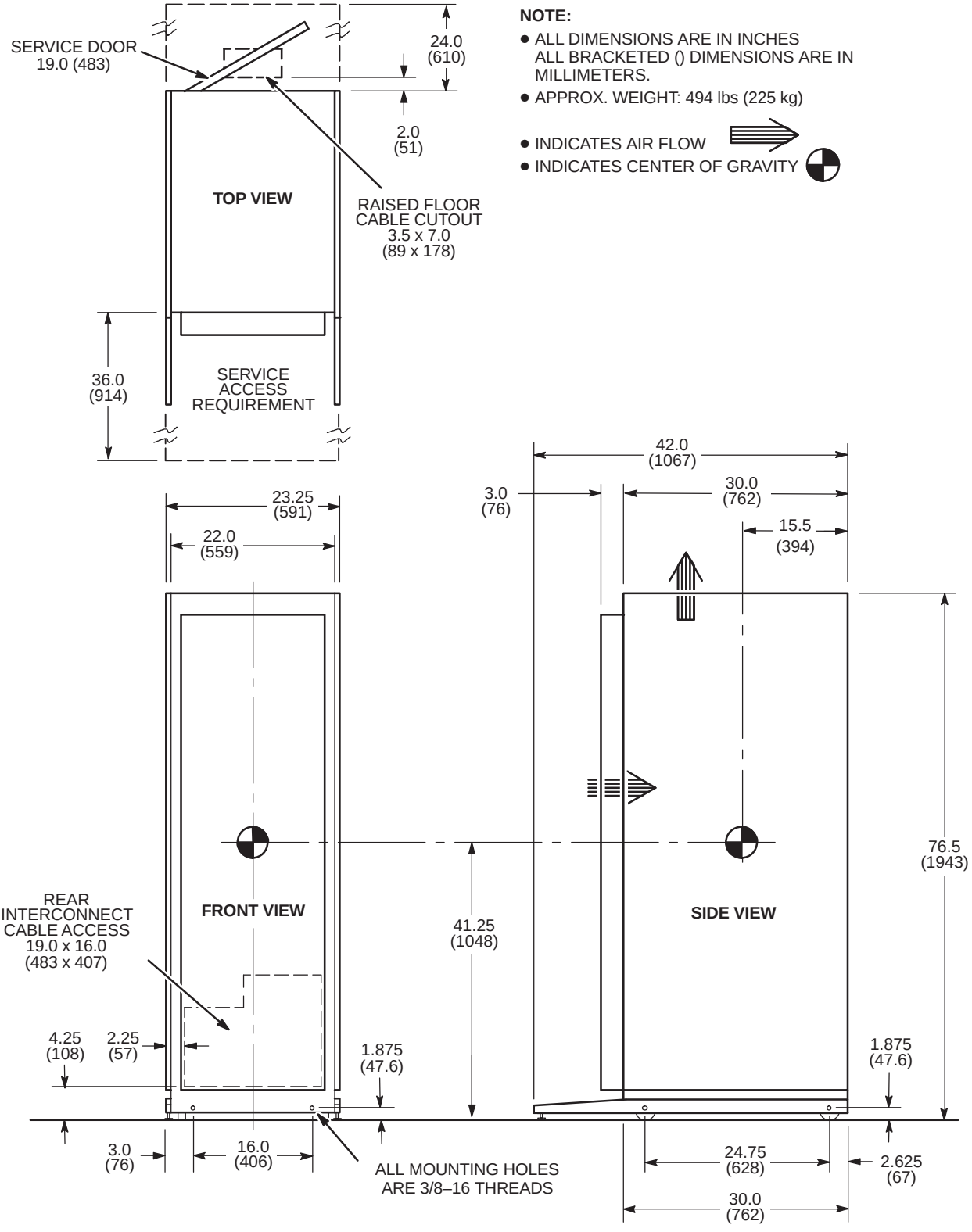
- ALL DIMENSIONS ARE IN INCHES ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.
- APPROX. WEIGHT: 550 lbs (250 kg) WEIGHT INCLUDES COOLING FLUID
- INDICATES AIR INLET
- INDICATES CENTER OF GRAVITY
- THIS CABINET MUST BE LOCATED IMMEDIATELY NEXT TO SYSTEM COOLING CABINET (SCC). SCC2 CAN BE POSITIONED ON EITHER SIDE OF SCC.



SYSTEM COOLING AUXILIARY CABINET [MODEL HPB–1] (SCC2)
ILLUSTRATION 2–18



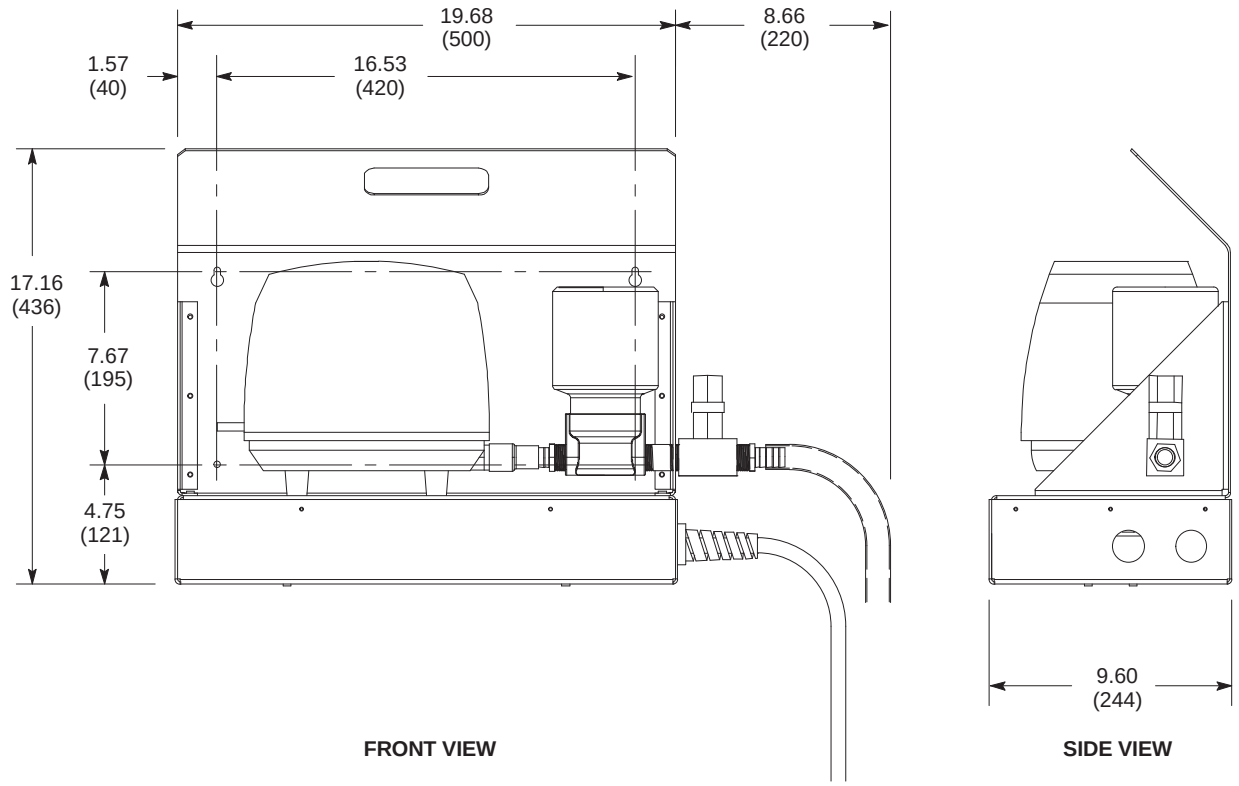
POWER CABINET (MR1)
ILLUSTRATION 2–19



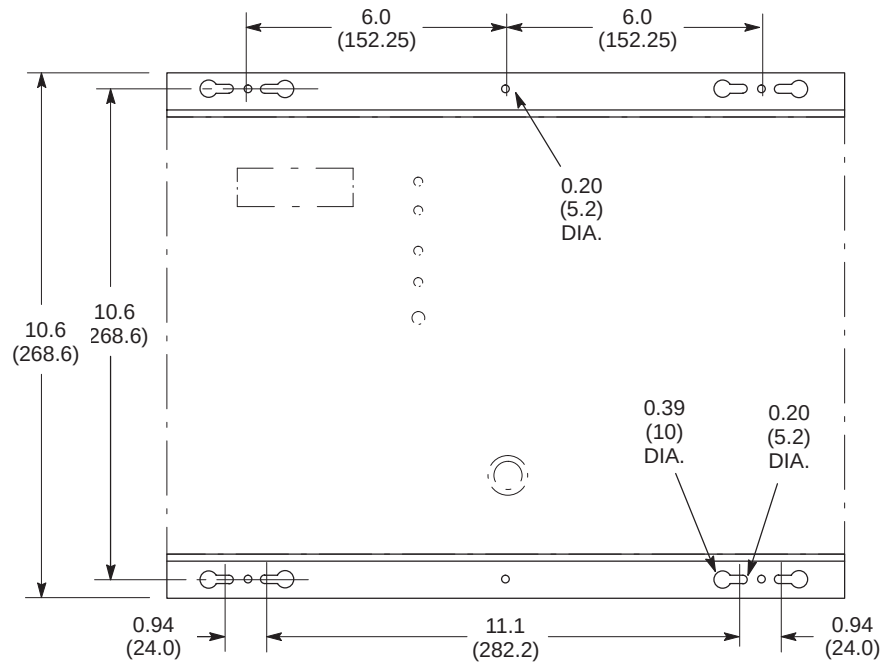
SYSTEM CABINET (MR2)
ILLUSTRATION 2–20

NOTE:

- ALL DIMENSIONS ARE IN INCHES ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.
- APPROX. WEIGHT: 45 lbs (20.5 kg)



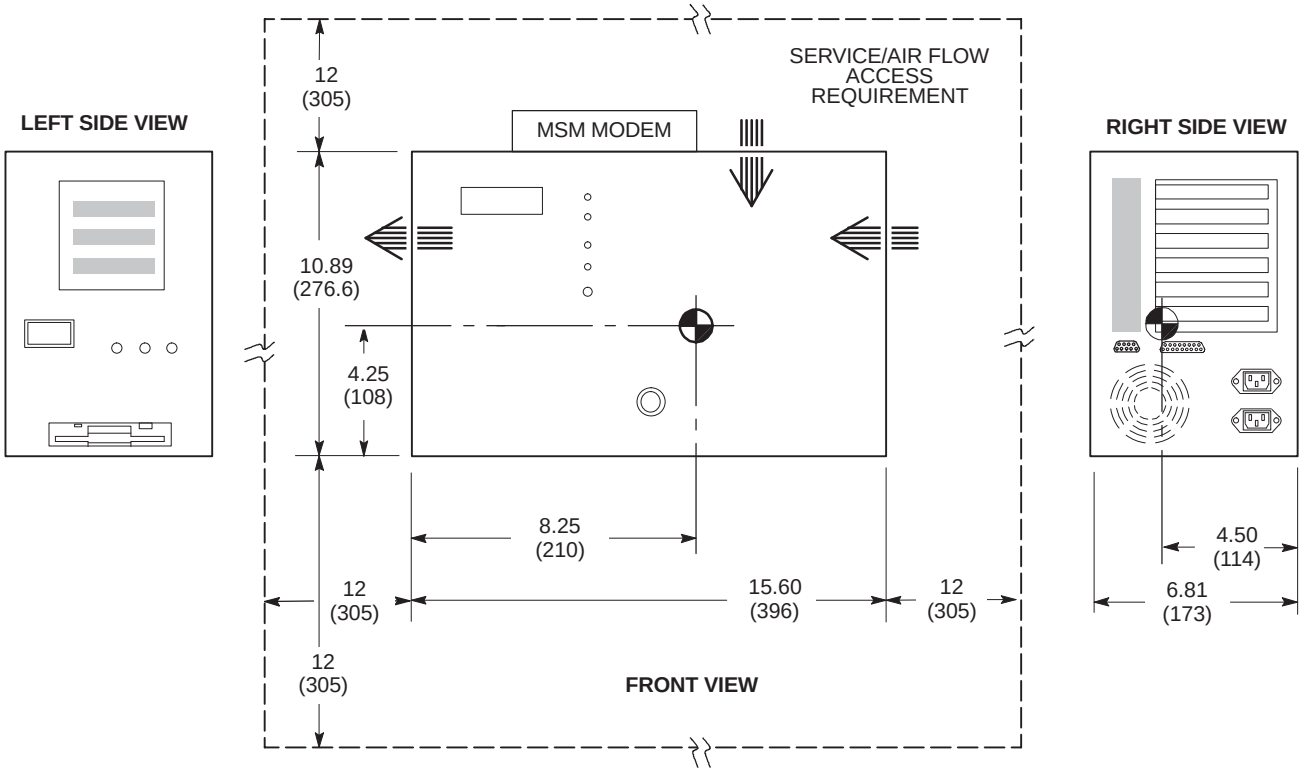
PATIENT COOLING COMPRESSOR
ILLUSTRATION 2–21



MOUNTING PATTERN

NOTE:

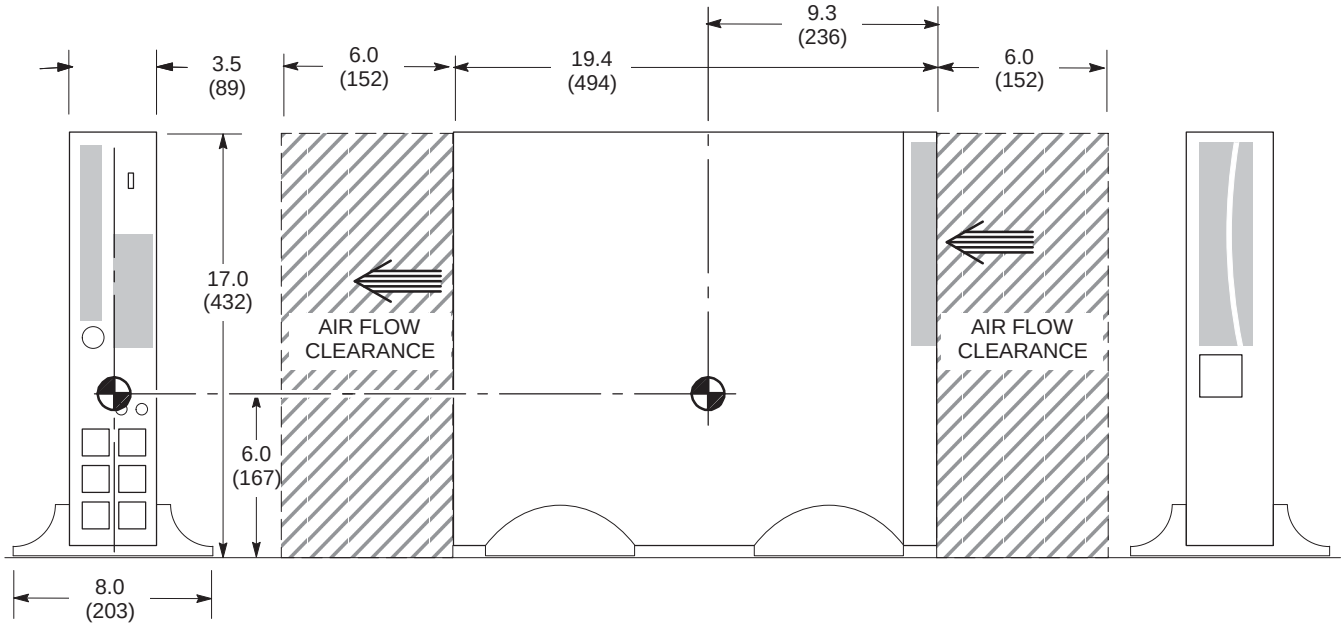
- ALL DIMENSIONS ARE IN INCHES ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.
- APPROX. WEIGHT: 22 lbs (10 kg)
- INDICATES AIR FLOW
- INDICATES CENTER OF GRAVITY



MAGNET MONITOR (MSM)
ILLUSTRATION 2–22

NOTE:

- ALL DIMENSIONS ARE IN INCHES ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.
- APPROX. WEIGHT: 50 lbs (23 kg)
- INDICATES AIR FLOW
- INDICATES CENTER OF GRAVITY

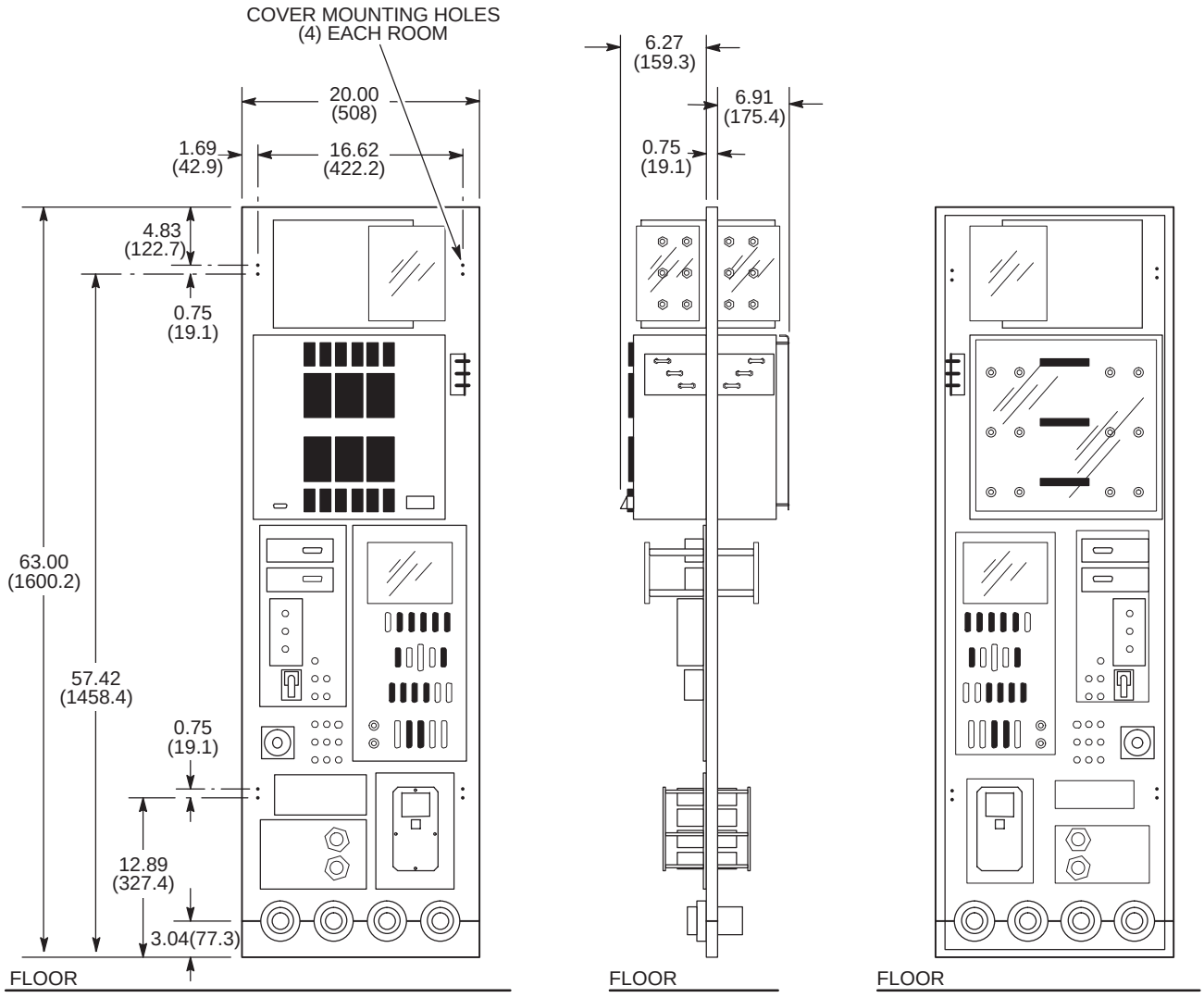


REAR VIEW **SIDE VIEW** **FRONT VIEW**

UPS FOR MAGNET MONITOR
ILLUSTRATION 2–23

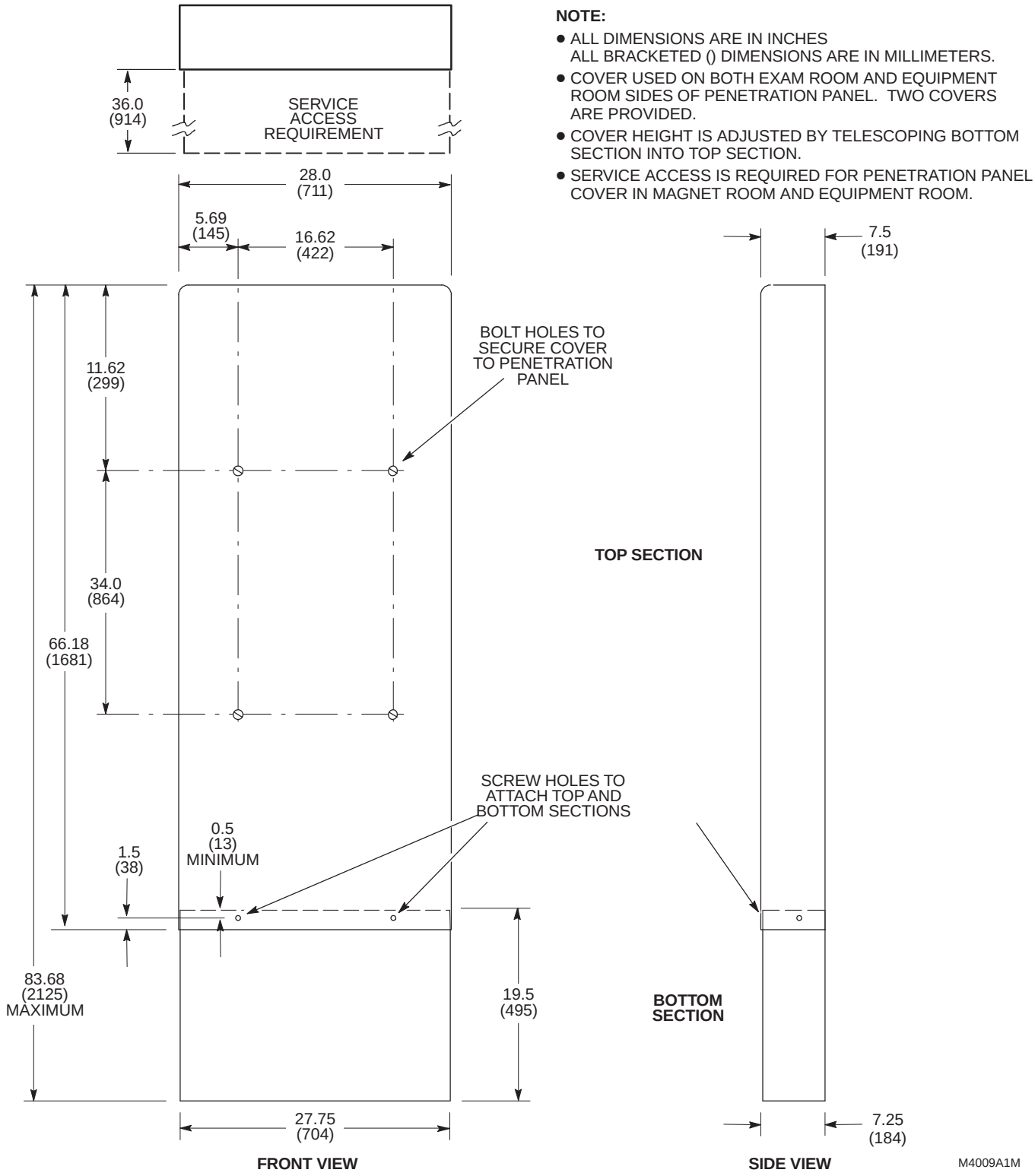
NOTE:

- ALL DIMENSIONS ARE IN INCHES
  ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.
- APPROXIMATE WEIGHT: 52 lbs (23.6 kg)
- SEE ILLUSTRATION 2–25 FOR SERVICE ACCESS REQUIRED FOR PENETRATION PANEL & COVERS IN MAGNET ROOM AND EQUIPMENT ROOM.



M4528A

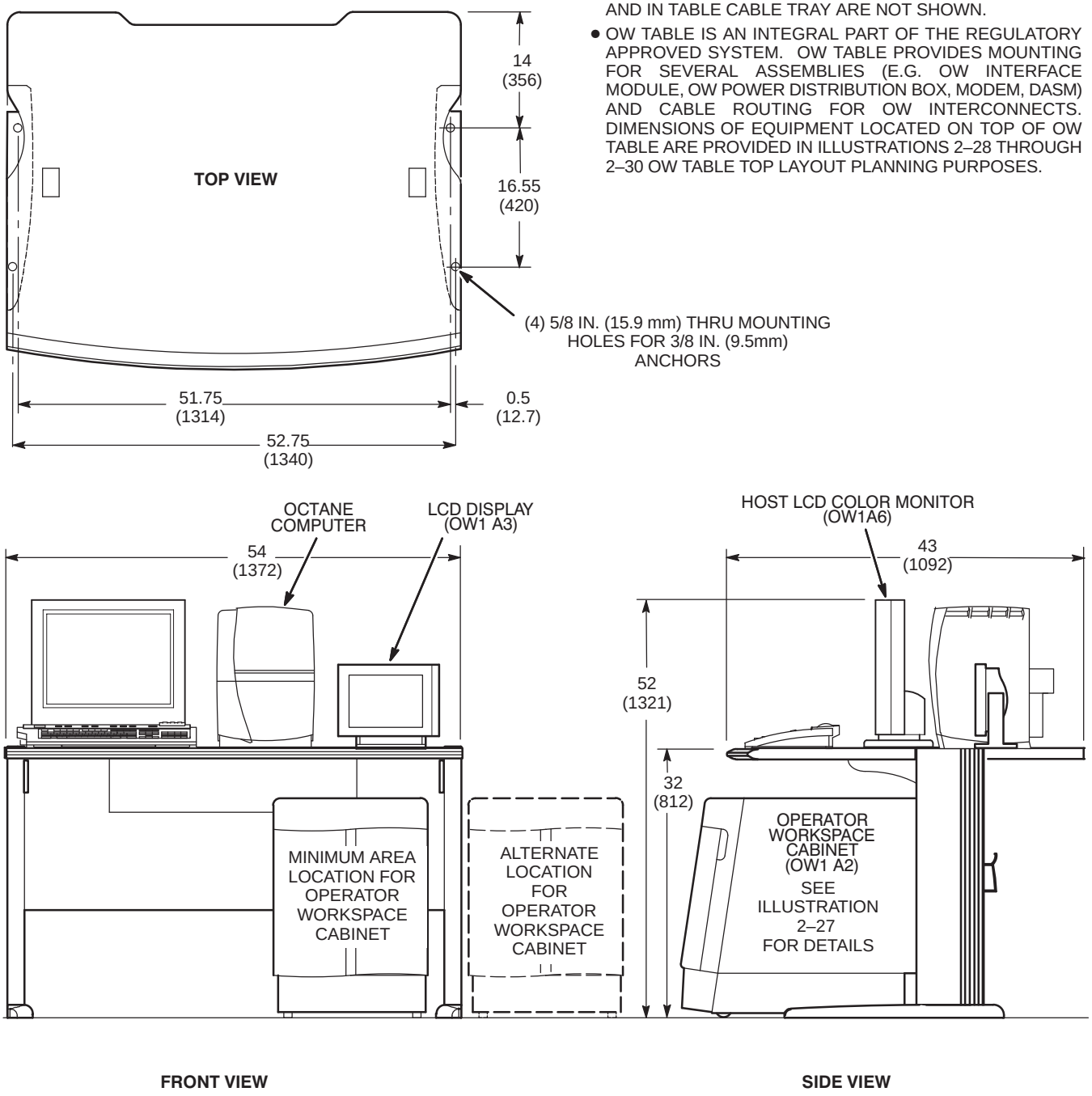
PENETRATION PANEL (PP1)
ILLUSTRATION 2–24



PENETRATION PANEL COVER
ILLUSTRATION 2–25

NOTE:

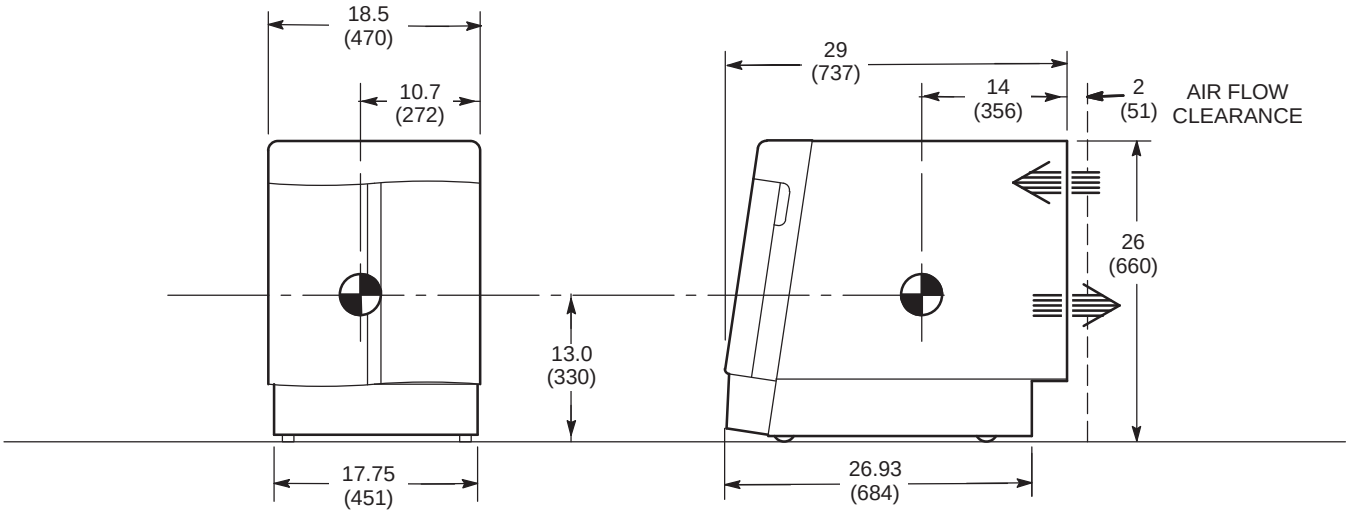
- ALL DIMENSIONS ARE IN INCHES.
  ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.
- ASSEMBLIES WHICH MOUNT TO UNDERSIDE OF TABLE AND IN TABLE CABLE TRAY ARE NOT SHOWN.
- OW TABLE IS AN INTEGRAL PART OF THE REGULATORY APPROVED SYSTEM. OW TABLE PROVIDES MOUNTING FOR SEVERAL ASSEMBLIES (E.G. OW INTERFACE MODULE, OW POWER DISTRIBUTION BOX, MODEM, DASM) AND CABLE ROUTING FOR OW INTERCONNECTS. DIMENSIONS OF EQUIPMENT LOCATED ON TOP OF OW TABLE ARE PROVIDED IN ILLUSTRATIONS 2–28 THROUGH 2–30 OW TABLE TOP LAYOUT PLANNING PURPOSES.



OPERATOR WORKSPACE (OW1)
ILLUSTRATION 2–26

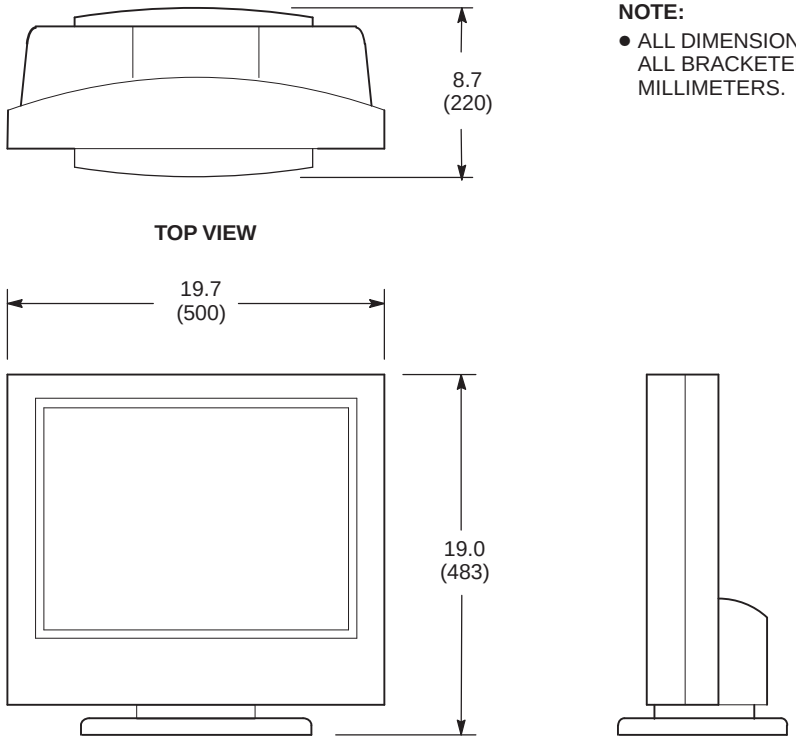
NOTE:

- ALL DIMENSIONS ARE IN INCHES ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.
- APPROX. WEIGHT: 192 lbs (87 kg)
- INDICATES AIR FLOW
- INDICATES CENTER OF GRAVITY



FRONT VIEW **SIDE VIEW**

OPERATOR WORKSPACE CABINET (OW1 A2)
ILLUSTRATION 2–27

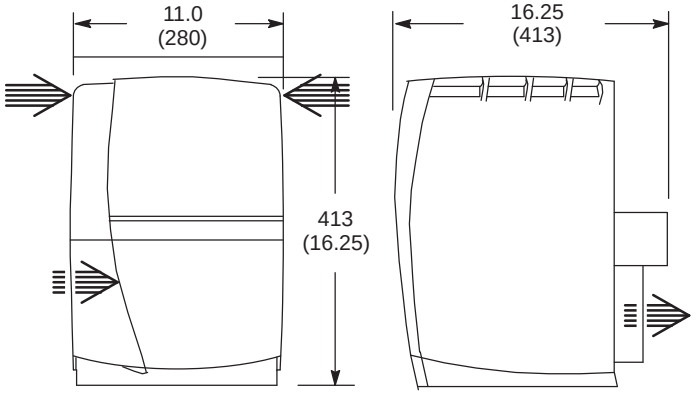


TOP VIEW

FRONT VIEW **SIDE VIEW**

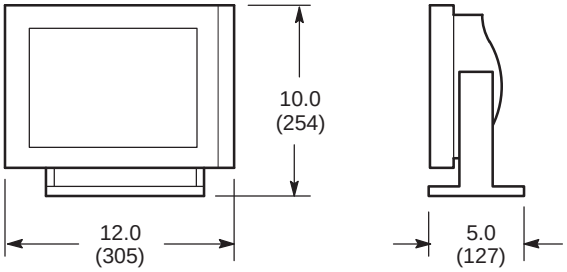
NOTE:
- ALL DIMENSIONS ARE IN INCHES ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.

OPERATOR WORKSPACE COMPONENTS POSITIONED ON TABLE TOP – LCD COLOR MONITOR
ILLUSTRATION 2–28



FRONT VIEW **SIDE VIEW**

OCTANE COMPUTER

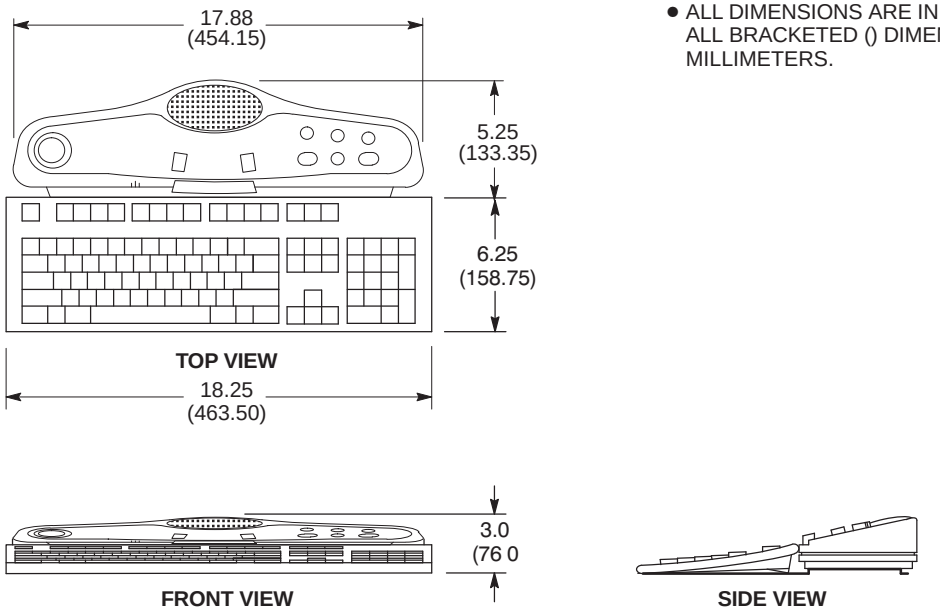


FRONT VIEW **SIDE VIEW**

LCD DISPLAY

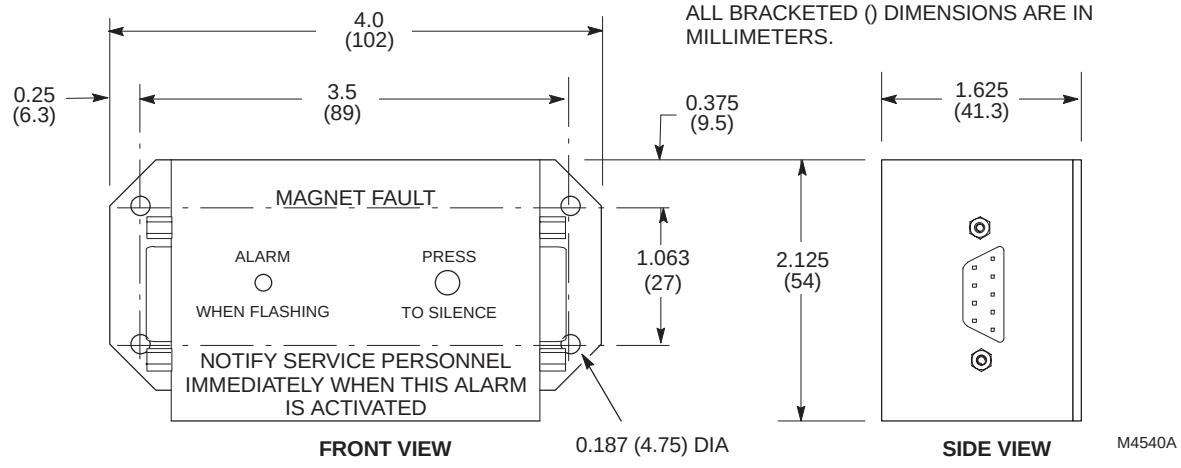
NOTE:
- ALL DIMENSIONS ARE IN INCHES ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.
- INDICATES AIR FLOW

OPERATOR WORKSPACE COMPONENTS POSITIONED ON TABLE TOP – OCTANE COMPUTER
ILLUSTRATION 2–29



NOTE:
- ALL DIMENSIONS ARE IN INCHES ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.

OPERATOR WORKSPACE COMPONENTS POSITIONED ON TABLE TOP – KEYBOARD
ILLUSTRATION 2–30

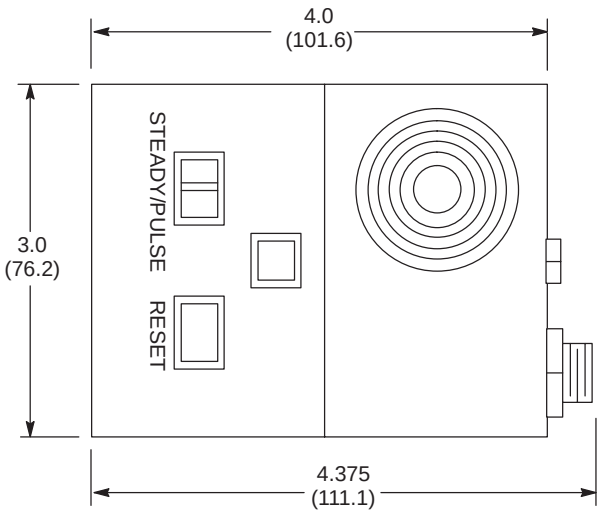


NOTE:
- ALL DIMENSIONS ARE IN INCHES ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.

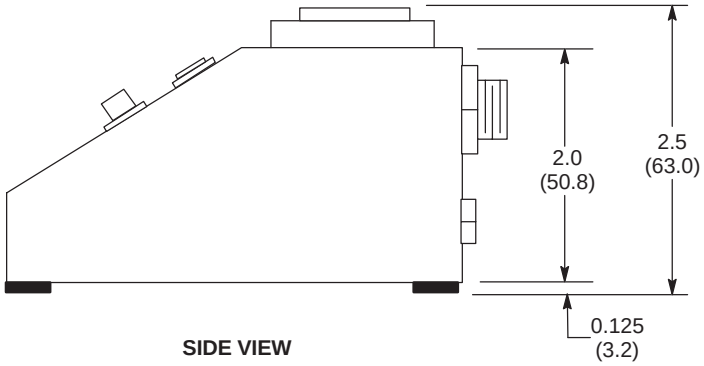
MAGNET MONITOR REMOTE ALARM BOX (MSM2) POSITIONED ON OW TABLE TOP
ILLUSTRATION 2–31

NOTE:

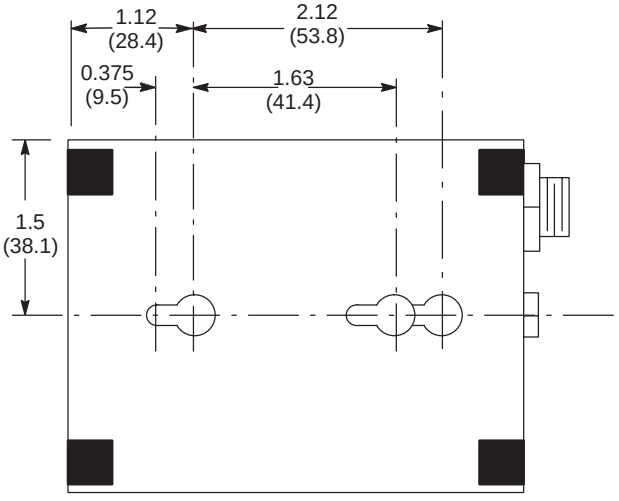
- ALL DIMENSIONS ARE IN INCHES. ALL BRACKETED ( ) DIMENSIONS ARE IN MILLIMETERS.
- APPROX. WEIGHT: 0.5 lbs (0.2 kg)



TOP VIEW



SIDE VIEW



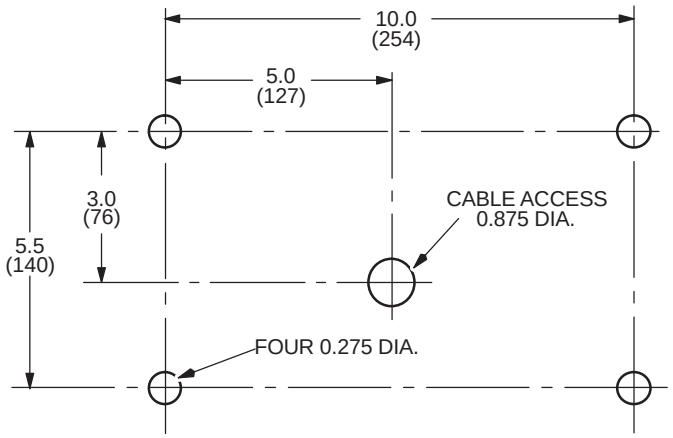
MOUNTING PATTERN

M4263A1

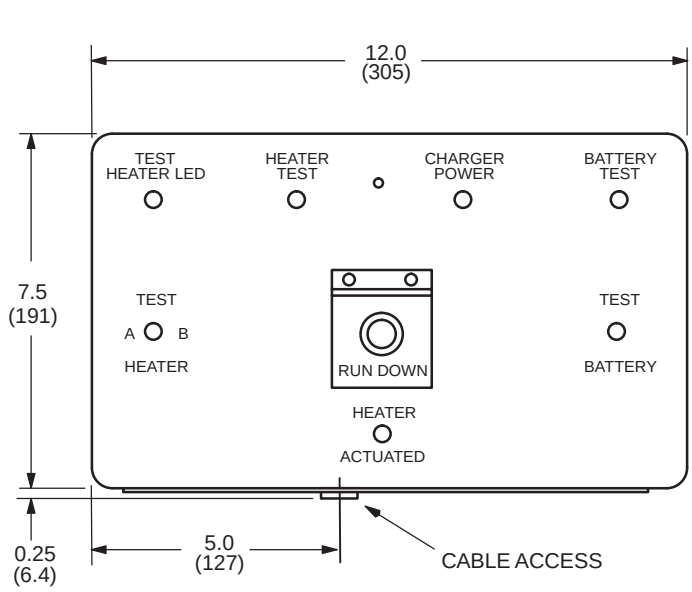
PNEUMATIC PATIENT ALERT CONTROL BOX (PA1)
ILLUSTRATION 2–32

NOTE:

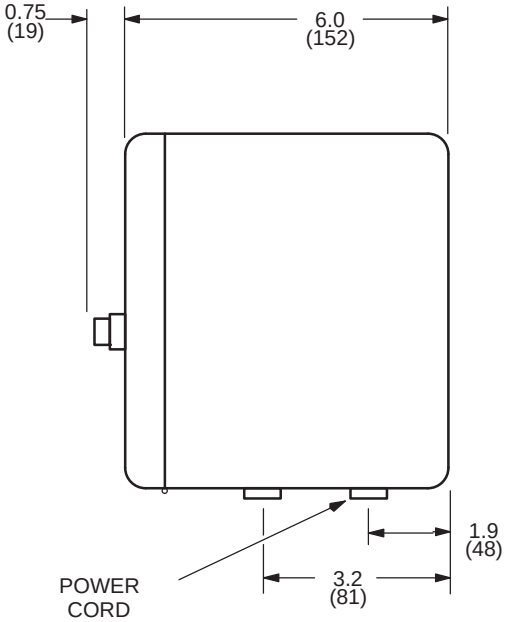
- ALL DIMENSIONS ARE IN INCHES. ALL BRACKETED ( ) DIMENSIONS ARE IN MILLIMETERS.
- APPROX. WEIGHT: 8.8 lbs. (4kg)



MOUNTING PATTERN



FRONT VIEW



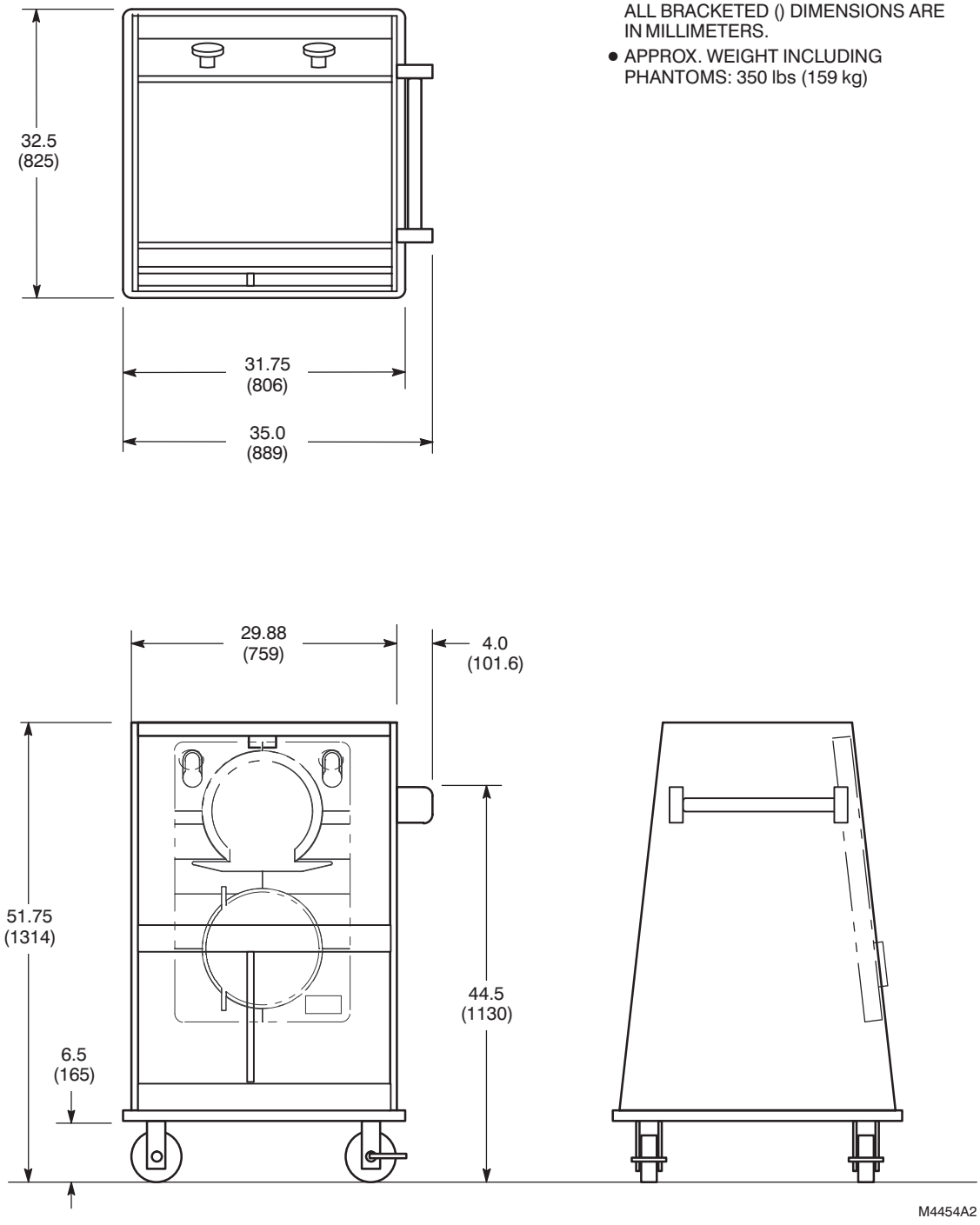
SIDE VIEW

M1517A5

MAGNET RUNDOWN UNIT (MS4)
ILLUSTRATION 2–33

NOTE:

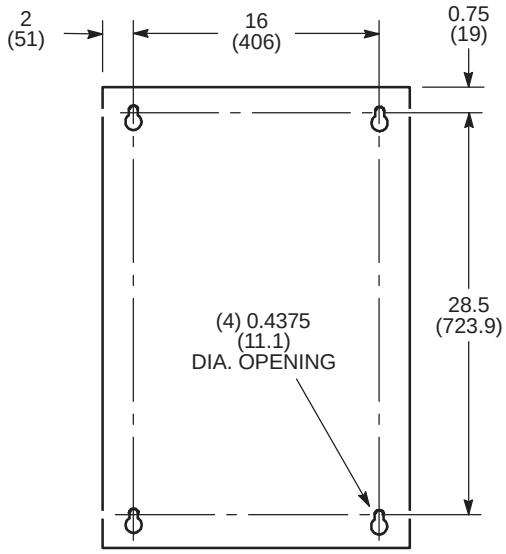
- ALL DIMENSIONS ARE IN INCHES ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.
- APPROX. WEIGHT INCLUDING PHANTOMS: 350 lbs (159 kg)



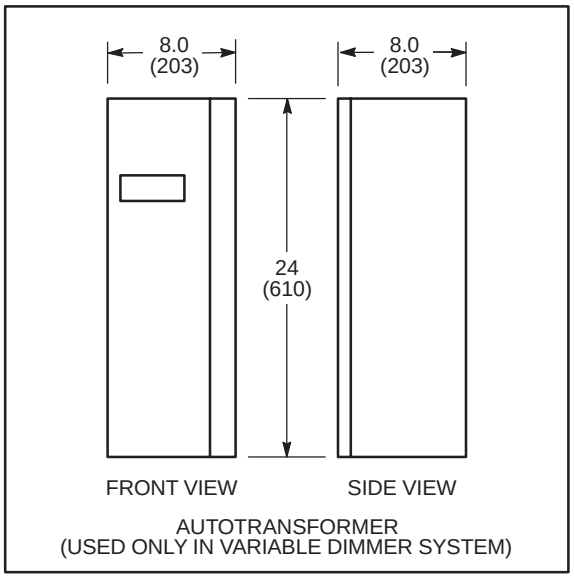
SPT PHANTOM SET SHIPPING/STORAGE CART
ILLUSTRATION 2–34

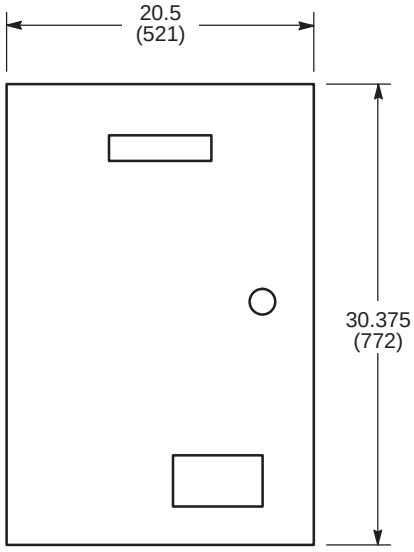
NOTE:

- ALL DIMENSIONS ARE IN INCHES
  ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.
- APPROX. WEIGHT
  CONTROL PANEL: 155 lbs (70 kg)
  AUTOTRANSFORMER: 60 lbs (27 kg)
- DC POWERED LIGHTING IS REQUIRED IN THE MAGNET ROOM PER SECTION 4–6 LIGHTING. ALSO REFER TO SECTION 1–4 FACILITY OPTIONS AND SECTION 5–8 DC LIGHTING CONTROLLER.

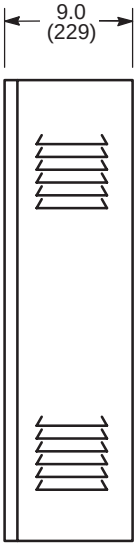


MOUNTING PATTERN
(CONTROL PANEL)





FRONT VIEW
(CONTROL PANEL)



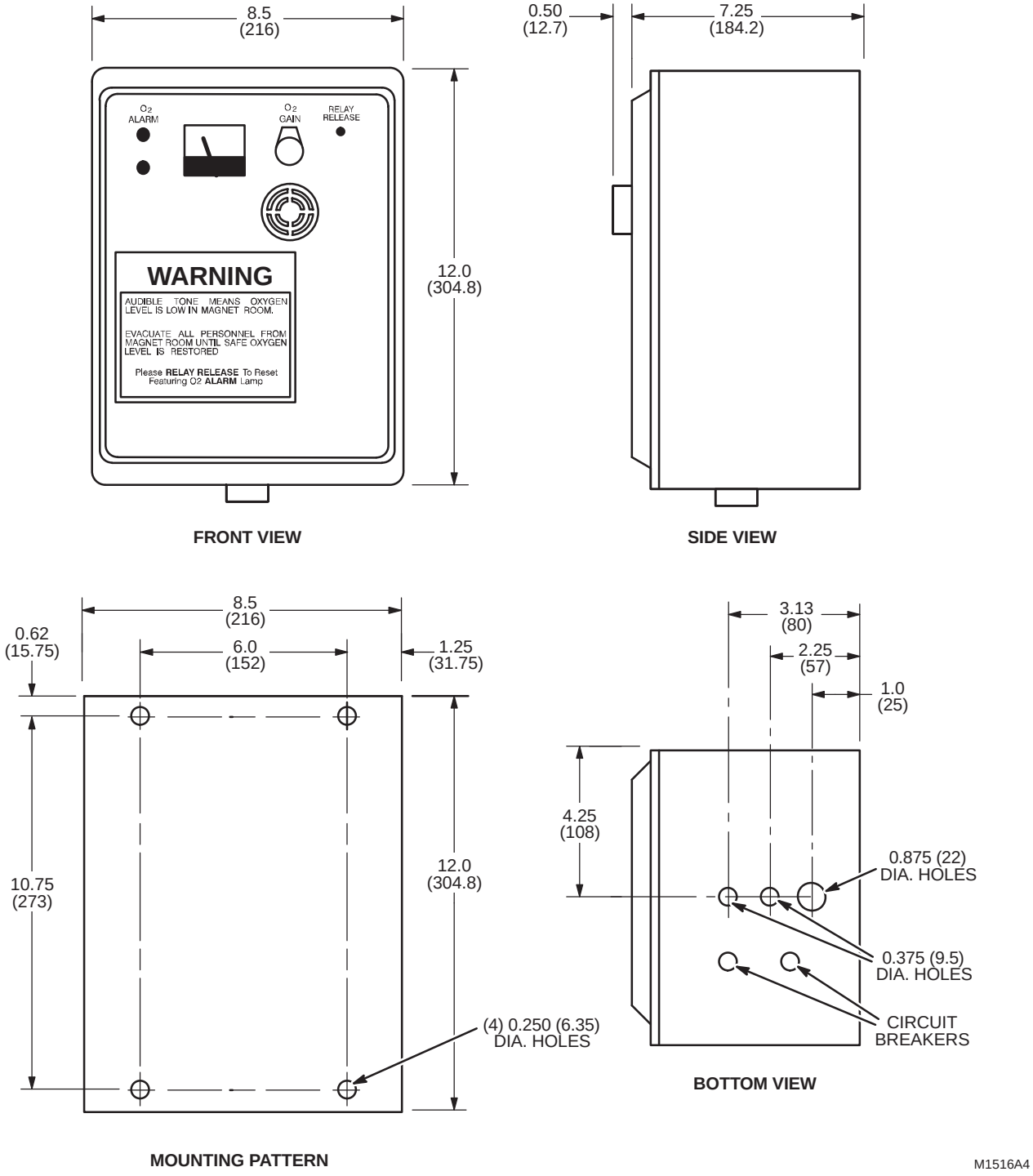
SIDE VIEW
(CONTROL PANEL)

M1519A3M

DC LIGHTING CONTROLLER – GE FACILITY OPTION
ILLUSTRATION 2–35

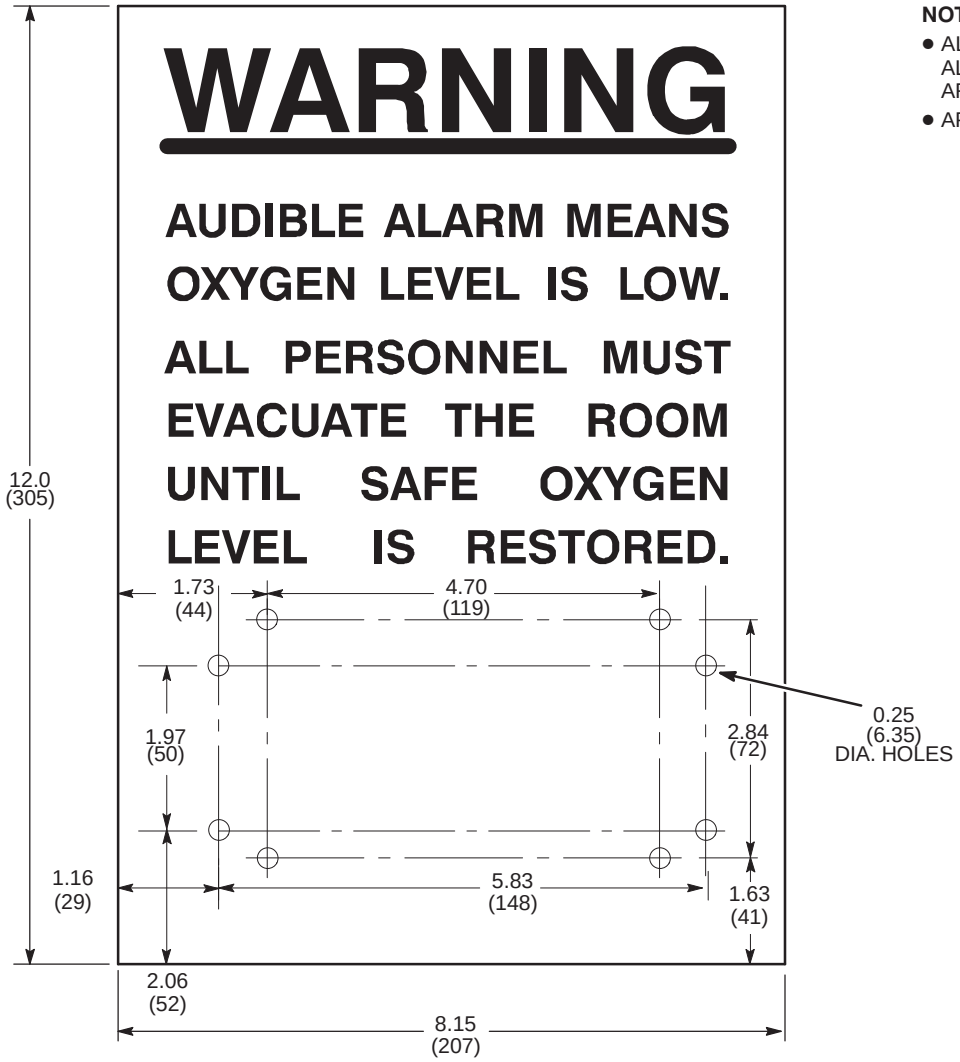
NOTE:

- ALL DIMENSIONS ARE IN INCHES. ALL BRACKETED ( ) DIMENSIONS ARE IN MILLIMETERS.
- APPROX. WEIGHT: 9 lbs (4.1 kg)

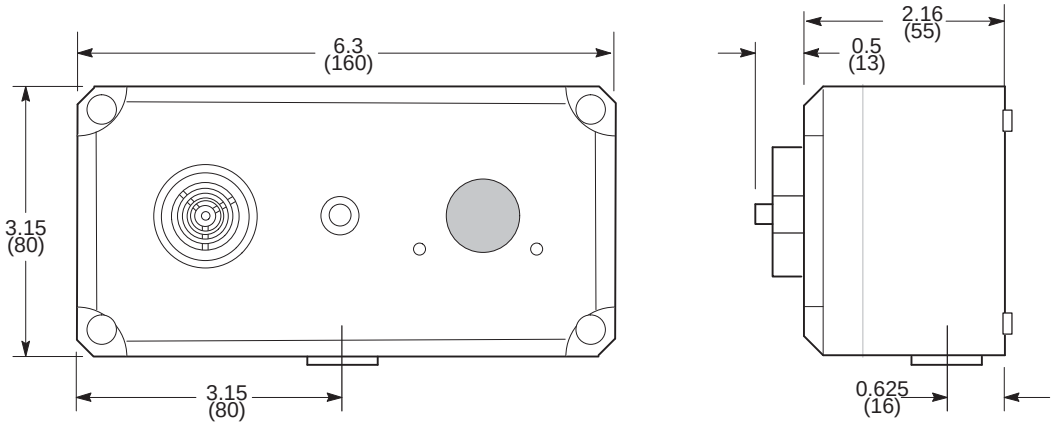


OXYGEN MONITOR (OM1) – OPTIONAL
ILLUSTRATION 2–36

NOTE:
- ALL DIMENSIONS ARE IN INCHES ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.
- APPROX. WEIGHT: 1.5 lbs (0.68 kg)



MOUNTING PATTERN

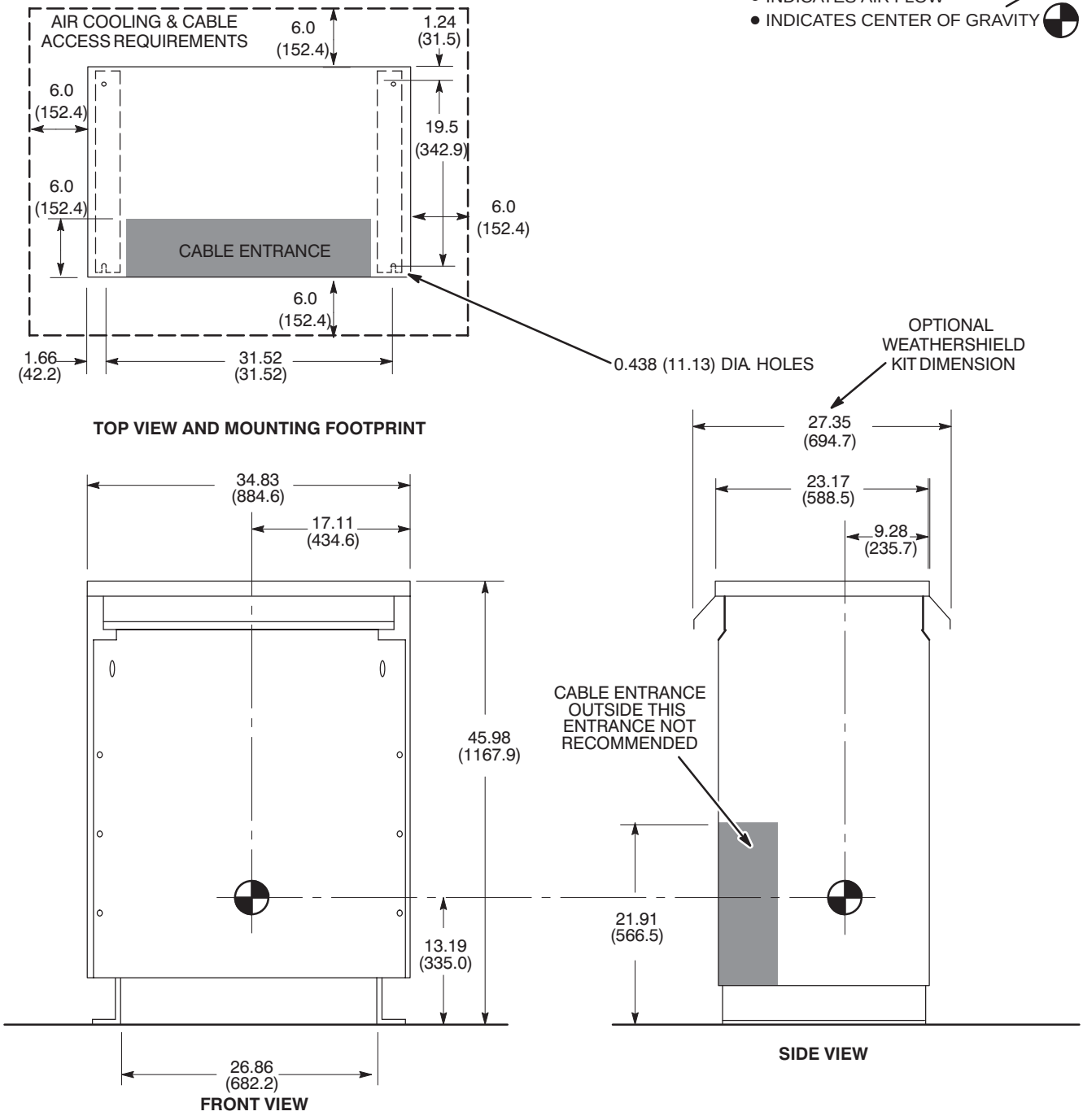


FRONT VIEW **SIDE VIEW**

M3346A1

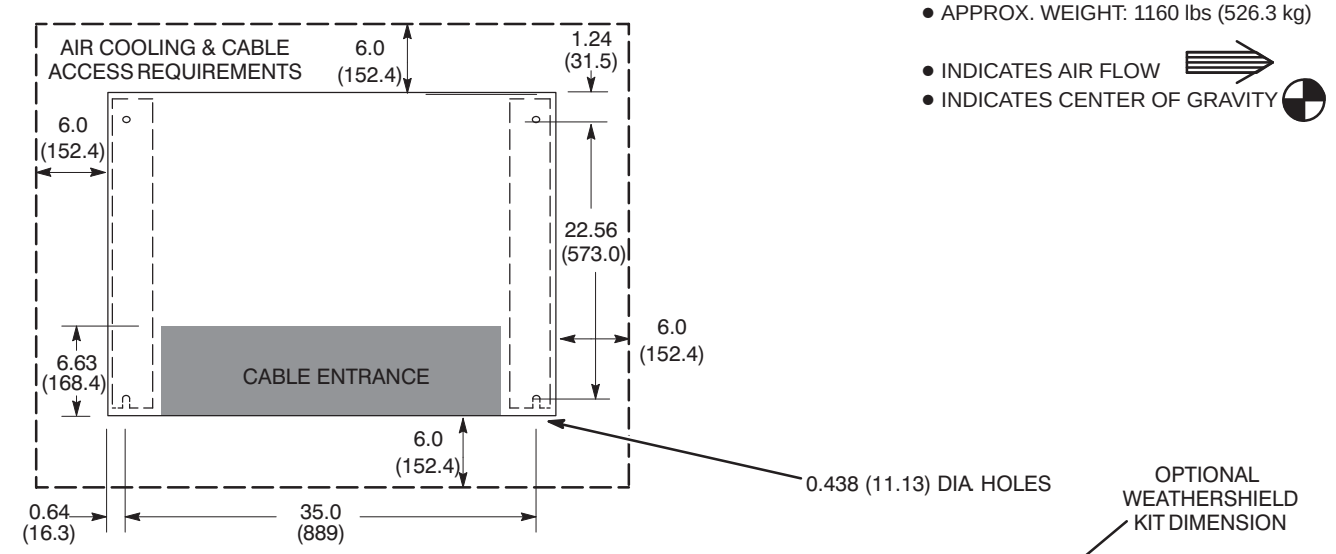
REMOTE OXYGEN SENSOR MODULE (OM3) – OPTIONAL
ILLUSTRATION 2–37

NOTE:
- ALL DIMENSIONS ARE IN INCHES ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.
- APPROX. WEIGHT: 875 lbs (397 kg)
- INDICATES AIR FLOW
- INDICATES CENTER OF GRAVITY

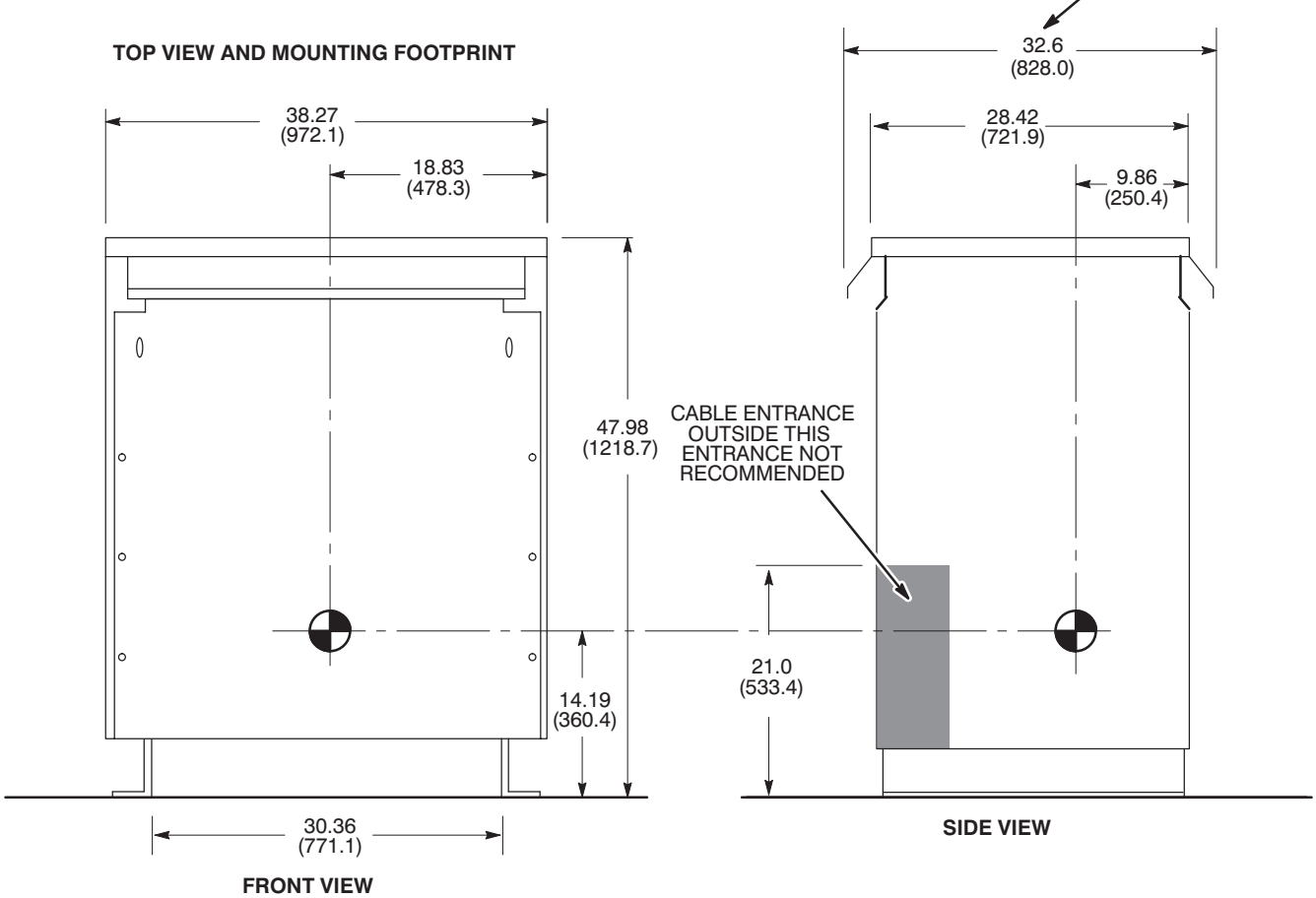


150 KVA 208–480Y277 VOLT, 60 Hz GE TRANSFORMER – R4500AS
ILLUSTRATION 2–38

NOTE:
- ALL DIMENSIONS ARE IN INCHES ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.
- APPROX. WEIGHT: 1160 lbs (526.3 kg)
- INDICATES AIR FLOW
- INDICATES CENTER OF GRAVITY



TOP VIEW AND MOUNTING FOOTPRINT



FRONT VIEW **SIDE VIEW**

150 KVA 200–400Y230 VOLT, 50/60 Hz GE TRANSFORMER – R4500BD
ILLUSTRATION 2–39

SECTION 3 – MAGNETIC FIELD CONSIDERATIONS

TABLE OF CONTENTS

3–1 INTRODUCTION

The static magnetic field is three–dimensional and extends into space above and below the magnet as well as to the surrounding space on the same level. Objects within this three–dimensional space can be affected by the magnetic field or can affect the magnetic field, refer to Table 2–1 PROXIMITY LIMITS in Section 2 – ROOM LAYOUTS. Therefore all ferromagnetic material within this three–dimensional magnetic field must be thoroughly examined to ensure it is not significantly affected by nor affects the magnetic field.

3–2 HOMOGENEITY REQUIREMENTS

Structural steel within the static magnetic field of an unshielded magnet has a definite impact on the homogeneity or uniformity of the field. The magnet's field homogeneity is an important criteria that impacts image quality of the system.

3–3 STRUCTURAL STEEL EVALUATION OF PROPOSED SITES

Structural steel near the magnet (especially unshielded and actively shielded magnets) causes perturbations in the magnetic field within the imaging region of the magnet. This may degrade the homogeneity of the magnet and thus system performance. An evaluation of the effects of structural steel on the magnet is required in some instances, refer to Section 4–14–1, Floors.

Therefore, the customer must provide information indicating mass and location of all iron and steel within an 8 feet (2.5 meter) radius of the magnet isocenter. This includes iron below the magnet such as sewer pipes, floor beams and any steel rebar in the concrete floor or structural members. Any structural steel required for the installation of the magnet at the particular site (i.e. floor reinforcement) must also be indicated.

If the steel in close proximity to the magnet exceeds the limits found in Section 4–14–1 Floors, one of the following actions may be taken:

- Choose an alternate site.
- Redesign steel structure.
- Request a steel analysis by the MR Siting & Shielding group.
- Install magnetic shielding (refer to Section 3–4, MAGNETIC SHIELDING). If containment of the stray magnetic field is required, shielding will also usually mask the effects of nearby structural steel.

3–4 MAGNETIC SHIELDING

Magnetic shielding is used to reduce the fringe field around the magnet.

Room Shield

Room magnetic shielding generally consists of iron plates in the room walls, floor, and ceiling. Special consideration should be given when selecting a magnet site location due to the expense and effort required to provide magnetic shielding.

Designing a magnetic shield requires a comprehensive computer analysis which predicts the effect the shield will have on the magnetic field as well as the effect of the shield on the homogeneity of the magnet. The structural capacity of the site and space availability are important factors in the design of the shield. The MR Siting & Shielding Group has the capability to design magnetic shields which meet a broad range of site requirements.

3–5 MAGNETIC FIELD

Illustrations 3–1 through 3–3 are the fringe field plots for the 0.7T magnet. These plots illustrate the three–dimensional area of magnetic field without the influence of any nearby ferrous objects or the earth's ambient magnetic field. Actual magnetic field intensity at given locations will vary from these plots due to the following effects:

- Ferrous materials used in building construction which will become permanently magnetized when in close proximity to the MR generated magnetic field.
- Earth's magnetic field – about 0.5 gauss in strength and unidirectional.

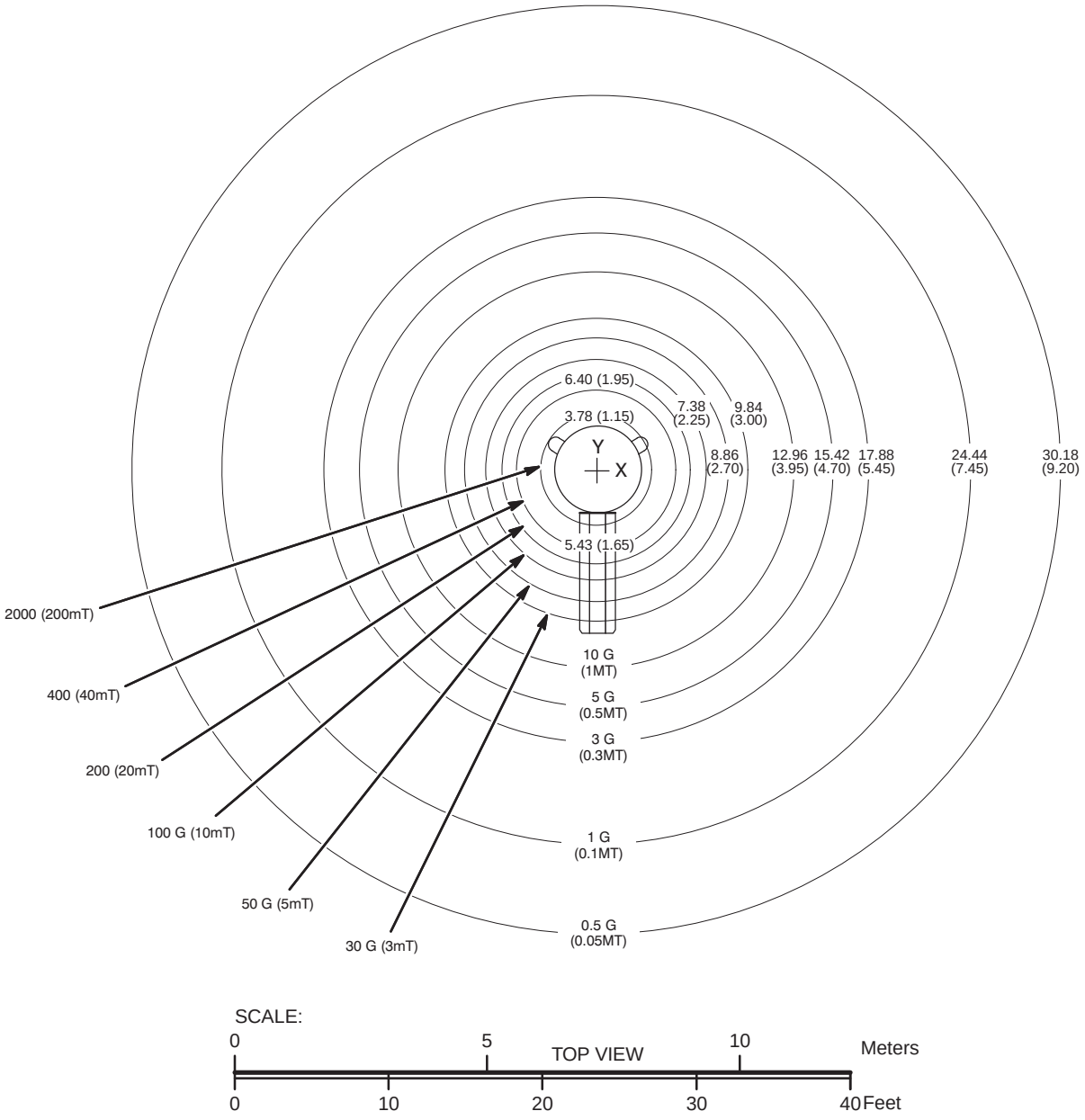
Therefore, these plots are only approximations of actual field intensities found at points surrounding the magnet. These plots should be used as an aid in reviewing the location of MR and hospital equipment and services (i.e. elevators, vehicular traffic, computer monitors, etc.). Refer to Section 2, ROOM LAYOUTS, for the sensitivities of various equipment within the magnetic field.

3–6 EXCLUSION ZONE

The five gauss exclusion zone for cardiac pacemakers, neurostimulators, and other biostimulation devices is shown in Illustrations 3–1 through 3–3 for 0.7T magnet. It should be noted the vertical views for the various magnetic field plots show 12 ft (3.66 m) between floors for reference.

The interaction of the main magnet coils and the cancellation coils results in the effective shielding for the active shield magnet. Certain kinds of magnet quenches including Magnet Rundown Unit (MS4) initiated quenches can actually cause a very short magnetic field transient resulting in the 5 gauss (0.5mT) field expanding for 2 seconds or less as noted in Illustrations 3–1 through 3–3. It should be noted that normal rampdowns WILL NOT cause the magnetic field to expand.

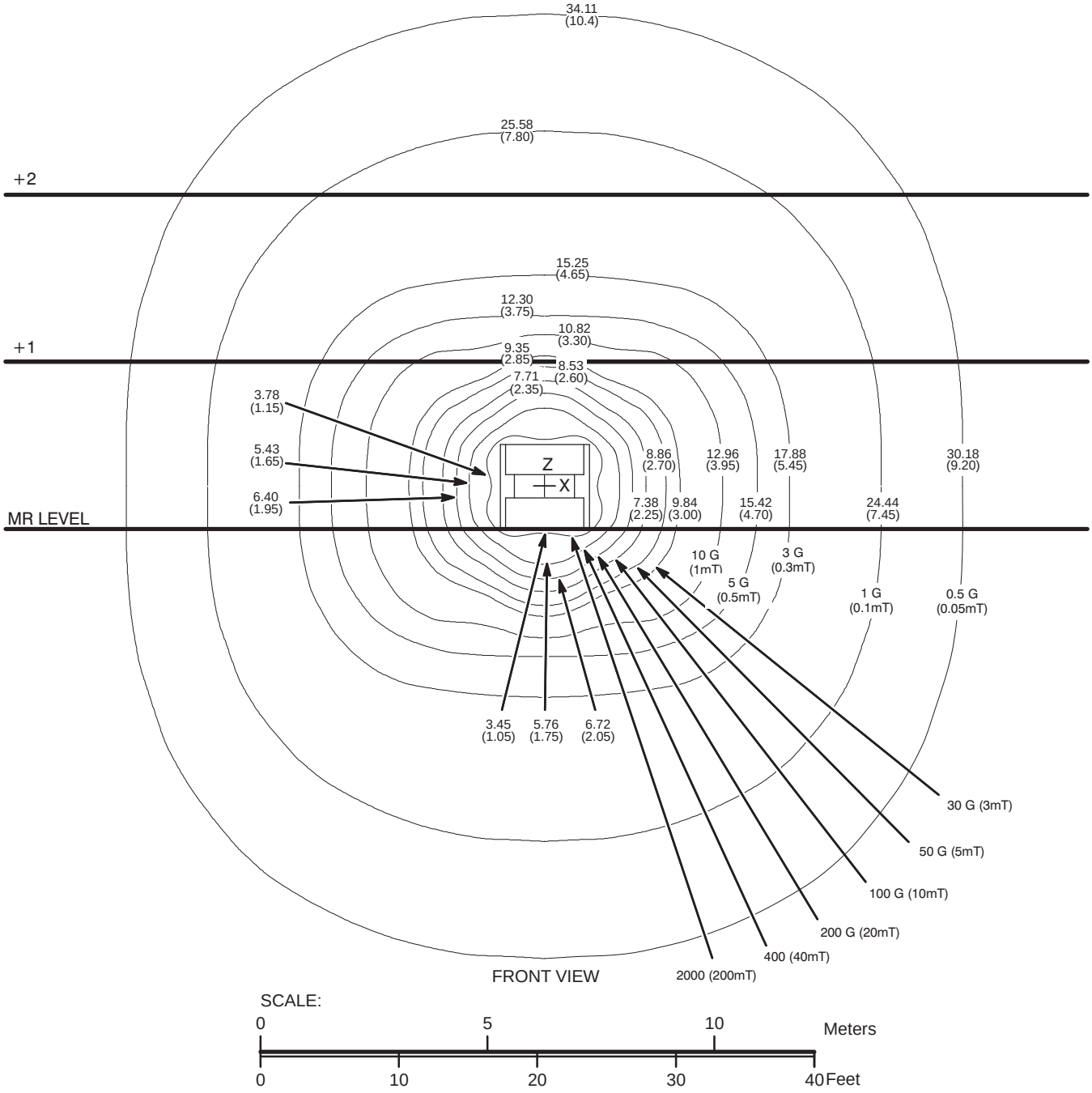
It is recommended every site consider the event of a quench and plan accordingly (such as placing 5 gauss (0.5mT) warning signs at the expanded locations).



NOTE:

- MEASURED MAGNETIC FLUX DENSITY WILL VARY FROM PLOT DUE TO FACTORS SUCH AS CONCENTRATING EFFECTS OF NEARBY FERROUS OBJECTS AND AMBIENT FIELDS, INCLUDING EARTH'S MAGNETIC FIELD.
- POTENTIAL EXISTS UNDER FAULT CONDITIONS & MAGNET RUNDOWN UNIT INITIATED QUENCHES THAT THE 5 GAUSS LINE MAY EXPAND TO 13.78 ft (4.2 m) AXIALLY FOR 2 SECONDS OR LESS. THERE IS NO RADIAL EXPANSION OF 5 GAUSS LINE UNDER THE FAULT CONDITIONS.

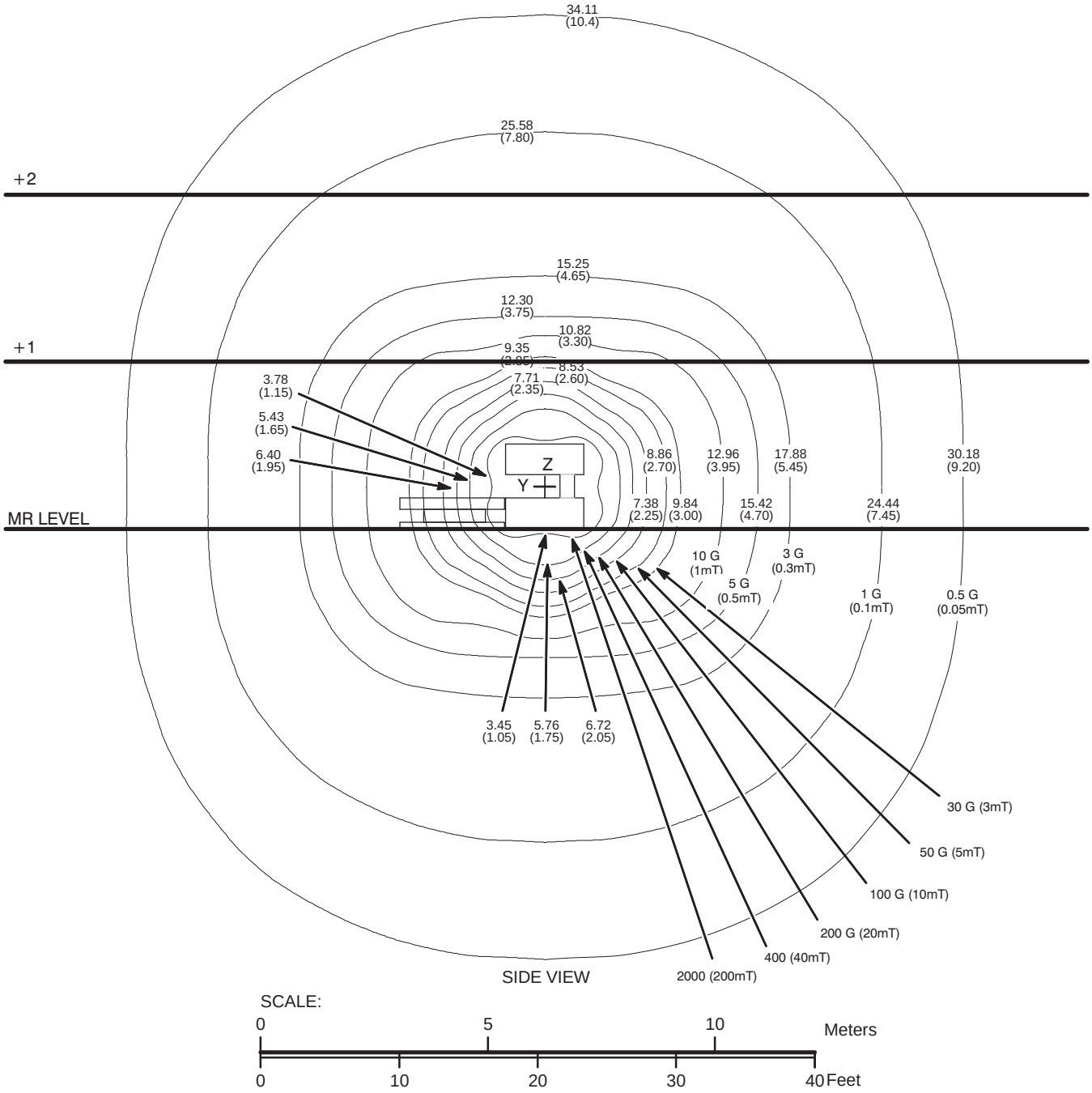
0.7 TESLA MAGNETIC ISOGAUSS LINE PLOT
TOP VIEW
ILLUSTRATION 3–1



NOTE:

- 12 ft (3.66 m) BETWEEN FLOORS
- MEASURED MAGNETIC FLUX DENSITY WILL VARY FROM PLOT DUE TO FACTORS SUCH AS CONCENTRATING EFFECTS OF NEARBY FERROUS OBJECTS AND AMBIENT FIELDS, INCLUDING EARTH'S MAGNETIC FIELD.
- POTENTIAL EXISTS UNDER FAULT CONDITIONS & MAGNET RUNDOWN UNIT INITIATED QUENCHES THAT THE 5 GAUSS LINE MAY EXPAND TO 13.78 ft (4.2 m) AXIALLY FOR 2 SECONDS OR LESS. THERE IS NO RADIAL EXPANSION OF 5 GAUSS LINE UNDER THE FAULT CONDITIONS.

0.7 TESLA MAGNETIC ISOGAUSS LINE PLOT
FRONT VIEW
ILLUSTRATION 3–2



NOTE:

- 12 ft (3.66 m) BETWEEN FLOORS
- MEASURED MAGNETIC FLUX DENSITY WILL VARY FROM PLOT DUE TO FACTORS SUCH AS CONCENTRATING EFFECTS OF NEARBY FERROUS OBJECTS AND AMBIENT FIELDS, INCLUDING EARTH'S MAGNETIC FIELD.
- POTENTIAL EXISTS UNDER FAULT CONDITIONS & MAGNET RUNDOWN UNIT INITIATED QUENCHES THAT THE 5 GAUSS LINE MAY EXPAND TO 13.78 ft (4.2 m) AXIALLY FOR 2 SECONDS OR LESS. THERE IS NO RADIAL EXPANSION OF 5 GAUSS LINE UNDER THE FAULT CONDITIONS.

0.7 TESLA MAGNETIC ISOGAUSS LINE PLOT
SIDE VIEW
ILLUSTRATION 3–3

SECTION 4 – SITE ENVIRONMENT

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TABLE OF CONTENTS (Continued)

4–1 INTRODUCTION

The rating and duty cycles of all subsystems are applicable only if the room environment is maintained as specified in the following sections. The environment must be constantly maintained (i.e. holidays, weekends, etc.) to prevent exceeding these restrictions. Subjecting the equipment to consistent excessive temperatures and humidity above specifications may shorten the life of the internal electrical components.

4–2 TEMPERATURE AND HUMIDITY SPECIFICATIONS

4–2–1 System Suite

Use the specifications listed in Table 4–1 for designing your HVAC (heating, ventilation, and air conditioning) system. Proper insulation and moisture barrier should be installed within the environmental controlled space (e.g. area above drop ceiling) for humidity, condensation, and temperature control.

To help prevent a patient from feeling uncomfortably warm during a scan, make sure the magnet room temperature does not exceed maximum temperature specified in Table 4–1.

TABLE 4–1
TEMPERATURE AND HUMIDITY SPECIFICATIONS

AREA	TEMPERATURE RANGE °F (°C)	TEMPERATURE CHANGE °F/Hr (°C/Hr)	HUMIDITY (%)	HUMIDITY CHANGE (%/Hr)	MAX. ROOM GRADIENT °F (°C)
Equipment Room at Inlet to Equipment	59–89.6 (15–32) **See Note 1**	5 (3)	30–75 **See Note 1**	5	5 (3) **See Note 2**
Magnet Room	59–69.8 (15–21)	5 (3)	30–60 **See Note 1**	5	5 (3)
Operator's Control Room	59–89.6 (15–32) **See Note 1**	5 (3)	30–75 **See Note 1**	5	5 (3)

Note 1 Non–condensing humidity with 50% nominal at 65°F (18.3°C).
2 Room temperature gradient specification for the Equipment Room applies from floor to height of top discharge of equipment cabinets.
3 Room temperature gradient and maximum room gradient specifications for the Magnet Room need only apply to the "exclusion zone" shown in Illustrations 4–1 and 4–2.

4–2–2 Remote Condenser Unit Operating Environment

The air cooled Remote Condenser Unit (RCU) for System Cooling Cabinet is designed to be located external to the building in environments meeting the following specifications.

- Operating Ambient Temperature: –30°F (–34.4°C) to 120°F (48.9°C)
- Operating Humidity: 0–100%

4–3 AIR COOLING REQUIREMENTS

The total air cooling requirement for the MR system varies depending on site construction, refer to Table 4–2 for the heat output of the equipment listed in the typical site location. These values do not include people, lighting, and non–MR equipment. Use the air cooling Table 4–2 to calculate your cooling requirements for each room.

TABLE 4–2
MAXIMUM MR AIR COOLING TABLE†

MR COMPONENT	MAGNET ROOM (SEE NOTE 1 & 2)		EQUIPMENT ROOM (SEE NOTE 3)		OPERATOR/CONTROL AREA	
	BTU/HR	WATT	BTU/HR	WATT	BTU/HR	WATT
RF/Gradient Body Coil Assembly, Magnet Enclosure Equipment	12,285	3600				
Main Disconnect Panel (MDP)			900	264		
Power Cabinet (MR1)			21,155	6200		
System Cabinet (MR2)			6140	1800		
Patient Cooling Compressor (PCC)			1640	480		
System Cooling Cabinet (SCC) & System Cooling Auxiliary Cabinet (SCC2) Configurations						
•Air Cooled SCC with Remote Condenser Unit (RCU) – See Notes 4, 5, & 7			12,000	3517		
•Water Cooled SCC – See Notes 4, 6, & 7			12,000	3517		
•Air Cooled SCC – See Note 4 & 7			120,000	35,170		
Magnet Monitor (MSM)			205	60		
Magnet Monitor UPS & Modem			450	132		
Water Cooled Shield/Cryo Cooler Compressor #1 & #2			See Note 4			
Operator Workspace with LCD Color Monitor (See Note 8)					4095	1200
Low Voltage Step–Up Transformer *						
•150 KVA 208 to 480Y277 Volt, 60 Hz transformer					18,113	5307
•150 KVA 200 to 400Y230 Volt, 50/60 Hz transformer					24,481	7173

Note * Optional equipment.

† Maximum heat output is defined for temperature and humidity as defined in Table 4–1.

1 Magnet Room must be an individual temperature zone controlled by a separate thermostat to allow for adjustments to meet room specifications as listed in Section 4–2, TEMPERATURE AND HUMIDITY SPECIFICATIONS.

2 The 0.7T Magnet is sensitive to temperature changes. If the Magnet Room air flow requirements are not followed and an air supply exclusion zone is not respected, consistent operation of the system is not guaranteed. Refer to Section **4–3–2 Magnet Room Requirements**.

3 FOR THE EQUIPMENT ROOM ONLY: The air cooling load averaged over a working day (~12 hours) is typically 1/2 of the maximum value.

4 The SCC provides water cooling for the Cryo Cooler Compressor Cabinet (MS5), Shield Cooler Compressor Cabinet (MS8), System Cooling Auxiliary Cabinet (SCC2), Gradient Coils and RF Coils. Both Cryo Cooler Compressor and Shield Cooler Compressor Cabinets are physically located inside the lower portion of the System Cooling Cabinet.

5 The Remote Condenser Unit (RCU) is separate from the System Cooling Cabinet (SCC). The RCU is designed to be installed external to building and exhaust heat to outside air.

6 The water cooled System Cooling Cabinet requires customer provided chilled water cooling in addition to the air cooling, refer to Section **4–4–2 Water Cooled System Cooling Cabinet Configuration Requirements** for details.

7 The System Cooling Auxiliary Cabinet (SCC2) heat output is included in the the System Cooling Cabinet (SCC) value. The SCC provides water cooling for the SCC2. The SCC2 takes in approximately 60 CFM (1.7m3/min) of air from the Equipment Room and supplies that air to the RF Coil inside the Magnet Enclosure.

8 Operator Workspace equipment includes the following: LCD Color Monitor, Octane Computer, Workspace Cabinet, Mouse and Mouse Pad, LCD Panel, Keyboard, and interface modules mounted to Workspace Table

4–3–1 Equipment Room Requirements

In the Equipment Room care must be taken in locating the air conditioning supply and return ducts to direct air flow appropriately. An existing system can be used if it is adequate. The air conditioning supply vents should be located near the floor with the air directed toward the cabinets inlet. The returns should be above the cabinets near the equipment exhaust. Actual site heat output values will vary depending on system use (i.e. protocols used, patient load, etc.). Note any variations of equipment location for your site when calculating your cooling requirements for each room.

Physical placement of the air conditioning equipment (compressor, etc.) is an important factor due to the homogeneous field requirements of the magnet. Therefore, it is important this equipment be located outside the 10 gauss line. Refer to Section 3, MAGNETIC FIELD CONSIDERATIONS, for plot of gauss lines.

4–3–2 Magnet Room Requirements

The Magnet Room must be an individual temperature zone controlled by a separate thermostat to allow for adjustments to meet room environmental specifications in Section 4–2, TEMPERATURE AND HUMIDITY SPECIFICATIONS. The 0.7T magnet is sensitive to temperature changes. Care must be taken in locating the air conditioning supply and return air ducts to the Magnet Room to ensure proper air flow. Supply ducts can be located by the Patient Table sides so conditioned air does not flow directly to the magnet. **Supply ducts should not be located in the following areas:**

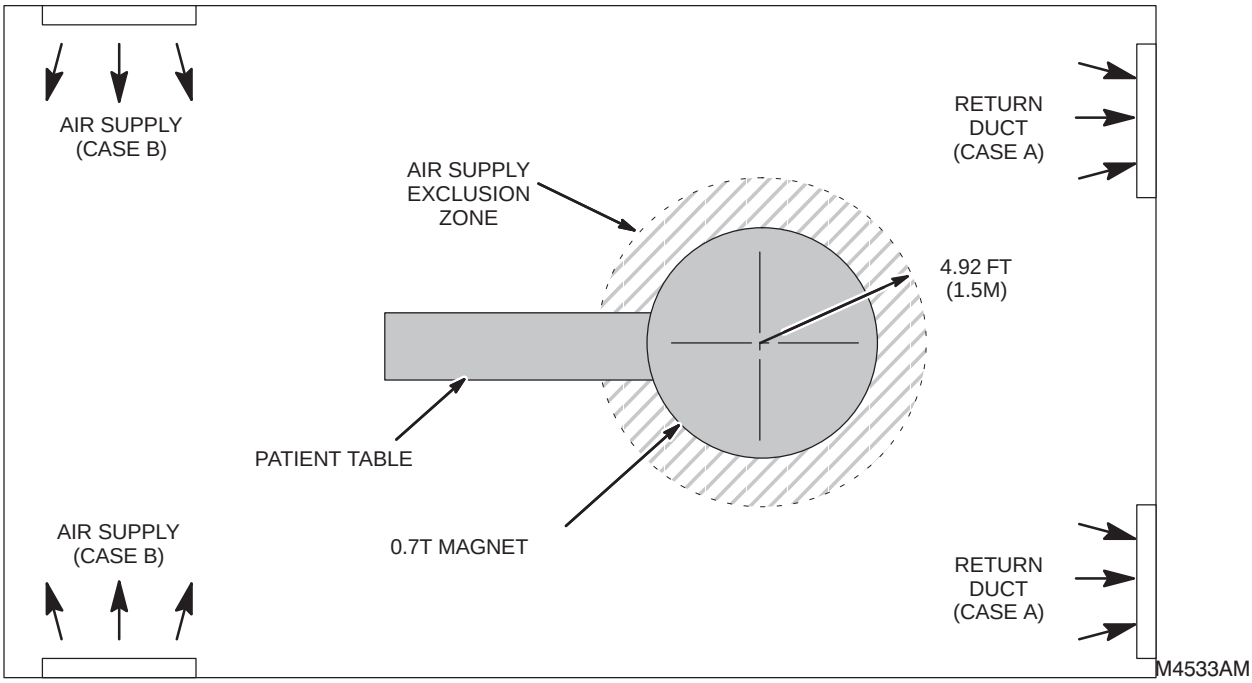
- Above the magnet within an exclusion zone of 4.92 ft (1.5 m) from the center line of the magnet.
- On the side of the magnet within an exclusion zone of 4.92 ft (1.5 m) from the center line of the magnet.

Illustrations 4–1 and 4–2 show the air flow exclusion zone and two possible cases (A and B) for the location of the air supply and return ducts. There can be more than one supply or return ducts on the ceiling.

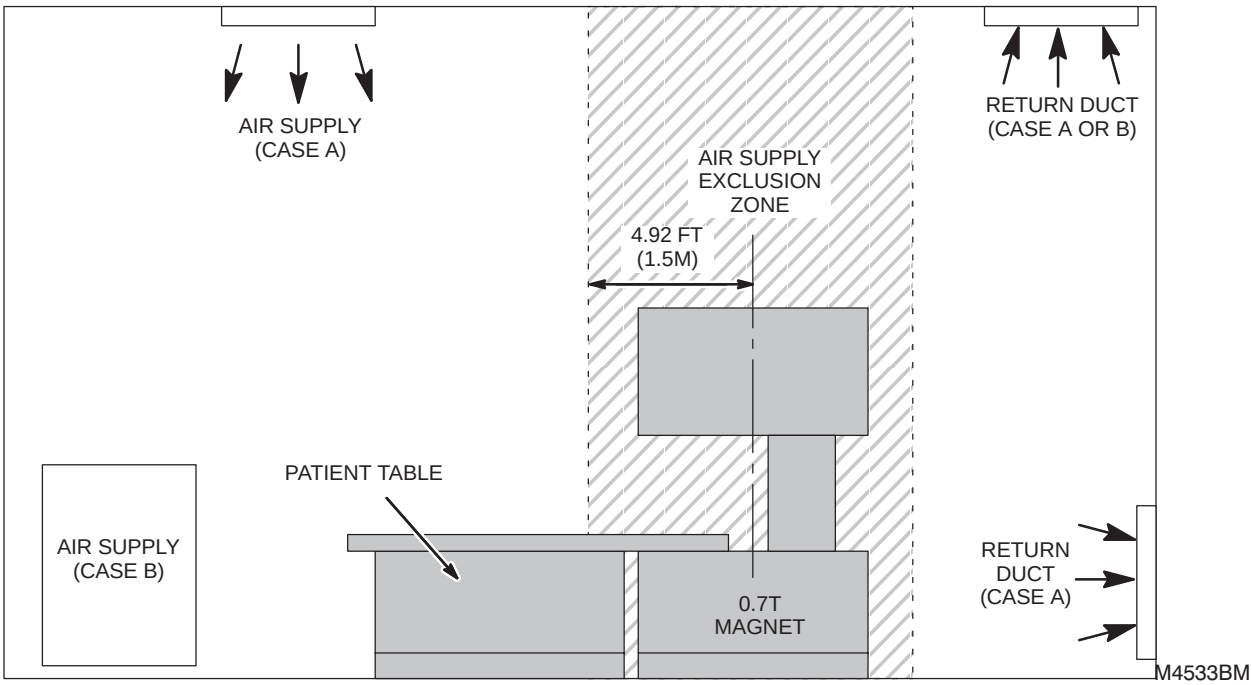
WARNING!

THE 0.7T MAGNET IS SENSITIVE TO TEMPERATURE CHANGES. IF THE MAGNET ROOM AIR FLOW REQUIREMENTS ARE NOT FOLLOWED AND THE AIR SUPPLY EXCLUSION ZONE IS NOT RESPECTED, CONSISTENT OPERATION OF THE SYSTEM IS NOT GUARANTEED.

4–3–2 Magnet Room Requirements (Continued)



MAGNET ROOM AIR FLOW REQUIREMENTS (TOP VIEW)
ILLUSTRATION 4–1



MAGNET ROOM AIR FLOW REQUIREMENTS (SIDE VIEW)
ILLUSTRATION 4–2

4–3–3 General Recommendations

A dedicated air conditioner with a dual compressor is preferred to avert shutdowns during repair of the primary air conditioner. Due to the large variation in heat loads, the compressors should be equipped with unloaders or hot gas bypass to prevent moisture stripping of the evaporator coils.

It is recommended that a temperature and humidity recorder be used during preinstallation and during actual installation and placed near the Gradient Cabinet air inlets to establish the true criteria. Refer to cooling table calculator in this section for each room's cooling requirements.

GE recommends the use of a 12 inch high raised flooring system for the equipment room (10 inch minimum clearance from floor slab to underside of access flooring). Care must be taken in locating the air conditioning supply vents in the floor. The air conditioning supply vents should be located directly in front of the cabinet inlets.

4–4 WATER COOLING REQUIREMENTS

4–4–1 Cryo Cooler Compressor Temporary Backup Water Cooling Recommendation

Customer provided temporary backup water cooling is highly recommended for the Cryo Cooler Compressor Cabinet which is located in the lower portion of the System Cooling Cabinet (SCC). The backup cooling design can utilize open loop city water only as temporary backup during loss of the closed loop water cooling from the System Cooling Cabinet. Open loop systems will not allow a chemical equilibrium to be established resulting in continual build up or etching that can take place which will eventually contribute to failure. Water system capacity must be selected to insure adequate reserve for overcoming all pressure drops and still maintain the required flow rate for the Cryo Cooler Compressor Cabinet, refer to Tables 4–3 and 4–4 and Illustration 4–3 for water cooling specifications. Note, open loop backup water cooling design must include routing and disposal of the output water cooling.

CAUTION

Continuous water cooling is critical for the Shield/Cryo Cooler Compressors and therefore MUST be available 24 hours per day / 7 days per week to maximize proper uninterrupted magnet operation. Water cooling is required immediately upon magnet arrival. The System Cooling Cabinet (SCC) and Main Disconnect Panel (MDP) must be installed and operational prior to magnet arrival.

Note

The **Cryo Cooler Compressor** requires customer supplied flexible hose for mating with the SCC for temporary backup water cooling. The SCC temporary by–pass connections are 0.5 inch (12.7 mm) NPT hose barbs and requires 0.5 inch (12.7 mm) inside diameter flexible hose with 1.0 inch (25.4 mm) adjustable compression clamps.

TABLE 4–3
CRYO COOLER COMPRESSOR WATER QUALITY REQUIREMENTS

PARAMETER	REQUIREMENT	NOTES
pH level	6.5–8.2	GE recommends the use of de–ionized water to ensure longest life with fewest problems.
Hardness	less than 200 ppm of calcium carbonate	Hard water will produce calcium deposits in the Gradient Coil and Shield/Cryo Cooler Compressor resulting in decrease of cooling efficiency.
Suspended matter	less than 10 mg per liter, less than 150 micron particle size	To meet the specification for suspended matter it is necessary to install a 100–150 micron filter. Install Cryo Cooler Compressor Cabinet filter at cabinet inlet.

4–4–1 Cryo Cooler Compressor Temporary Backup Water Cooling Recommendation (Continued)

TABLE 4–4
CRYO COOLER COMPRESSOR SPECIFICATIONS FOR TEMPORARY BACKUP WATER COOLING

EQUIPMENT	INLET TEMPERATURE RANGE °F (°C)	INLET PRESSURE psi (KPa)	RECOMMENDED FLOW RATE gal/min (liter/min) See Note 4	PRESSURE DROP psi (bar) [KPa] See Note 1	TEMPERATURE RISE Δ°F (Δ°C) See Notes 1, 4, 6	TYPICAL HEAT OUTPUT BTU/Hr (Watts) See Notes 6	MAXIMUM HEAT OUTPUT BTU/Hr (Watts) See Notes 6
Cryo Cooler Compressor **	39.2 – 82.4 (4 – 28)	Minimum 29 (200) Maximum 100 (690)	Minimum 1.1 (4) See Notes 2 & 3	7.5 (0.5) [52] at minimum flow rate See Note 5	at minimum flow rate 48.4 (26.9) for 60 Hz operation 39.4 (21.9) for 50 Hz operation	25,590 (7500) for 60 Hz operation	28,320* (8300) for 60 Hz operation
			Maximum 2.6 (10) See Notes 2 & 3	47 (3.2) [324] at maximum flow rate See Note 5	at maximum flow rate 19.4 (10.8) for 60 Hz operation 15.7 (8.7) for 50 Hz operation	20,728 (6100) for 50 Hz operation	23222* (6700) for 50 Hz operation

Note: * Ensure water cooling system capacity is capable of dissipating maximum heat output.

** These water cooling specifications are the requirements **at the equipment**. The backup cooling system design must have allowances for pressure/temperature changes due to distance the chiller is located from the equipment.

1 Pressure drop and water temperature rise across equipment is given for minimum and maximum recommended flow rates as indicated. Pressure drop is measured between coolant inlet and outlet at Cryo Cooler Compressor cabinet.

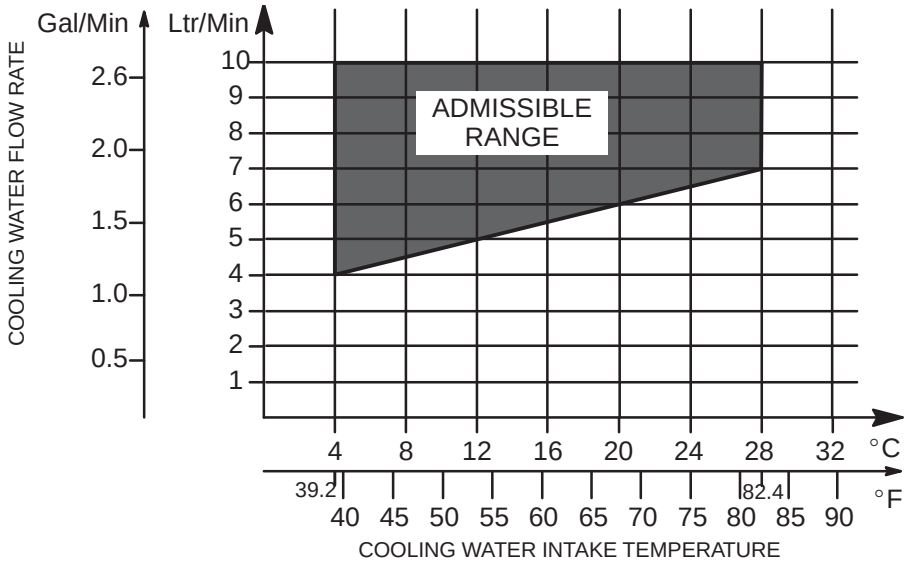
2 Cryo Cooler Compressor water flow rate is based on inlet water temperature of 82.4°F (28°C), lower temperature permits lower flow. See Illustration 4–3 for graphic water temperature and flow rate admissible range.

3 Minimum flow rate is for clean water (i.e. without antifreeze), maximum flow rate is for any mixture of water/antifreeze.

4 Water flow rate and temperature rise value are based on water.

5 Pressure drop values based on new system, may rise due to calcification.

6 Cryo Cooler Compressor temperature rise, typical and maximum heat output are reduced by 18% at 50 Hz operation.



CRYO COOLER COMPRESSOR REQUIREMENTS FOR TEMPORARY BACKUP WATER COOLING
ILLUSTRATION 4–3

4–4–2 Water Cooled System Cooling Cabinet Configuration Requirements

The Water Cooled optional configuration of the System Cooling Cabinet (SCC) contains a dedicated, closed loop, liquid–to–liquid water chiller system providing water cooling for the Shield Cooler Compressor Cabinet, Cryo Cooler Compressor Cabinet, the Gradient Coils, and the System Cooling Auxiliary Cabinet (SCC2) which provides cooled compressed air to the RF Coil. The water cooled SCC configuration requires customer provided water cooling, refer to Table 4–5 and Illustration 4–4 for cooling water requirements. The SCC has 1–1/2 inch (38 mm) NPT female ball valve connections at the top of the SCC unit for customer water cooling connection.

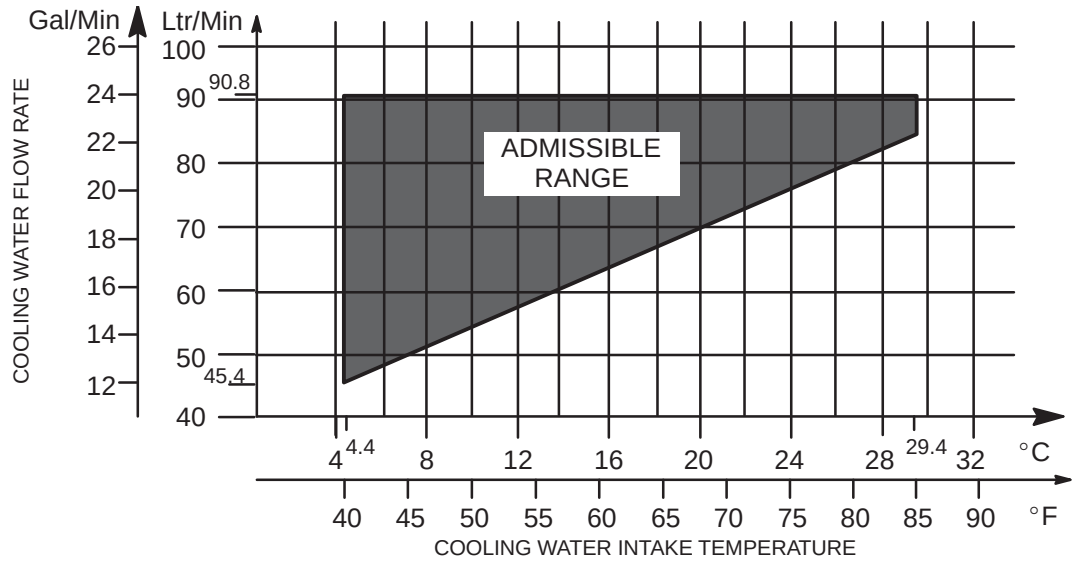
CAUTION

Continuous water cooling is critical for the Shield/Cryo Cooler Compressors and therefore MUST be available 24 hours per day / 7 days per week to maximize proper uninterrupted magnet operation. Water cooling is required immediately upon magnet arrival. The SCC and Main Disconnect Panel must be installed and operational prior to magnet arrival.

TABLE 4–5
WATER COOLED SYSTEM COOLING CABINET WATER REQUIREMENTS

PARAMETER	REQUIREMENT	NOTES
Composition	Water	
pH level	6.5–8.2	GE recommends the use of de–ionized water to ensure longest life with fewest problems.
Hardness	less than 200 ppm of calcium carbonate	Hard water will produce calcium deposits in the Gradient Coil and Shield/Cryo Cooler Compressor resulting in decrease of cooling efficiency.
Suspended matter	less than 10 mg per liter, less than 150 micron particle size	To meet the specification for suspended matter it is necessary to install a 100–150 micron filter. Install Cryo Cooler Compressor Cabinet filter at cabinet inlet.
Maximum Heat Output to the cooling water	92,530 BTU/Hr 27,118 Watts	Refer also to Section 4–3 AIR COOLING REQUIREMENTS
Pressure Drop	2.7 psi at minimum flowrate of 12 gpm 9.5 psi at maximum flowrate of 24 gpm	
Inlet Pressure	150 psi maximum	
Anti–Freeze	Maximum of 50% glycol in water mixture	

4–4–2 Water Cooled System Cooling Cabinet Configuration Requirements (Continued)



SYSTEM COOLING CABINET COOLING WATER REQUIREMENT
ILLUSTRATION 4–4

4–5 ALTITUDE

100 ft (30.5 m) below sea level to 11,808 ft (3600 m) above sea level.

4–6 LIGHTING

Direct Current (DC) lighting is **required** in the Magnet Room with the Signa OpenSpeed. DC Lighting product options are available from GE Medical Systems which provides for two circuits of DC power and adjustable light levels in the Magnet Room. Refer to Section 1–4 FACILITY OPTIONS for catalog offerings. Refer to Table 4–6 for additional lighting requirements.

Note

Fluorescent lighting is not allowed in the Magnet Room due to the RF noise generated by the fluorescent light tubes.

TABLE 4–6
ROOM LIGHTING REQUIREMENTS

AREA	LIGHTING TYPE	LUMINOUS INTENSITY	NOTES
Magnet Room	Direct Current (DC) Incandescent or Quartz (See Notes)	• Minimum 300 lux around the front of the magnet for patient access. • Need provision to provide 300 lux above the magnet (non–magnetic, portable lighting is acceptable).	• Direct Current (DC) lighting is **required** in the Magnet Room to avoid RF noise • Light fixtures must be placed in fringe field less than 140 gauss. • Florescent lighting is not allowed in the Magnet Room to avoid RF noise. • Short filament length is recommended, linear lamps are not recommended because of the filament length and high incidence of filament failure. • The alternating current (AC) ripple from the DC power should be no greater than 5%. • Dimmers in the Magnet Room are not acceptable due to electric noise emission which can impact image quality. Dimmer switch must be located outside of the Magnet Room. Discrete level switching may be used in the Magnet Room for light level control.
Operator Area	Customer defined	• Minimum 300 lux	• Lighting to minimize interference (ie. glare) on monitor at Operator Workspace. • Recommend light level be adjustable for operator comfort. • Dimmers can be used, must be on a circuit separate from Magnet Room dimmer circuit.
Equipment Room	Customer defined	• Minimum 300 lux	

4–7 ACOUSTICS

The following acoustic information is provided for site planning and architectural design activities to address acoustics to meet local regulations and customer requirements. For more information about recommended safety procedures regarding patient exposure to MR–generated acoustic levels, see the system operator manual.

4–7–1 Background

A typical MR suite has two types of acoustic noise issues. The first is the acoustics of the room where patients and technicians are impacted by the noise of the MR system as the gradients are pulsed. The second is noise transmitted to other spaces via airborne and structureborne paths.

Airborne

The airborne transmission path entails the excitation of air within the magnet room; the resonator module consisting of the magnet, RF coil, and gradient coil generates acoustics noise similar to an intense loud speaker. The airborne noise passes through walls via any openings, i.e. small holes, cracks, HVAC ducts, and waveguides, into surrounding spaces within and possibly beyond the confinements of the building. Acoustic energy can transmit across distances of significant length.

Examples of airborne acoustics issues may include the following (not limited to only these):

- MR Operator exposure at Operator Workstation
- Image reading rooms adjacent to Magnet Room, may be separated by hallways
- Secretarial, offices, meeting rooms, patient rooms (ICU, exam, primary care, etc.)
- Adjacent residential areas/spaces
- In–house library facilities

Structureborne

The structureborne transmission path is the result of mechanical excitation of the floor/building structure causing the building to vibrate. The vibration of the surfaces at surrounding spaces then radiates as acoustic noise. Acoustic energy can transmit across distances of significant length.

Note
Less than 5% of installed sites have experienced structureborne acoustic issues.

Examples of structureborne acoustics issues may include the following (not limited to only these):

- Areas directly above or below the Magnet Room, may not always be an issue
- Image reading rooms adjacent to Magnet Room, may be separated by hallways
- Secretarial, offices, meeting rooms, patient rooms (ICU, exam, primary care, etc.)
- Adjacent residential areas/spaces
- In–house library facilities

4–7–2 System Acoustic Noise Levels

Any GE factory–installed protocol can be modified by operators, which can increase or decrease acoustic SPL (Sound Pressure Level); or operators may create their own protocol which could produce a higher or lower acoustic SPL as stated under **Operating Conditions** Condition 1 below. Typical scans generate acoustic levels as stated under **Operating Conditions** Condition 2 below. In addition, the exposure times are completely under operator control. Consequently, hearing protection is required for all people in the Magent Room during scans to prevent hearing impairment, acoustic levels may exceed 99dBA. Again, for more information about recommended safety procedures regarding patient exposure to MR–generated acoustic noise, see the MR system operator manual.

Ambient Conditions

To reduce any background noise due to cabinet blowers, etc., acoustical ceilings, walls, and floors are recommended. The following are typical noise level readings:

- Operator Area . . . . . 55 dBA
- Equipment Room . . . . . 75 dBA

Operating Conditions

Condition 1

MR scanners under “worst–case” operating conditions for any GE factory–installed protocol, could generate acoustic levels (as measured at the magnet iso–center) as follows:

Average SPL 110 dBA SPL= Sound Pressure Level
Peak 120 dB
Frequency Range 20 to 20k Hz

Condition 2

MR scanners for many typical clinical scanning scenarios though, generate acoustic levels (as measured at the magnet iso–center) somewhat lower as follows:

Average SPL 85 to 90 dBA
Peak 105 to 110 dB
Frequency Range 20 to 20k Hz

As recent history has shown an evolution towards more powerful (and hence louder) gradient subsystems, architects should consider the acoustic levels stated in the “worst case” Condition 1, mentioned above. Note that high–field Signa systems have the ability to run scanning protocols which can generate acoustic levels over the entire human perceptible frequency range (20 to 20k Hz), therefore attenuation over this entire range must be considered for site design.

4–7–3 Design Guidelines

Magnet Room

Noise generated by the MR system is inherent to the operation of the system, refer to Section 4–7–2 System Acoustic Noise Levels. The sound quality (human perception) within the Magnet Room can be modified by including sound absorbing materials to make the room sound more subdued and less harsh. The measured sound levels via a sound level meter will not change. However, the measured sound levels can be reduced only when the sound level generated by the MR System is reduced.

Sound quality improvements can be achieved by the following:

- Use ceiling tiles with fiberglass panels having a 2 inch (51mm) thickness set into the standard T–bar grid system.
- Adding fiberglass panels to the side walls covering approximately 20% of the side wall surface area. The panels should focus on covering the top half of the side walls. Panels could take many different and decorative shapes to improve the sterile look of the rooms. Typically panels might be on the order of 4ft x 6ft (1.2m x 1.8m) with a thickness of 4 inches (102mm) or equivalent. Panels shape could vary to produce mosaic effects to meet the customer preference. Any decorative materials used to cover the wall panels must be porous so that sound waves can pass through with ease. In principle, a person should be able to breath through the material with ease. Fire retardant cloth should be used. The NRC (Noise Reduction Coeffient) of the panels should be 0.95 or better when mounted against a hard surface such as drywall or concrete.

Inter–Spacial Areas

Noise control to mitigate noise from being transmitted to other spaces often amounts to paying attention to small details while working with ordinary construction materials. The key objectives are to eliminate all cracks and gaps in the wall construction while making sure that the doors, walls, floor, and ceiling have adequate transmission loss via mass or special double wall construction along with good fitting massive doors.

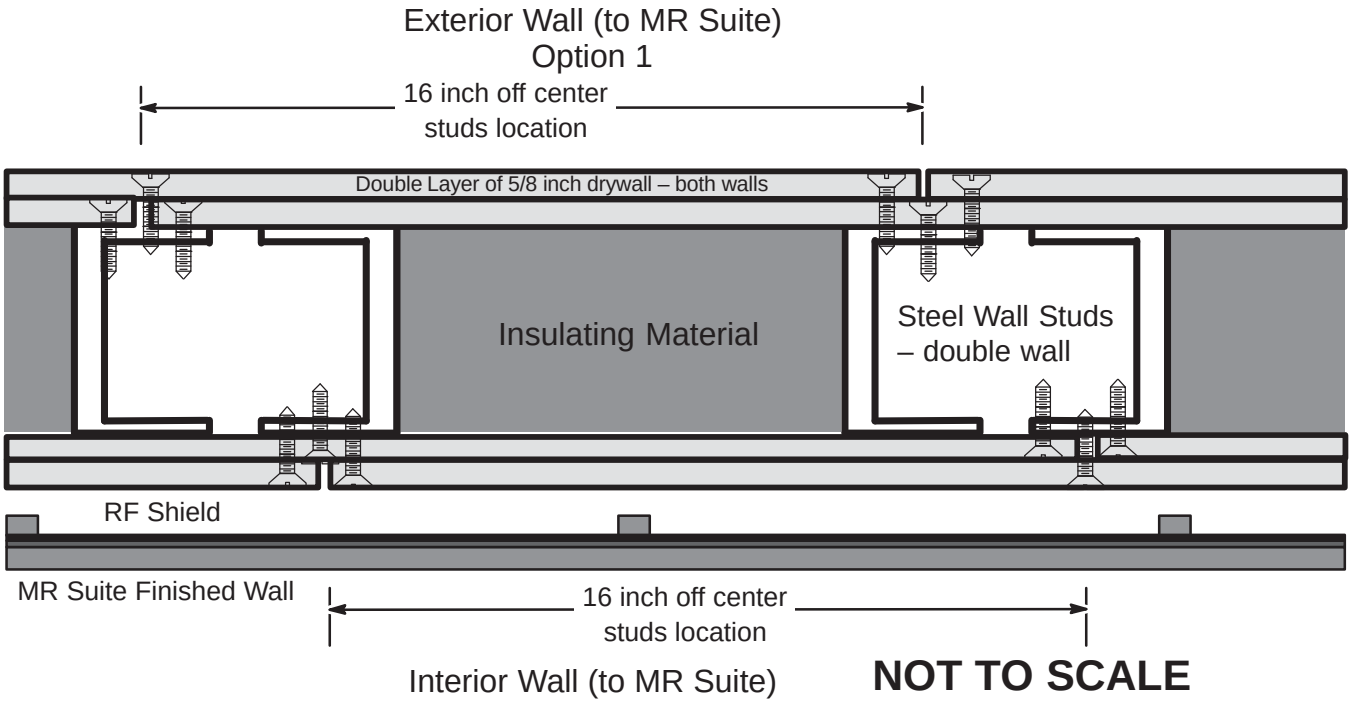
The entire Magnet must be surrounded by walls with substantial mass and/or double wall construction so that noise is contained in the room and not allowed to pass through into nearby spaces. Wall junctions must be sealed with acoustical sealant so that noise waves to do not escape from the room. In principle, if the room were filled with smoke and under a positive pressure, no smoke would leak from the room.

<u>Wall Construction</u>

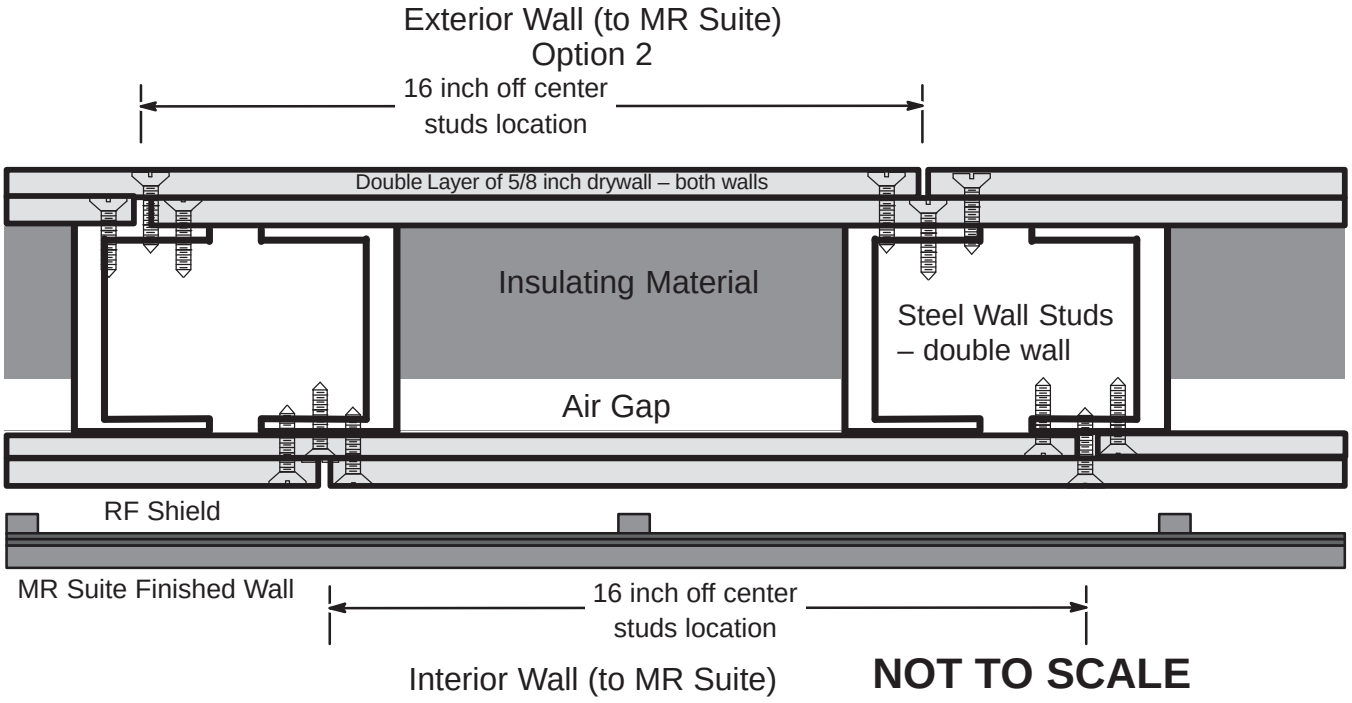
Wall Construction will entail ordinary building materials in a careful configuration.

- The preferred wall would have an ASTM STC 50 construction which entails the use of standard wall construction of steel studs (typically 3–5/8 inch (92 mm)) with 2 layers of Type X drywall (typically 5/8 inch (16 mm)) on each side totaling 4 layers and fiberglass batt in the stud cavity. All drywall must be overlapped by 6 inches (152 mm) or more. Beads of (USG) Acoustical Caulking (non–hardening) would be used around the entire perimeter of the drywall. Any form of wall penetration should be avoided. Any necessary wall penetrations must be sealed using combination of Acoustical Caulking (non–hardening) and fiberglass batt material. See examples of wall construction shown in Illustrations 4–5 and 4–6.
- The top of the wall must join the ceiling/floor above so that no cracks or gaps occur. If metal pan is used on the ceiling/floor (above), then flute seals would be used to seal the gaps between the drywall and the pan. Alternately drywall can be cut out to fit into the flutes. Acoustical caulking (non–hardening) will be used to seal the remaining cracks and gaps.

4–7–3 Design Guidelines (Continued)



EXAMPLE OF WALL CONSTRUCTION FOR AIRBORNE NOISE CONTROL – OPTION 1
ILLUSTRATION 4–5



EXAMPLE OF WALL CONSTRUCTION FOR AIRBORNE NOISE CONTROL – OPTION 2
ILLUSTRATION 4–6

4–7–3 Design Guidelines (Continued)

High Bay RF Room

A high bay RF Room is a self contained RF Room which has open air space between the RF Room ceiling and the building floor above. The air space is an acoustic transmission path. Acoustic energy must be reduced to minimize this transmission of energy through this path.

In cases where the Magnet is to be installed in a high bay, it may be most effective to enclose the RF Room with its own drywall and steel stud room. The key difference being a ceiling assembly that mimics the sidewall construction to contain noise.

- Normal high STC stud walls from above would be used to support a ceiling assembly constructed of structural C channel with two layers of drywall on each side (total of 4 layers) with fiberglass batt in the cavity.
- Penetrations should be avoided via the use of surface mounted lights. HVAC and ducts passing through the ceiling, party wall or side walls would require acoustic noise attenuation in the form of inline silencers. Gaps and cracks would be sealed between the ceiling, party wall or vertical side walls and the cryogen vent plumbing. In essence the Magnet would be enclosed in a drywall ”doghouse”.

Miscellaneous Plumbing, RF Windows and RF Doors

Other construction details are equally important to mitigate noise transmission to meet the intended goal.

- Pipes (gas or water) and electrical conduit or Magnet Room signal cables must be sealed where they penetrate the walls or ceiling. A heavy mastic material such as Duxseal™ is appropriate.
- RF windows should be purchased as window/frame units with an STC rating obtained from laboratory testing per ASTM standards. STC 55 or 60 windows are needed. The installation must include proper sealing to avoid sound leaks.
- RF doors should be selected to provide and STC 45 or 50 to quell the noise. Contact RF Shield Room supplier for selection of RF doors that meet local acoustic codes and site acoustic requirements. RF door seals must be selected to prevent small gaps around the door perimeter and at the door threshold. RF door seals would either require periodic replacement or a door seal that would last the life of the Magnet Room.

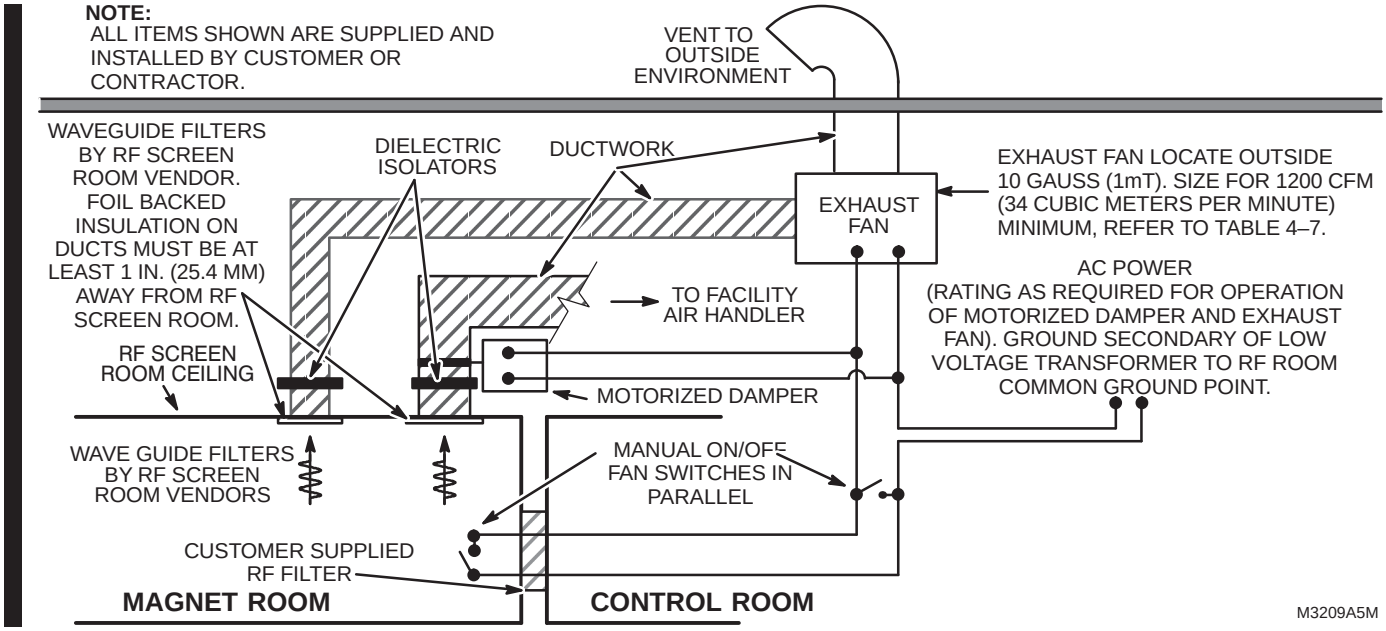
4–8 ROOM VENTILATION

Refer to Table 4–7 for ventilation specifications for the magnet and cryogen storage rooms. Refer to Section 4–12, POLLUTION, for air quality specifications.

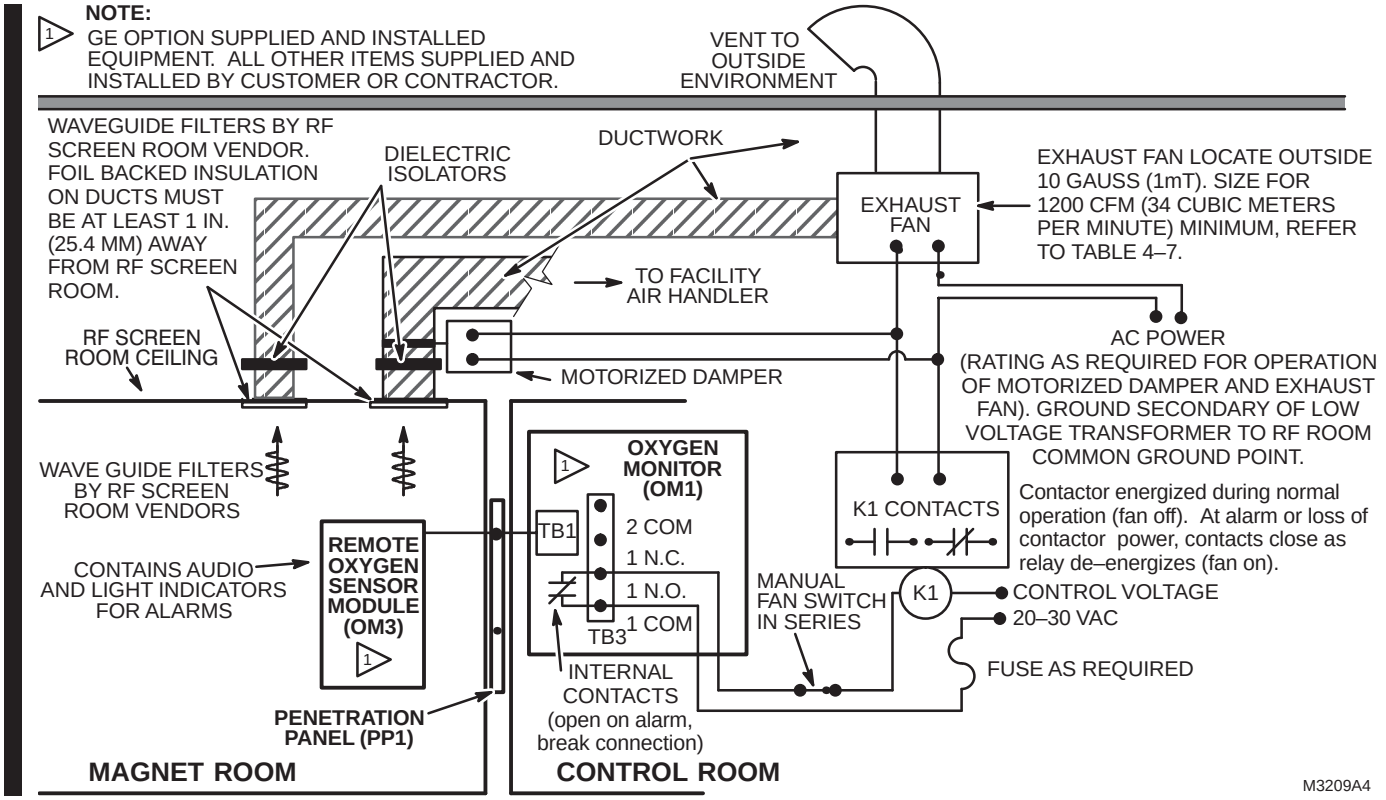
TABLE 4–7
ROOM VENTILATION REQUIREMENTS/RECOMMENDATIONS

ROOM	VENTILATION REQUIREMENTS	VENTILATION RECOMMENDATIONS
MAGNET	• Sufficient air ventilation in the magnet room must be maintained, not only for patient comfort during scans but also to maintain proper oxygen level during cryogen replenishment. • An exhaust fan to be placed above RF shielding with appropriate wave guide filtering for quick removal of helium gas if large amounts of helium disperse into magnet room. Inert gas containers, such as dewars, are not air tight. • **Magnet Room exhaust fan intake vent must be located at the highest ceiling plane near the magnet cryogen vent.** • Exhaust fan to exhaust to safe outside area and be independent of cryogenic venting. • The exhaust fan and air inlet must be sized for an air flow of 1200 CFM minimum. • Two manual exhaust fan controls connected parallel, one to be located near the Operator Workspace and second control located in the Magnet Room. Refer to Illustration 4–7 for exhaust fan recommended set–up or Illustration 4–8 for recommended set–up with optional Oxygen Monitor. • Exhaust fan (customer supplied) to be installed and operating before magnet is moved into room. • Provide minimum 2 ft x 2 ft (0.61 m x 0.61 m) pressure equalizing waveguide vent in the magnet room **ceiling** to prevent positive or negative pressures from interfering with opening of the magnet room door.	• Minimum 5–7% of outside makeup air to be vented into magnet room. For example, with an air input rate of 1200 cubic feet per minute (CFM) (34 cubic meters per minute), there must be a minimum of 60 CFM (1.7 cubic meters per minute) (5%) of outside makeup air. • The exhaust fan and air inlet provide for a minimum of 12 air exchanges per hour or 1200 CFM (34 cubic meters per minute), which ever is larger. • **Note**: Annual customer inspection and cleaning / maintenance of the exhaust fan system (fan, inlet grill/filter, ducts, etc.) is needed to meet the minimum airflow requirement to an outside area.
CRYOGEN STORAGE	• Adequate ventilation to ensure acceptable oxygen level per local regulation.	

4–8 ROOM VENTILATION (Continued)



EXHAUST FAN SET–UP
ILLUSTRATION 4–7



EXHAUST FAN SET–UP WITH OPTIONAL OXYGEN MONITOR
ILLUSTRATION 4–8

4–9 CRYOGENIC VENTING

The superconducting magnet used in the MR System contains large amount of liquid helium at 4 Kelvin (K) = –452° Fahrenheit (F) or –269° Celsius (C). During a quench, the magnet quickly boils off 90% of this liquid. Consequently, a very large volume of extremely cold helium gas must be safely vented outside of the building. Failure of the cryogenic vent can result in this cold gas entering the magnet room or another portion of the building and lowering the ambient oxygen supply to an unsafe level. Therefore it is very important that designer/contractors familiar with industrial piping systems be responsible for the vent system design and installation.

When a quench occurs, the helium gas will immediately begin to warm up and expand rapidly. As the gas escapes from the magnet, the helium gas will increase in temperature from 4.5 K to approximately 30 K. As a result, the gas will expand to 10 times of its original volume. Consequently, venting systems must never decrease in size and may increase in size (diameter) as the distance from the magnet increases.

CAUTION

THE CRYOGENIC VENT INSPECTION MUST BE COMPLETED TO FINAL EXIT OUTSIDE OF THE BUILDING INCLUDING RF SHIELD PENETRATION PRIOR TO MOVING THE MAGNET INTO THE MAGNET ROOM.
IN THE SITUATION WHERE THE MAGNET DELIVERY WILL BE THROUGH A ROOF HATCH AND THE CRYOGENIC VENT WILL BE LOCATED IN THE SAME HATCH THEN THE CRYOGENIC VENT MUST BE INSTALLED AND INSPECTED TO FINAL EXIT WITHIN 24 HOURS OF THE MAGNET DELIVERY THROUGH THE HATCH.

Note

To minimize the confusion due to various domestic and foreign venting material sizing systems, the actual dimensions of the vent material are used to describe the required vent sizes in this document. Please use the locally available venting material best matching or exceeding the requirements discussed in this document.

Note

The difference in the American terminologies of pipes and tubes is disregarded in this document.

Note

The vent size is described by the inside diameter in the pressure drop tables, because the pressure drop is calculated with the inside diameter. The vent size is described by the outside diameter for the waveguide requirements, because sealing the Ventglass® and matching the outside diameters are the critical issues.

Note

Portions of this document may not be applicable to the mobile units. Cryogenic vent design for mobile units must be submitted to GE Medical Systems MR Engineering for certification.

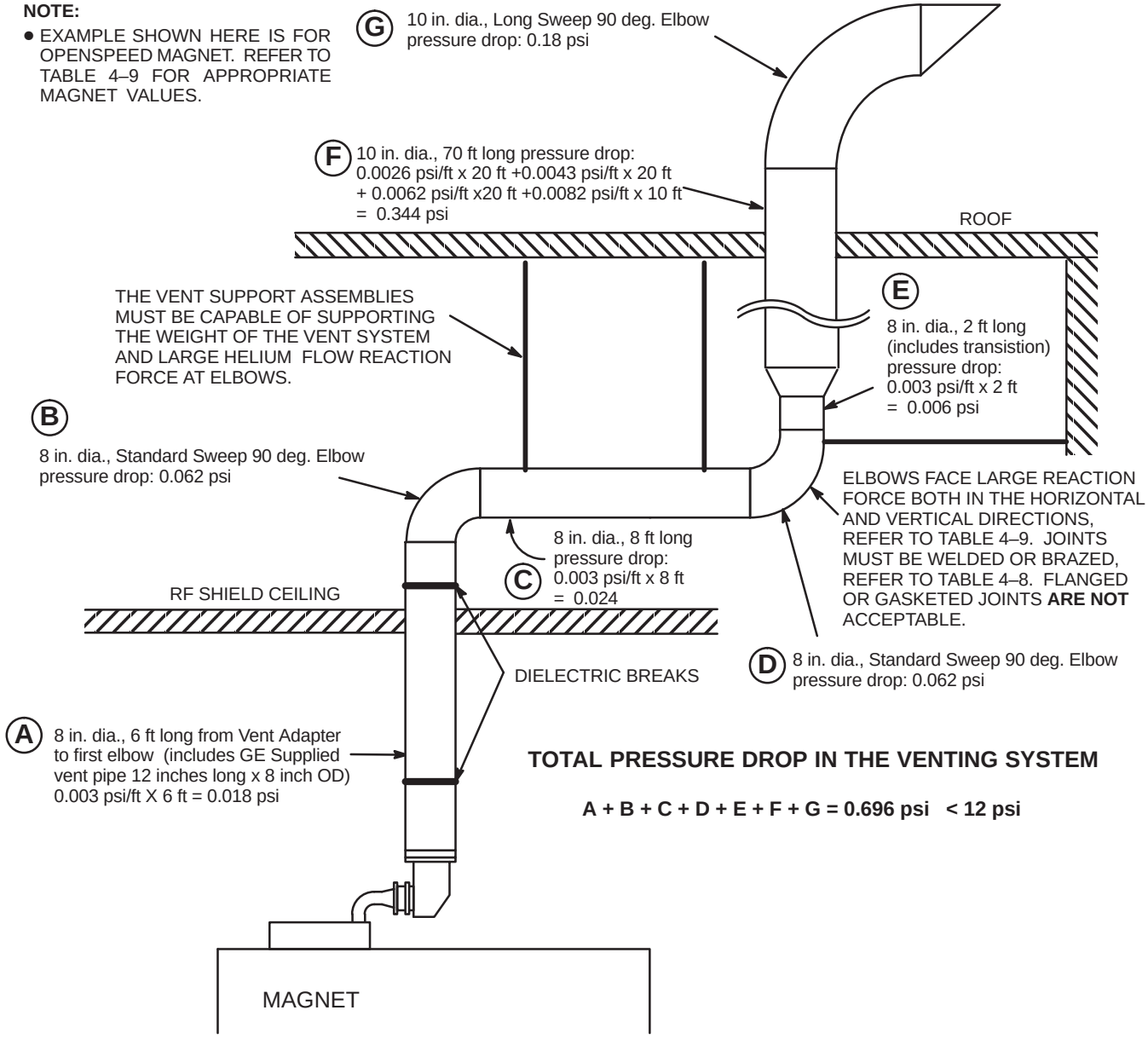
4–9–1 Requirements For Outside Magnet Room

The customer's vent system designer/contractor must design and install the cryogenic vent from the RF shield waveguide to the final exit on the building roof top or outside wall. Table 4–8 contains the requirements which must be strictly adhered to in order to prevent failure of the vent system during a magnet quench.

TABLE 4–8
CRYOGENIC VENTING REQUIREMENTS FOR OUTSIDE MAGNET ROOM

PARAMETER	CRYOGENIC VENTING REQUIREMENTS
VENT SIZE	• The total pressure drop of the entire cryogenic vent system must be less than 12 psi (82.7 KPa). The calculation starts at the magnet vent interface and ends at the termination point outside of the building. Use Table 4–9 to determine proper vent sizes. See Note 1. See Illustration 4–9 for a sample calculation. • The pressure drop of the RF shield waveguide must be included in the overall calculation. Make sure the RF shielded room supplier provides a straight pipe for the waveguide with an outside diameter which matches the tubing from the magnet within ± 0.125 inch (3 mm). Refer to Section 7, RF SHIELDED ROOM, for location of vent pipe/waveguide. • The vent route must be as direct as possible and designed with a minimum number of elbows. If elbows must be used, they must be standard or long sweep types. Refer to Section 7, RF SHIELDED ROOM, for routing of vent pipe.
VENT CONSTRUCTION	• Expansion/contraction joints must be provided to account for dimensional changes that will occur during a magnet quench when the vent temperature decreases from ambient to 4.5 K (–451° F or –268° C). • At the waveguide, non–metallic isolation joint must be provided to ensure the integrity of the magnet room RF shield. The joint gap must be 1.0 ± 0.25 inch (25 ± 6 mm). • The location of the isolation joint must be readily accessible for inspection and/or replacement. • All components must be able to withstand the minimum static pressure as calculated from Table 4–9 and a helium flow reaction force at temperatures from 4.5 K (–451° F or –268° C) and above. • Electro–mechanical fire dampers must not be used in the design of the vent system. Fusible link fire dampers are acceptable and require routine inspection and maintenance. • Appropriate protection must be provided for any portion of the cryogenic vent system which may drip condensation on personnel or ceiling components. • Access must be available for any portions of the cryogenic vent system made of non–metallic materials which require routine inspection and maintenance by the customer.
VENT SUPPORT	• All portions of the cryogenic vent system must be adequately supported. The vent support assemblies must be capable of supporting the weight of the vent system and the helium flow reaction force of 1850 lbs (8229 N) for 0.7T magnet at the vent elbows. • Non–metallic (i.e. Ventglass) joints **must not** be used as the support for the vent system.
VENT EXIT AND TERMINATION	**WARNING!** • The exit location of the cryogenic vent system must be chosen to prevent the extremely cold exhaust gas from injuring anyone, including maintenance personnel. Exhaust opening access must be limited by warning signs or other barriers within a distance 10 feet (3.05 m) for 0.7T magnet. • The exhaust vent must be directed in a manner to prevent the cold gas from injuring personnel or damaging any building components. It must also be directed away from air intake vents. • For a roof top exit, GE recommends that the exhaust flow be directed horizontally using a 90° elbow having minimal pressure drop and the outlet covered with a 0.5 inch (12.7 mm) mesh screen to prevent the entry of foreign material. See Illustration 4–10. Other low pressure drop, high flow rate roof caps are acceptable. • The bottom of the 90° elbow must be at least 3 feet (0.9 meters) above the roof deck. This dimension must be higher if the location of the vent exhaust is susceptible to being blocked by drifting snow.
Note: 1 The customer's designer is responsible for selecting materials and hardware capable of safely handling the pressures and cold temperature generated within the vent at each MRI site.	

4–9–1 Requirements For Outside Magnet Room (Continued)



SAMPLE PRESSURE DROP CALCULATION OF CRYOGENIC VENTING
ILLUSTRATION 4–9

4–9–1 Requirements For Outside Magnet Room (Continued)

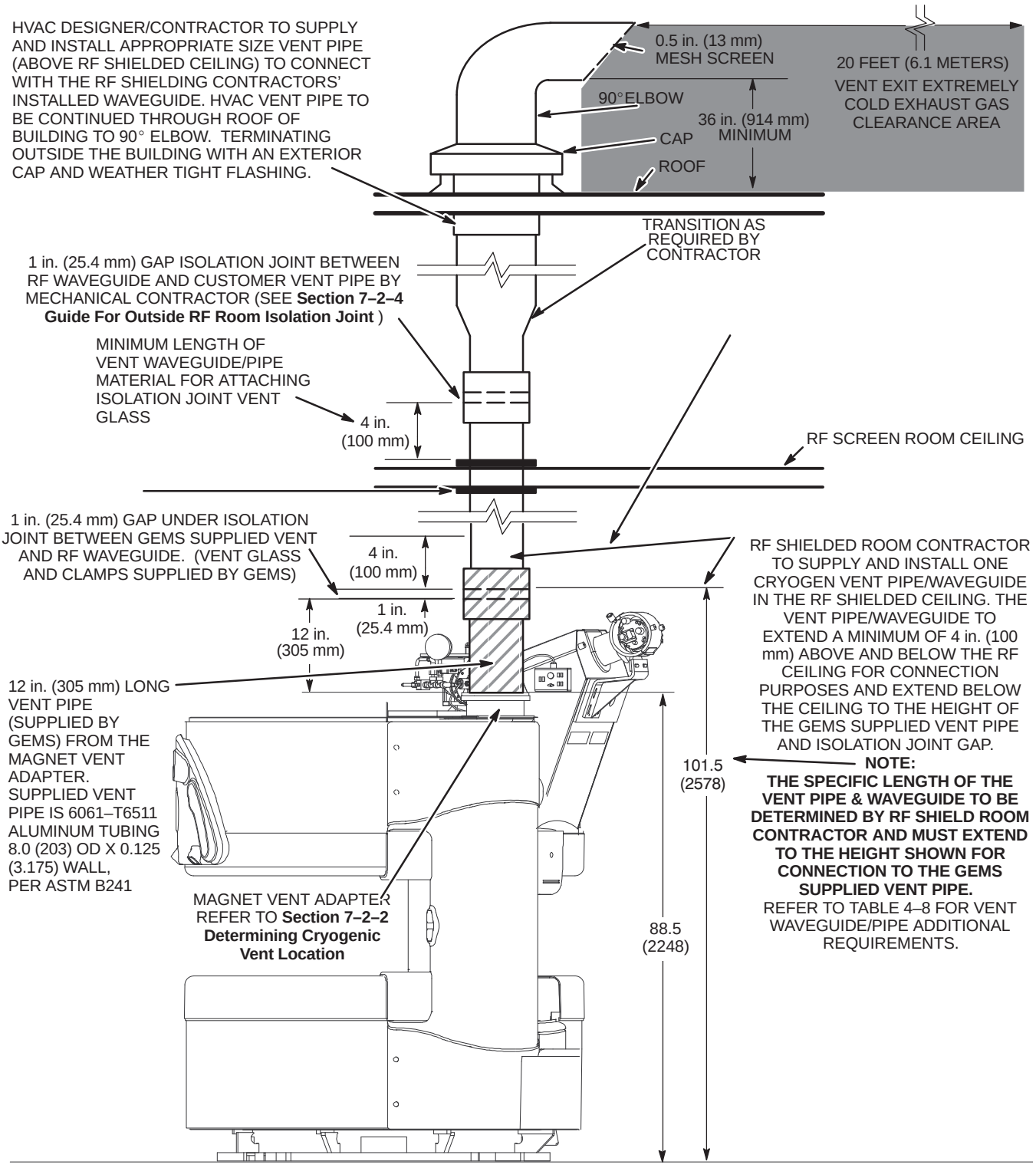
TABLE 4–9
CRYOGENIC VENT SYSTEM PRESSURE DROP MATRIX FOR 0.7T MAGNET
(THIS TABLE MUST BE USED FOR CRYOGENIC VENT SYSTEM DESIGN)

CRYOGENIC VENT SYSTEM PRESSURE DROP MATRIX FOR A 0.7 TESLA MAGNET				PRESSURE DROP PER ELBOW USED ANYWHERE WITHIN A 20 FT VENT SEGMENT			
INSIDE DIAMETER OF VENT PIPE in. (mm)	DISTANCE OF VENT SYSTEM COMPONENT FROM MAGNET ft (m)	PRESSURE DROP FOR STRAIGHT VENT PIPE WITH SMOOTH INSIDE SURFACE psi/ft (KPa/m)		STANDARD SWEEP 45° ELBOW psi (KPa)	STANDARD SWEEP 90° ELBOW psi (KPa)	LONG SWEEP 45° ELBOW psi (KPa)	LONG SWEEP 90° ELBOW psi (KPa)
8 (203.2)	0–20 (0–6.1)	0.003	(0.021)	0.031 (0.21)	0.062 (0.43)	0.015 (0.10)	0.044 (0.30)
	20–40 (6.1–12.2)	0.0075	(0.052)	0.075 (0.52)	0.15 (1.03)	0.036 (0.25)	0.10 (0.67)
	40–60 (12.2–18.3)	0.012	(0.083)	0.125 (0.86)	0.25 (1.72)	0.059 (0.41)	0.17 (1.17)
	60–80 (18.3–24.4)	0.018	(0.124)	0.179 (1.23)	0.36 (2.48)	0.086 (0.59)	0.25 (1.72)
	80–100 (24.4–30.5)	0.024	(0.17)	0.237 (1.63)	0.47 (3.24)	0.11 (0.76)	0.33 (2.28)
10 (254.0)	0–20 (0–6.1)	0.0011	(0.0076)	0.013 (0.09)	0.028 (0.19)	0.006 (0.041)	0.023 (0.16)
	20–40 (6.1–12.2)	0.0026	(0.018)	0.031 (0.21)	0.067 (0.46)	0.016 (0.11)	0.055 (0.38)
	40–60 (12.2–18.3)	0.0043	(0.03)	0.052 (0.36)	0.11 (0.76)	0.026 (0.18)	0.093 (0.64)
	60–80 (18.3–24.4)	0.0062	(0.043)	0.075 (0.52)	0.16 (1.10)	0.037 (0.26)	0.13 (0.90)
	80–100 (24.4–30.5)	0.0082	(0.057)	0.099 (0.68)	0.21 (1.45)	0.049 (0.34)	0.18 (1.24)
12 (304.8)	0–20 (0–6.1)	0.00045	(0.0031)	0.007 (0.048)	0.014 (0.097)	0.003 (0.021)	0.009 (0.062)
	20–40 (6.1–12.2)	0.0011	(0.0076)	0.016 (0.11)	0.034 (0.23)	0.008 (0.055)	0.021 (0.14)
	40–60 (12.2–18.3)	0.0018	(0.0124)	0.027 (0.19)	0.056 (0.39)	0.013 (0.090)	0.036 (0.25)
	60–80 (18.3–24.4)	0.0026	(0.018)	0.039 (0.27)	0.081 (0.56)	0.018 (0.124)	0.052 (0.36)
	80–100 (24.4–30.5)	0.0035	(0.024)	0.052 (0.36)	0.11 (0.76)	0.024 (0.165)	0.069 (0.48)
	100–120 (30.5–36.6)	0.0043	(0.030)		0.14 (0.97)		0.087 (0.60)
	120–140 (36.6–42.7)	0.0053	(0.037)		0.16 (1.10)		0.105 (0.72)
	140–160 (42.7–48.8)	0.0062	(0.043)		0.19 (1.31)		0.125 (0.862)

Note 1 : Elbows with angles greater than 90° **must not** be used.

Note 2 : The table data is based on the following:
a. Initial flow conditions at magnet interface
b. Gas temperature starting at 4.5 Kelvin (–452° F or –268° C).
c. Helium gas flow rate of 750 cubic feet per minute (21.24 cubic meters per minute)
d. Helium volume 85 gallons (322 liters)

4–9–1 Requirements For Outside Magnet Room (Continued)



TYPICAL CRYOGENIC VENT DETAIL
ILLUSTRATION 4–10

4–9–2 Requirements For Inside Magnet Room

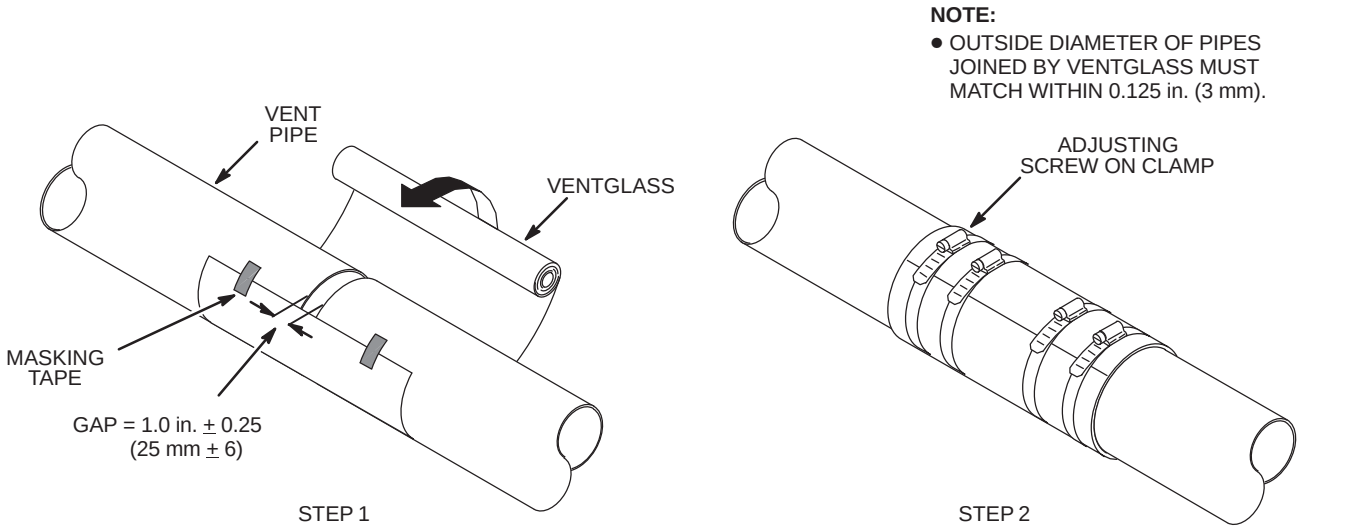
GE provides and installs a vertical 8 in. (203.2 mm) outside diameter 12 in. (305 mm) long cryogenic vent pipe within the magnet room straight up from the magnet in line with the waveguide in the RF Shield. The customer is responsible to provide additional vent pipe within the magnet room to meet requirements defined in Table 4–10. The Vent diameter is determined by magnet, refer to Section 7–2–2, Determining Cryogenic Vent Location. For other vent configurations (i.e. offset ceiling exits, wall exits and geodesic domes) the customer's contractor is responsible for the design and installation of the cryogenic vent system and vent supports within the magnet room. In these cases, a complete description of the vent size, materials/properties and routing must be sent to GE Medical Systems MR Siting & Shielding Group for final review. Table 4–10 contains the GE requirements for vent design within the magnet room.

4–9–2 Requirements For Inside Magnet Room (Continued)

TABLE 4–10
CRYOGENIC VENTING REQUIREMENTS FOR INSIDE MAGNET ROOM

PARAMETER	CRYOGENIC VENTING REQUIREMENTS
VENT SIZE	• The total pressure drop of the entire cryogenic vent system must be less than 12 psi (82.7 KPa). The calculation starts at the magnet vent interface and ends at the termination point outside of the building. Use Table 4–9 to determine proper vent sizes. • The pressure drop of the RF shield waveguide must be included in the overall calculation. Make sure the RF shielded room supplier provides 8 inch (203.2 mm) outside diameter straight pipe for the waveguide for 0.7T magnet. Refer to Section 7, RF SHIELDED ROOM, for location of vent pipe/waveguide.
VENT MATERIAL	• The vent material must be Stainless Steel 304, Aluminium 6061–T6 or Copper type DWV, M or L. • Either tubes or pipes meeting the requirements may be used for venting. The vent pipe must be either seamless or have welded seams. Corrugated pipe **must not** be used. If necessary, bellows pipe of length less than 1 ft (30 cm) is allowed for thermal expansion joint. • The vent pipe must be capable of withstanding pressures up to 25 psi (172.4 KPa). • For the waveguide, the vent material must match the 8 inch (203.2 mm) outside diameter of the magnet's vent. • Venting wall thickness: SS 304 Minimum 0.035 in. (0.89 mm) Maximum 0.125 in. (3.18 mm) AL 6061–T6 Minimum 0.083 in. (2.11 mm) Maximum 0.125 in. (3.18 mm) CU DWV, M or L Minimum 0.083 in. (2.11 mm) Maximum 0.140 in. (3.56 mm)
VENT SUPPORT	• All portions of the cryogenic vent system must be adequately supported. The vent support assemblies must be capable of supporting the weight of the vent system. To ensure the integrity of the RF shield for the magnet room, electrically isolate any support assemblies which are used to support sections of venting between the magnet interface and the isolation joint at the waveguide. • The vent support assemblies must be capable of supporting the weight of the vent system and 850 lb. (3781 N) helium flow reaction force at vent elbows. • Non–metallic (i.e. Ventglass) joint **must not** be used as the support for the vent system.
VENT CONSTRUCTION	• One dielectric break in the vent system (i.e.. Ventglass) is required within the Magnet Room. A non–metallic isolation joint must be provided between the GEMS supplied 12 in. (305 mm) long vent pipe and the cryogen vent system ensure the integrity of the RF shield for the Magnet Room. • For vent systems with offsets, a thermal expansion joint may be necessary to allow for the thermal expansion and contraction of the vent system. • All joints except 1 non–metallic isolation (i.e.. Ventglass) must be welded or brazed. No clamped, sealed flanges permitted. • All isolation/thermal expansion joints except 1 non–metallic isolation (i.e.. Ventglass) must be able to withstand temperatures from 4.5 K (–451° F or 268° C) and above. For 1.0T or 1.5T magnets, these joints must also withstand pressures up to 35 psi (241.4 KPa). • GE requires Ventglass material to be used for 1 isolation joint, which may serve as a non–metallic thermal expansion joint. Rubber soil pipe couplings are not acceptable for this application. When using Ventglass material to join 2 pipes together make sure the gap between the pipes is 1.0 ± 0.25 inch (25.4 ± 6 mm) and use a continuous wrap technique during installation. See Illustration 4–11. Use 2 hose clamps on each side of the joint for securing the Ventglass to the vent pipe. • To prevent condensation during magnet ramping, the vent must be insulated with 1.5 inch (38 mm) thick flexible unicellular insulation. For appearances, all exposed insulation should be covered with white PVC jackets. **Note** Access must be available to the non–metallic isolation joint located within 12 in. (305 mm) of the Magnet Vent Adapter for annual inspection and/or maintenance by the customer. **Note** The installation of the vent pipe section between the waveguide and the supplied magnet vent pipe **must not** result in any vertical or side load to the waveguide and the magnet vent pipe.

4–9–2 Requirements For Inside Magnet Room (Continued)



VENTGLASS CONTINUOUS WRAP
ILLUSTRATION 4–11

4–10 ALARM DEVICES, WATER SENSORS AND THERMOSTATS

4–10–1 System Cabinet

The System Cabinet has one temperature sensor and one control module which sounds an alarm located in the System Cabinet when temperature reaches 94° F (34.4° C). After 3 minutes of alarm condition PDU will revert to full off condition. Any external alarm device other than mentioned above must be supplied by the customer.

4–10–2 Water Sensor Alarm and Floor Drain

It is recommended that customer supplied water sensor alarms and floor drain be located on floors where water cooled cabinets are positioned, especially under raised flooring.

4–10–3 Pneumatic Patient Alert

The Pneumatic Patient Alert Control Box provides an audible and visual alarm near the operator when the patient depresses the hand held squeeze bulb. The control box is to be mounted with consideration for ease of use by operator, remaining in sight of operator, and remaining within 5 ft. (1.5 m) of an electrical outlet. Note, an outlet on the Operator Console can be used. Options for control box location include mounting box vertically (on a wall or other vertical surface), horizontally (place box on a counter top, desk top, or other horizontal surface), or under a shelf within sight of operator.

4–10–4 Magnet Monitor Remote Alarm Box

The Magnet Monitor Remote Alarm Box will activate an audible and visual alarm near the operator for the following conditions:

- The magnet helium level goes below the specified lower limit on the Magnet Monitor.
- If the Magnet recondenser temperature sensors are above specification for more than 90 minutes.

The Magnet Monitor Remote Alarm Box should be located on or near the Operator Workspace.

4–11 AMBIENT RADIO FREQUENCY INTERFERENCE (RFI)

The MR System utilizes spatially encoded radio frequency information to create the MR image. Therefore, it is sensitive to ambient RFI. To protect the MR from ambient RFI (as well as the local environment from Magnetic Resonance RF), all sites require a 100 dB RF Shield, refer to Section 7, RF SHIELDED ROOM, for exact requirements. It is very unlikely that local signals will affect an MR System with a properly designed and installed RF Shield. During the site evaluation visit, GE notes the location of nearby sources of RFI and will advise if further information or on–site testing is required. Most sites do not require on–site testing. Listed in Table 4–11 are the recommended centerband and bandwidth frequencies to be used when measuring radio frequency interference. This table includes those frequency bands which are important for both proton imaging.

TABLE 4–11
RADIO FREQUENCY SURVEY SPECIFICATIONS

ISOTOPE	CENTERBAND MHz/Tesla	BANDWIDTH Hz/Tesla
^{1}H	29.803	285,629

When required, RFI site surveys are to be performed by cycling through the preceding frequency bands and a broad band range from 10MHz–100MHz. Special emphasis, however, should be placed on the ^{1}H band since this is used in proton imaging. The RFI site survey should be performed for a length of time necessary to determine, within a reasonable degree of certainty, that the RFI noise at the site will not exceed the 100 db attenuation provided by the RF shielded room. Note that any RFI site survey no matter how thorough, will not preclude the possibility of future or unmeasured RFI caused by new or intermittent sources.

The ambient RF noise measured should be less than 100 millivolt per meter (100 dB microvolt per meter). When a RFI site survey is required, it must be completed before the purchase and installation of the RF shielded room.

To ensure that 100 millivolt (or greater) RF noise peaks outside the bandwidths specified above do not actually extend into these bandwidths and exceed the 100 millivolt limit, adjust the resolution of the test equipment (spectrum analyzer) according to the equation:

- BW (resolution) = f_0 /50
- where:
  BW = Bandwidth (resolution)

  f_0 = Center frequency (29.803 MHz for ^{1}H at 0.7 Tesla)

4–12 POLLUTION

The site must be clean prior to delivery of the equipment. Although individual components have filters for optimum air filtration, care should be taken to keep air pollution to a minimum.

Since static discharge can cause system failures or affect its operation, carpeting should be of the anti–static type or treated with an anti–static solution.

When cleaning tile floors, do not use steel wool which could enter cabinet enclosures and cause internal shorts.

The computer/equipment area requires that the air be filtered to remove 90 percent of all particles down to 10 microns and 80 percent of all particles from 10 to 5 microns in size.

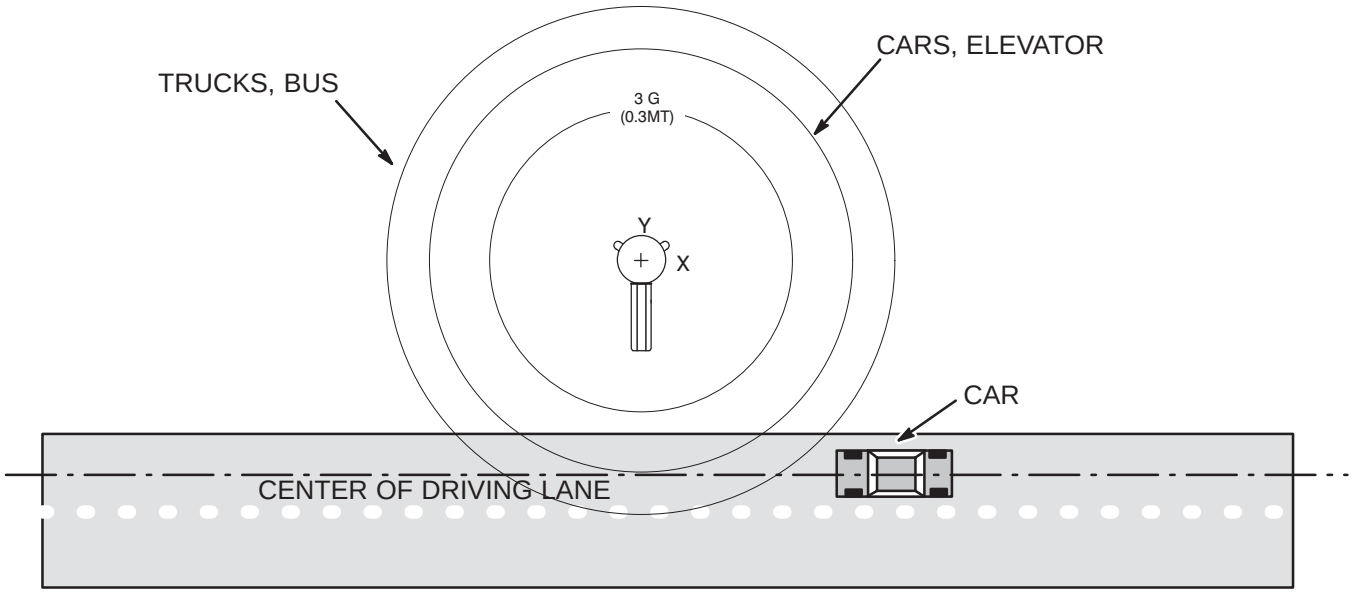
4–13 CHANGING MAGNETIC ENVIRONMENT SPECIFICATIONS

Note

Refer also to Table 2–1, PROXIMITY LIMITS, for additional proximity limitations.

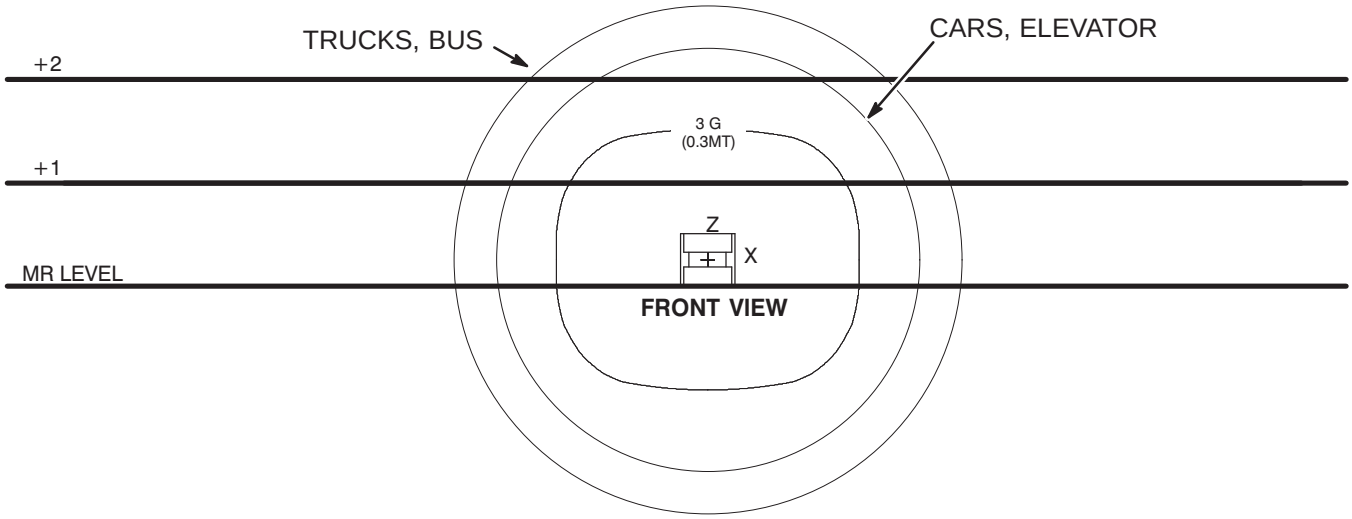
4–13–1 Definition Of Moving Metal

Moving metal means metal objects that move inside of the moving metal sensitivity line during system scans. For example, cars being driven inside the moving metal sensitivity line are moving metal, see Illustrations 4–12 and 4–13. However, if a car or a dumpster is within the moving metal sensitivity line and **does not** move during scans, then it is not an issue. Note, the 3 gauss line proximity limit for metal objects still applies to magnets.



0.7T MAGNET MOVING METAL SENSITIVITY LINE PLOT
ILLUSTRATION 4–12

4–13–1 Definition Of Moving Metal (Continued)



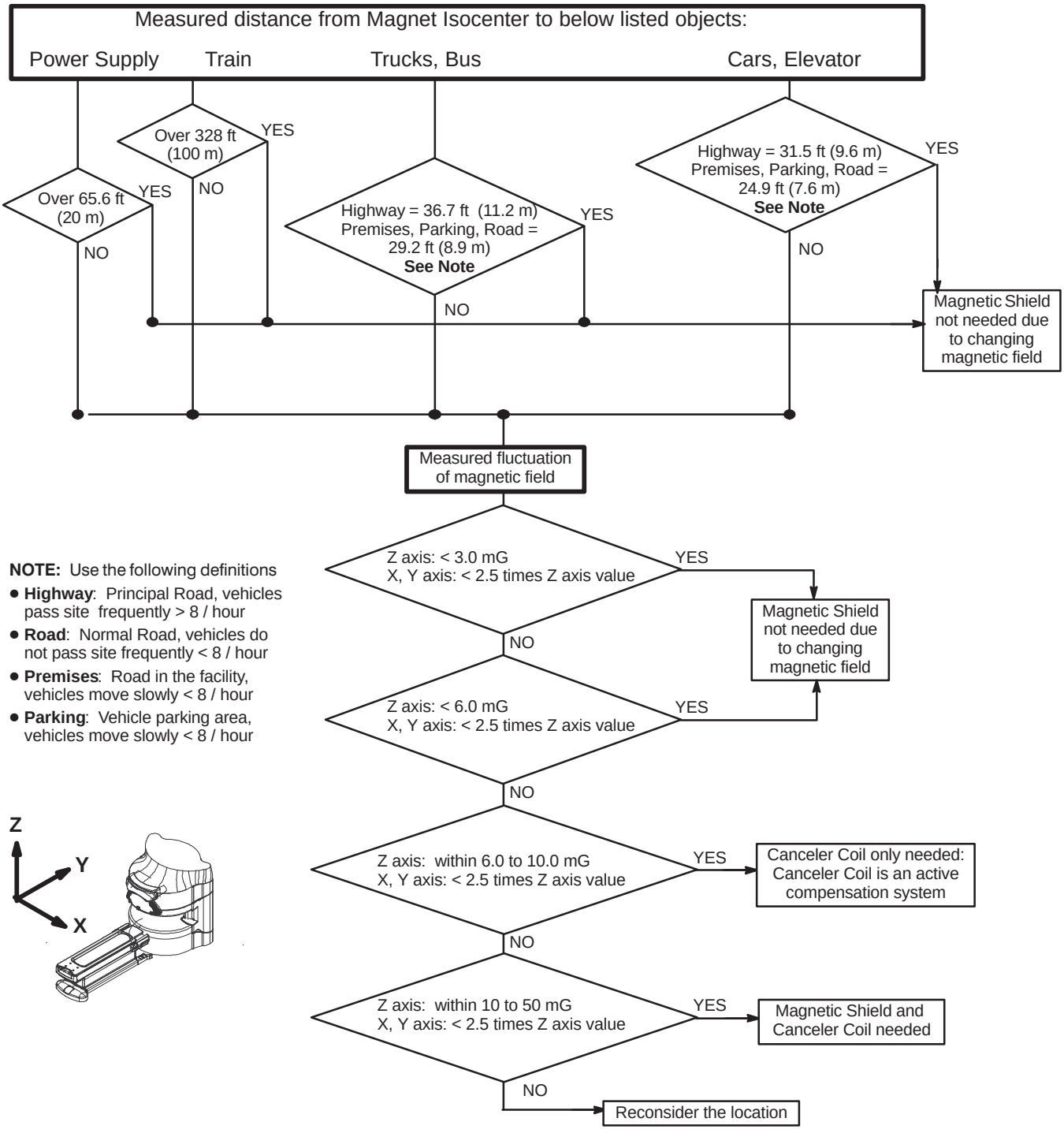
0.7T MAGNET MOVING MAGNETIZED METAL SENSITIVITY LINE PLOT
ILLUSTRATION 4–13

4–13–2 Countermeasures For Changing Magnetic Field

Read the following notices before applying the flowchart in Illustration 4–14.

1. Silicon steel of 3 mm thickness is used for Magnetic shield.
2. “The distance of magnet isocenter to cars” means the distance from the magnet isocenter to the center line of the car in the driving lane, see Illustrations 4–12 and 4–13.
3. If one of the following is faced toward the source of the magnetic field fluctuation then the countermeasure of using a 6 sided (3 mm thick) silicon steel shield is not effective.
   - Door
   - Window
   - Penetration Panel
4. The floor under the Magnet and Magnet Room must meet the requirements in in **Section 4–14–1 Floors**.

4–13–2 Countermeasure For Fluctuated Magnetic Field (Continued)



COUNTERMEASURE DETERMINATION FOR CHANGING MAGNETIC FIELD
ILLUSTRATION 4–14

4–13–3 Distances For AC Power Lines, Transformers And Electric Motors

In general most AC equipment in sites is not an issue if it kept outside the 5 gauss line. If a site has large AC equipment (building mains, substations, electric trains, or subways) see Illustration 4–15 and calculate or measure the field along the Z axis at the magnet isocenter.

Electrical currents flowing in high voltage power lines, transformers, and large generators or motors near the magnet can affect the magnetic field homogeneity that is essential to the proper performance of the MR System. Although it is highly unlikely that induced magnetic fields will be a problem, possible sources of AC interference are identified by GE during the site evaluation visit. GE will analyze this information and advise if further shielding or site rearrangement are necessary.

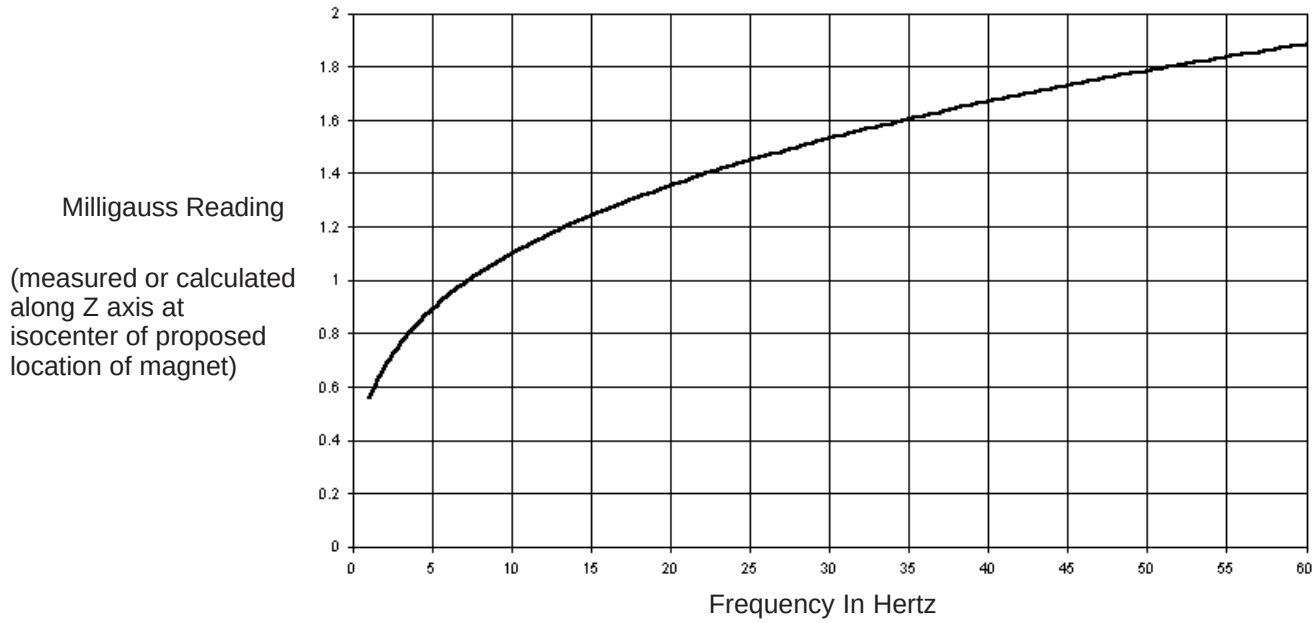
Magnetic field interference at 50 or 60 Hz must not exceed 1.8 milligauss RMS at the magnet location. The following equation can be used as a general guide in determining allowable current in feeder lines at a given distance from the magnet isocenter.

- $$I = \frac{0.9X^2}{S}$$
- where:

  I= Maximum allowable RMS single phase current (in amps) or maximum allowable RMS line current (in amps) in three phase feeder lines

  S=Separation (in meters) between single phase conductors or greatest separation between three phase conductors

  X=Minimum distance (in meters) from the feeder lines to isocenter of the magnet



ALLOWABLE MILLIGAUSS VS LINE FREQUENCY FOR AC EQUIPMENT
ILLUSTRATION 4–15

See Illustration 4–16 for a sample calculation.

4–13–3 Distances For AC Power Lines, Transformers And Electric Motors (Continued)

This is a sample calculation to determine minimum distance from a feeder, transformer, or other AC electrical source, using the Formula found in **Section 4–13–3 Distances For AC Power Lines, Transformers And Electric Motors**.

$$\mathrm{I(amps)} = 0.9\mathrm{X^2(meters)} \div \mathrm{S(meters)}$$

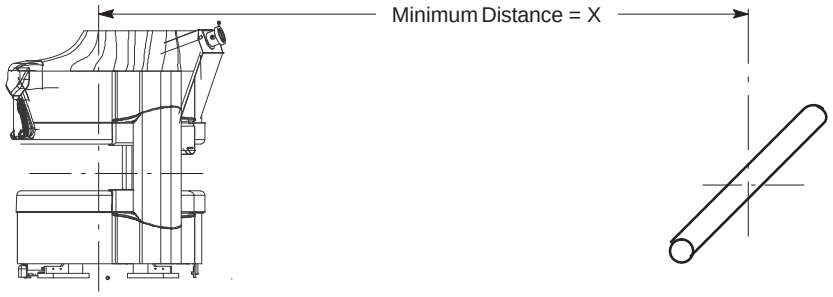
Note that the formula has 3 variables, if you have 2 of them, you can calculate the 3rd. In this example, we calculate the minimum distance **X** from the source, in this case a main electrical feeder carrying 450 amps of current in a 5 inch conduit.

Rearranging: $$X^2 = \{I(amps) \times S(meters)\} \div 0.9$$

$$X = \sqrt{\left\{\frac{\{I(amps) \times S(meters)\}}{0.9}\right\}}$$

Note that the separation “S” is the spacing between the conductors and when all 3 conductors are run in a single conduit, “S” is simply the diamter of the conduit.

$$S = 5inches = 0.127meters$$



$$X = \sqrt{\left\{\frac{\{450(amps) \times 0.127(meters)\}}{0.9}\right\}}$$

$$X = 8meters = 26.2feet$$

So in this example, the condiut should be 8 meters or 26.2 feet or farther from the magnet’s isocenter.

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

What if it is too close? Keep in mind that 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 worse case and does not take into account the vector direction of the AC interference. Ths magnet is only sensitive to AC disturbances that are directed vertically. Also the calcuation does not account for any magnetic shielding effect of steel conduit.

SAMPLE CALCULATION
ILLUSTRATION 4–16

4–14 CONSTRUCTION MATERIALS

The following recommendations are for maintaining field homogeneity of the magnet. All construction must comply with local and national building codes.

Note

When welding in an MR room with system equipment installed, the return path for the welding must be in very close proximity to the welding. The close proximity is needed to make sure the welding currents do not cause damage to the system. Never use the building structure as a return path for welding.

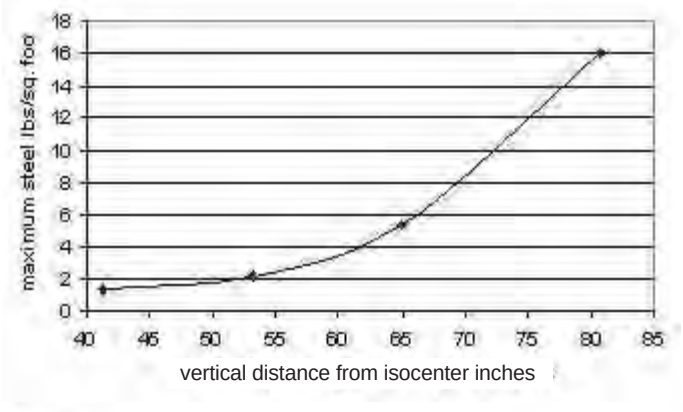
4–14–1 Floors

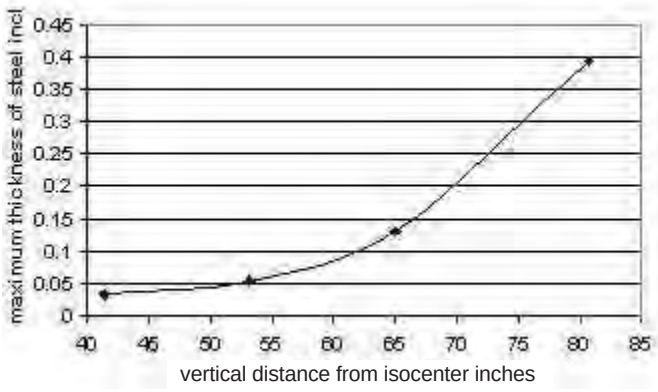
The magnet room floor should be poured slab on grade with polypropelene fiber impregnated or epoxy reinforced concrete. Non–magnetic stainless steel rebar or fiberglass rebar may also be used as a reinforcing material. Steel reinforcing rods or corrugated iron sheets should be avoided especially within the 50 gauss for the 0.7T magnet. If these materials exist at the site, or if installation of these materials is contemplated, they must be taken into account in the structural steel evaluation of the site. Refer to **Section 3, MAGNETIC FIELD CONSIDERATIONS**, for more magnetic field information.

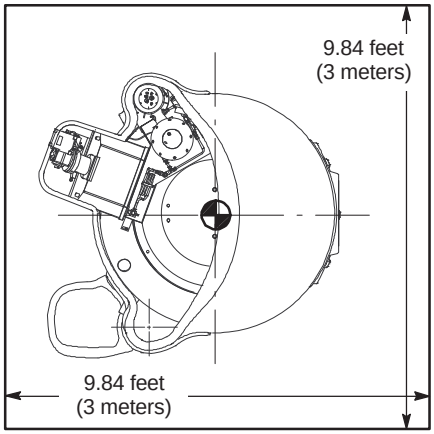
Refer to **Section 7–7 MAGNET MOUNTING REQUIREMENTS INSIDE RF SHIELDED ROOM** for floor requirements for anchoring magnet.

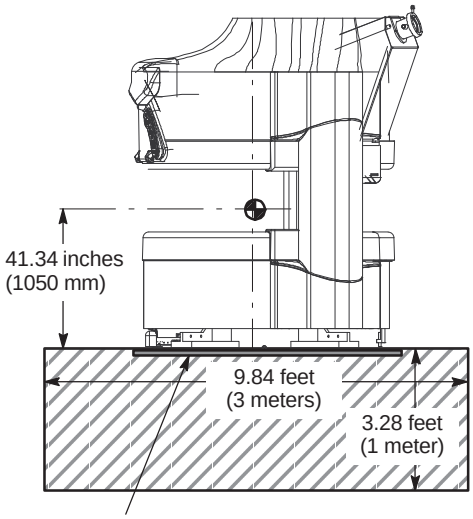
The 0.7T magnet is capable of being shimmed with the maximum14.3 lb/ft^2 (70 kg/m$^{2)}$ of ferrous steel in an area of 9.84 feet x 9.84 feet (3 meters x 3 meters) within 3.28 feet (1 meter) distance from the bottom of the magnet feet. See Illustration 4–17 for the varying limits of steel in close proximity to the magnet isocenter when using normal system shimming techniques. The data is based on a square area located directly beneath the magnet as shown in Illustration 4–17. A ferrous I–Beam located directly beneath the magnet is prohibited. The values shown Illustration 4–17 shall not be exceeded.

4–14–1 Floors (Continued)

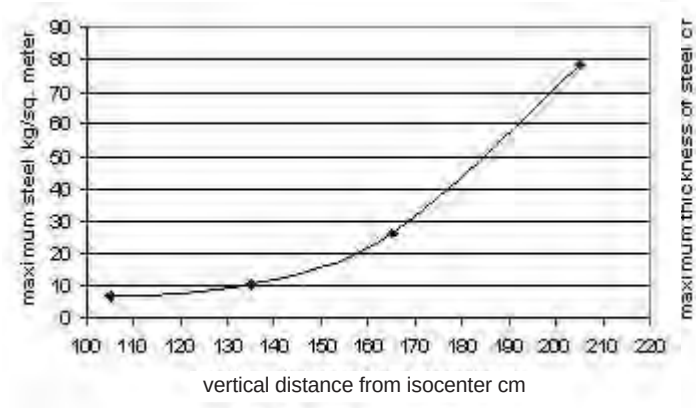


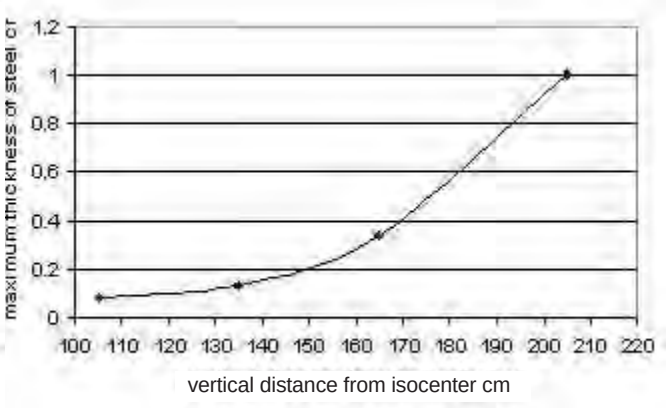






FOR SUSPENSION FOUNDATION SITES:
GE PROVIDED NON–MAGNETIC
304 STAINLESS STEEL ASTM A240
MAGNET MOUNTING PLATE





MAXIMUM THICKNESS OF STEEL PLATES UNDER MAGNET
ILLUSTRATION 4–17

4–14–2 Walls, Ceilings, and Fixtures

General

Standard steel nails, screws, and other hardware are acceptable if properly secured. Any loose steel objects can be violently accelerated into the aperture of the magnet. Careful thought should be given to the selection of light fixtures, cabinets, wall decoration, etc. to minimize this potential hazard. For safety, all **removable** items within the magnet room such as switch box cover plates, light fixture components, mounting screws, etc. must be non–magnetic. If you have a specific question about material, bring it to the attention of your GE Installation Specialist.

Non–movable steel such as wall studs or HVAC components will produce negligible effect on the magnet.

4–14–3 Electrical conduits

Electrical conduit within the magnet room must be metal, steel is acceptable provided it is inside walls and ceilings. Note, conduit for a receptacle must be metallic. Ferromagnetic material inside the magnet room could inadvertently become a projectile.

4–14–4 Plumbing pipes and drains

Ferrous pipes and drains within the magnet room must meet the distance and mass requirements in **Section 4–14–1 Floors**. For safety, any removable items such as faucet handles, drain covers, etc. must be non–magnetic material such as PVC, copper, or brass. Any magnetic material inside the magnet room could inadvertently become a projectile. Refer to Section 4–9, CRYOGENIC VENTING, for cryogenic vent materials requirements.

4–15 VIBRATION

Certain MR procedures require a stable environment to achieve high resolution image quality.

Environmental site vibration has the ability to affect the magnet phase stability and ultimately image quality.

To minimize the interference, locate the Signa OpenSpeed site on grade and as far as possible from common vibration sources. Some examples of common vibration sources are listed below:

- parking lots
- roadways
- subways
- trains
- hallways
- hospital physical plants
- Mechanical equipment such as pumps, motors, air handling equipment, air conditioning units or generators
- elevators
- heliports.

Note

Please note that other items not listed could also be potential sources of vibration.

Detrimental vibration effects on image quality can be minimized early in the site planning of the MR suite, by analyzing the proposed site's existing vibrations, the slab configuration, and soil conditions. For Signa OpenSpeed orders, GEMS will manage this investigation for our customers and recommend a foundation solution (i.e. slab on grade, suspension foundation) or other site modifications required to prepare the site for our system.

It is the customer's architect/engineer's responsibility to design and implement the recommended site solution. GEMS will assist by furnishing typical design guidelines and reviewing the customer's construction drawings.

Note

Vibration isolation is recommended at floor connection points of the air conditioning unit(s) to be installed for the purpose of cooling the MR Suite. Vibration isolation will also be required for any mechanical equipment found to be a detrimental vibration source. Vibration isolation requirements to be determined by GEMS.

SECTION 5 – POWER REQUIREMENTS

TABLE OF CONTENTS

5–1 INTRODUCTION

The Signa OpenSpeed system includes a Main Disconnect Panel (MDP) with Low Voltage Low Energy control capability and remote Emergency Off capability in the feeder lines that supply input power to the following system components:

- Power Distribution Unit (PD1) module in the lower portion of the Power Cabinet (MR1) which distributes power to system electronics components.
- Temperature Control Unit (TCU), Magnet Monitor equipment including the Magnet Monitor, UPS for Magnet Monitor, Modem for Magnet Monitor, and optional phone line multiplexer.
- System Cooling Cabinet (SCC) physically contains the Cryo Cooler Compressor Cabinet, the Shield Cooler Compressor Cabinet, a water chiller which provides water cooling for the Cryo & Shield Cooler Compressors, Gradient Coil, and air compressor for RF Coil air cooling. The air compressor for RF Coil air cooling is physically located in the System Cooling Auxiliary Cabinet (SCC2) which is powered from the SCC.

The MDP utilizes an Automatic Restart function to restart power to the SCC, TCU, UPS for Magnet Monitor, modem, and the optional Multiplexer Box.

Note

If the SCC configuration with the Remote Condenser Unit (RCU) is being utilized the RCU is powered from the SCC via customer supplied power wiring with a Lock Out / Tag Out capable disconnect box located on the RCU.

Refer to Section 5–2, CRITICAL POWER REQUIREMENTS, for specifications of required facility input to the MR System. Refer to Table 5–1 for required customer power.

Customers should carefully consider the advantages and disadvantages of raised flooring, conduits, floor ducts, and surface raceways for running cables in accordance with local codes. If used, conduits should be large enough to pass any cable and its connector through with all other cables already in the conduit.

To reduce voltage regulation problems and wiring costs, minimize the cable length between the primary power source, the MDP and the PDU. When routing cables, keep all phase conductors and ground for a circuit in the same trough. Whenever possible, keep power cables away from signal and data cables. Use separate trough or dividers in duct.

CAUTION

The system is able to maintain field strength for a maximum of 2 days (48 hours) of power loss and/or System Cooling Cabinet / Cryo Cooler Compressor water cooling loss. Beyond that duration the magnet may quench and require a minimum of 5 days to ramp/shim the magnet with the need for cryogen replenishment. In the event of a magnet quench due to 2 day or more power or cooling loss the customer will be responsible for the cost (materials and labor) to return the magnet to field. Cooling may be air or air/water dependent on System Cooling Cabinet configuration chosen.

5–1 INTRODUCTION (Continued)

CAUTION

Continuous water cooling is critical for the Shield/Cryo Cooler Compressors and therefore MUST be available 24 hours per day / 7 days per week to maximize proper uninterrupted magnet operation. Water cooling is required immediately upon magnet arrival. The System Cooling Cabinet (SCC) and Main Disconnect Panel (MDP) must be installed and operational prior to magnet arrival. These requirements apply to all sites regardless of System Cooling Cabinet configuration.

TABLE 5–1
REQUIRED CUSTOMER POWER

MR COMPONENT	VOLTAGE (VAC)	FREQUENCY	PHASE	MAX. AMPS	COMMENTS
Main Disconnect Panel (MDP) See Notes 1, 2 & 3	480Y/277 VAC, 400Y/230 VAC ±10% See Note 4	50/60 Hz	(3+GND) See Comments	See Note 5	Recommend input configuration: 3 phase Grounded WYE with Neutral and Ground (5 wire system). Note, Neutral must be terminated prior to PDU or inside the Main Disconnect Panel and not brought to the Power Cabinet. (See Note 6) Optional input configuration: 3 phase DELTA with Ground (4 wire) input, recommend corner Grounded Delta configuration.
Magnet Rundown Unit	100–120 or 200–240	50/60 Hz	1	1.0	Hard wired in unit.
Service Receptacle in Magnet Room	110–120 local voltage and portable transformers for voltages values	50/60 Hz	1	2.0	Receptacle required for small power tools
*O_2 Monitor	110–120 or 200–240	50/60 Hz	1	3.0	Hard wired in monitor

Note * Optional equipment.

1 Power phase conductors, neutral (if present), and ground conductor must be routed inside the same raceway, cable tray, trench cable. or cord per National Electric Code (NEC) 2002 Articles 250.134, 300.3, 517.13 or 1999 Articles 250–134, 300–3, 517–13.

2 Signa OpenSpeed MDP controls power to the following system equipment:
– Power Distribution Unit
– System Cooling Cabinet including Cryo Cooler Compressor, Shield Cooler Compressor, water cooling for Gradient Coil and System Cooling Auxiliary Cabinet which provides RF Coil Air Cooling.
– Magnet Temperature Control Unit and Magnet Monitor equipment including the Magnet Monitor, Uninterruptible Power Supply (UPS) for Magnet Monitor, Modem, Multiplexer Box (optional).

3 MDP power circuits for System Cooling Cabinet and TCU along **with air cooling for these are required immediately upon magnet arrival**. If permanent site power is not ready, temporary power drop line **and air cooling** must be made available. If site voltage is not any of the voltages listed above, customer must provide transformer and secondary circuit breaker to provide correct voltage and/or configuration.

4 The system Main Disconnect Panel (MDP) & System Cooling Cabinet (SCC) configurations require high voltage for input voltage. A step–up transformer is required if the site input voltage for the system is 200 V or 208V.

5 Maximum amps dependent on voltage selected. Refer to Section 5–2, CRITICAL POWER REQUIREMENTS configuration.

6 PDU Module is located in the lower portion of the Power Cabinet (MR1).

5–2 CRITICAL POWER REQUIREMENTS

The system includes a Main Disconnect Panel (MDP) with low voltage low energy local and multi–point control capability for the feeder lines that supply input power to:

- the Power Distribution Unit (PD1) located in the lower portion of the Power Cabinet
- the System Cooling Cabinet (SCC) [includes the Cryo Cooler Compressor Cabinet, the Shield Cooler Compressor Cabinet, and system water chiller equipment] and the System Cooling Auxiliary Cabinet (SCC2) [provides RF Coil air cooling],
- Temperature Control Unit (TCU) and the Magnet Monitor equipment [Magnet Monitor, UPS for Magnet Monitor, Modem, and optional Multiplexer Box].

All work is to be done in accordance with national and local electrical codes. Refer to Section 5–3, POWER DISTRIBUTION SYSTEM, for Main Disconnect Control capability and set up.

Configuration:

- Recommend input configuration 3 phase Grounded WYE with Neutral and Ground (5 wire system). Neutral must be terminated prior to or inside the MDP and not brought to PD1 in the Power Cabinet.
- Optional input configuration 3 phase DELTA with Ground (4 wire) input, recommend corner Grounded Delta configuration.

Maximum Momentary Demand: 105 KVA consisting of 67 KVA for SCC, 35 KVA for PDU, and 3 KVA for TCU/Magnet Monitor equipment.

Average (while scanning) Power Demand: 63 KVA consisting of 41.5 KVA for SCC, 20 KVA for PDU, and 1.5 KVA for TCU/Magnet Monitor equipment.

Standby (no scan) Power Demand: 50 KVA consisting of 41.5 KVA for SCC, 7 KVA for PDU, and 1.5 KVA for TCU/Magnet Monitor equipment.

Frequency: 50 $\pm$ 3 Hz or 60 $\pm$ 3 Hz

System Voltage: 480Y/277 VAC or 400Y/230 VAC $\pm$10% The system MDP and SCC require high voltage for input voltage. A step–up transformer is required if the site input voltage for the system is 200 V or 208V.

Note

MDP contains individual circuit breakers for PDU, SCC, TCU/Magnet Monitor equipment. Refer to Section 5–3–1 Main Disconnect Control.

Daily Voltage Variation: $\pm$10% from nominal under worst case line and load regulation.

Voltage Transients: Phase–to–phase voltages must be within 2% of the lowest phase–to–phase voltage. Maximum allowable transient voltage above or below nominal waveshape not to exceed 200 V at a maximum duration of 1 cycle and frequency of 10 times per hour.

Regulation: 4% maximum at 105 KVA maximum power demand from source to the MR System (i.e. includes all feeders and transformer to utility).

Phase Balance: Difference between the highest phase line–to–line voltage and the lowest phase line–to–line voltage must not exceed 2%.

Facility Zero Voltage Reference Ground:

- Main facility ground wire to be minimum 1/0 AWG copper or same size as power feeder wire, which ever is larger.
- Main facility ground wire to be insulated.
- Ground impedance to earth at power source to be 2 ohms or less.
- Main facility ground wire to be bonded at every distribution box in an approved grounding block.

5–3 POWER DISTRIBUTION SYSTEM

5–3–1 Main Disconnect Panel (MDP)

The Signa OpenSpeed system includes a Main Disconnect Panel with multi–point remote control capability which is shown in Illustration 5–1. The Main Disconnect Panel consists of the following:

- A three–pole circuit breaker rated for the current of the PDU circuit. The short–circuit current interrupting rating of the breaker is 25,000 Amperes to accommodate facility available short circuit current.
- A three–pole circuit breaker rated for the current of the System Cooling Cabinet circuit. The short–circuit current interrupting rating of the breaker is 25,000 Amperes to accommodate facility available short circuit current.
- A circuit to provide 120VAC single phase power to the TCU, Magnet Monitor, UPS for Magnet Monitor, and Multiplexer Box (optional). The short–circuit current interrupting rating of the breaker is 25,000 Amperes to accommodate available fault current. The MDP includes a single phase step down transformer for 120VAC loads such as TCU, Magnet Monitor equipment (Magnet Monitor, UPS for Magnet Monitor, modem and the optional Multiplexer Box).
- The MDP Panel has receptacles inside the panel enclosure for connections of the UPS for Magnet Monitor input and output, Multiplexer Box, Magnet Monitor, and modem. The enclosure has provision for these cables to enter through the access panels in the bottom left side of the enclosure. Mounting of the panel must allow for 5–6 inch (127–152 mm) of free space to allow for cable bending and installation. Strain relief bushings are provided with the individual equipment for each of these cables, not provided with the MDP.

Check national and local electrical codes to determine if additional disconnect equipment is required.

Main Disconnect Panel is to be located so the top of the upper circuit breaker handle when in the ON position does not exceed 79 inches (2000 mm) from the floor and visible to Power Distribution Unit (PD1), System Cooling Cabinet (SCC) and the service personnel. The UPS for the Magnet Monitor may be located below the MDP if sufficient space is available or adjacent if sufficient space is not available, refer to Section 2–7–4 Magnet Monitor.

Note

The MDP circuits for the System Cooling Cabinet (including the Cryo Cooler Compressor Cabinet and the Shield Cooler Compressor Cabinet) and the single phase transformer for TCU/Magnet Monitor equipment (Magnet Monitor, UPS for Magnet Monitor, modem and the optional Multiplexer Box) auto restart upon return of normal power after a 3 sec time delay to minimize cryogen consumption of the system. The MDP Emergency Off circuit turns off power to all branch circuits including the Magnet Monitor UPS output and turns off the auto restart function.

The PDU circuit has low voltage release feature which disconnects power from the PDU upon the first loss of power. Power to the PDU is not restored automatically after a power interruption. Emergency Off operation disconnects power from all circuits including the PDU.

For the System Cooling Cabinet (including the Cryo Cooler Compressor Cabinet and the Shield Cooler Compressor Cabinet) and TCU/Magnet Monitor equipment the auto restart function is disabled by the Emergency Off pushbuttons. Extended power outages of 2 days or more will result in the auto restart function loss of battery backup and will require pressing of the Main Power ON push button manual restart after restoration of normal power.

5–3–1 Main Disconnect Panel (MDP) (Continued)

The circuit breakers or fuses ahead of the MDP must be capable of handling the magnetizing inrush currents of the System Cooling Cabinet, TCU/Magnet Monitor/UPS, and transformer of the PDU module (PD1) in the Power Cabinet (MR1). If fuses are used time delayed fuses are recommended.

Check local and national codes to determine if an interlock to the air–conditioning unit in the Computer/Equipment Room is required in the protective disconnect set–up.

The MDP provides two Emergency Off buttons to be connected to the MDP to disable the power to all system equipment in emergency situations. The Emergency Off buttons are to be mounted near each exit 60 in. (1524 mm) from the floor in the Magnet Room and Equipment Room The Emergency Off buttons are clearly labeled “Emergency Off” and visible to personnel. It is important the buttons are labeled “off” and not “stop” since there exists an “Emergency Stop” button in the Signa system which powers down only a portion of system equipment for patient safety.

Note

The emergency off circuit disconnects power to the PDU, System Cooling Cabinet and from the single phase transformer for TCU/Magnet Monitor equipment. Power can be restored to the MDP outputs by pressing the MAIN POWER ON pushbutton on the MDP for the SCC, TCU, Magnet Monitor equipment (Magnet Monitor, UPS for Magnet Monitor, modem and the optional Multiplexer Box). Power to the PDU is restored by pressing the PDU POWER ON pushbutton and also requires pressing the EMO Reset button on the PDU.

The Main Disconnect Panel (MDP) is lockable to meet OSHA requirements for power Lockout/Tagout requirements. The MDP provides for the disconnection of the facility power to the PDU, the TCU and System Cooling Cabinet. Individual branch circuits for the PDU, TCU, Magnet Monitor equipment, and System Cooling Cabinet consisting of lockable GE Spectra circuit breakers. The MDP also has electrical contacts for an interlock to the air–conditioning units in the Equipment Room. Check local and national codes to determine if an interlock to the air–conditioning unit in the Computer/Equipment Room is required in the protective disconnect set–up.

The Main Disconnect Control Panel is UL labeled in accordance with 2002 National Electric Code (NEC) Article 110.2 or 1999 NEC Article 110–2.

Note

The maximum conductor the MDP can accept is #3/0 AWG (83 mm^2). For feeders larger than 3/0 AWG (83 mm^2) the wires must be reduced (ie. splice, junction box, etc.) to 3/0 AWG (83 mm^2) within 10 feet (3 meters) of MDP. It is important to note the maximum cable wire from the MDP to the PDU must not be larger than 1/0 AWG (50 mm^2).

5–3–1 Main Disconnect Panel (MDP) (Continued)

NOTE: ●RUNS 296 AND 297, & POWER CORDS FOR MAGNET MONITOR EQUIPMENT (MAGNET MONITOR, UPS INPUT & OUTPUT, MODEM, OPTIONAL MULTIPLEXER) ARE GE SUPPLIED CABLES. **ALL OTHER WIRING IS CUSTOMER SUPPLIED.**

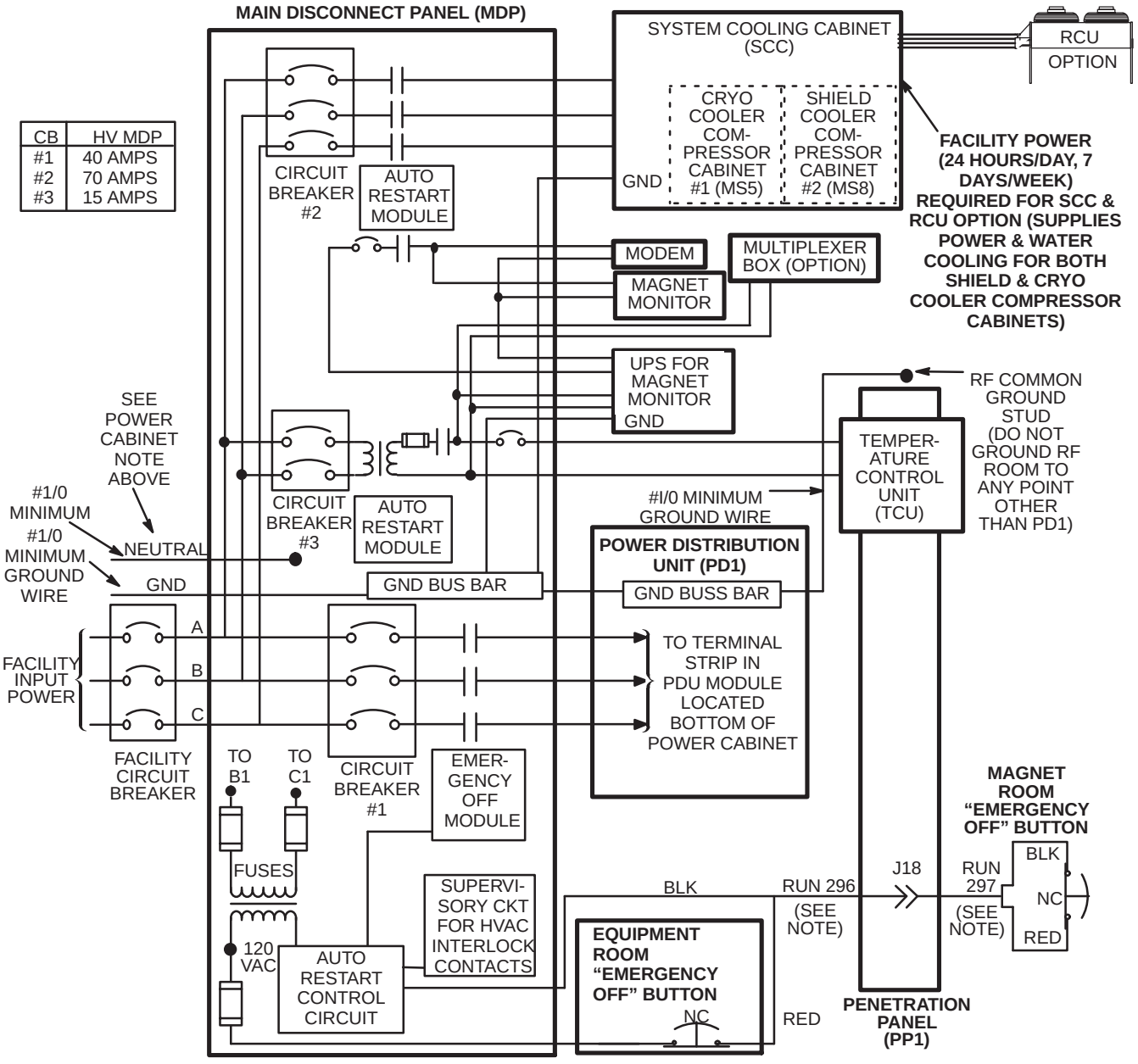
●TWO REMOTE EMERGENCY "OFF" BUTTONS ARE SUPPLIED WITH SYSTEM MDP.

●CIRCUIT BREAKERS ARE PROVIDED FOR PDU, TCU, SCC, MAGNET MONITOR/UPS/MODEM CIRCUITS.

●ALL BRANCH CIRCUITS DROP OUT ON LOSS OF POWER. SCC, TCU, MAGNET MONITOR EQUIPMENT (MAGNET MONITOR, UPS FOR MAGNET MONITOR, MODEM AND OPTIONAL MULTIPLEXER BOX) AUTOMATICALLY RESTART AFTER 3 SEC TIME DELAY UPON RESTORATION OF POWER. EMERGENCY OFF LOCKS OUT ALL CONTACTORS.

●IF 3 PHASE WYE WITH NEUTRAL AND GROUND (5 WIRE SYSTEM) INPUT USED THEN NEUTRAL MUST BE TERMINATED INSIDE THE MAIN DISCONNECT CONTROL AND NOT BROUGHT TO THE POWER CABINET

●SUPERVISORY CIRCUIT FOR HVAC INTERLOCK CONTACTS OPEN ON LOSS OF DC POWER OR EMERGENCY OFF OPERATION.



MAIN DISCONNECT PANEL SET–UP
ILLUSTRATION 5–1

5–3–2 System Power Distribution Unit (PDU)

The PDU module in lower portion of the Power Cabinet has an integrated filter for a level of power conditioning for the equipment powered from the PDU. The largest allowable phase conductor the PDU will accept is 1/0AWG (50 mm^2. Larger feeder wires can be connected to the MDP with 1/0 AWG (50 mm^2) between the MDP and PD1.

Note

The ground conductor shall be minimum size of 1/0 AWG copper or the same size as the feeder wire, which ever is larger. Lug connector for the ground wire is to be provided by the contractor, recommended Amp Inc. number 36919 lug.

Note

Facility power Neutral, if present, must be terminated prior to or inside the Main Disconnect Panel and not brought to the Power Cabinet.

5–3–3 TCU, Magnet Monitor & UPS For Magnet Monitor

The TCU, Magnet Monitor equipment [Uninterruptible Power System (UPS) for the Magnet Monitor, modem for Magnet Monitor] and Multiplexer (Option) are powered from the MDP and includes the auto restart feature. The MDP has individual circuit breakers to disconnect the TCU, Magnet Monitor UPS input / Multiplexer Box combination, and UPS Output to Magnet Monitor / modem combination, totally isolating each circuit for lockout/tagout and servicing.

Note

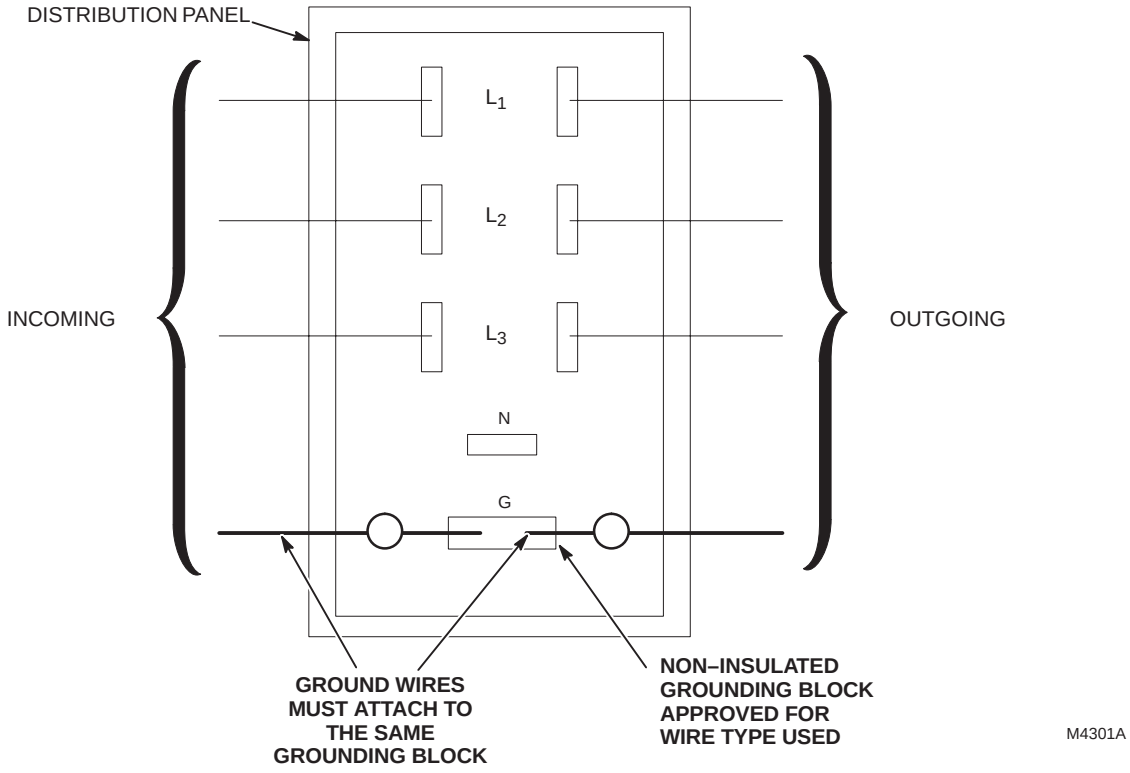
The Multiplexer Box, Magnet Monitor UPS Input, Magnet Monitor UPS Output, and Magnet Monitor Modem all are 115 VAC, plug and receptacle connections inside the MDP enclosure. Strain release must be installed on the cables prior to connecting the MDP receptacles.

5–4 GROUNDING

5–4–1 Facility Ground

The ground for the MR system shall originate at the system power source, ie. transformer or first access point of power into a facility, and be continuous to the MR system power disconnect in the room. This ground can be spliced with "High Compression Fittings" and should be terminated at each distribution panel it passes through. When it is broken for a connection to a panel, it shall be connected into an approved non–insulated grounding block with the incoming and outgoing ground in this same grounding block, which is then connected to the steel panel, never using the steel or other material of the panel as the block. See Illustration 5–2.

The connection at the power source shall be at the grounding point of the "Neutral – Ground" if a "Wye" transformer is used, or typical grounding points of separately derived system. In the case of an external facility, it shall be bonded to the facility ground point at the service entrance.



GROUND CONNECTION AT DISTRIBUTION PANEL
ILLUSTRATION 5–2

Ground Wire

The ground wire shall be copper wire with a minimum of AWG 1/0 or the same size as the power feeders whichever is larger. This means that if there is a primary feeder to a distribution panel of 500 MCM with a secondary feeder to the MR system of AWG 2 wire, the ground to the distribution panel shall be 500 MCM with an AWG 1/0 to the MR system. The ground wire impedance from the MR system disconnect, including the ground rod, shall not have an impedance greater than 2 ohms to earth as measured by one of the applicable techniques described in Section 4 of ANSI/IEEE Standard 142 – 1982 which can be accomplished using 3–point Fall Of Potential (3 point measurement) method or Clamp–On Ground Resistance measurement which requires a ground measurement device such as AEMC 3730.

5–4–2 System Ground

The MR system is designed with minimum ground loops to prevent noise currents and natural disturbances from flowing through the low–level signal reference path.

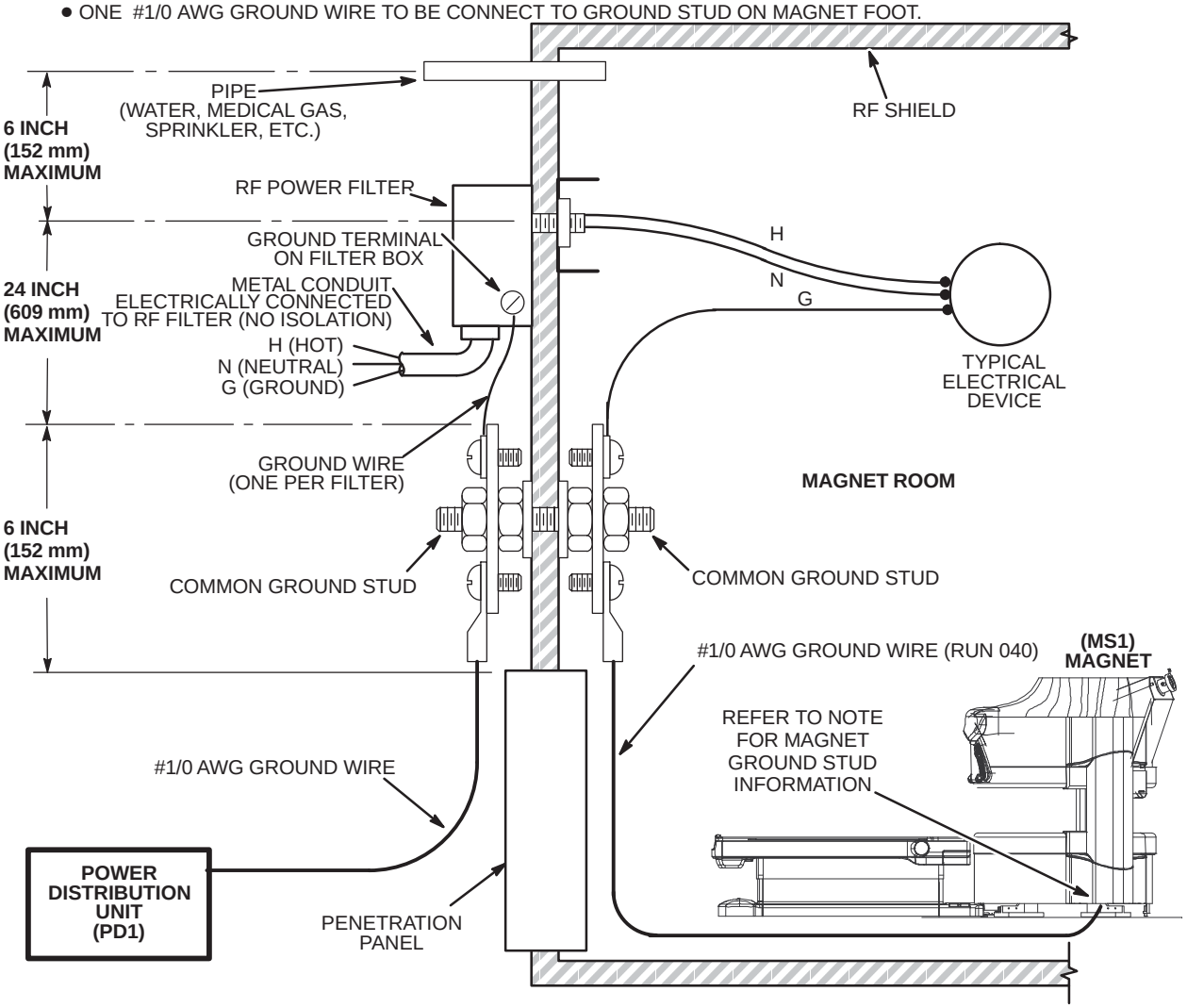
The three major grounding points in the MR system are: the system ground point (bus) in the System PDU (PD1), the enclosure ground points (ground studs located in each cabinet or enclosure), and the RF shielded room common ground point. **This RF shielded room common ground point is to be located within 6 in. (152 mm) of the GE supplied Penetration Panel.** Refer to Section 7, RF SHIELDED ROOM, for a further description of the RF shielded room common ground point.

To ensure patient safety and system performance, the conditions defined in Illustration 5–3 must be met when running power lines into the Magnet Room.

Any modifications or non–MR equipment grounds added to the MR ground system must be approved by your GE Service Representative in order to ensure safety and performance.

5–4–2 System Ground (Continued)

NOTE:
- ALL ITEMS SHOWN ARE CUSTOMER SUPPLIED EXCEPT POWER DISTRIBUTION UNIT, MAGNET, AND #1/0 AWG GROUND WIRE BETWEEN MAGNET GROUND STUD AND RF COMMON GROUND POINT.
- **RESISTANCE BETWEEN ANY TWO GROUNDED DEVICES *MUST NOT EXCEED 0.1 OHM* TO ENSURE EQUAL POTENTIAL GROUND SYSTEM WITHIN MAGNET ROOM.**
- **LOCATE FILTERS WITHIN 2 FEET (600 mm) OF RF COMMON GROUND STUD WHICH MUST BE LOCATED WITHIN 6 INCHES (152 mm) OF PENETRATION PANEL.**
- ALL EXTERNAL CONDUIT MUST BE METAL AND ELECTRICALLY CONNECTED TO THE RF POWER FILTERS (IE. NO ISOLATION) UNLESS THE FILTERS ARE LOW VOLTAGE (<30 VOLTS).
- RF POWER FILTERS OF 30 VOLTS OR LESS MAY BE LOCATED ANYWHERE ON THE RF SHIELD **PROVIDED THE INCOMING CONDUIT IS NON–METALLIC OR IS DIELECTRICALLY ISOLATED AND WITH NO GROUND WIRE. IF THE INCOMING CONDUIT IS METALLIC AND/OR HAVE A GROUND WIRE, THESE FILTERS MUST ALSO BE LOCATED WITHIN 24 INCHES (609 mm) OF THE RF COMMON GROUND STUD.**
- ALL CONDUITS IN THE RF ROOM MUST BE METAL. STEEL IS ACCEPTABLE PROVIDED IT IS ADEQUATELY ANCHORED.
- ALL ELECTRICAL DEVICES (IE. OUTLETS, LIGHT FIXTURES, ETC.) MUST HAVE A GROUND WIRE FROM ITS POWER SOURCE AND BE GROUNDED TO RF ROOM SHIELD AT THE RF COMMON GROUND STUD AS SHOWN BELOW.
- ALL METALLIC PIPES ENTERING THE RF ROOM, EXCLUDING CRYOGENIC VENT AND FLOOR DRAINS, MUST BE LOCATED WITHIN 30 INCHES (762 MM) OF THE RF COMMON GROUND.
- ONE #1/0 AWG GROUND WIRE TO BE CONNECT TO GROUND STUD ON MAGNET FOOT.



MR MAGNET ROOM GROUNDING REQUIREMENTS AND TYPICAL DIAGRAM
ILLUSTRATION 5–3

5–5 GROUND FAULT PROTECTION

MR suites and radiology departments are considered health care facilities pursuant to National Electric Code (NEC) 2002 Article 517.2 definitions or NEC1999 Article 517–3 definitions and as such must be powered from sources that comply with the ground fault requirements of NEC 2002 Article 517.17 or NEC 1999 Article 517–17. NEC 2002 Article 517.17(A) or NEC 1999 Article 517–17(a) states “Where ground fault is required for the operation of the service disconnecting means or feeder disconnecting means as specified in NEC 230.95 or 215.10, an additional step of ground fault protection shall be provided in the next level of feeder disconnecting means downstream towards the load.”

NEC 2002 Article 230.95 or 215.10 or NEC 1999 Article 230–95 or 215–10 requires ground fault protection on service disconnecting means rated 1000 Amps or more on solidly grounded WYE services over 150 volts to ground but not over 600 volts phase to phase.

The two or more levels of ground fault shall be coordinated to provide selectivity between each level of ground fault such that a ground fault on the load side of the feeder would cause the feeder and not the service disconnect to open on a ground fault. Six cycles of separation between the different levels of ground fault tripping is required for the system to be considered selective in accordance with NEC 2002 Article 517.17(B) or NEC 1999 Article 517–17(b).

Check national and local electrical codes.

5–6 POWER SOURCE MONITORING

The facility input power for the proposed system should be checked using a power line disturbance monitor for average line voltage, surges–sags, impulses, and frequency. Some of the recommended line analyzers which are designed for unattended monitoring are the Dranetz Models 656A or 658 and RPM Models 1651, 1656, or 1658.

Analysis should span a period to include two weekends so as to cover several days of normal use. The possibility of “brown–out” conditions which may be experienced in summer must be considered. Any existing power problems with large power consuming systems (x–ray units, CT scanners, etc.) or other computer installations at the proposed site should be reviewed as they may affect the MR system. Results of this analysis should be reviewed with your GE representative to determine if line conditioning is needed.

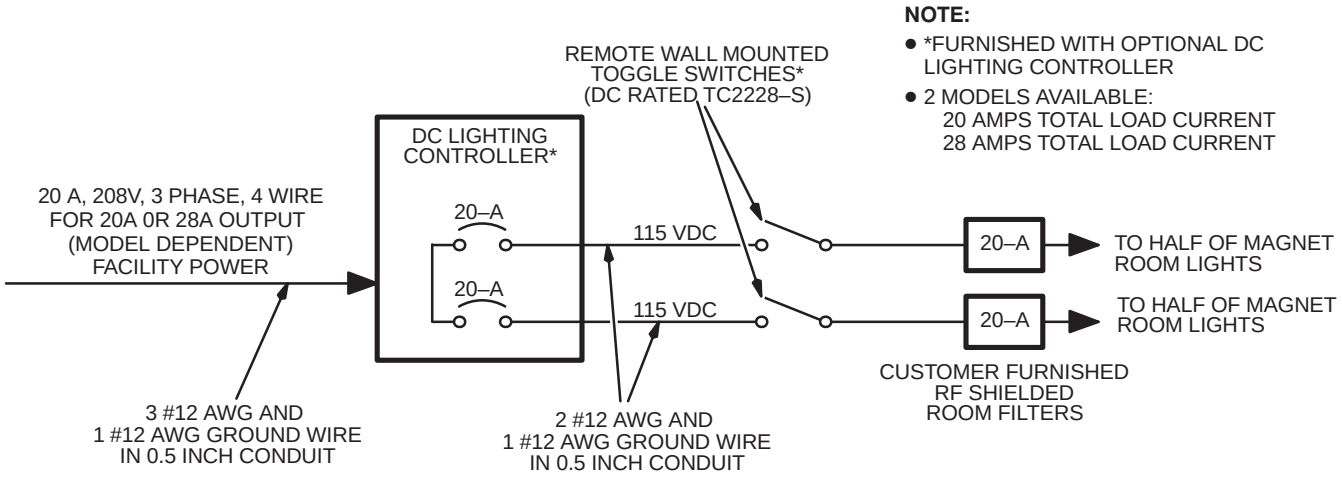
5–7 EMERGENCY POWER

Primary power should be distributed from the customer’s emergency life–safety power branch to an emergency lighting source in the Magnet Room. All input power lines must be filtered upon entrance into the RF shielded room (Magnet Room) and grounded according to the requirements listed in Section 5–4–2, SYSTEM GROUND. Always check national and local codes for other emergency power requirements.

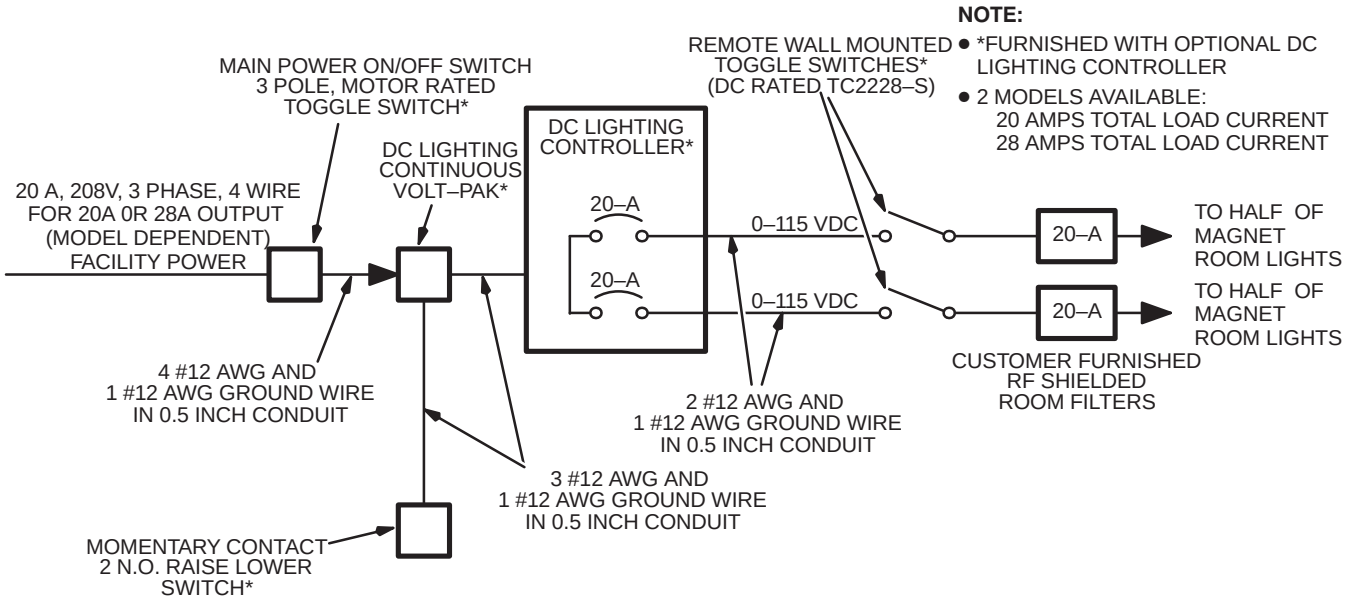
5–8 DC LIGHTING CONTROLLER

Direct current (DC) powered lighting is required in the Magnet Room per Section 4–6 LIGHTING. A DC light controller is available from GE as well as a variable DC lighting controller system, refer to Section 1–4 FACILITY OPTIONS catalog offerings. The wiring diagrams for these units are shown in Illustrations 5–4 and 5–5. The input power, interconnect cabling, RF shielded room filters, and conduit are customer furnished.

5–8 DC LIGHTING CONTROLLER (Continued)



DC LIGHTING CONTROLLER (Facility Option) WIRING DIAGRAM
ILLUSTRATION 5–4



VARIABLE DC LIGHTING CONTROLLER (Facility Option) WIRING DIAGRAM
ILLUSTRATION 5–5

SECTION 6 – INTERCONNECT DATA

TABLE OF CONTENTS

6–1 INTRODUCTION

Section 6, INTERCONNECT DATA, addresses cable interconnections and customer furnished components for the system. It's subsections are broken down as follows:

- 6–1 INTRODUCTION
  - overall system interconnects, component designations
- 6–2 POWER INTERCONNECTS
  - cable connections to the Main Disconnect Panel & Power Distribution Unit for subsystem power distribution
- 6–3 EMERGENCY OFF WIRING
  - wiring to main disconnect for emergency off
- 6–4 SYSTEM INTERCONNECTS
  - cable interconnects for the system
- 6–5 CONTRACTOR FURNISHED COMPONENTS
  - miscellaneous components typically provided by a contractor

6–1–1 Component Designators

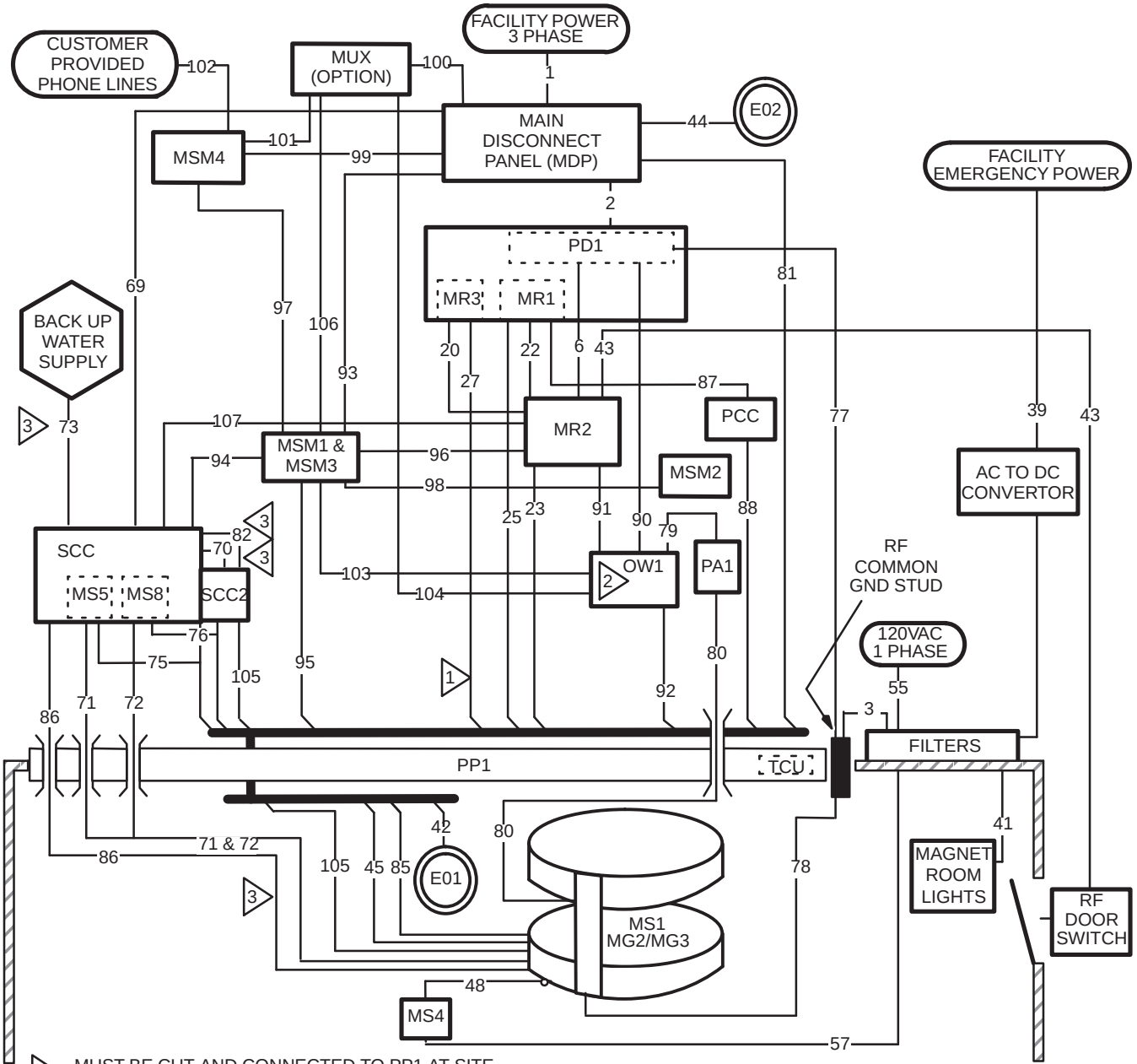
GE uses a Component Designator System as a means of identifying system components in a consistent manner. All subsystem cabinets and other components are referred to by their component designators in the diagrams and tables of this section. For example, the Power Cabinet is referred to as MR1. Refer to Table 6–1 for all component designators.

TABLE 6–1
COMPONENT DESIGNATION

BASIC SYSTEM OR OPTION	COMPONENT DESIGNATOR	DESCRIPTION
Basic System	EO1/EO2	Emergency Off Buttons
	MDP	Main Disconnect Panel
	MG2/GM3	Magnet Enclosure
	MR1	Power Cabinet MR3 is a module in middle of MR1 cabinet PD1 is a module in lower portion of MR1 cabinet
	MR2	System Control Cabinet
	MR3	Gradient Driver (refer to MR1)
	MS1	Superconducting Magnet
	MS4	Magnet Rundown Unit
	MS5	Cryo Cooler Compressor Cabinet; dual–stage operation (refer to SCC)
	MS8	Shield Cooler Compressor Cabinet; single–stage operation (refer to SCC)
	MSM1	Magnet Monitor
	MSM2	Remote Alarm Box
	MSM3	Modem for Magnet Monitor
	MSM4	UPS for Magnet Monitor
	OW1	Operator Workspace
	TCU	Temperature Control Unit (refer to PP1)
	PD1	Power Distribution Unit (refer to MR1)
	PA1	Pneumatic Patient Alert Control Box
	PP1	Penetration Panel TCU is mounted in Penetration Panel
	PT1	Patient Table
	SCC	System Cooling Cabinet MS5 & MS8 are located in lower portion of SCC Cabinet
	SCC2	System Cooling Auxiliary Cabinet
	PCC	Patient Cooling Compressor
System Options	MUX	Phone Line Multiplexer Box
	RCU	Remote Condenser Unit

6–1–2 Group Interconnects

Illustration 6–1 show the Group Interconnect Diagram system. Each group contains one or more cables. This diagram should be referred to when using the tables in this section.



1. MUST BE CUT AND CONNECTED TO PP1 AT SITE.
NOTE: IMPEDANCE IS NOT CRITICAL SO EXCESS CABLE SHOULD BE CUT OFF.

2. OPERATOR WORKSPACE (OW1) SUBSYSTEM EQUIPMENT IS PROVIDED WITH MAXIMUM LENGTH CABLES POSSIBLE. SEVERAL OW ASSEMBLIES ARE MOUNTED TO OW TABLE & OW INTERCONNECTS ARE ROUTED THROUGH TABLE CABLE TRAY. FOR REFERENCE USE ONLY THE OW1 RUN NUMBERS ARE 049, 792, 793, 794, 795, 796, 797, 798, 799, 806, & 807.

3. THIS GROUP CONTAINS WATER LINES WHICH SHALL BE ROUTED SEPARATE FROM ELECTRICAL LINES (I.E. POWER & SIGNAL).

0.7T SYSTEM GROUP INTERCONNECT DIAGRAM
ILLUSTRATION 6–1

6–1–3 Definition of Terms

The definition of terms used in Tables 6–2 and 6–3 are:

- Group Number: identifying number referenced to bundles (i.e. groups) of cables as shown in Illustrations 6–1
- Between Units (From/To): component designators as found in Table 6–1
- Area: cross–sectional area of the combined cables in a group

Note

The group area was found by adding up the circular cross–sectional areas of all individual cables within a group. It does not take any fill factors or space between cables into account. Adhere to applicable electrical codes for fill factors.

- Usable Length: total length of a cable MINUS any required take up within cabinets
- Run Number: unique number assigned to each GE–supplied cable

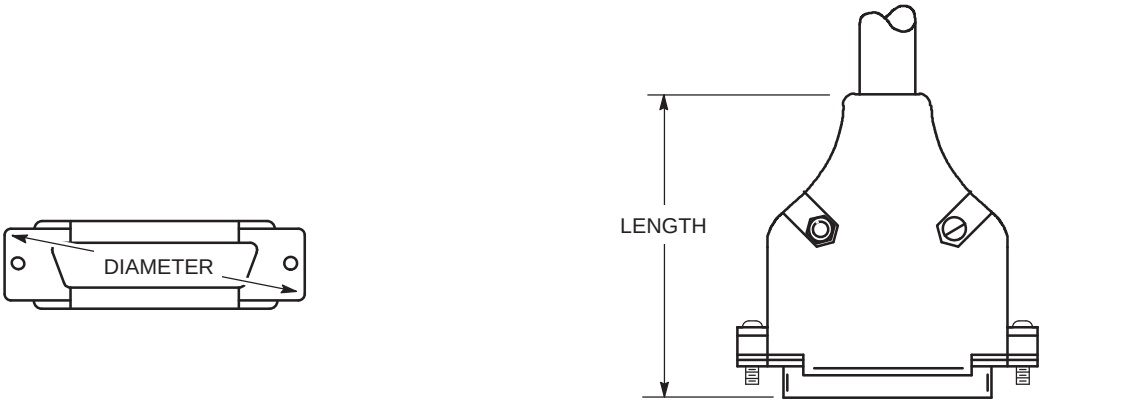
Note

The run number must be used when making special cable orders.

- Cable Diameter: diameter of an individual cable
- Plug Pulling Diameter x Length: cable plug dimensions as shown in Illustration 6–2

Note

In some cases, a cable has more than one connector on an end. These cables will have the number of connectors following the english dimensions of the plug pulling diameter times length (e.g. '2.0x3.25 –x2' means there are 2 connectors with dimensions of 2.0 in. diameter and 3.25 in. length). Of course, the same number of connectors apply to the metric dimensions as well.



SUBMINIATURE–D CONNECTOR PLUG PULLING DIMENSIONS
ILLUSTRATION 6–2

6–2 POWER INTERCONNECTS

Table 6–2 contains information on interconnects between system components and the Main Disconnect (MDP) or Power Distribution Unit (PD1) located in the lower portion of the Power Cabinet.

The interconnects for the MDP include:

- Facility Main power; refer to Section 5 – POWER REQUIREMENTS for detailed information on main power connections.
- Main power to PD1.
- Emergency off wiring; refer to Section 6–3, EMERGENCY OFF WIRING, for information on the emergency off circuit interfacing.
- System Cooling Cabinet which includes 2 Shield/Cryo Cooler Compressor Cabinets (MS5 & MS8) and RF Coil Air Cooling Compressor (SCC2)
- Magnet Monitor equipment (Magnet Monitor, UPS for Magnet Monitor, Modem, and optional Multiplexer Box)

The interconnects for the PD1 include:

- Power cables GE–supplied subsystems for Operator Workspace, System Cabinet, Patient Comfort Compressor.
- 2 auxiliary ground cables to the PD1.
- 2 control cables to the PD1

Conduit or pipe is not recommended for cable runs since the system uses many prefabricated cables with large connectors. However, there may be instances in which conduit is used for power cables. In those cases, cables may be pulled by the lug terminal ends so the connector pulling dimensions on the plug ends will not be a factor for power cables.

Note

The power cables will probably need to be terminated at PD1 located in the lower portion of the Power Cabinet if conduit is used.

Unless otherwise specified, cables and components listed in Table 6–2 are supplied by GE.

TABLE 6–2
POWER CABLES FROM MDP & PD1

GROUP NUMBER	GROUP AREA in.^{2}(mm^2)	BETWEEN UNITS		USABLE LENGTH ft (m)	RUN NUMBER	CABLE DIAMETER in. (mm)	PLUG PULLING DIAMETER X LENGTH in. (mm)		NOTES
		FROM	TO				FROM	TO	
1	—	Facility Power	MDP	—	—	—	—	—	Customer Furnished. See Note 1.
2	—	MDP	PD1 See Note 2	—	—	—	—	—	Customer Furnished.
Note 1 If Low Voltage Step–Up Transformer (R4500AS or R4500BD) then customer furnished interconnects are required between Facility Power, Transformer, and MDP. 2 The PDU is a module (PD1) in the lower portion of the Power Cabinet (MR1).									

(Continued)

6–2 POWER INTERCONNECTS (Continued)

TABLE 6–2 (Continued)
POWER CABLES FROM MDP & PD1

GROUP NUMBER	GROUP AREA in.²(mm²)	BETWEEN UNITS		USABLE LENGTH ft (m)	RUN NUMBER	CABLE DIAMETER in. (mm)	PLUG PULLING DIAMETER X LENGTH in. (mm)		NOTES
		FROM	TO				FROM	TO	
6	1.25 (797)	PD1 See Note 2	MR2	26 (7.93)	030	1.13 (28.58)	Hard Wired	Hard Wired	#8 AWG / 5 wire Power cable
					037	0.20 (4.95)	Hard Wired	Hard Wired	#10 AWG / 1 wire Ground cable
					703	0.375 (9.50)	1.60x2.00 (41.1x50.8)	1.60x2.00 (41.1x50.8)	
					706	0.36 (9.14)	1.30x2.00 (33.5x50.8)	1.30x2.00 (33.5x50.8)	
44	—	MDP	EO2	—	—	—	—	—	Customer Furnished. Refer to Section 6–3.
69	—	MDP	SCC	—	—	—	—	—	Customer Furnished.
77	0.27 (172)	PD1 See Note 2	RF COM-MON GND STUD	—	—	0.584 (14.8)	Ring Terminal	Ring Terminal	Customer supplied ground cable, refer to Section 5–4–2.
81	0.44 (282)	MDP	PP1	40 (12.2)	296	0.31 (7.75)	Hard Wired	1.30x2.00 (33.5x50.8)	Refer to Section 6–3.
					907	0.681 (17.3)	Hard Wired	Hard Wired	#10AWG / 3 wire power cable
90	0.413 (266)	PD1 See Note 2	OW1	51 (15.5)	047	0.70 (17.78)	Hard Wired	Hard Wired	#10 AWG / 4 wire power cable
					048	0.188 (4.78)	Hard Wired	Hard Wired	#10 AWG / 1 wire Ground cable
93	0.159 (103)	MDP	MSM1 & MSM3	6 (1.8) minus takeups at each end	—	0.375 (9.5)	1.2x3.00 (30.5x76.2)	1.25x2.5 (31.8x63.5)	MSM1 power cable
					—	0.25 (6.35)	2.00x2.50 (50.8x63.5)	2.00x2.50 (50.8x63.5)	Modem for MSM1 power cable. Modem located on top of MSM1. Refer to Section 2–7–4
99	0.22 (142)	MDP	MSM4	6 (1.83) minus takeups at each end	—	0.375 (9.53)	1.00x2.50 (25.4x63.5)	Hard Wired	UPS Power IN
					939	0.375 (9.53)	1.00x2.50 (25.4x63.5)	1.00x2.50 (25.4x63.5)	UPS Power OUT
100	0.05 (32.3)	MDP	MUX	7 (2.1)	—	0.25 (6.35)	1.00x2.50 (25.4x63.5)	1.00x2.50 (25.4x63.5)	

Note 2 The PDU is a module (PD1) in the lower portion of the Power Cabinet (MR1).

6–3 EMERGENCY OFF WIRING

6–3–1 Introduction

This section addresses wiring for the Emergency Off circuit (also known as protective disconnect circuit). Refer to Section 5–3, RECOMMENDED POWER DISTRIBUTION SYSTEM, for information on the Main Disconnect Panel and emergency off button locations and mounting.

The emergency off wiring for the MR system is unique because the wiring into the magnet room must be RF tight.

6–3–2 Main Disconnect Panel Connections

The emergency off circuit is shown in Section 5–3, POWER DISTRIBUTION SYSTEM, Illustration 5–1. The circuit utilizes the normally closed series loop shown. The MDP provides 2 emergency off buttons.

6–3–3 Magnet Room Wiring

GE provides two cables for routing the emergency off circuit through the Penetration Panel and into the magnet room (Runs 296 and 297). Alternate wiring may be used by the customer; however, the use of these cables ensures that the emergency off wiring will be RF tight.

In Illustration 5–1 black and red wires are used for connections on the ends of Runs 295 and 297. Actually any pair of wires on these runs could be used so long as both ends are consistent with one another. (Runs 296 and 297 are actually nine wire cables.)

6–4 SYSTEM INTERCONNECTS

Table 6–3 contains information on interconnects between all system components. Cables found in Tables 6–2 are not repeated here, although their groups are referenced for completeness. Conduit or pipe is not recommended for cable runs since the system uses many prefabricated cables with large connectors. Unless otherwise specified, cables and components listed in Table 6–3 are supplied by GE.

TABLE 6–3
INTERCONNECT LIST

GROUP NUMBER	GROUP AREA in.^{2}(mm^2)	BETWEEN UNITS		USABLE LENGTH ft (m)	RUN NUMBER	CABLE DIAMETER in. (mm)	PLUG PULLING DIAMETER X LENGTH in. (mm)		NOTES
		FROM	TO				FROM	TO	
1	—	Facility Power	MDP	—	—	—	—	—	Refer to Table 6–2.
2	—	MDP	PD1	—	—	—	—	—	Refer to Table 6–2.
3	—	Facility Emerg Power Filter	PP1	—	—	—	—	—	Customer Furnished Ground.
4	—	—	—	—	—	—	—	—	Not Used
5	—	—	—	—	—	—	—	—	Not Used
6	—	PD1	MR2	—	—	—	—	—	Refer to Table 6–2.
7 to 19	—	—	—	—	—	—	—	—	Not Used
20	0.784 (506)	MR2	MR3 in MR1	14 (4.27)	710	1.04 (26.4)	1.04x2.00 (26.4x50.8)	1.04x2.00 (26.4x50.8)	Run 710 is flexible conduit containing fiber optic cable(s) with a minimum bend of 2 in. (51 mm).
21	—	—	—	—	—	—	—	—	Not Used
22	0.831 (537)	MR2	MR1	14 (4.27)	229	0.23 (5.84)	0.57x2.00 (14.5x50.8)	0.57x2.00 (14.5x50.8)	
					702	0.35 (8.90)	1.30x2.00 (33.5x50.8)	1.30x2.00 (33.5x50.8)	
					708	0.83 (21.1)	0.83x2.00 (21.1x50.8)	0.83x2.00 (21.1x50.8)	Run 708 is flexible conduit containing fiber optic cable(s) with a minimum bend of 2 in. (51 mm).
					774	0.44 (11.2)	2.30x2.00 (58.4x50.8)	2.30x2.00 (58.4x50.8)	

(Continued)

TABLE 6–3 (Continued)
INTERCONNECT LIST

GROUP NUMBER	GROUP AREA in.^{2}(mm^2)	BETWEEN UNITS		USABLE LENGTH ft (m)	RUN NUMBER	CABLE DIAMETER in. (mm)	PLUG PULLING DIAMETER X LENGTH in. (mm)		NOTES
		FROM	TO				FROM	TO	
23	1.512 (974)	MR2	PP1	31 (9.45)	231	0.212 (5.38)	0.57x2.00 (14.5x50.8)	0.57x2.00 (14.5x50.8)	**RF Receive Cable**
					488	0.24 (6.1)	0.55x1.10 (14.0x27.9)	0.55x1.10 (14.0x27.9)	**RF Receive Cable**
					489	0.24 (6.1)	0.55x1.10 (14.0x27.9)	0.55x1.10 (14.0x27.9)	**RF Receive Cable**
					490	0.24 (6.1)	0.55x1.10 (14.0x27.9)	0.55x1.10 (14.0x27.9)	**RF Receive Cable**
					711/ 712	1.04 (26.4)	1.04x2.00 (26.4x50.8)	1.04x2.00 (26.4x50.8)	Run 711/712 is a flexible conduit containing fiber optic cables with a minimum bend of 2 in. (51 mm).
					929	0.234 (5.94)	0.57x2.00 (14.5x50.8)	0.57x2.00 (14.5x50.8)	**RF Receive Cable**
					949	0.525 (13.3)	2.80.x2.00 (71.1x50.8)	2.80x2.00 (71.1x50.8)	
					950	0.305 (7.75)	1.30x2.00 (33.0x50.8)	1.30x2.00 (33.0x50.8)	
					951	0.305 (7.75)	1.30x2.00 (33.0x50.8)	1.30x2.00 (33.0x50.8)	
					957	0.234 (5.94)	0.57x2.00 (14.5x50.8)	0.57x2.00 (14.5x50.8)	
					958	0.234 (5.94)	0.57x2.00 (14.5x50.8)	0.57x2.00 (14.5x50.8)	
24	—	—	—	—	—	—	—	—	Not Used

(Continued)

TABLE 6–3 (Continued)
INTERCONNECT LIST

GROUP NUMBER	GROUP AREA in.^{2}(mm^2)	BETWEEN UNITS		USABLE LENGTH ft (m)	RUN NUMBER	CABLE DIAMETER in. (mm)	PLUG PULLING DIAMETER X LENGTH in. (mm)		NOTES
		FROM	TO				FROM	TO	
25	3.03 (1954)	MR1	PP1	21 (6.40)	044	0.20 (5.1)	1.32x0.23 (33.5x5.8)	1.32x0.23 (33.5x5.8)	Ground Cable for MR1 System Support Module
					487	0.45 (11.4)	1.60x2.00 (40.6x50.8)	1.60x2.00 (40.6x50.8)	
					726	0.45 (11.4)	1.60x2.00 (40.6x50.8)	1.60x2.00 (40.6x50.8)	
					768	0.525 (13.3)	2.80x2.00 (70.4x50.8)	2.80x2.00 (70.4x50.8)	
					769	0.44 (11.2)	2.30x2.00 (57.2x50.8)	2.30x2.00 (57.2x50.8)	
					770	0.31 (7.9)	1.30x2.00 (33.5x50.8)	1.30x2.00 (33.5x50.8)	
					771	0.415 (10.5)	2.30x2.00 (57.2x50.8)	2.30x2.00 (57.2x50.8)	
					772	0.525 (13.3)	2.80x2.00 (70.4x50.8)	2.80x2.00 (70.4x50.8)	
					773	0.64 (16.3)	1.60x2.00 (40.6x50.8)	1.60x2.00 (40.6x50.8)	
					775	0.34 (8.64)	2.30x2.00 (57.2x50.8)	2.30x2.00 (57.2x50.8)	
					777	0.212 (5.4)	0.57x1.125 (14.5x28.6)	0.57x1.125 (14.5x28.6)	
					887	0.59 (15.0)	0.91x2.50 (23.0x63.5)	0.91x2.50 (23.0x63.5)	**RF Transmit Cable**
					888	0.59 (15.0)	0.91x2.50 (23.0x63.5)	0.91x2.50 (23.0x63.5)	**RF Transmit Cable**
					935	0.87 (22.1)	0.91x2.50 (23.0x63.5)	0.91x2.50 (23.0x63.5)	**RF Transmit Cable**
26	—	—	—	—	—	—	—	—	Not Used
27	3.450 (740.2)	MR3	PP1	33 (10.0)	762	1.21 (30.7)	Hard wired	Ring Terminals	These runs are cut and connected to PP1 at site: total length is 100 ft (30.5 m) including **both** Equipment and Magnet Rooms. Refer to Group 85 for Magnet Room routing of these interconnects.
					763	1.21 (30.7)	Hard Wired	Ring Terminals	
					764	1.21 (30.7)	Hard Wired	Ring Terminals	

(Continued)

TABLE 6–3 (Continued)
INTERCONNECT LIST

GROUP NUMBER	GROUP AREA in.²(mm²)	BETWEEN UNITS		USABLE LENGTH ft (m)	RUN NUMBER	CABLE DIAMETER in. (mm)	PLUG PULLING DIAMETER X LENGTH in. (mm)		NOTES
		FROM	TO				FROM	TO	
27 to 38	—	—	—	—	—	—	—	—	Not Used
39	—	Facility Emerg Power	Filter	—	—	—	—	—	Refer to Section 5–8 for DC Lighting Controller option cabling.
40	—	—	—	—	—	—	—	—	Not Used
41	—	Filter	Magnet Room Lights	—	—	—	—	—	Refer to Sections 5–7 and 5–8.
42	0.096 (61.94)	PP1	E01	84 (25.6) **minus** takeup at EO1	297	0.35 (8.9)	1.30x2.00 (33.5x50.8)	Hard Wired	Refer to Section 6–3.
43	0.096 (61.94)	MR2	RF Door Switch	67 (20.4) **minus** takeup at RF Door Switch	701	0.35 (8.9)	1.30x2.00 (33.5x50.8)	Hard Wired	RF Door Switch provided by RF Screen Room vendor.
44	—	MDP	EO2	—	—	—	—	—	Refer to Table 6–2.
45	9.309 (6000)	PP1	MG3	30 (9.15)	624	0.26 (6.6)	Ring Terminals	1.00x1.38 (25.4x35.1)	
					628	0.26 (6.6)	Ring Terminals	1.00x1.38 (25.4x35.1)	
					711/ 712	1.04 (26.4)	1.04x2.00 (26.4x50.8)	1.04x2.00 (26.4x50.8)	Run 711/712 is flexible conduit containing fiber optic cables with a minimum bend radius of 2 in. (51 mm).
					715	0.525 (13.3)	2.80x2.00 (70.4x50.8)	2.80x2.00 (70.4x50.8)	
					716	0.34 (8.64)	1.60x2.00 (40.6x50.8)	1.60x2.00 (40.6x50.8)	
					746	0.50 (12.7)	0.91x2.50 (23x63.5)	0.91x2.50 (23x63.5)	**RF Transmit Cable**
					829	0.30 (7.62)	1.30x2.00 (33.5x50.8)	1.30x2.00 (33.5x50.8)	
					841	0.3 (7.6)	1.30x2.00 (33.0x50.8)	1.30x2.00 (33.0x50.8)	
					842	0.44 (11.2)	2.30x2.00 (57.2x50.8)	2.30x2.00 (57.2x50.8)	
					843	0.34 (8.64)	1.60x2.00 (40.6x50.8)	2.80x2.00 (70.4x50.8)	

(Continued)

TABLE 6–3 (Continued)
INTERCONNECT LIST

GROUP NUMBER	GROUP AREA in.^{2}(mm^2)	BETWEEN UNITS		USABLE LENGTH ft (m)	RUN NUMBER	CABLE DIAMETER in. (mm)	PLUG PULLING DIAMETER X LENGTH in. (mm)		NOTES
		FROM	TO				FROM	TO	
45 (continue)	9.309 (6000)	PP1	MG3	30 (9.15)	844	0.5 (12.7)	2.30x2.00 (57.2x50.8)	2.30x2.00 (57.2x50.8)	
				30 (9.15)	846	0.5 (12.7)	2.30x2.00 (57.2x50.8)	2.30x2.00 (57.2x50.8)	
					889	0.59 (15.0)	0.91x2.50 (23.0x63.5)	0.91x2.50 (23.0x63.5)	**RF Transmit Cable**
					890	0.59 (15.0)	0.91x2.50 (23.0x63.5)	0.91x2.50 (23.0x63.5)	**RF Transmit Cable**
					906	0.415 (10.5)	2.30x2.00 (57.2x50.8)	2.30x2.00 (57.2x50.8)	
					913	0.31 (7.75)	2.30x2.00 (57.2x50.8)	1.30x2.00 (33.5x50.8)	
					919	0.31 (7.75)	1.30x2.00 (33.5x50.8)	1.30x2.00 (33.5x50.8)	
					920	0.464 (11.8)	2.30x2.00 (57.2x50.8	2.30x2.00 (57.2x50.8	
					921	0.35 (8.9)	1.30x2.00 (33.5x50.8)	1.30x2.00 (33.5x50.8)	
					922	0.24 (6.1)	0.55x1.10 (14.0x27.9)	0.55x1.10 (14.0x27.9)	**RF Receive Cable**
					923	0.36 (9.1)	0.55x1.10 (14.0x27.9)	0.55x1.10 (14.0x27.9)	**RF Receive Cable**
					924	0.24 (6.1)	0.55x1.10 (14.0x27.9)	0.55x1.10 (14.0x27.9)	**RF Receive Cable**
					925	0.24 (6.1)	0.55x1.10 (14.0x27.9)	0.55x1.10 (14.0x27.9)	**RF Receive Cable**
					926	0.45 (11.4)	1.60x2.00 (40.6x50.8)	1.60x2.00 (40.6x50.8)	
					927	0.45 (11.4)	1.60x2.00 (40.6x50.8)	1.60x2.00 (40.6x50.8)	
					934	0.234 (5.94)	0.57x2.00 (14.5x50.8)	0.57x2.00 (14.5x50.8)	**RF Receive Cable**
					945	0.193 (4.9)	0.57x1.125 (14.5x28.6)	0.57x1.125 (14.5x28.6)	
					946	0.193 (4.9)	0.57x1.125 (14.5x28.6)	0.57x1.125 (14.5x28.6)	
					947	0.193 (4.9)	0.57x1.125 (14.5x28.6)	0.57x1.125 (14.5x28.6)	
					948	0.193 (4.9)	0.57x1.125 (14.5x28.6)	0.57x1.125 (14.5x28.6)	

(Continued)

TABLE 6–3 (Continued)
INTERCONNECT LIST

GROUP NUMBER	GROUP AREA in.^{2}(mm^2)	BETWEEN UNITS		USABLE LENGTH ft (m)	RUN NUMBER	CABLE DIAMETER in. (mm)	PLUG PULLING DIAMETER X LENGTH in. (mm)		NOTES
		FROM	TO				FROM	TO	
45 (continue)	9.747 (6285)	PP1	MG3	30 (9.15)	953	0.525 (13.3)	2.80.x2.00 (71.1x50.8)	2.80x2.00 (71.1x50.8)	
					954	0.305 (7.75)	1.30x2.00 (33.0x50.8)	1.30x2.00 (33.0x50.8)	
					955	0.305 (7.75)	1.30x2.00 (33.0x50.8)	1.30x2.00 (33.0x50.8)	
					959	0.234 (5.94)	0.57x2.00 (14.5x50.8)	0.57x2.00 (14.5x50.8)	
					960	0.234 (5.94)	0.57x2.00 (14.5x50.8)	0.57x2.00 (14.5x50.8)	
					Air Line	1.0 (25.4)	air tubing	air tubing	Patient Comfort Compressor air line
					pneumatic tubing	0.25 (6.4)	pneumatic tubing	pneumatic tubing	Pneumatic Patient Alert connection, refer to Group 80 for route.
					Air hose	2.25 (57.15)	Air hose	Air hose	RF Coil air cooling connection, refer to Group 105 for route.
46 to 47	—	—	—	—	—	—	—	—	Not Used
48	0.071 (45.6)	MS4	MS1	86 (26.2)	606	0.30 (7.6)	0.65x1.85 (16.5x47.0)	0.65x1.85 (16.5x47.0)	
49 to 54	—	—	—	—	—	—	—	—	Not Used
55	—	Facility Power	Filter	—	—	—	—	—	Customer Furnished Magnet Room power (refer to Sections 5–1 and 7–4).
56	—	—	—	—	—	—	—	—	Not Used
57	—	Filter	MS4	—	—	—	—	—	Customer Furnished (refer to Sections 5–1).
58 to 68	—	—	—	—	—	—	—	—	Not Used
69	—	MDP	SCC	—	—	—	—	—	Refer to Table 6–2.
70 **See Note 1**	0.322 (208)	SCC	SCC2	8.0 (2.44)	938	0.64 (16.26)	Hard Wired	Hard Wired	Power Cord

Note 1 This Group contains water lines which shall be routed separate from electrical lines (i.e. power & signal).

(Continued)

TABLE 6–3 (Continued)
INTERCONNECT LIST

GROUP NUMBER	GROUP AREA in.^{2}(mm^2)	BETWEEN UNITS		USABLE LENGTH ft (m)	RUN NUMBER	CABLE DIAMETER in. (mm)	PLUG PULLING DIAMETER X LENGTH in. (mm)		NOTES
		FROM	TO				FROM	TO	
71	4.28 (2759)	MS5 in SCC	MS1	38.5 (11.7)	621 622	1.65 (41.91) 1.65 (41.91)	2.00x3.75 (50.8x95.3) 2.00x3.75 (50.8x95.3)	2.00x3.75 (50.8x95.3) 2.00x3.75 (50.8x95.3)	Runs 621 and 622 are continuous helium flex lines routed through PP1. **Do not bend lines to less than 12 in. (305 mm) radius or damage may occur.** Cable diameter includes a non–metallic flexible corrugated raceway installed on lines.
72	7.95 (5130)	MS8 in SCC	MS1	38.5 (11.7)	625 626	2.25 (57.15) 2.25 (57.15)	2.00x3.75 (50.8x95.3) 2.00x3.75 (50.8x95.3)	2.00x3.75 (50.8x95.3) 2.00x3.75 (50.8x95.3)	Runs 625 and 626 are continuous helium lines routed through PP1. **Do not bend lines to less than 12 in. (305 mm) radius or damage may occur.** Cable diameter includes a non–metallic flexible corrugated raceway installed on lines.
73 SEE NOTE 1	—	Backup Water	SCC	—	—	—	—	—	Customer Furnished water lines (refer to Section 4–4–1 Cryo Cooler Compressor Backup Temporary Water Cooling Requirement).
74	—	—	—	—	—	—	—	—	Not Used
75	0.053 (34.3)	MS5 in SCC	PP1	42 (12.8)	623	0.26 (6.6)	1.00x1.38 (25.4x35.1)	Ring Terminals	
76	0.053 (34.3)	MS8 in SCC	PP1	42 (12.8)	627	0.26 (6.6)	1.00x1.38 (25.4x35.1)	Ring Terminals	
77	—	PD1	RF COM-MON GND STUD	—	– –	—	—	—	Refer to Table 6–2.
78	0.338 (218)	RF COM-MON GND STUD	MS1 GND STUD	60 (18.29) **minus** takeup at RF Common GND Stud	040	0.464 (11.79)	Hard Wired	Ring Terminal	1 ground wire.
79	0.013 (8.0)	OW1	PA1	5 (1.5) **minus** takeup at PA1	—	0.13 (3.2)	3.00x3.00 (76.2x76.2)	0.38x1.75 (9.6x44.5)	

Note 1 This Group contains water lines which shall be routed separate from electrical lines (i.e. power & signal).

(Continued)

TABLE 6–3 (Continued)
INTERCONNECT LIST

GROUP NUMBER	GROUP AREA in.²(mm²)	BETWEEN UNITS		USABLE LENGTH ft (m)	RUN NUMBER	CABLE DIAMETER in. (mm)	PLUG PULLING DIAMETER X LENGTH in. (mm)		NOTES
		FROM	TO				FROM	TO	
80**	0.049 (32.1)	PA1	MG2	97 (29.6) **minus** takeup at PA1	—	0.25 (6.4)	pneumatic tubing	pneumatic tubing	This pneumatic tubing is continuously routed from PA1 through PP1 to MG3.
81	—	MDP	PP1	—	—	—	—	—	Refer to Table 6–2.
82 SEE NOTE 1	0.884 (573.0)	SCC	SCC2	8.0 (2.44)	—	0.75 (19.1)	Flexible Hose	Flexible Hose	Water cooling supply line
					—	0.75 (19.1)	Flexible Hose	Flexible Hose	Water cooling return line
83 to 84	—	—	—	—	—	—	—	—	Not Used
85	3.450 (740.2)	PP1	MG3	30 (9.15)	762	1.21 (30.7)	Ring Terminals	Ring Terminals	These runs are cut and connected to PP1 at site: total length is 100 ft (30.5 m) including **both** Equipment and Magnet Rooms. For Equipment Room routing of these interconnects refer to Group 27. These cables have a minimum bend radius of 8 in. (203 mm).
					763	1.21 (30.7)	Ring Terminals	Ring Terminals	
					764	1.21 (30.7)	Ring Terminals	Ring Terminals	
86 SEE NOTE 1	0.884 (573)	SCC	MG2	80 (24.4)	536	0.75 (19.1)	Flexible Hose	Flexible Hose	Gradient Coil water cooling lines Runs 536 and 537 are routed through waveguides in PP1.
					537	0.75 (19.1)	Flexible Hose	Flexible Hose	
87	0.643 (417)	PCC	MR1	27 (8.23) **minus** takeup at PCC	930	0.64 (16.3)	Hard Wired	12.28x3.85 (57.9x97.8)	Power Cable 120 VAC
					931	0.64 (16.3)	Hard Wired	12.28x3.85 (57.9x97.8)	
88	0.785 (506)	PCC	PP1	See Notes	Air Line	1.0 (25.4)	Air Line	Air Line	This air line is cut and connected to PP1 at site: total length is 100 ft (30.5 m) including **both** Equipment and Magnet Rooms. For Magnet Room routing of this interconnects refer to Group 45.
89	—	—	—	—	—	—	—	—	Not Used
90	—	PD1	OW1	—	—	—	—	—	Refer to Table 6–2.

Note ** If installation requires greater than 97 feet (29.6 meters) of pneumatic tubing between the squeeze bulb, located on the front of the Magnet Enclosure, and the Patient Alert Control Box (PA1), located near the Operator's Console or Operator Workspace, an Extender Kit (46–317758P2) must be ordered. The Extender Kit consists of a small Extender Box (to be mounted in Equipment Room) and 95 feet (29.0 meter) of pneumatic tubing.

1 This Group contains water lines which shall be routed separate from electrical lines (i.e. power & signal).

(Continued)

TABLE 6–3 (Continued)
INTERCONNECT LIST

GROUP NUMBER	GROUP AREA in.^{2}(mm^2)	BETWEEN UNITS		USABLE LENGTH ft (m)	RUN NUMBER	CABLE DIAMETER in. (mm)	PLUG PULLING DIAMETER X LENGTH in. (mm)		NOTES
		FROM	TO				FROM	TO	
91	0.612 (393)	MR2	OW1	51 (15.5)	789	0.31 (7.75)	1.30x2.00 (33.5x50.8)	1.30x2.00 (33.5x50.8)	
					791	0.44 (11.2)	2.30x2.00 (57.2x50.8)	2.30x2.00 (57.2x50.8)	
					818	0.44 (11.2)	2.30x2.00 (57.2x50.8)	See Notes	OW1 end of cable has 3 connectors, each connector plug pull dimensions are 2.3x2.0 (57.2x50.8).
					836	0.45 (11.4)	1.75x2.00 (44.5x50.8)	1.75x2.00 (44.5x50.8)	Run 836 is flexible conduit containing fiber optic cable with a minimum bend of 4 .5 in. (114 mm).
					956	0.305 (7.75)	1.30x2.00 (33.0x50.8)	2.3x2.00 (57.2x50.8)	
92	0.293 (189)	PP1	OW1	53 (16.1)	788	0.44 (11.2)	2.30x2.00 (57.2x50.8)	2.30x2.00 (57.2x50.8)	
					837	0.3 (7.6)	1.30x2.00 (33.0x50.8)	1.30x2.00 (33.0x50.8)	
					838	0.3 (7.6)	1.30x2.00 (33.0x50.8)	1.30x2.00 (33.0x50.8)	
93	—	MDP	MSM1 & Modem	—	—	—	—	—	Refer to Table 6–2.
94	0.16 (103)	MSM1	SCC	47 (14.3) **minus** takeup at MSM1	826	0.34 (8.64)	1.60x2.00 (40.6x50.8)	1.60x2.00 (40.6x50.8)	
					941	0.30 (7.62)	1.30x2.00 (33.5x50.8)	1.30x2.00 (33.5x50.8)	
95	0.37 (243)	MSM1	PP1	54 (16.4) **minus** takeup at MSM1	824	0.44 (11.2)	2.30x2.00 (57.2x50.8)	2.30x2.00 (57.2x50.8)	
					825	0.30 (7.62)	1.30x2.00 (33.5x50.8)	1.30x2.00 (33.5x50.8)	
					914	0.44 (11.2)	2.30x2.00 (57.2x50.8)	2.30x2.00 (57.2x50.8)	
96	0.09 (58.6)	MSM1	MR2	54 (16.4) **minus** takeup at MSM1	823	0.34 (8.64)	1.60x2.00 (40.6x50.8)	1.60x2.00 (40.6x50.8)	

(Continued)

TABLE 6–3 (Continued)
INTERCONNECT LIST

GROUP NUMBER	GROUP AREA in.^{2}(mm^2)	BETWEEN UNITS		USABLE LENGTH ft (m)	RUN NUMBER	CABLE DIAMETER in. (mm)	PLUG PULLING DIAMETER X LENGTH in. (mm)		NOTES
		FROM	TO				FROM	TO	
97	0.07 (45.2)	MSM1 & MSM3	MSM4	6 (1.8) **minus** takeups at each end	—	0.30 (7.62)	1.30x2.00 (33.5x50.8)	1.30x2.00 (33.5x50.8)	Customer provided phone line, cable diameter & plug pull information are estimates.
98	0.07 (45.2)	MSM1	MSM2	100 (30.5) **minus** takeups at each end	916	0.30 (7.62)	1.30x2.00 (33.5x50.8)	1.30x2.00 (33.5x50.8)	
99	—	MSM4	MDP	—	—	—	—	—	Refer to Table 6–2.
100	—	MDP	MUX	—	—	—	—	—	Refer to Table 6–2.
101	—	MSM4	MUX	—	—	—	—	—	Customer provided phone line. Phone line routed through UPS for transient protection.
102	—	Phone Line Con-nection	MSM4	—	—	—	—	–	Refer to Section 2–7–5 Telephone Lines Requirements for additional customer phone line information.
103	0.09 (58)	MSM1	OW1	70 (21.3) **minus** takeup at MSM1	942	0.34 (8.64)	0.50x0.75 (12.7x19.1)	0.50x0.75 (12.7x19.1)	
104	—	MUX	OW1 InSite Modem	—	—	—	—	—	Customer provided phone line.
105	0.09 (59)	SCC2	MG3	90 (27.4)	—	2.25 (57.2)	Air hose	Air hose	Air hose is connected to waveguide on PP1.
106	0.09 (58)	MSM3	MUX	6 (1.8) **minus** takeups at each end	—	0.34 (8.64)	0.50x0.75 (12.7x19.1)	0.50x0.75 (12.7x19.1)	Modem–MUX phone line
107	0.07 (47)	SCC	MR2	50 (15.4)	952	0.305 (7.75)	1.30x2.00 (33.0x50.8)	1.30x2.00 (33.0x50.8)	

6–4–1 System Cooling Cabinet With Remote Condenser Unit Additional Interconnects

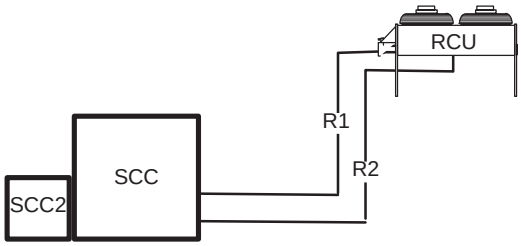
The SCC with RCU requires the interconnects defined in this section in addition to the interconnects in Section 6–4 SYSTEM INTERCONNECTS.

Installation of the RCU must be in accordance with local and national codes for electrical and according to standard accepted refrigeration practices (i.e. proper traps in lines). The following recommendations should be adhered to:

- Use only refrigeration grade copper tubing.
- Soft solder joints are not acceptable
- Put dry nitrogen through lines while brazing.
- Do not leave dehydrated piping or components open to the atmosphere any longer than absolutely necessary.

Note

Refer to **Section 2–7–1 System Cooling Cabinet Subsystem Equipment** Table 2–5 for listing of responsibility for the specific installation tasks. Also refer to Ellis & Watts *Technical Publication 468 Pre installation/Installation/Operating LC 20M/RAC Chilled Water System for GE Signa OpenSpeed MRI Equipment* for additional SCC with RCU information and details.



REMOTE CONDENSER UNIT & SYSTEM COOLING CABINET CUSTOMER PROVIDED INTERCONNECTS
ILLUSTRATION 6–3

TABLE 6–4
CUSTOMER PROVIDED REMOTE CONDENSER UNIT INTERCONNECT LIST

GROUP NUMBER	GROUP AREA in.^{2}(mm^2)	BETWEEN UNITS		USABLE LENGTH ft (m)	RUN NUMBER	CABLE DIAMETER in. (mm)	PLUG PULLING DIAMETER X LENGTH in. (mm)		NOTES
R1	1.595* (1029)*	SCC	RCU	See Note 1	gas	1.125* (28.6)*	refrigeration tubing	refrigeration tubing	RCU is supplied with sweat fittings on the SCC and RCU. Refer to Illustrations 2–12 and 2–13.
					liquid	0.875* (22.2)	refrigeration tubing	refrigeration tubing	Refrigeration tubing is Customer Supplied.
R2		SCC	RCU	See Note 1	power	0.064 See Note 2	hard wired	hard wired	At RCU Customer Supplied power wiring is connected to Lock Out /Tag Out Breaker Box supplied and installed on the unit.

Note * Dimension values are estimated, need to determine dimensions for customer supplied materials.

1 The SCC and RCU must not be separated by a distance greater than 200 ft (61 m) of customer provided refrigeration tubing. The vertical separation must not exceed 100 ft (30.5 meter) for the RCU above the SCC and 10 ft (3 m) if for the RCU is below the SCC.

2 Customer provided power wire from SCC to RCU must be 14 AWG (25 mm^2) minimum with actual wire size to be determined by customer/contractor dependent on total run length. RCU power demands for are Start–up 10 Amps and Full Load 3.7 Amps for 2 fans (1@1/3 hp 1.3 FLA and 1@3/4 hp 2.4 FLA). Refer to vendor manual for additional information .

6–4–2 Water Cooled System Cooling Cabinet Additional Interconnects

The water cooled SCC requires the customer provided water cooling lines, refer to Section 4–4–2 Water Cooled System Cooling Cabinet Configuration Requirements for details.

Note

Water lines shall be routed separate from electrical lines (i.e. power & signal).

6–5 CONTRACTOR FURNISHED COMPONENTS

Table 6–5 lists contractor furnished components and details for connections to the system.

CAUTION

Continuous water cooling is critical for the Shield/Cryo Cooler Compressors and therefore MUST be available 24 hours per day / 7 days per week to maximize proper uninterrupted magnet operation. Water cooling is required immediately upon magnet arrival. The System Cooling Cabinet (SCC) and Main Disconnect Panel (MDP) must be installed and operational prior to magnet arrival.

TABLE 6–5
CONTRACTOR FURNISHED COMPONENTS

ASSOCIATED EQUIPMENT	MATERIAL/LABOR PROVIDED BY CUSTOMER CONTRACTOR
POWER IN MAGNET ROOM	Provide and install power and wall duct for Magnet Rundown Unit. (See **Section 5, POWER REQUIREMENTS**, for power specifications.)
SYSTEM GROUND	Provide ground cable between RF shielded room common ground point and Power Distribution Unit (PD1). (See **Section 5–4–2, SYSTEM GROUND**, for cable specifications.)
EQUIPMENT POWER ● Low Voltage Step–up Transformer* ● Main Disconnect Panel (MDP) ● MDP to Power Distribution Unit (PDU) ● MDP to System Cooling Cabinet (SCC) ● SCC to RCU* ● Magnet Rundown Unit ● Service Outlet in Magnet Room	Provide and install power, conduits, duct work, receptacle, and/or coverplate as required for each item listed. See **Section 5, POWER REQUIREMENTS**, for power specifications.
EQUIPMENT POWER ● SCC to SCC2	Install provided interconnects. See **Section 6–2 POWER INTERCONNECTS** and **Section 6–4 SYSTEM INTERCONNECTS** for interconnects details.
ELECTRICAL WIRING	**Required for SCC with Remote Condenser Unit (RCU) optional configuration**: Provide and install power wiring between SCC and RCU, refer to **Section 6–4–1 System Cooling Cabinet With Remote Condenser Unit Additional Interconnects**.
PLUMBING	Water cooling for the Shield/Cryo Cooler Compressor Cabinets supplied by the System Cooling Cabinet (SCC) is required at time of magnet delivery. Install plumbing for all water cooling equipment, refer **Section 4, SITE ENVIRONMENT**, for customer supplied components & requirements. Refer to **Section 4–4 WATER COOLING REQUIREMENTS** for backup temporary water cooling for all SCC configurations and specific requirements for Water Cooled SCC and SCC with Remote Condenser Unit (RCU).
Note * Optional Equipment	
(Continued)	

6–5 CONTRACTOR FURNISHED COMPONENTS (Continued)

TABLE 6–5 (Continued)
CONTRACTOR FURNISHED COMPONENTS

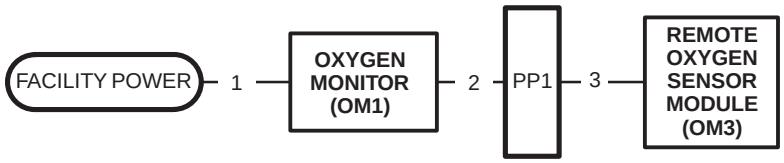
ASSOCIATED EQUIPMENT	MATERIAL/LABOR PROVIDED BY CUSTOMER CONTRACTOR
REFRIGERATION	**Required for SCC with Remote Condenser Unit (RCU) optional configuration**: Provide & install refrigeration lines between SCC and RCU, refer to: • **Section 2–7–1 System Cooling Cabinet Subsystem Equipment** Table 2–5 for listing of responsibility for the specific installation tasks • **Section 6–4–1 System Cooling Cabinet With Remote Condenser Unit** Additional Interconnects.
CRYOGENIC VENTING	Provide and install cryogenic vent system. (See **Section 4–9, CRYOGENIC VENTING**, for vent specifications.)
PENETRATION PANEL MOUNTING HARDWARE	RF shielded room vendor to provide appropriate mounting hardware for GE supplied penetration panel. (See **Section 7, RF SHIELDED ROOM**.)
RF DOOR SWITCH AND CABLING	RF shielded room vendor to provide and install RF door switches on all RF shielded room doors. All switches must be wired in series. GE supplies a 100 ft (30.5 m) cable from System Cabinet which is terminated with 2 leads. These leads are connected to the set of switches. Switches must be in the open position when RF door is open but closed when door is closed. (See **Section 7, RF SHIELDED ROOM**.)
MAGNET ROOM FLOOR	RF shielded room vendor or customer contractor to provide and install filler around magnet mounting plate, refer to **Section 7–7 MAGNET MOUNTING REQUIREMENTS INSIDE RF SHIELDED ROOM.**

6–6 OXYGEN MONITOR OPTION INTERCONNECTS

The Oxygen Monitor option consists of the following items:

- Oxygen Monitor
- Remote Oxygen Sensor Module
- Interconnect cables

Illustration 6–4 shows the Interconnect Diagram. Table 6–6 contains the cable data.



DISTANT REMOTE CONSOLE CABLING
ILLUSTRATION 6–4

TABLE 6–6
OXYGEN MONITOR INTERCONNECT LIST

GROUP NUMBER	GROUP AREA in.^{2}(mm^2)	BETWEEN UNITS		USABLE LENGTH ft (m)	RUN NUMBER	CABLE DIAMETER in. (mm)	PLUG PULLING DIAMETER X LENGTH in. (mm)		NOTES
		FROM	TO				FROM	TO	
1	—	Facility Power	OM1	—	—	—	—	—	Customer Furnished recommended power source for OM1 (refer to Section 5–1).
2	0.096 (61.94)	OM1	PP1	94 (28.7) **minus** takeup at OM1	457	0.35 (8.9)	Hard Wired	1.30x2.00 (33.5x50.8)	
3	0.096 (61.94)	PP1	OM3	84 (25.6) **minus** takeup at OM3	458	0.35 (8.9)	1.30x2.00 (33.5x50.8)	Hard Wired	

SECTION 7 – RF SHIELDED ROOM

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

7–1 RF SHIELDED ROOM SPECIFICATION

Every GE MR system requires that the Magnet Room be RF shielded. Table 7–1 contains the RF Shielded Room specifications.

Note

It is advisable to check the integrity of all RF Shielded (screen) Rooms in proximity to the MR system. Poor RF Shield integrity can contribute to system image quality artifacts i.e. zippers.

TABLE 7–1
RF SHIELDED ROOM REQUIREMENTS

PARAMETER	REQUIREMENTS
RF ATTENUATION	• 100dB (10MHz – 100MHz) **planewave**
GROUND ISOLATION	• 1,000 ohms or greater Refer to **Section 7–7–6 Electrical Isolation** for additional information on electrical isolation requirement.
MATERIALS See Note 1	• The choice of material is the responsibility of the customer's architect and RF vendor. Normally, copper–brass or treated aluminum is used because these materials are non–magnetic and will not affect homogeneity. However, RF Shielding has also been fabricated from galvanized steel or by modifying steel magnetic shielding to produce the required RF attenuation. Any steel RF enclosure will affect the magnet's homogeneity and must be reviewed by GE Medical Systems MR Siting and Shielding Group. The door or any other moving or non–rigid parts must not be fabricated from magnetic materials.
CONSTRUCTION See Note 1	• The design of the shield support system is the responsibility of the customer's architect and RF vendor. If magnetic steel panels are used, these materials must be rigidly supported to prevent any slight movement, from air pressure changes or other reasons, that could degrade magnet homogeneity and system performance. For safety reasons, magnetic steel material must also be well anchored; loose steel components can become dangerous projectiles and accelerated into the magnet. • It is the customer's responsibility to coordinate magnet mounting methods with the RF shielded room vendor to prevent RF leaks and secondary grounding problems.
TESTING	• The customer's architect and RF vendor are responsible for conducting RF attenuation and ground isolation tests to verify that the shield meets GE specifications. The RF shielded room verification test is to be performed in the presence of a GE representative. • When to test: The RF shielded room must be 100% finished, magnet installed, all penetrations complete including floor mounting bolts. The test must be conducted with an RF vendor supplied blank penetration panel and the same mounting hardware which is used with the GE penetration panel. • How to test: The FINAL RF Shielded room acceptance test shall be performed in accordance with Appendix A, RF SHIELDED ENCLOSURE TEST GUIDELINE.
MAINTENANCE	• Follow RF vendor's recommended maintenance. Alert GE Service Representative of any RF shielded room maintenance issues since there may be system performance impacts.
ACOUSTIC	• RF Screen Room including all openings (i.e. windows, doors, vents, etc.) need acoustic properties to meet local regulations and customer requirements. **Note** RF Screen Room doors with < 45 to 50 db acoustic attenuation have caused customer acoustics issues. Refer to Section 4–7 ACOUSTICS for additional information.
Note 1 Suspension Foundation and Seismic Zone sites requires the Magnet Mounting Plate be installed into the Magnet Room floor and the plate must be utilized as the RF Shield under the Magnet. In cases where the RF Shield is located well below the magnet, i.e. in a combined RF and Magnetic shield design, than the magnet mounting plate will not be utilized as part of the RF Shield. Refer to Section 7–7 **MAGNET MOUNTING REQUIREMENTS INSIDE RF SHIELDED ROOM.**	

7–2 VENTS

7–2–1 Cryogenic

Due to normal boil–off of liquid helium and the possibility of a quench with superconducting magnets, outside cryogenic venting is required. RF shielded room contractor is to provide one straight pipe with maximum 0.125 in. (3.175 mm) wall thickness for the cryogenic vent pipe/waveguide. The vent pipe/waveguide is to be made of non–magnetic metal (e.g. aluminium or stainless steel) which is grounded to the RF room and electrically isolated from any other grounds. The vent pipe/waveguide must extend inside and outside of the RF shielded room to allow for non–metallic isolation joint connections. The HVAC (heating, ventilation, and air conditioning) contractor is to make cryogenic vent connections to vent pipe/waveguide outside of the RF shield and GE will make the normal connection in the Magnet Room. Refer to Section 4–9–2, Requirements For Inside Magnet Room, for exceptions.

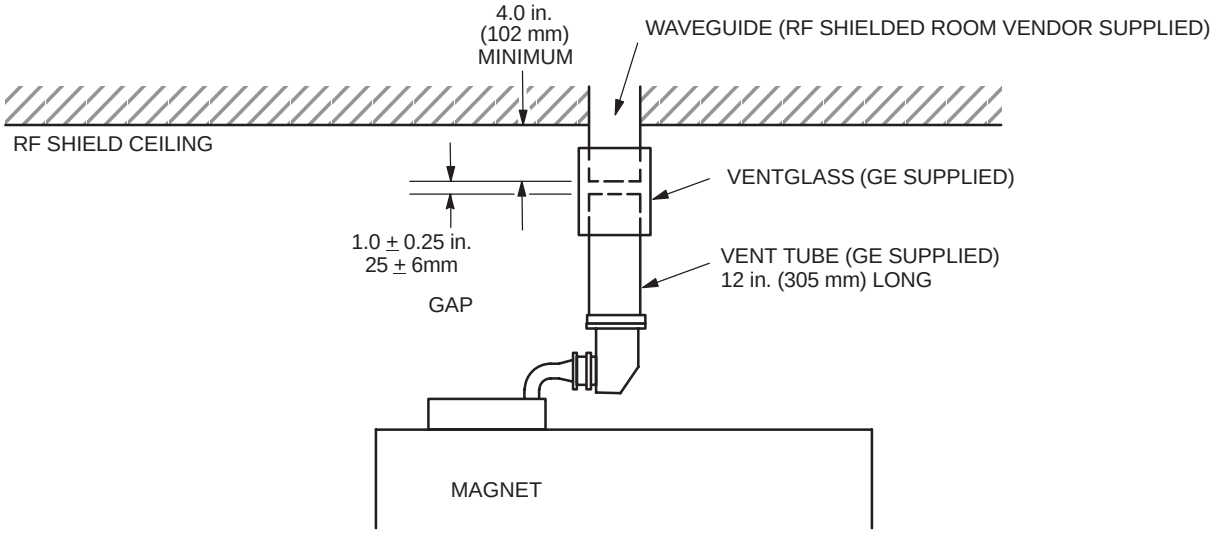
7–2–2 Determining Cryogenic Vent Location

Shown in Illustration 7–17 is the 0.7T magnet vent location relative to isocenter on the magnet mounting plate. It is important that the 0.25 in. (6.35 mm) tolerance for vent opening be met. Included with the basic Signa system is an 8 in. (203.2 mm) ID vent tube. A typical route for this vent tube is shown in Illustration 7–1. However, the customer's contractor is responsible for the design and installation of a cryogenic vent system which meets the requirements in Section 4–9, CRYOGENIC VENTING.

GE provides a Floating Flange Vent Adaptor Kit with the 0.7T magnet. The kit increases the vent adapter radial adjustability in any direction to one inch (25.4 mm). The adjustability helps absorb some mismatch (1 inch (25.4 mm) in any horizontal direction) of the locations of the Vent Pipe from the magnet and the Ceiling Vent Pipe, installed by the RF Room contractor. See Illustration 7–2. The GE provided Vent Pipe is 12 inches (305 mm) long with a wall thickness of 0.125 inch (3.175 mm) and may be cut short to create 1 $\pm$ 0.25 inch (25 $\pm$ 6 mm) gap between the Vent Pipe and the Ceiling Waveguide for dielectric isolation to ensure the integrity of the RF shield room.

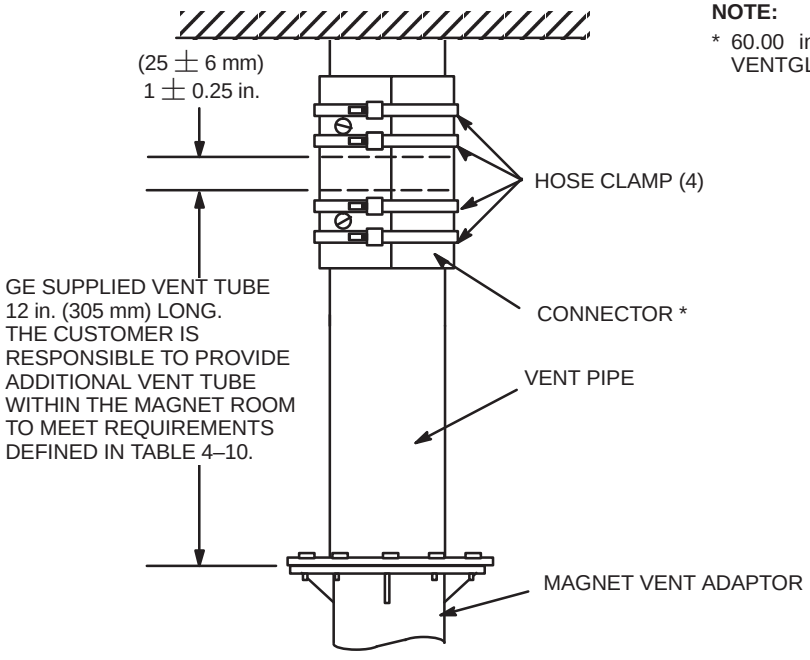
7–2–2 Determining Cryogenic Vent Location (Continued)

NOTE:
- ALL DIMENSIONS ARE IN INCHES ALL BRACKETED ( ) DIMENSIONS ARE IN MILLIMETERS.



CRYOGENIC VENT ROUTING
ILLUSTRATION 7–1

NOTE:
* 60.00 in X 8.00 in (152 cm X 20 cm) VENTGLASS CONTINUOUS WRAP SLEEVE



FLOATING FLANGE
ILLUSTRATION 7–2

7–2–3 Waveguide

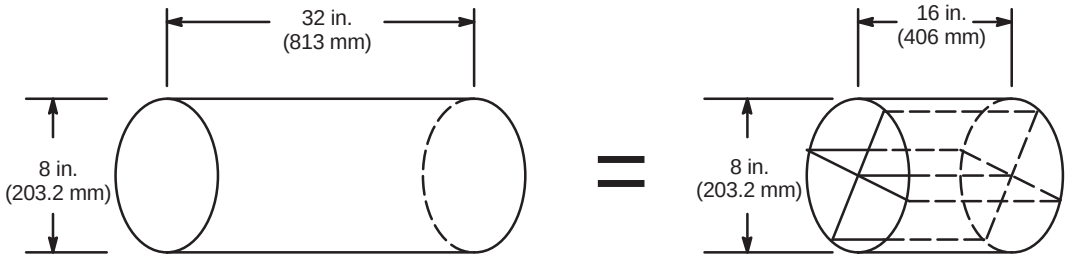
RF shield room contractor/designer is responsible for choosing and installing a RF shield waveguide . The generally accepted length of the waveguide is four times the outside diameter of the tube. Therefore, a 8 in. (203.2 mm) OD waveguide should be 32 in. (813 mm) long. Refer to Table 7–2 for list of GE requirements for the waveguide.

TABLE 7–2
WAVEGUIDE REQUIREMENTS

PARAMETER	REQUIREMENTS
WAVEGUIDE SIZE	• If the provided GE vent tube is to be connected directly to the waveguide via the GE Ventglass method, the outside diameter of the waveguide must match the outside diameter of the GE vent tube within ± 0.125 in. (3 mm). Larger mismatches in diameters will result in unacceptable leakage during a quench. • The generally accepted length of the waveguide is four times the inside diameter of the tube. Therefore, an 8 in. (203.2 mm) OD waveguide should be 32 in. (813 mm) long.
WAVEGUIDE MATERIAL	• The Waveguide must be constructed from one of the GE accepted materials (i.e. stainless steel, aluminium or copper). Typically, the waveguide is made from the same material as the RF shielded enclosure to avoid dissimilar metal interfaces (i.e. galvanic reaction).
WAVEGUIDE CONSTRUCTION	• The waveguide does not have to be positioned equally on either side of the RF ceiling (or wall). For example, 8 in. (203.2 mm) of a 32 in. (813 mm) long waveguide may hang down below the RF ceiling with the remaining 26 in. (660 mm) extending above. • If a 90 degree elbow is required to avoid ceiling structures, the elbow can be a part of the waveguide and contribute to its overall length. Waveguides do not have to be completely straight. • If a full length waveguide is not possible due to structural interferences, a shorter waveguide can be fabricated by dividing the inside volume into no more than four chambers. For example, if an 8 in. (203.2 mm) OD waveguide is divided into four equal chambers, as shown in ILLUSTRATION 7–3, the length of the waveguide may be decreased from 32 in. (813 mm) to 16 in. (406 mm). If this technique is used, 1 psig must be added to the pressure drop calculation to account for the pressure drop of the four chambered waveguide. (Section 4–9, CRYOGENIC VENTING) • Flat, honeycomb type waveguide is not acceptable.

NOTE:

- 1 psi MUST BE ADDED TO THE PRESSURE DROP CALCULATION TO ACCOUNT FOR THE PRESSURE DROP OF THE FOUR CHAMBERED WAVEGUIDE.
- IN A CASE OF WAVEGUIDE LENGTH RESTRICTION, A HALF LENGTH WAVEGUIDE WITH FOUR CHAMBERS MAY BE USED.



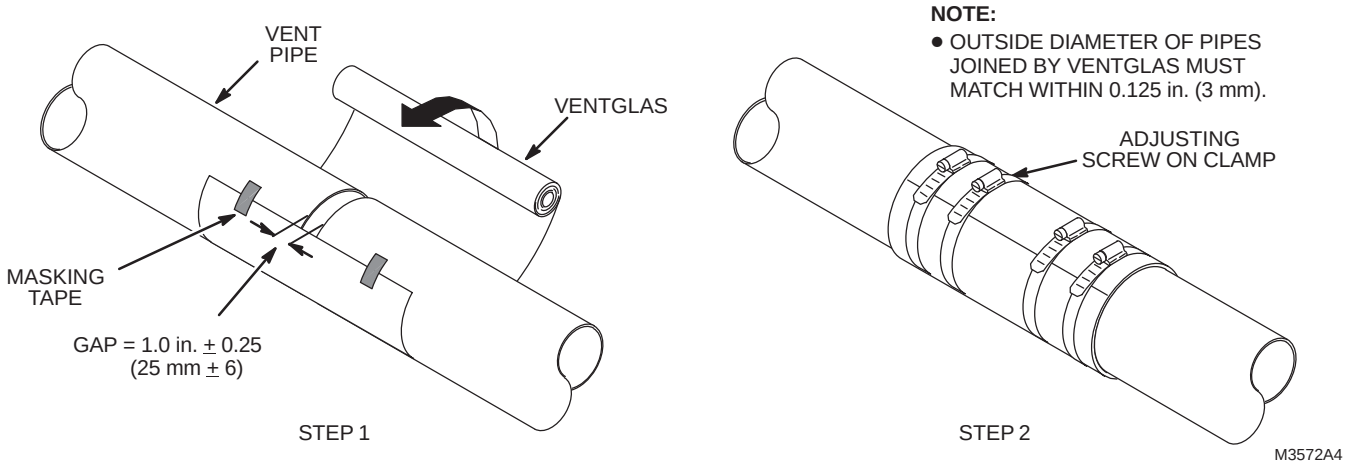
4 CHAMBER WAVEGUIDE
ILLUSTRATION 7–3

7–2–4 Guide For Outside RF Room Isolation Joint

The RF shielded room contractor/designer is responsible for choosing and installing an isolation joint outside of the RF shielded room as shown in Section 4–9–1, Requirements For Outside Magnet Room. This isolation joint is required to maintain the single point ground concept for the RF shielded room. Table 7–3 contains suggestions for the RF room isolation joint.

TABLE 7–3
OUTSIDE RF ROOM ISOLATION JOINT SUGGESTIONS

PARAMETER	ISOLATION JOINT SUGGESTIONS
ISOLATION JOINT MATERIAL	• PVC, rubber or soil pipes **must not** be used to construct the isolation joint. • Ventglas and Lorenz clamp are two GE recommended methods of achieving the isolation.
ISOLATION JOINT CONSTRUCTION	• Ventglas: If the connection diameter is 8 in. (203.2 mm), a Ventglas connection method as shown in Illustration 7–4 is recommended. • Lorenz clamp: If the connection diameter is 8 in. (203.2 mm), a Lorenz clamp connection as shown in Illustration 7–5 is recommended. • The mating diameters must match within ± 0.125 in. (3 mm). • The Ventglas **must not** be used for structural support.
INFORMATION	• Ventglas information may be obtained from: Industrial Machine & Fabricating Inc. 2808 E Sammys Lane Florence, SC 29506–3841 USA (843) 667–4582 e–mail address indmachfab@aol.com Vent Fabrics Inc. 5520 N Lynch Avenue Chicago, IL 60630–1418 USA (800) 621–1207 or (773) 775–4477 web site address www.ventfabrics.com • Lorenz clamp information may be obtained from: Lorenz and Son Mfg. Co. LTD. P.O. Box 1002 Cobourg, Ontario, Canada K9A4W4 (905) 372–2240, fax (905) 372–4456

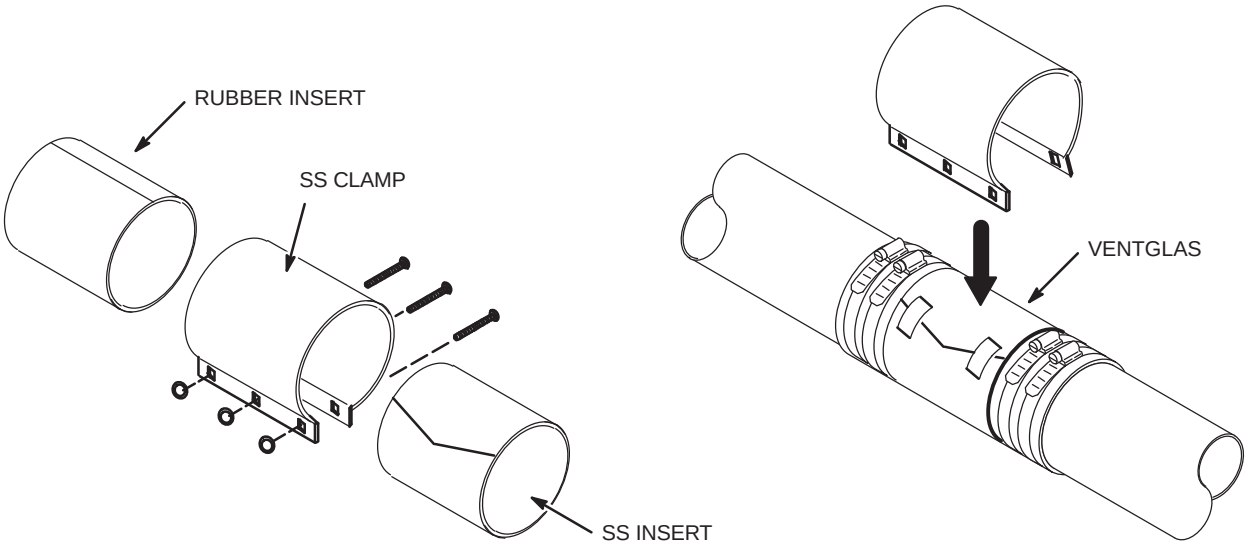


VENT GLASS CONTINUOUS WRAP
ILLUSTRATION 7–4

7–2–4 Guide For Outside RF Room Isolation Joint (Continued)

NOTE:

- LORENZ CLAMP IS ATTACHED OVER THE VENT GLASS FOR ADDED REINFORCEMENT.
- SS = STAINLESS STEEL



LORENZ CLAMP
ILLUSTRATION 7–5

7–2–5 HVAC

RF shielded room contractor is to install HVAC waveguides (open pipes or honeycomb–type) which penetrate room and to ensure waveguides are non–magnetic and electrically isolated. HVAC contractor is to determine size and number of vents, consistent with local codes.

An exhaust fan placed outside the RF shielding with appropriate wave guide filtering is required for quick removal of helium gas in the event large amounts of helium disperse into the Magnet Room. The exhaust fan can be connected to the output relay of the optional oxygen monitor. The fan will then be activated in the event the room oxygen level is less than 18%. Refer to Section 4–8, ROOM VENTILATION, for other exhaust fan requirements.

7–3 PLUMBING

All metallic pipes entering the RF Room, excluding cryogenic vent and floor drains, must be located within 30 inches (762 mm) of the RF common ground.

Note

When welding in an MR room with system equipment installed, the return path for the welding must be in very close proximity to the welding. The close proximity is needed to make sure the welding currents do not cause damage to the system. Never use the building structure as a return path for welding.

7–3–1 Water

All pipe waveguides must meet the 100 dB requirements. If a floor drain is to be installed in the Magnet Room, it must be electrically isolated and meet the 100 dB requirements. All plumbing must be consistent with local codes.

7–3–2 Medical Gases

The customer should consider if medical gases are to be piped into the Magnet Room along with suction service for patient life support. Remember, all non–electrical entries into the Magnet Room must use appropriate waveguide. Special precaution must be taken to ensure that ferromagnetic medical gas cylinders are not brought into the Magnet Room.

7–3–3 Sprinklers

If using sprinklers in the Magnet Room, dry pipe systems have the advantage of reducing ground problems. However, all decisions regarding fire protection systems are the customer's responsibility. If wet–type sprinkler system is used, pipe penetration should be limited to one location.

7–4 ELECTRICAL

The entry of any electrical lines into the RF shielded room must be filtered to ensure that the RF shielded room meets the minimum attenuation levels. The RF shielded room vendor must supply filters for all penetrations of the RF shielding excluding the lines entering through the GE supplied RF penetration panel. All filters (for electrical lines) must be located outside the 200 gauss line.

Note

AC outlets must have ground wires firmly attached per electrical codes to avoid intermittent grounding which can cause undesirable emi (electro magnetic interference) issues within the RF shielded room.

RF shielded room vendor should review with the electrical contractor the number of incoming power lines to the Magnet Room in determining the number of filters needed for electrical requirements.

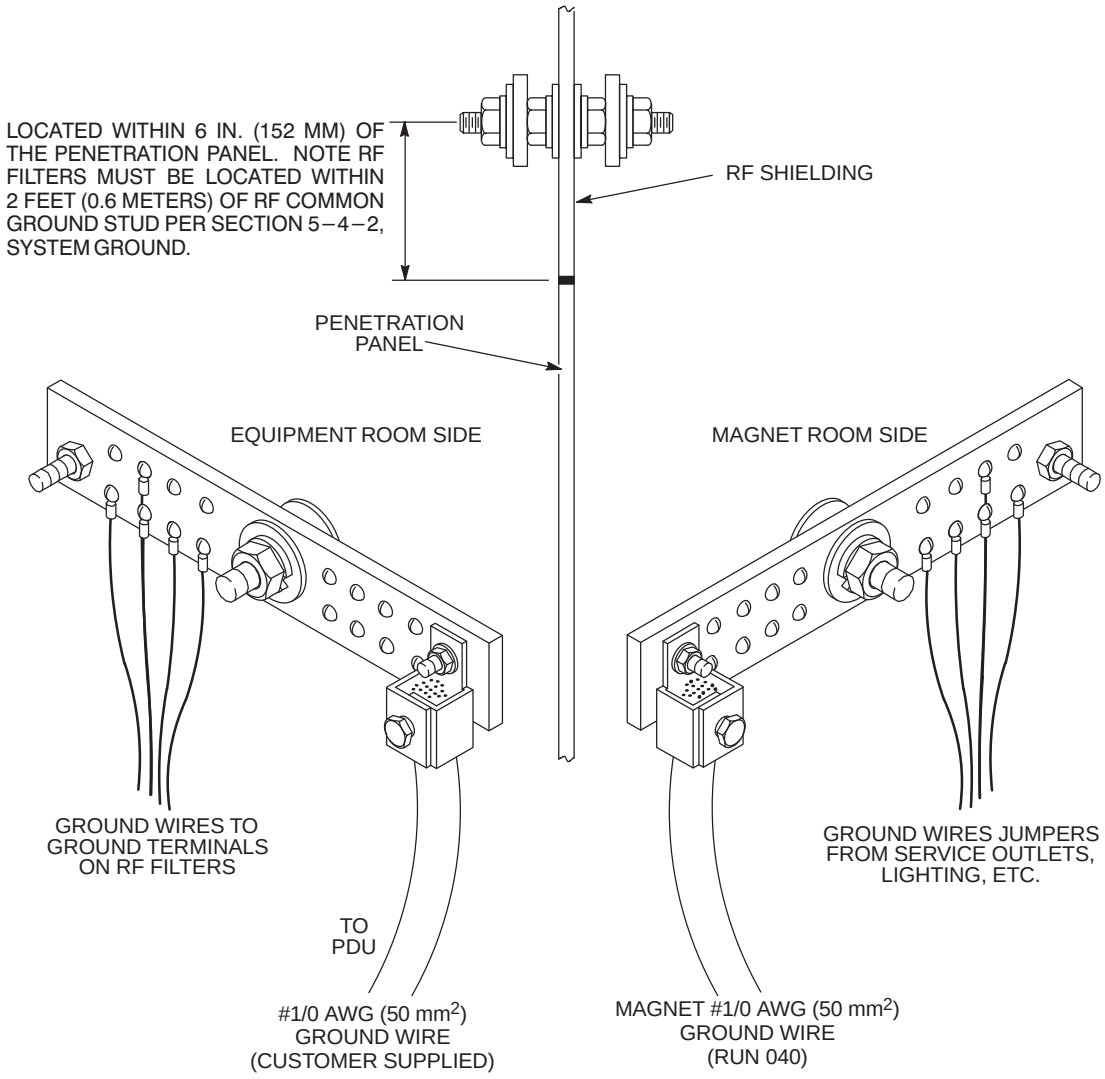
The power ground lines from customer supplied power filters must be grounded to the RF shield common ground point and be located as close as possible to the RF penetration panel. See Section 5, POWER REQUIREMENTS, for power and grounding requirements of all incoming power lines to the RF shielded room.

All lighting in the RF shielded room must be DC/incandescent. Dimmer switches must not be used; however, a selectable switch may be used to change the light intensity. For additional Magnet Room lighting information refer to Section 4, SITE ENVIRONMENT, Section 5, POWER REQUIREMENTS, and Section 6, INTERCONNECT DATA.

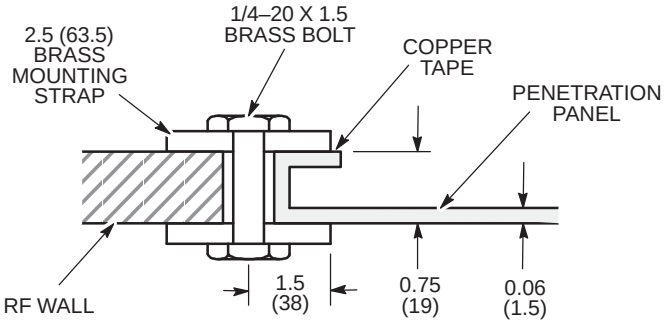
Common ground connection for shielded room must be located within 6 in. (152 mm) of the RF shielded room Penetration Panel with RF filters located within 2 feet (0.6 meters) of the RF common ground. RF shielded room vendor to provide this common ground connection on both sides of shielded room by means of a stud extending through the shielded room (see Illustration 7–6). RF Common ground stud must be accessible for servicing purposes on both sides of shield room. For aesthetic purposes, it is recommended that the stud be positioned above the Penetration Panel so it is concealed behind the penetration panel cover (see Illustration 7–9).

NOTE:

- ALL DIMENSIONS ARE IN INCHES. ALL BRACKETED ( ) DIMENSIONS ARE IN MILLIMETERS



RF COMMON GROUND PENETRATION STUD
ILLUSTRATION 7–6

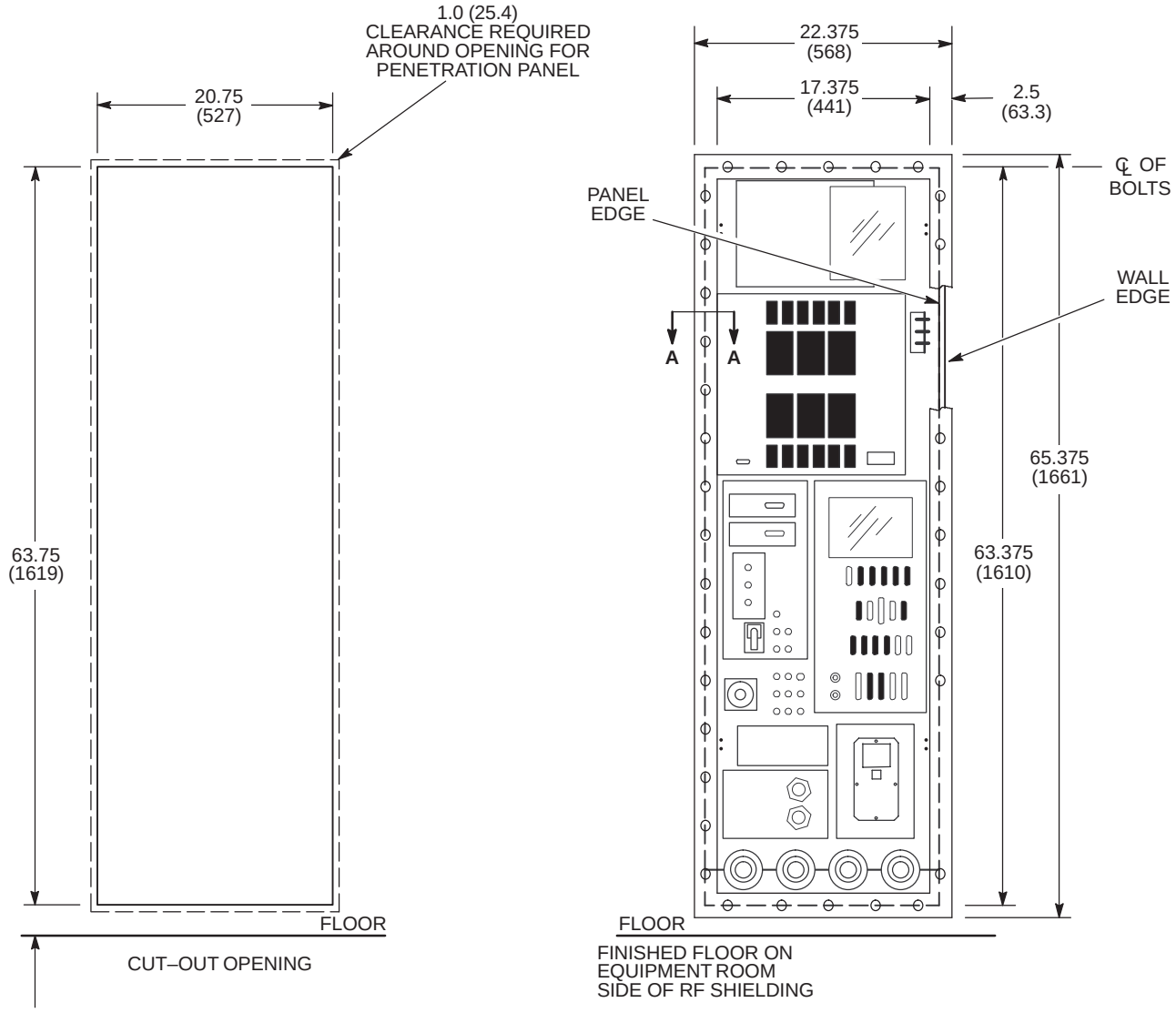


SECTION A–A

NOTE:

- ALL DIMENSIONS ARE IN INCHES. ALL BRACKETED ( ) DIMENSIONS ARE IN MILLIMETERS.
- ALL DIMENSIONS ARE ±0.0625 (1.6)

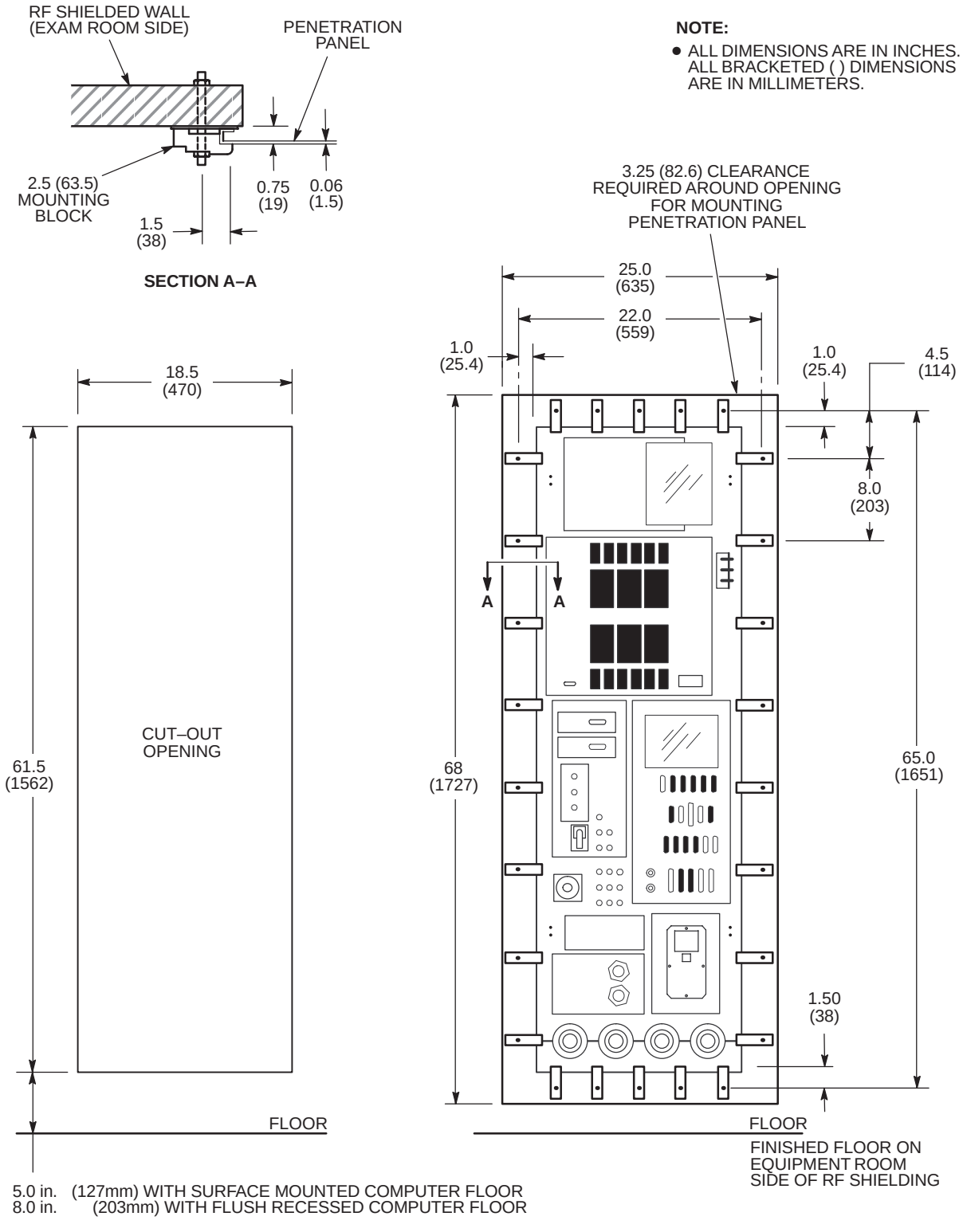
PENETRATION PANEL MOUNTED



3.0 in. (76 mm) WITH SURFACE MOUNTED COMPUTER FLOOR
6.0 in. (152 mm) WITH FLUSH RECESSED COMPUTER FLOOR

M4526A

PENETRATION PANEL CUT OUT FOR 0.75 INCH (19 MM) THICK RF WALL
ILLUSTRATION 7–7



PENETRATION PANEL CUT OUT FOR RF WALL THICKNESS VARYING FROM SMALL TO LARGE
ILLUSTRATION 7–8

7–5 RF PENETRATION PANEL

Illustrations 7–7 and 7–8 show two different methods for mounting the GE MR penetration panel. Either method may be used depending on RF shielded room wall thickness. Ensure if the mounting method in Illustration 7–7 is used, the RF wall thickness is 0.75 in. (19 mm) ± 0.0625 in. (1.6 mm). Check with RF shielded room vendor to determine appropriate mounting method. The penetration panel must be covered on both sides for safety. If GE supplied adjustable covers are not used, customer must furnish covers or enclosures with key or tool required for opening to limit access to the panel.

The penetration panel is to be mounted above the finished floor on the penetration cabinet side of the RF shielded room. GE supplies only the penetration panel as shown in Illustrations 7–7 and 7–8. The mounting and clearance dimensions for the penetration panel covering are shown in Illustration 7–9.

RF shielded room vendor must provide the opening in the RF shielding and appropriate mounting hardware for the GE penetration panel. The RF shielded room acceptance test must be performed after the opening is cut in the RF shielding for the GE penetration panel. This acceptance test must be conducted with vendor supplied blank panel and the same mounting hardware to be used with the GE penetration panel. It is the facility's responsibility to ensure that the RF shielded room vendor testing meets the attenuation specifications listed in Section 7–1, RF SHIELDED ROOM INTRODUCTION.

7–6 PHYSICAL CONSIDERATIONS

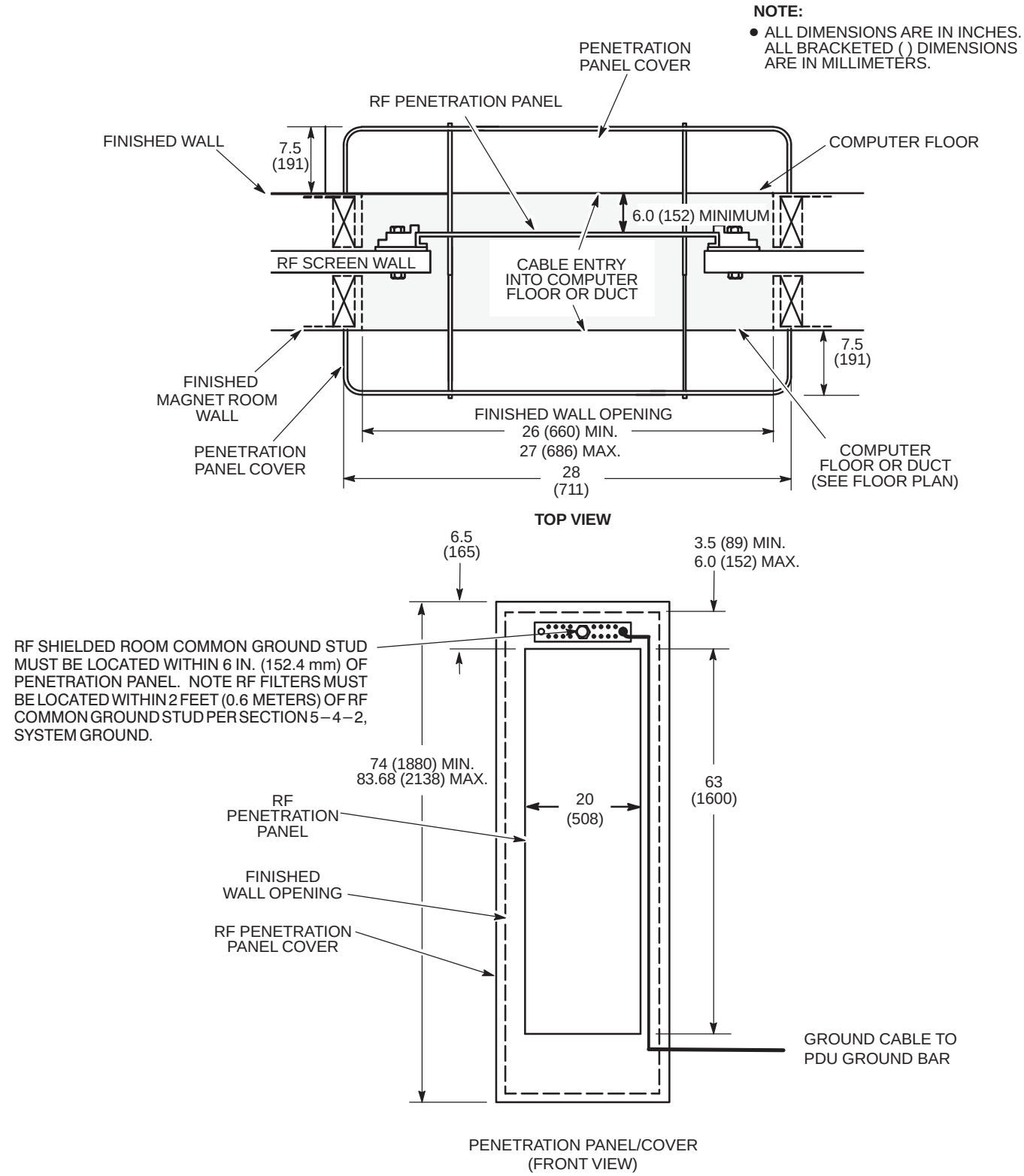
The RF shielded room can be either a free standing shielded structure or a shielded room within an existing room. Either style must be electrically isolated from earth ground by 1000 ohms or greater. Magnetic shields that are used as RF shield must also be isolated from ground by the same specification.

7–6–1 Doors and Other Openings

Shielded room doors are a major source of RFI leaks and should be kept to a minimum.

The main door requires a minimum finished opening of 43 in. (1092 mm) to allow for helium dewars and patient transports to pass through the opening. However, a 48 in. (1219 mm) wide door is recommended for easy maneuvering of the patient transports i.e. gurneys. Maximum door sill height is 1 in. (25 mm) with a 10 degree maximum threshold inclination.

For moving the magnet into the room, a 9 ft wide by 9 ft high removable panel wall or 9 ft by 9 ft roof hatch is required. This normally consists of several panels that are bolted together to ensure a good RF shield when opening is not in use. Since future access may be required for magnet entrance/exit through the removable panels, avoid permanently sealing the removable panels. Note the room removable wall panel or roof hatch opening may need to be larger to achieve the required opening defined above in this section. Consideration for clear opening dimensions is especially applicable to sites requiring magnetic shielding.



PENETRATION PANEL/COVERING MOUNTING REQUIREMENTS
ILLUSTRATION 7–9

7–6–2 Ceiling Height

Table 7–4 lists the absolute minimum (lowest) ceiling height required for servicing the 0.7T magnet, this height is required for the shaded area shown in Illustration 7–10. The cryogen vent must not be positioned or routed between the Magnet/Enclosure and the minimum (lowest) ceiling height in the areas indicated in Illustration 7–10 to allow for service access. GE Medical Systems, Modality Installation Planning Service group must be notified of any ceiling dimensions less than ceiling heights stated in Table 7–4 in the shaded area in Illustration 7–10. Modality Installation Planning Service group can be reached at (262) 548–4500.

TABLE 7–4
MAGNET SERVICING CEILING HEIGHT REQUIREMENTS

MAGNET TYPE	ABSOLUTE MINIMUM CEILING HEIGHT IN. (MM) See Note 1	COMMENTS
0.7T Magnet	102.68 (2608)	Magnet servicing is performed from a platform ladder which is positioned at the Coldhead side of the Magnet. Ceiling height allows clearance for ramp lead insertion, cryogen fill line stinger insertion, and coldhead extraction tool.
Note 1 Absolute minimum ceiling height values are from magnet room finished floor to fixed ceiling.		

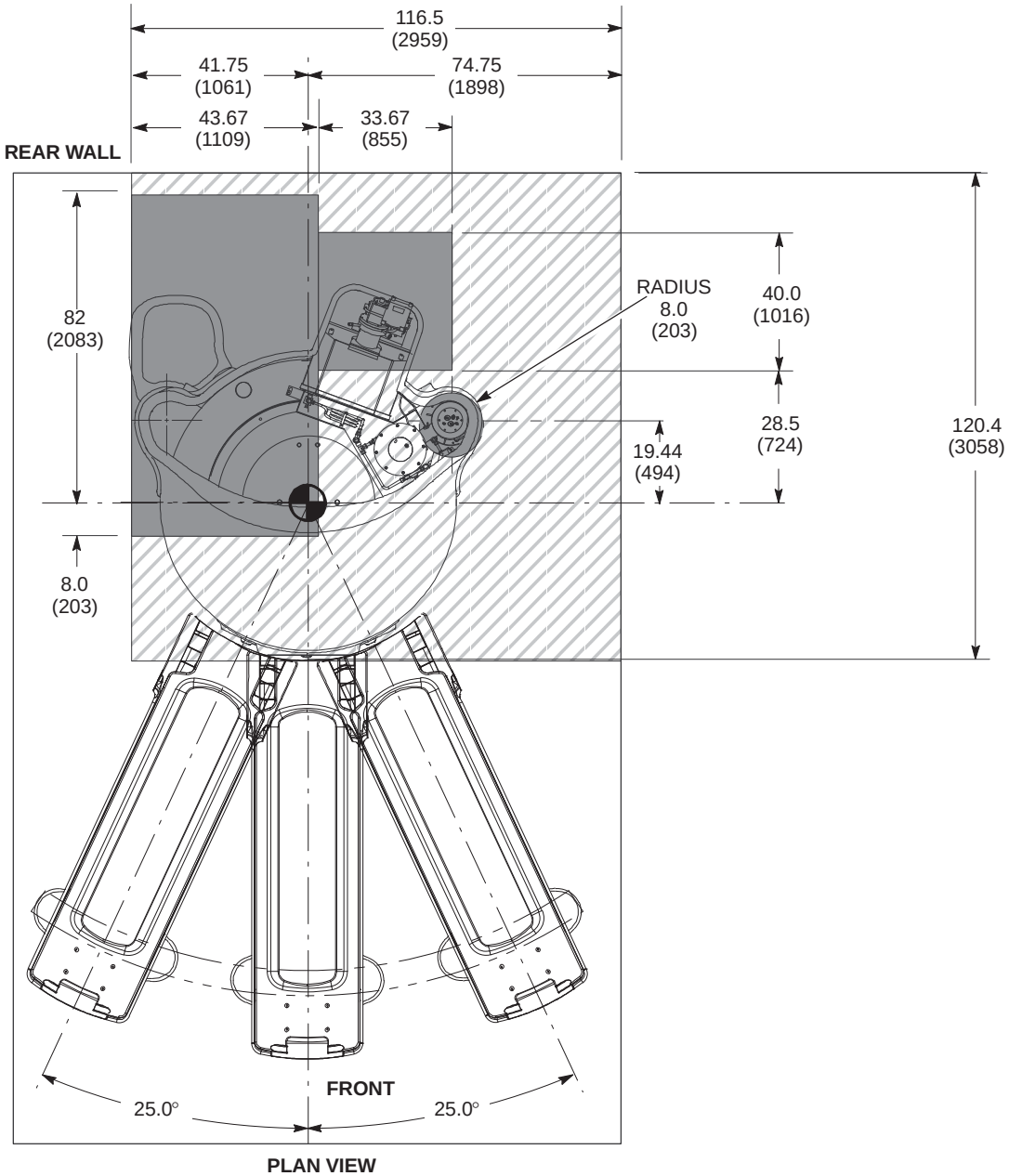
Use of a standard valved helium transfill line and a 250 liter dewar (not more than 70 in. (1778 mm) high) requires a ceiling height of 135.5 in. (3442 mm) for inserting transfill line into the dewar. Note that this need only be a 24 in. (610 mm) square ceiling recess located either in the Magnet Room or in an accessible area near the Magnet Room where the transfill line can be inserted into the dewar. A 500 liter dewar (not more than 73 in. (1854 mm) high) requires a ceiling height of 138 in. (3505 mm) for the same process.

If the helium transfill requirements cannot be satisfied in or near the Magnet Room, consider a location outside the building or on a loading dock. The standard valved transfill line, after insertion into either a 500 or 250 liter dewar, will fit through 79 in. (2007 mm) high doorways and hallways. Provide free access from the dewar location to the magnet. If elevators are to be used along cryogen delivery route, verify that elevator dimensions and weight capacity is sufficient to handle the cryogen dewars. Also, elevator must be dedicated with restricted access during cryogen transport (will not allow stops between initial start and final floor destination).

7–6–2 Ceiling Height (Continued)

NOTE:

- ALL DIMENSIONS ARE IN INCHES.
  ALL BRACKETED ( ) DIMENSIONS ARE IN MILLIMETERS.
- SHADED AREA ROOM CEILING MUST NOT BE BELOW TABLE 7–4 REQUIREMENTS.
- SHADED AREA INDICATES AREAS WHERE NOTHING CAN BE POSITIONED OR ROUTED BETWEEN MAGNET/ENCLOSURE AND MINIMUM CEILING HEIGHT. CRYOGEN VENT MUST NOT BE ROUTED IN THESE AREAS TO ALLOW FOR SERVICING ACCESS.



MINIMUM CEILING HEIGHT 0.7T MAGNET
ILLUSTRATION 7–10

7–6–3 Walls

It is recommended that walls be covered to protect RF material and to add to the aesthetics of the room for patient comfort. Fire retarding material must be used per building codes. Consult RF shield room vendor for RF shielding service requirements prior to covering RF walls. Removable wall covering may be needed if periodic RF shield servicing is required to maintain RF integrity.

The recommended patient viewing window dimensions are 48 in. wide by 42 in. high (1219 mm x 1067 mm). The location of the window is dependent on the position of Operator Workspace position.

Note

The operator at the Operator Workspace must be able to view the patient during a scan.

7–6–4 Floors

For Slab On Grade sites the concrete slab on which the magnet will be mounted must be continually supported on grade (no local voids allowed) and must be isolated from the rest of the building. Minimum concrete slab thickness must be 18 inches (457 mm) within the entire floor area of the RF Shield Room and cannot be limited to the magnet footprint area only. Refer to **Section 7–7 MAGNET MOUNTING REQUIREMENTS INSIDE RF SHIELDED ROOM** for specifications for mounting the magnet.

For Suspension Foundation sites the magnet mounting plate must be installed recessed into the floor. The magnet mounting plate must be utilized as the RF Shield under the Magnet and the magnet mounting plate must be mounted to the 18 inch (457 mm) concrete floor slab. In cases where the RF Shield is located well below the magnet, i.e. in a combined RF and Magnetic shield design, than the magnet mounting plate will not be utilized as part of the RF Shield. Refer to **Section 7–7 MAGNET MOUNTING REQUIREMENTS INSIDE RF SHIELDED ROOM** for specifications for mounting the magnet and the magnet mounting plate.

The Magnet Room floor levelness requirement is important for operation of the Patient Swing Table. Floor levelness in the Magnet Room must not exceed 0.236 in. (6 mm) between depressions and high spots. The floor itself must be no higher than the surface which the rear Patient Swing Table wheels contact, see shaded area shown in Illustration 7–11.

Note, the critical dimension of 41.34 in. $\pm$0.118 in. (1050 mm +/– 3mm) from finished floor to vertical center of the Magnet and Patient Swing Table rear wheel plate must be must be maintained. This will allow the Patient Swing Table to swing without obstruction from the floor.

Note

The Magnet foot/mounting pad must be in direct contact with the Magnet Mounting Plate. Do not use finished floor material under the Magnet foot flange or Patient Swing Table wheel plate to achieve final Patient Swing Table rear wheel plate alignment to Magnet vertical isocenter, refer to Illustration 7–18.

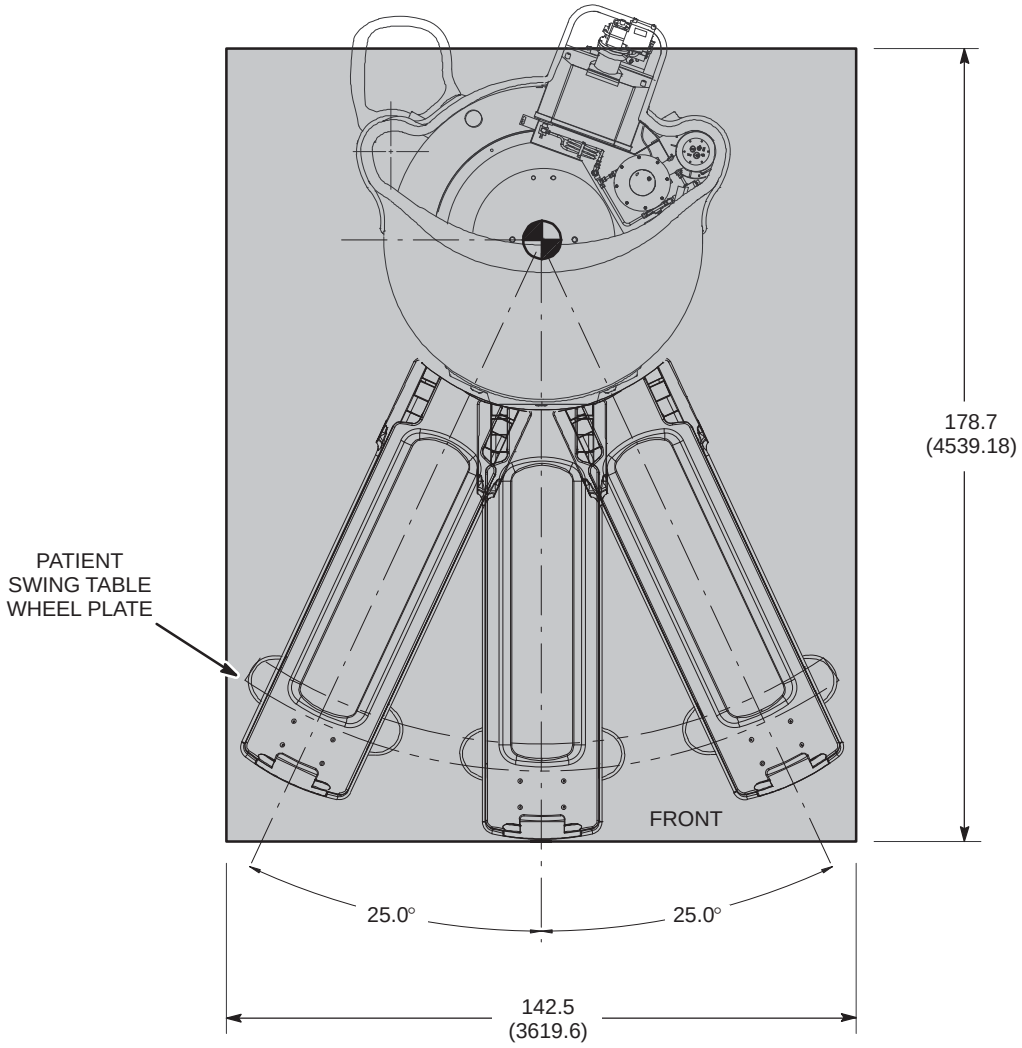
Magnet Room layout and RF Shield designs must include cable routing to the Magnet. Refer to Illustration 7–19 for cable access opening through the magnet mounting plate if customer plans to utilize cable access below the magnet.

The finished floor in the Magnet Room should be waterproof and be a conductive type flooring to reduce the possibility of a static discharge. The floor covering must be hard–surfaced with the seams sealed to protect the RF flooring against possible water damage. This floor should also be easily replaceable to repair tiles that are damaged from occasional cryogen spillage. Removable access flooring in the Magnet Room must be aluminium or non magnetic for safety purposes.

7–6–4 Floors (Continued)

NOTE:

- ALL DIMENSIONS ARE IN INCHES. ALL BRACKETED ( ) DIMENSIONS ARE IN MILLIMETERS.



PLAN VIEW

MAGNET FLOOR LEVELNESS AREA
ILLUSTRATION 7–11

7–7 MAGNET MOUNTING REQUIREMENTS INSIDE RF SHIELDED ROOM

7–7–1 Overview & Background Information

All GE MR systems require an RF enclosure which is commonly called an RF Shielded Room or an RF Screen Room. RF signals from sources outside of the RF Shielded Room are attenuated so they do not interfere with the MR system. Likewise, the RF signals produced by the MR scanner are kept from interfering with other RF devices. This RF quiet environment is necessary for the MR system to produce quality images.

RF Shield Rooms come in a variety of shapes and sizes but the feature they all have in common is a total RF shield produced by one continuous ground plane. This is achieved by making the magnet mounting plate, walls, floor, doors and ceiling out of an electrically conductive material such as copper, aluminum, brass, or steel. All the room components (the magnet mounting plate, walls, floor, ceiling, etc.) must be electrically bonded together to form one solid, common ground plane. Once this is established the ground plane is then tied to earth ground to create the RF shield. This ground point is known as the PRIMARY ground. The primary grounding technique works well for any battery powered devices that may be operated within the RF Shield Room. Devices requiring facility power or the introduction of facility power into the Screen Room requires a change in the primary grounding technique for the RF Shield Room. The RF Shield Room must now be grounded back to the facility power ground.

The addition of water systems or other grounds required by the national electrical code will cause the RF Shield Room ground impedance to be ZERO ohms. These additional grounds that connect the outside of the RF Shield Room to earth grounds are called SECONDARY grounds. It is the secondary grounding that needs to be controlled. If the secondary ground introduces any current to the RF Shield, indicating the RF Shield is a better ground path than the secondary ground, then the current can set up electrical fields on the surface of the RF Shield which may cause image artifact.

The equipment anchors are generally installed into the grade below the RF Shield Room because the floor thickness within the room does not provide the proper embedment depth. With this in mind the hardware used to anchor the equipment will be either a bolt or a stud. This hardware must penetrate the RF Shield and be in full contact with the shield thereby preventing RF leaks at the point of penetration as specified in **Section 7–7–5 RF Shield Integrity**. In this case, the anchoring hardware may be in direct electrical contact to the anchored equipment. The anchoring device that is set below the RF Shield Room floor must be isolated from ground. If it should come in contact with rebar or wire mesh and this in turn is contacting building steel then a secondary ground has been established and needs to be corrected. The magnet mounting plate is supplied with alternate mounting holes to assist in the avoidance of hidden rebar.

RF Shield Rooms that have the RF shield far enough below the finished floor in the room to allow the anchor to be installed without penetrating the shield have no issues with secondary grounding.

7–7–2 Roles & Responsibilities

The roles and responsibilities of the Customer RF Shield Room vendor, and GE Medical Systems are detailed below.

The Customer is responsible for the following tasks:

- Coordinate equipment anchor location with the contracted RF shield room vendor, structural engineer, and architect to prevent RF leaks and secondary grounding problems.
- Coordinate with the contracted RF shield room vendor, structural engineer, and architect the design of the Magnet Room floor per GE requirements in preparation for Magnet Floor Preparation Kit or Magnet Mounting Plate installation, refer to information of this section and Section 7–6–4 Floors.
- Obtain any and all approvals necessary for the construction of equipment support and seismic anchoring. Provide copy of building inspector's (inspection) report and approval on anchor method to GE Medical Systems local office.
- Customer's mechanical contractor/rigger is responsible for the preparation of room floor and installation of the Magnet Floor Preparation Kit or the Magnet Mounting Plate.
- Customer's mechanical contractor is responsible for installation of the Magnet Floor Preparation Kit or the Magnet Mounting Plate anchors and the coldhead mounting anchors to meet specified torque.
- Customer's mechanical contractor to make sure the final finished height of anchor stud to be flush or below top surface of Magnet Floor Preparation Kit or the Magnet Mounting Plate.

The RF Shield Room vendor is responsible for the following tasks:

- Integration of the Magnet Floor Preparation Kit or the Magnet Mounting Plate into the RF Shield Room floor design.
- For Slab On Grade Sites: Layout and installation of Magnet Floor Preparation Kit and table rail anchors utilizing template supplied in kit. Coordination with Building Contractor/Architect for proper floor preparation to prevent interference with rebar or structural steel that would cause a secondary ground path through the anchor.
- For Suspension Foundation Sites: Layout and installation of the magnet mounting plate anchors (mounting plate can be utilized as template). Coordination with Building Contractor/Architect for proper floor preparation to prevent interference with rebar or structural steel that would cause a secondary ground path through the anchor.
- Participate in the installation of the magnet mounting plate to insure proper integration with RF Shield floor.
- Perform ground impedance test on installed anchors prior to connection to RF Shield floor.
- Perform RF integrity test on room after anchors and studs are installed and connected to RF Shield.
- Provide copy of ground impedance and RF room integrity tests to GE Medical Systems local office.
- All magnet mounting plate holes have been cleared of any debris and covered with RF tape prior to magnet positioning on mounting plate. Metal filings left in the holes may introduce image artifacts.

7–7–2 Roles & Responsibilities (Continued)

GE Medical Systems is responsible for the following tasks:

- For Slab On Grade Sites: GE Installation Specialist to make sure the Magnet Floor Preparation Kit shall be installed, anchors pulled tested, and integrated to RF Shield prior to magnet delivery to allow time to address any issues that may arise.
- For Suspension Foundation Sites: GE Installation Specialist to make sure the Magnet Mounting Plate shall be installed, anchored, epoxy cured, integrated to RF Shield, and plate to floor gap filled–in prior to magnet delivery to allow time to address any issues that may arise.
- GE Installation Specialist to provide magnet mounting plate drawings and installation instructions to the RF Shield and mechanical contractor/rigger.
- GE Installation Specialist to assist Mechanical Contractor/RF Shield Room vendor by locating magnet isocenter during layout of Magnet Room for mounting anchors.
- GE Installation Specialist to inspect and verify the Magnet Floor Preparation Kit or the Magnet Mounting Plate installation is correct prior to magnet delivery. Carefully inspect the electrical connectivity of the anchor/stud to the RF Shield and Magnet Mounting Plate to make sure anchors are properly installed.
- For Slab On Grade: GE Service to work with riggers to attach magnet to floor anchors (Magnet Floor Preparation Kit) per Magnet installation documentation requirements.
- For Suspension Foundation Sites: GE Service to work with riggers to attach magnet to magnet mounting plate per Magnet installation documentation requirements.

Note

If a Suspension Foundation site RF Shield Room is installed at floor level the magnet mounting plate must be utilized as the RF Shield under the Magnet and the magnet mounting plate must be mounted to the concrete. In cases where the RF Shield is located well below the magnet, i.e. in a combined RF and Magnetic shield design, than the magnet mounting plate will not be utilized as part of the RF Shield. Refer to *Direction 2268297 GE 0.7T OpenSpeed Magnet Mounting Plate Installation* for additional details and install procedure.

7–7–3 Slab On Grade Sites Physical Requirements

Slab On Grade sites require the Magnet mounted to the concrete floor. The Magnet Support Ring is bolted through utilizing foam isolation pads and a bracket is utilize to mount the lower Coldhead to the concrete floor to minimize image artifacts generated by magnet vibration.

Note

For Slab On Grade Sites the 0.7T Magnet **cannot** be hard bolted to the floor and must be installed using the provided Magnet Mounting Kit to meet the vibration specifications.

5. **Important!!** The Magnet Room floor must meet the requirements specified in Table 7–5 for the Magnet and Coldhead mounting areas.

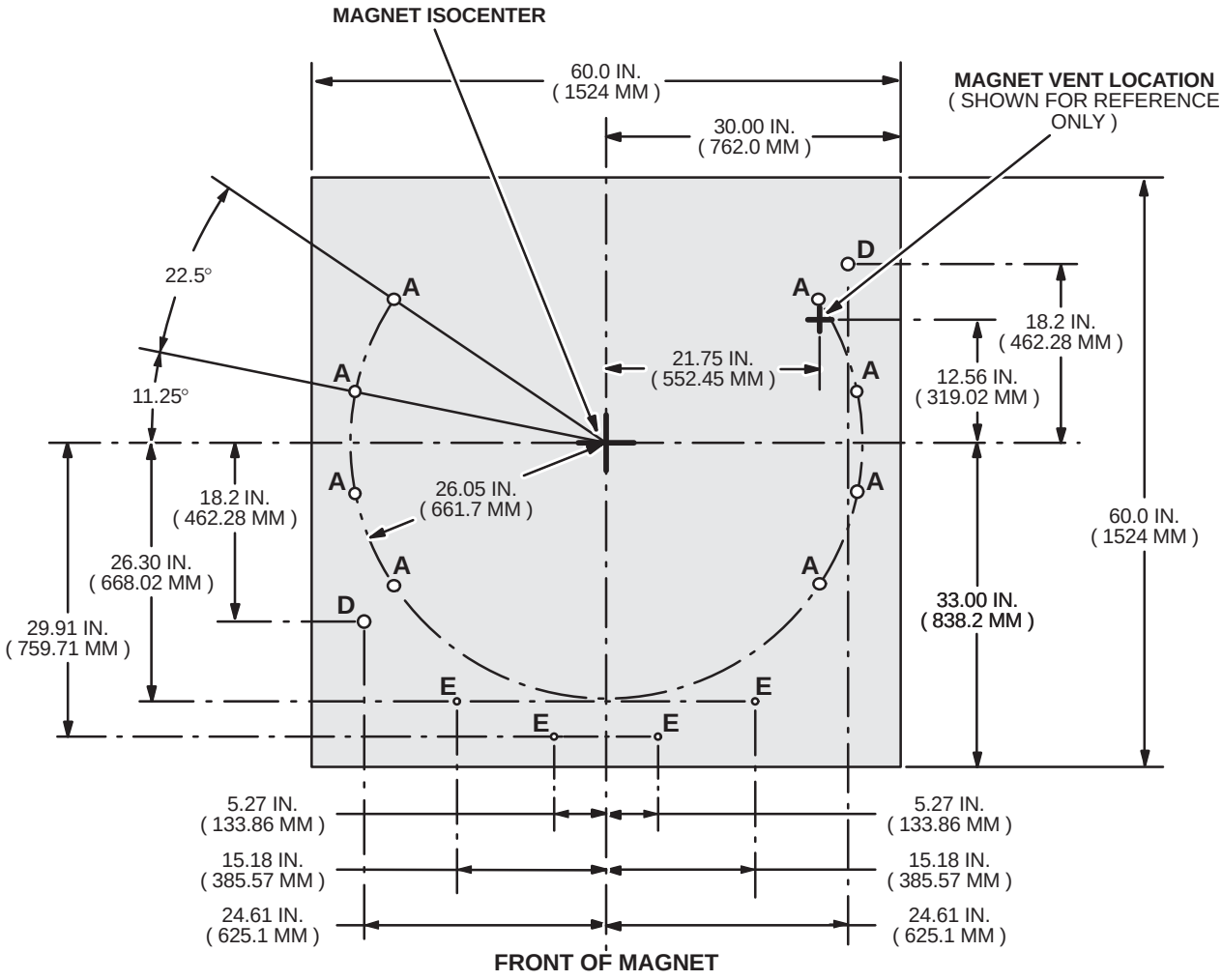
6. The Floor Preparation Kit provides a full–size Magnet Support Ring Mounting Template for locating floor holes, expansion anchors, anchor setting tools, and materials for RF sealing of the holes. See Illustration 7–12 for an overview of the template

TABLE 7–5
FLOOR REQUIREMENTS FOR MAGNET AND COLDHEAD MOUNTING AREA

Floor Requirements	Specification
Flatness / levelness over mounting area	0.08 IN. (2 mm)
Minimum concrete depth	18 IN. (457 mm) integral with room and must be isolated from the rest of the building. **Note** Minimum concrete slab thickness must be within the entire floor area of the RF Shield Room and cannot be limited to the magnet footprint area only.
Floor surface	Continuous copper plate RF shield over concrete sub–floor. **No** finished floor material. **No** composite RF shield material. See Illustrations 7–13 and 7–14
Rebar / Metal Reinforcement	Rebar MUST be porisitioned per GE Foundation Drawing to avoid coldhead andcors.
ISO Center Marking	ISO Center crosshatch clearly marked on floor.

7–7–3 Slab On Grade Sites Physical Requirements (Continued)

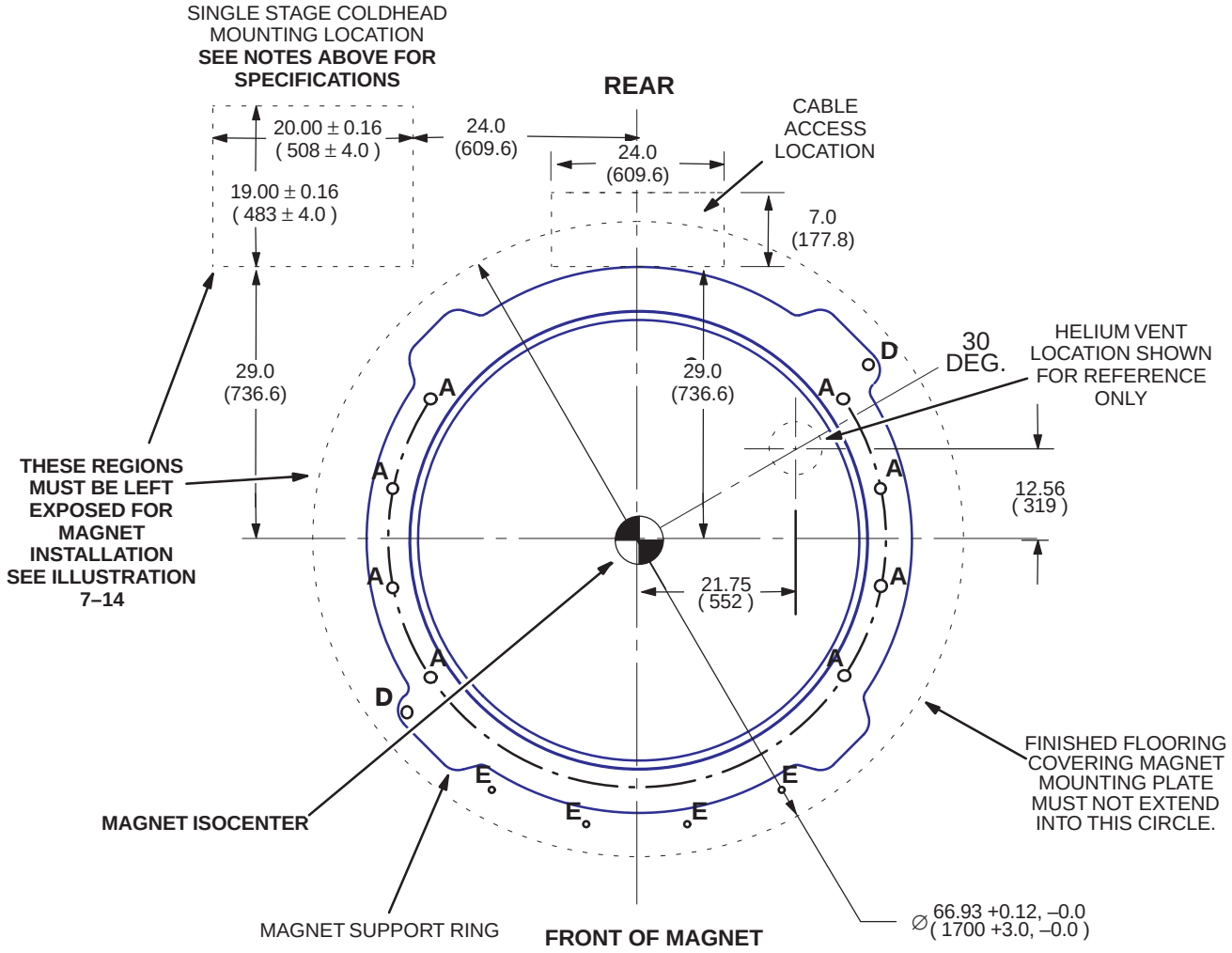
NOTE:
- MOUNTING PLATE HOLE IDENTIFIERS:
  A = USED TO BOLT MAGNET SUPPORT RING TO FLOOR.
  D = USED FOR INSERTION OF ALIGNMENT PINS FOR MAGNET LOCATION.
  E = TABLE RAIL MOUNTING HOLES



MAGNET SUPPORT RING MOUNTING TEMPLATE (2294577)
ILLUSTRATION 7–12

7–7–3 Slab On Grade Sites Physical Requirements (Continued)

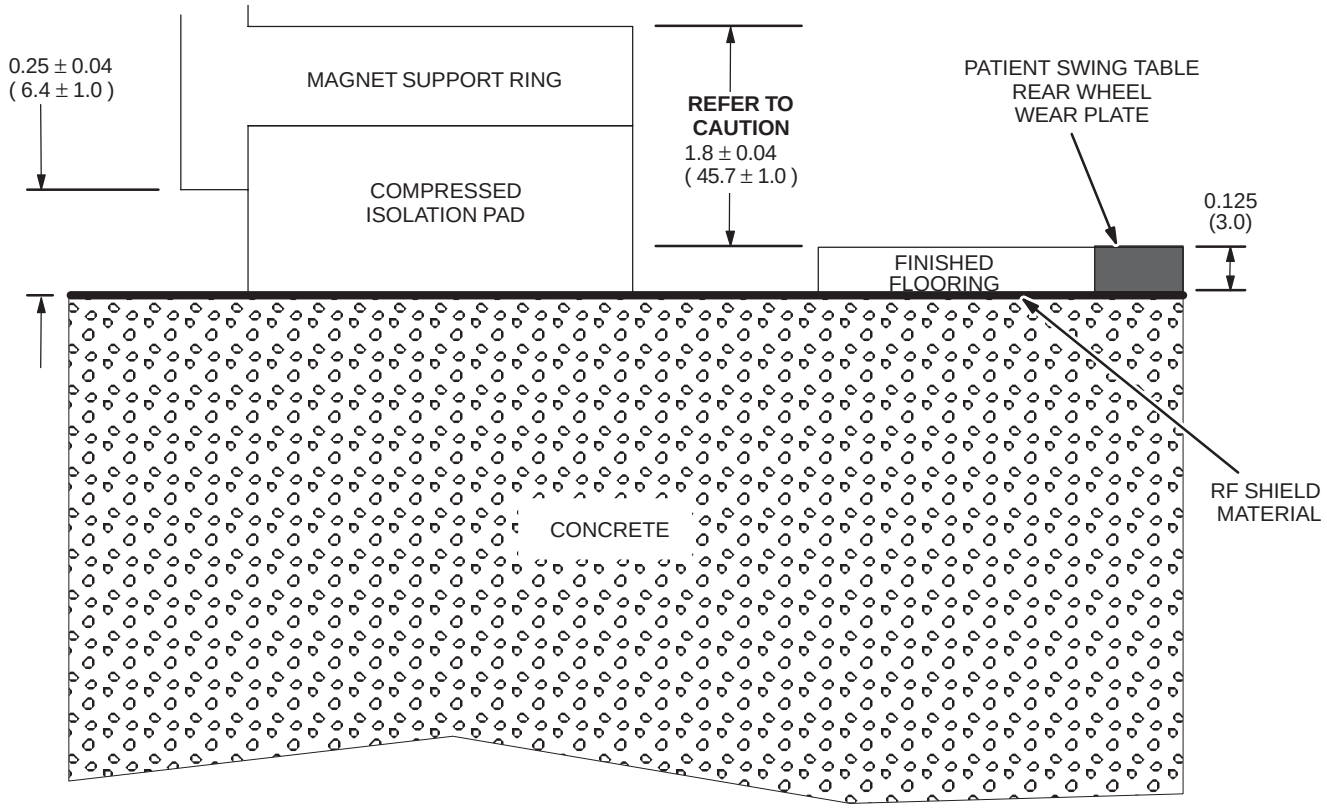
NOTE:
- ALL DIMENSIONS ARE IN INCHES.
  ALL BRACKETED ( ) DIMENSIONS ARE IN MILLIMETERS.
- **SINGLE STAGE COLDHEAD MOUNTING LOCATION FLOOR AREA MUST MEET FOLLOWING SPECIFICATIONS:**
  - — SURFACE AREA TO BE AT SAME HEIGHT (WITHIN ± 0.5 INCHES (12.7 MM)) AND LEVEL (WITHIN 0.08 INCHES (2 MM)) AS MAGNET MOUNTING SURFACE OVER THE 20 INCH (508 MM) WIDE BY 19 INCH (483 MM) HIGH REGION SHOWN BELOW.
  - — AREA TO HAVE MINIMUM 18 INCHES (457 MM) DEPTH OF CONCRETE WHICH IS INTEGRAL WITH THE MAGNET ROOM CONCRETE. THE COLDHEAD MOUNTING AREA SURFACE MUST NOT BE COVERED BY FINISHED FLOOR.
  - — **KEEP FLUSH FLOOR TRENCH DUCT 3.0 INCHES (76 MM) OR MORE FROM COLDHEAD MOUNTING AREA.**
  - — CONTINUOUS COPPER PLATE RF SHIELD OVER CONCRETE SUB–FLOOR. **NO** FINISHED FLOOR MATERIAL. **NO** COMPOSITE RF SHIELD MATERIAL.
  - — REBAR MUST BE POSITIONED PER GE FOUNDATION DRAWING TO AVOID COLDHEAD ANCHORS.



AREAS FINISHED FLOORING NOT ALLOWED
ILLUSTRATION 7–13

7–7–3 Slab On Grade Sites Physical Requirements (Continued)

NOTE: ALL DIMENSIONS ARE IN INCHES. ALL BRACKETED ( ) DIMENSIONS ARE IN MILLIMETERS.



CAUTION

Shown dimension from top of Magnet Support Ring to top of finished flooring material & Patient Table Rear Wheel Wear Plate MUST be maintained for proper operation/alignment of the Magnet & Patient Table.

MAGNET SUPPORT RING & FINISHED FLOORING HEIGHT REQUIRMENT
ILLUSTRATION 7–14

7–7–4 Seismic Zone & Suspension Foundation Sites Physical Requirments

Important!! If a Suspension Foundation site RF Shield Room is installed at floor level the Magnet Mounting Plate must be utilized as the RF Shield under the Magnet. In cases where the RF Shield is located well below the magnet, i.e. in a combined RF and Magnetic shield design, than the magnet mounting plate will not be utilized as part of the RF Shield. Following are the requirements for utilizing the Magnet Mounting Plate.

1. The Magnet Mounting Plate location and orientation must meet centerline and vent location requirements for the room. Centerline and vent location are marked on plate. The plate location (recessed area) must be flat and level within 0.08 inches (2.0 mm) over the entire surface. The epoxy grout must be uniformly spread 0.20 – 0.25 inch (5.08 – 6.35 mm) thick in the grout area shown in Illustration 7–16 to result in the plate being level within 0.08 inch (2.0 mm) at all four corners. See Illustration 7–15.

CAUTION

RF Shield material thickness and finished flooring material thickness must be included in the determination of depth of Magnet Mounting Plate recess into the floor.

2. The Magnet Mounting Plate must be recessed into the floor in the area shown inside the dotted lines in Illustration 7–15. The remainder of room floor built up above the top of the plate in conformance with Table 7–6. A minimum depth of 18 inches (457 mm) of concrete is required in the Magnet Room. The minimum concrete depth under the mounting plate is 15.0 inches (381.0 mm) due to plate depression into the concrete.

Note

For Suspension Foundation Sites the 0.7T Magnet **must** be hard bolted to the Magnet Mounting Plate and must be installed using the provided Magnet Mounting Kit to meet the vibration specifications.

TABLE 7–6
FLOOR RECESS / HEIGHT REQUIREMENTS FOR MAGNET MOUNTING PLATE

Concrete Floor Plate Recess Depth From Top of Concrete to Top of Finished Floor (assumes 0.12 inch [3.0 mm] compressed grout thickness)	Finished Floor Height Above Top of Mounting Plate
2.25 inches ± 0.08 inches (57.1 mm ± 2.0 mm)	0.13 inch ± 0.04 inch (3.2 mm ± 1.0 mm)

3. Where the RF Shield Room is installed at floor level the magnet mounting plate must be an integral part of the magnet room RF integrity. The RF shield material must extend under the full perimeter of the mounting plate for a distance of 1.0 inch (25.4 mm) minimum to 1.5 inch (38.1 mm) maximum. RF shield material must be insulated from the concrete floor.

4. Floor rebar must be positioned within as shown on GE Foundation Drawing to prevent interference with mounting bolts for the “B” and “C” holes**.** See Illustration 7–15.

7–7–4 Seismic Zone & Suspension Foundation Sites Physical Requirments (Continued)

5. The top surface of the magnet mounting plate must be fully exposed under the circle of the magnet to allow for placement of the Magnet Mounting Kit pads between the magnet support ring and the magnet mounting plate. The concrete floor surface must also be left exposed (i.e. no material over or under the RF shield material other than insulation that must be under the RF shield material) in the Single–Stage coldhead mounting and cable trough locations. See Illustrations 7–15 through 7–19.

6. The floor area where the Single–Stage Coldhead will be mounted must meet the following specifications:

   a. Entire floor area must be composed of concrete integral with concrete to which Magnet Mounting Plate is attached. This concrete must **not** be finished with any subflooring / flooring materials prior to mounting Coldhead. Coldhead cannot be mounted through materials other than RF Shield and Conductive Pad specified in the Direction 2243897 GE 0.7T OpenSpeed Magnet Delivery and Installation.

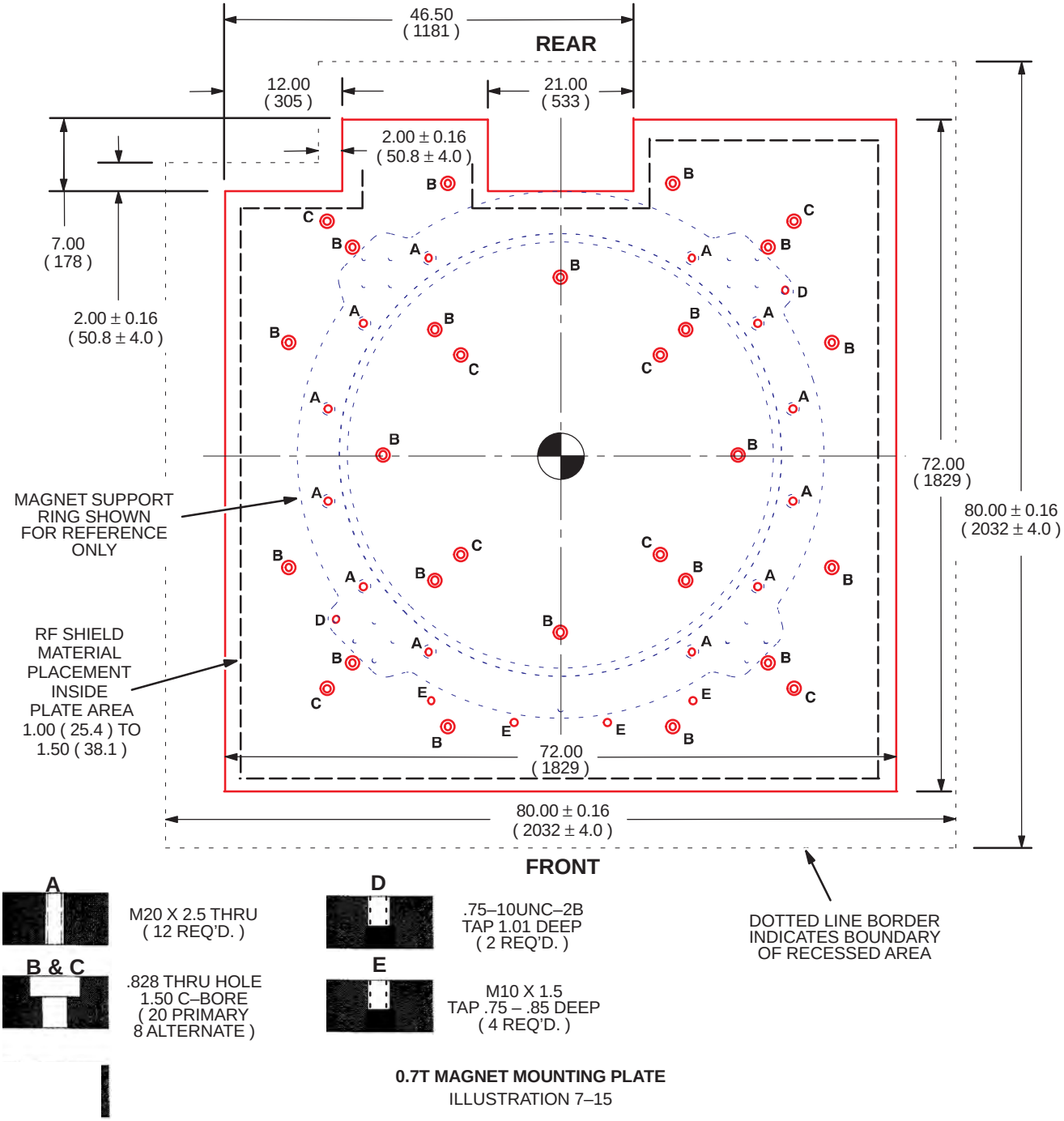
   b. Surface area to be the same height as Magnet Mounting Plate within ± 0.5 inches (12.7 mm) and level within 0.08 inches (2 mm).

   c. Area to have a minimum 18 inches (457 mm) depth of concrete which is integral with the Magnet Room concrete. The coldhead mounting area surface must not be covered by finished floor.

   d. Rebar must be positioned per GE Foundation Drawing to avoid Coldhead anchors. See Illustration 7–17.

7–7–4 Seismic Zone & Suspension Foundation Sites Physical Requirments (Continued)

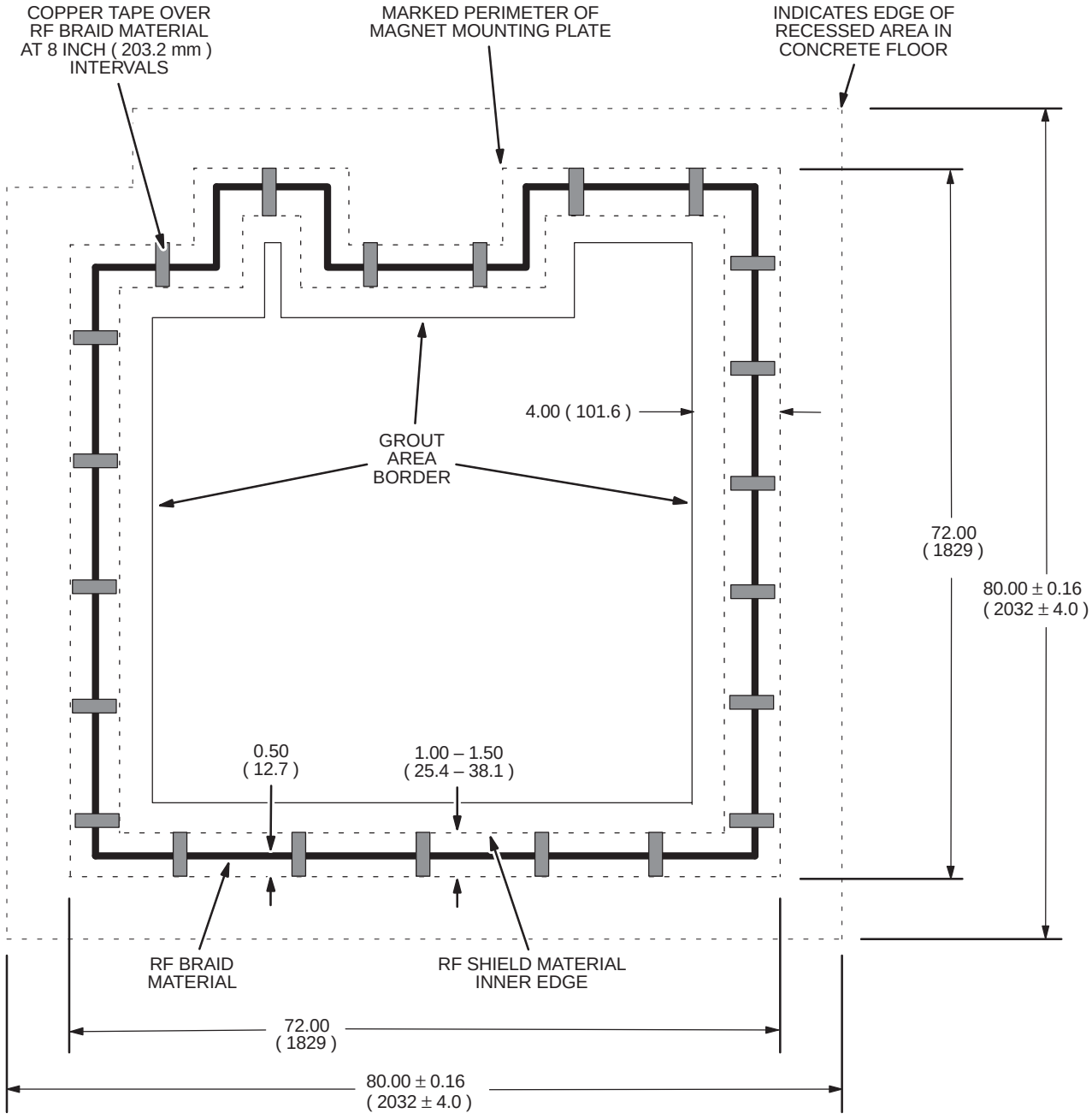
NOTE:
* ALL DIMENSIONS ARE IN INCHES. ALL BRACKETED ( ) DIMENSIONS ARE IN MILLIMETERS.
* APPROXIMATE WEIGHT OF MAGNET MOUNTING PLATE IS 3,100 LBS (1409 KG).
* MOUNTING HARDWARE AND MATERIALS ARE PROVIDED WITH GE SUPPLIED MAGNET MOUNTING PLATE.
* MOUNTING PLATE HOLE IDENTIFIERS: **A** = USED TO BOLT MAGNET FLANGE TO MOUNTING PLATE. **B** = PRIMARY HOLES TO ATTACH MOUNTING PLATE TO BUILDING FLOOR. **C** = ALTERNATE HOLES TO ATTACH MOUNTING PLATE TO BUILDING FLOOR. **D** = USED FOR INSERTION OF ALIGNMENT PINS FOR MAGNET LOCATION. **E** = TABLE RAIL MOUNTING HOLES



0.7T MAGNET MOUNTING PLATE
ILLUSTRATION 7–15

7–7–4 Seismic Zone & Suspension Foundation Sites Physical Requirments (Continued)

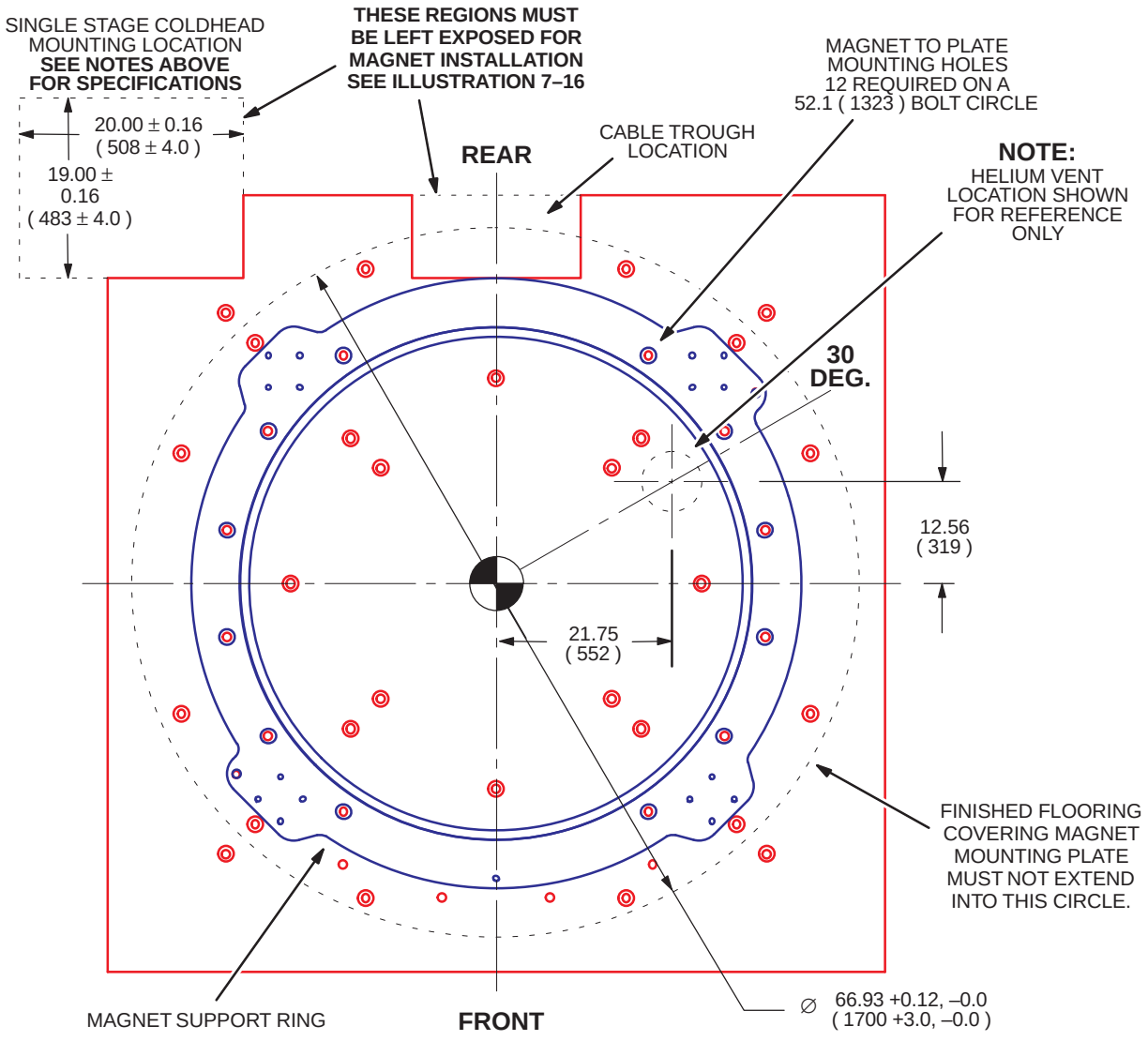
NOTE: ALL DIMENSIONS ARE IN INCHES. ALL BRACKETED ( ) DIMENSIONS ARE IN MILLIMETERS.



CONCRETE FLOOR PREPARATION FOR MOUNTING PLATE
ILLUSTRATION 7–16

7–7–4 Seismic Zone & Suspension Foundation Sites Physical Requirments (Continued)

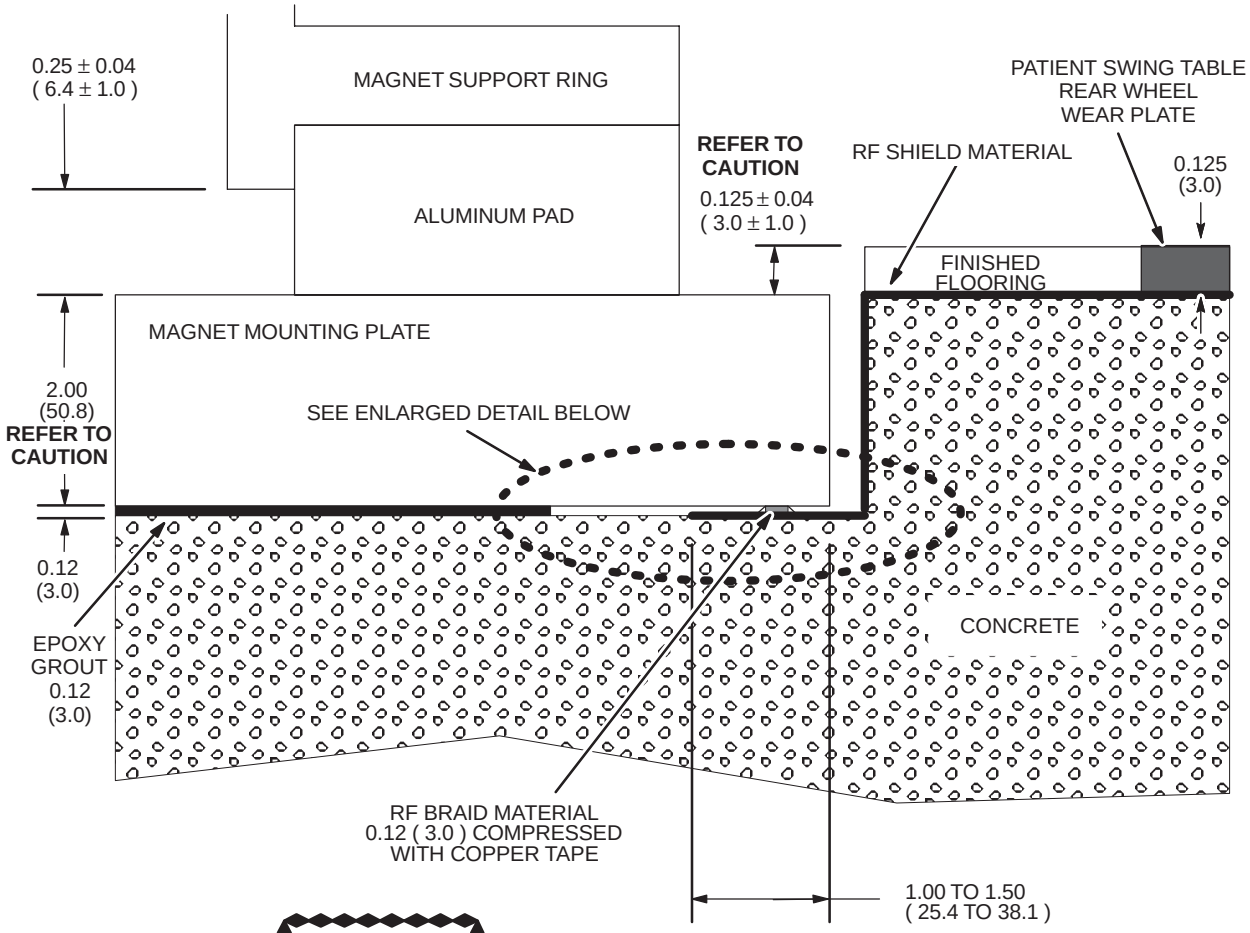
NOTE:
- ALL DIMENSIONS ARE IN INCHES.
  ALL BRACKETED ( ) DIMENSIONS ARE IN MILLIMETERS.
- **SINGLE STAGE COLDHEAD MOUNTING LOCATION FLOOR AREA MUST MEET FOLLOWING SPECIFICATIONS:**
  - SURFACE AREA TO BE AT SAME HEIGHT (WITHIN ± 0.5 INCHES (12.7 MM)) AND LEVEL (WITHIN 0.08 INCHES (2 MM)) AS MAGNET MOUNTING PLATE OVER THE 20 INCH (508 MM) WIDE BY 19 INCH (483 MM) HIGH REGION SHOWN BELOW.
  - AREA TO HAVE MINIMUM 18 INCHES (457 MM) DEPTH OF CONCRETE WHICH IS INTEGRAL WITH THE MAGNET ROOM CONCRETE. THE COLDHEAD MOUNTING AREA SURFACE MUST NOT BE COVERED BY FINISHED FLOOR.
  - **KEEP FLUSH FLOOR TRENCH DUCT 3.0 INCHES (76 MM) OR MORE FROM COLDHEAD MOUNTING AREA.**
  - REBAR MUST BE POSITIONED PER GE FOUNDATION DRAWING TO AVOID COLDHEAD ANCHORS



0.7T MAGNET FINISHED FLOOR REQUIREMENTS FOR MOUNTING PLATE
ILLUSTRATION 7–17

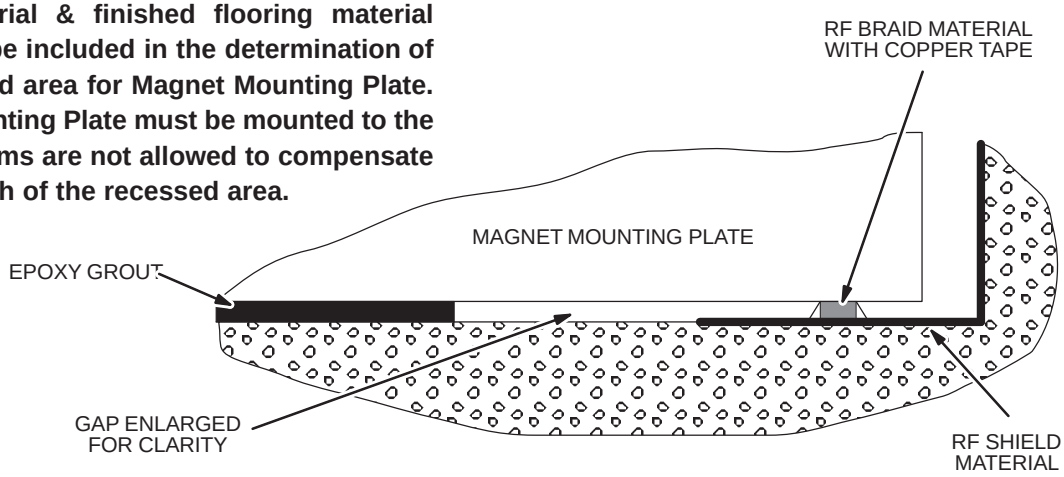
7–7–4 Seismic Zone & Suspension Foundation Sites Physical Requirments (Continued)

NOTE: ALL DIMENSIONS ARE IN INCHES. ALL BRACKETED ( ) DIMENSIONS ARE IN MILLIMETERS.



CAUTION

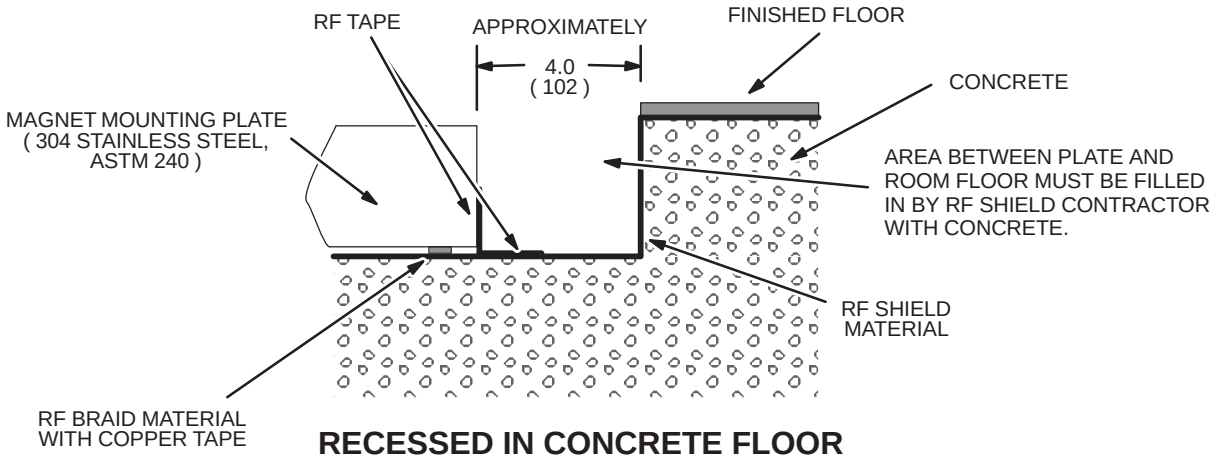
RF Shield material & finished flooring material thickness must be included in the determination of depth of recessed area for Magnet Mounting Plate. The Magnet Mounting Plate must be mounted to the concrete and shims are not allowed to compensate for errors in depth of the recessed area.



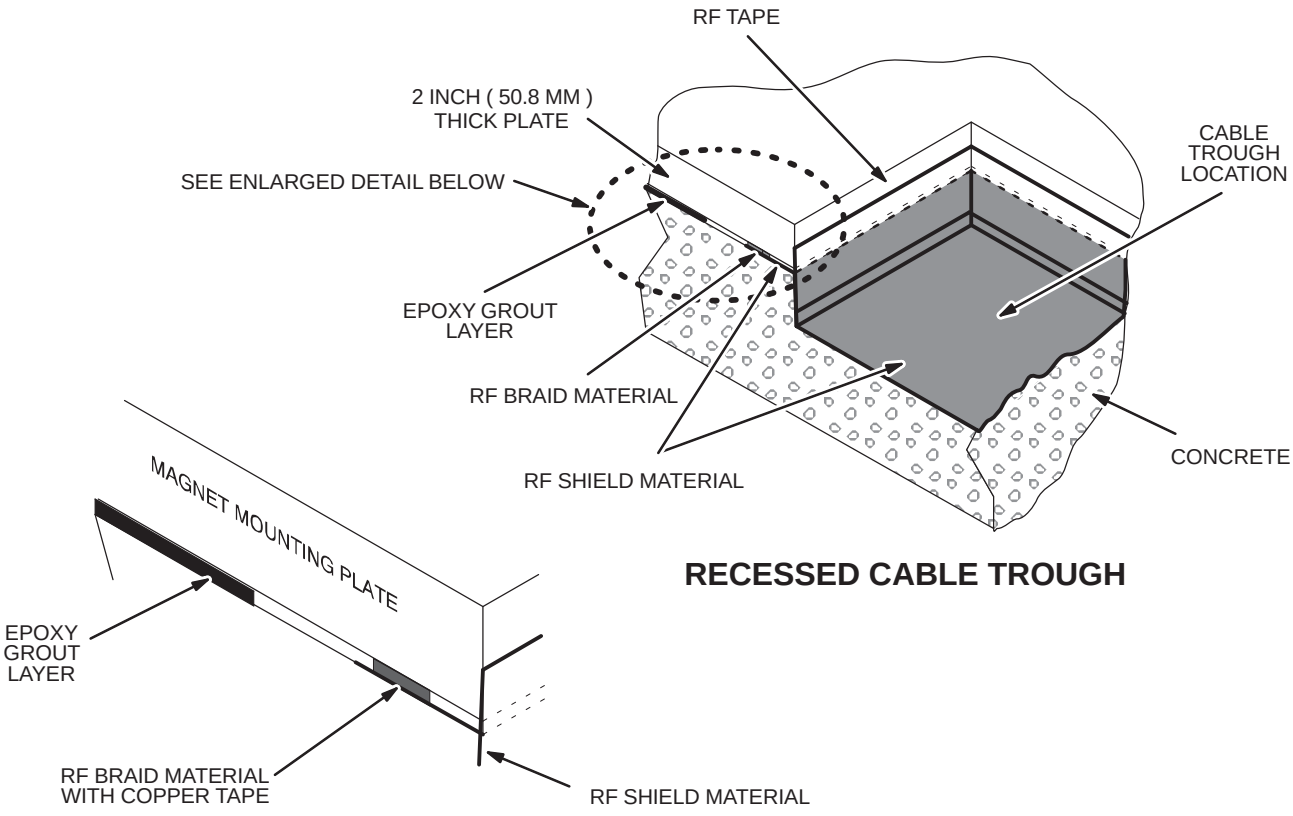
MAGNET MOUNTING PLATE INSTALLATION SIDE VIEW
ILLUSTRATION 7–18

7–7–4 Seismic Zone & Suspension Foundation Sites Physical Requirments (Continued)

NOTE: ALL DIMENSIONS ARE IN INCHES. ALL BRACKETED ( ) DIMENSIONS ARE IN MILLIMETERS.



RECESSED IN CONCRETE FLOOR



RECESSED CABLE TROUGH

RF SEALING OF MOUNTING PLATE
ILLUSTRATION 7–19

7–7–5 RF Shield Integrity

The anchor hardware must maintain RF shield integrity. This is accomplished by electrically sealing the stud at the penetration point on the RF shield. The method by which the electrical contact is made must take into account any stretch in the stud resulting from the applied clamping force (tension). RF tape applied over magnet mounting plate holes will minimize the ingress of debris (i.e. metal filings) in the holes which could introduce artifacts into the MR images. The RF room test should result in a specific attenuation at the operating frequency of the system under the following conditions:

1. Blank Penetration Panel installed
2. Floor Preparation Kit or Magnet mounting plate installed and anchored.
3. Electrical connection made between the anchor stud and the RF shield.

Refer to APPENDIX A – RF SHIELDED ENCLOSURE TEST GUIDELINE.

7–7–6 Electrical Isolation

The Magnet mounting hardware must not provide a secondary ground path for the RF Shield Room. A secondary ground may occur by having the anchor come in contact with steel rebar, wire mesh or structural steel in the floor. Ideally the ground impedance between the anchor and earth ground should be greater than 1000 ohms. This may not be possible due to moisture conditions in the concrete or soil beneath the concrete. Therefore the following requirements for ground isolation shall be observed.

1. A ground isolation test performed on each electrically conductive anchor and stud.
   a. If the result is greater than 1000 ohms on each stud then record the resulting measurement and give documentation to GE Medical Systems.
   b. If the result is less than 1000 ohms but greater than100 ohms, contact the power and grounding support personnel at GE Medical Systems and review process and site conditions.
   c. If the result is less than 100 ohms then it is very likely the anchor has made contact to steel rebar or wire mesh. In this case the steel in the floor will need to be removed or the anchors will need to be relocated. In either case GE Medical Systems must be notified and a retest performed after the corrective action is taken.
2. The test results must be recorded by RF Shield Room Vendor and the information forwarded to GE Medical Systems for the customers record file.

7–7–6 Electrical Isolation (Continued)

Electrical Isolation Measurement Method

Prior to attaching the primary ground and installing any power outlets, room lights, water supplies, etc. into the RF Shield Room, a ground isolation test is performed between the room's ground plane and earth ground.

- This measurement should be greater than 1000 ohms DC. However, the results of this measurement may appear lower for RF Shield Rooms located below or at grade level. This is caused by a capacitive voltage, setup by the measurement meter's DC voltage, between the RF Shield Room and earth ground.
- For RF Screen Rooms with a resistance reading less than 1000 ohms the following method should be used to determine if the low resistance reading is caused by this capacitive effect.
  - Use a Meggar Insulation Tester capable of reading < 1000 ohms to most accurately make the measurement. An analog meter with a D'Arsonval meter movement may be used if a Meggar is not available.
  - After making the measurement reverse the leads and watch for the measurement to start high and decrease to a lower resistance value. This change in measurement verifies the capacitive effect.
  - In this case the peak measurement is the approximate resistance between the RF Shield Room and earth ground.

Note

For sites where magnet mounting is isolated from the RF Shield (RF Shield positioned below concrete) the magnet will require grounding to the RF Shield.

7–7–7 Magnet Mounting Plate Anchors Installation Location

For Slab On Grade Sites the exact locations for installing the Magnet Support Ring anchors are determined by utilizing the Floor Preparation Kit template, see Illustration 7–12.

For Seismic Zone and Suspension Foundation Sites the exact locations for installing the magnet mounting plate anchors are determined by Illustration 7–15. The anchors will be installed after the magnet mounting plate is in position on the floor. Refer to *Direction 2268297 GE 0.7T OpenSpeed Magnet Mounting Plate Installation* for additional details and install procedure.

Coordination between the RF Shield Room Vendor and Building Contractor/Architect may be necessary to mark the location of the anchors to prevent interference with rebar or structural steel. A re–arrangement of the room layout may be necessary to ensure ground isolation.

7–8 MAGNET ROOM – WALL MOUNTED EQUIPMENT REQUIREMENTS

7–8–1 Remote Oxygen Sensor Module (OM3) – Optional

The Remote Oxygen Sensor Module (if option ordered) must be mounted approximately 60 in. (1524 mm) above the Magnet Room floor near the front of the magnet enclosure.

7–8–2 Magnet Rundown Unit (MS4)

The magnet rundown unit should be mounted 60 in. (1524 mm) above the Magnet Room floor near the front of the magnet enclosure but outside the 200 gauss zone.

7–8–3 Emergency Off buttons

Emergency off buttons supplied with the Main Disconnect Panel (MDP) are to be located near room exit of magnet and equipment rooms. These buttons must be clearly labeled, “Emergency Off”. Refer to Section 5, POWER REQUIREMENTS, for emergency off power requirements.

7–9 RF DOOR SWITCH

RF shielded room vendor must supply and install RF door switches on all RF shielded doors. These switches must be wired in series and a GE supplied cable (two loose lead conductors) will attach to one door switch. RF switches must be rated for 24 volts at 750 milliamperes maximum and the switches must be in the open position when the doors are open (switch contacts close when the doors are completely closed).

7–10 EMERGENCY EXIT

Emergency exiting from the Magnet Room is to be specified by the customer’s architect and contractor. Such measures as an out swinging door, emergency door latch release, easily removed window, or other measures must be designed into the room. Emergency exit instructions must be permanently and prominently mounted near the door and/or window.

7–11 ROOM VENTILATION SWITCH

Placement of the room ventilation switch should be near the Magnet Room door and is the responsibility of the architect and mechanical contractor.

SECTION 8 – SHIPPING AND DELIVERY DATA

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8–1 SHIPMENT

Domestic shipment transportation for the MR system, excluding the magnet, will be via an air–ride moving van. The magnet will be shipped on an air–ride flat–bed truck. Export transportation for the MR system overseas will be via air shipment in a pressurized cargo hold. See Table 8–2 for the shipping weights and dimensions of the major MR system components. Actual shipping may vary, international shipment may require equipment to be crated.Refer to Table 8–1 for transportation enviromentalal conditions.

TABLE 8–1
TRANSPORTATION ENVIRONMENTAL CONDITIONS

SYSTEM EQUIPMENT	TEMPERATURE RANGE °F (°C)	TEMPERATURE CHANGE °F/Hr (°C/Hr)	RELATIVE HUMIDITY %	HUMIDITY CHANGE (%/Hr)	ATOMSPHERIC PRESSURE hPa
Electronics Cabinets & equipment	–30 to 140 (–34 to 60)	176 (80)	0–90 non–condensing	30	1012 to 525
Magnet	–31 to 122 (–35 to 50)	176 (80)	0–90 non–condensing	30	1012 to 525

The GE magnet utilizes a Shield/Cryo Cooler System to maintain a reduced helium boil–off. However, the Shield Cooler System is not operational during transportation. Therefore the magnet will require liquid helium replenishment if transportation time exceeds two weeks. Contact GE Service for magnet servicing.

The 0.7T Magnet is filled with liquid helium at initial shipment but can be allowed to warm up during transportation without damage to the support structure.

8–2 STORAGE REQUIREMENTS

If the system is stored before installation, it must be stored in a warehouse protected from weather. The storage temperature should be between –30 and 140 degrees F (–34 and 60 degrees C) and the relative humidity between 0 and 90% (non–condensing).

There are two scenarios for storing the magnet. One is to maintain the magnet cold temperature by connecting and operating the Shield/Cryo Cooler System. Periodic replenishment of liquid helium may be required depending on the storage time. The other scenario is to store the magnet without maintaining the cold temperature. The 0.7T magnet can be moved cold or warm, refer to *Direction 2243897 GE 0.7T OpenSpeed Magnet Delivery / Installation* for magnet moving requirements and details. Contact GE Service for necessary servicing before moving the magnet.

8–3 MAGNET CONSIDERATIONS

For domestic, the magnet is shipped inside a rib cage crate covered with plastic (no shipping pallet). For export, the magnet is crated for shipment on a special shipping pallet. Refer to Table 8–2 for the weight and dimensions of the magnet in its cold ship configuration (i.e. with liquid cryogens in vessel within the cryostat) and with the Gradient Coil installed in the magnet.

The magnet moving dimensions are shown in Illustration 8–1.

Consideration must be given to the delivery route of the magnet to ensure that the floor can support the magnet and any rigging equipment required to move it. A structural analysis should be performed by a professional structural engineer. The magnet must not be tilted more than 30° in any direction when being moved into position.

The customer is to provide and arrange for riggers to move the magnet from the delivery truck to the final site location. Contact local GE Service for a list of recommended rigger companies. The customer's riggers should have an adequate amount of liability insurance to cover any damage to property or MR system that may occur during delivery of the magnet. The GE sales representative or installation specialist can provide customer riggers with the replacement value of the MR system for insurance purpose.

8–4 COLD–SHIPPED MAGNET DELIVERIES

Cold–shipped magnets are those magnets which are shipped with liquid helium in the vessel within the cryostat. Thus, when these magnets arrive at site, a cryogen delivery route must be available for moving cryogen dewars to the magnet for periodic replenishment of liquid helium. Also, means must be provided for venting of the cryogenic gases if the GE supplied venting kit is not yet installed and if the RF shielded room vent opening is not completed.

Note

Power for the System Cooling Cabinet via the Main Disconnect Panel must be available when the magnet is delivered to minimize cryogens usage. Section 5, POWER REQUIREMENTS, for specifications. The System Cooling Cabinet provides power and water cooling for both Shield/Cryo Cooler Compressor Cabinets.

TABLE 8–2
SHIPPING DATA

MR COMPONENT	APPROXIMATE W x D x H inches (mm)	APPROXI-MATE WEIGHT lbs (kg)	METHOD OF SHIPMENT
Magnet with cryogens, coil, partial Enclosure installed	See Note 1	See Note 1	Domestic: rib cage crate International: enclosed crate with skid
Magnet Accessories (quantity 4)	36 x 48 x 36 (914 x 1219 x 914)	150 (68)	skid with box cover
Cryo Cooler Compressor Cabinet See Note 2	26 x 28 x 42 (660 x 711 x 1067)	240 (109)	skid with box cover
Shield Cooler Compressor Cabinet See Note 2	26 x 28 x 42 (660 x 711 x 1067)	240 (109)	skid with box cover
System Cooling Cabinet See Note 2	68 x 36 x 80 (1727 x 914 x 2032)	1060 (482) domestic 1250 (586) international dry weight	Domestic: on cabinet casters, wrapped with plastic International: crate
Ship Loose Package for SCC	26 x 56 x 27 (660 x 1422 x 686)	200 (91) domestic 240 (109) international	Domestic: cardboard box on skid International: crate
Remote Condenser Unit (optional) See Note 2	83 x 48 x 34 (2108 x 1219 x 864)	520 (236) domestic 645 (293) international dry weight	Domestic: open crate/skid International: crate
System Cooling Auxiliary Cabinet See Note 2	32 x 40 x 20 (81 x 102 x 51)	514 (233) domestic 600 (272) international dry weight	Domestic: on cabinet casters, wrapped with plastic International: crate
Main Disconnect Panel See Note 2	45 x 64 x 10 (610 x 1626 x 254)	280 (127)	box
RF Coil	12 x 36 x 42 (305 x 914 x 1067)	160 (73)	crate
Patient Table	45 x 52 x 110 (1143 x 1321 x 2794)	1575 (716)	crate/skid
Penetration Panel	64 x 22 x 15 (1626 x 559 x 381)	80 **(**36**)**	box
Power Cabinet	24 x 42 x 78 (610 x 1067 x 1981)	1205 **(**548**)**	on cabinet casters, wrapped with plastic
System Cabinet	24 x 33 x 78 (610 x 838 x 1981)	500 (227)	on cabinet casters, wrapped with plastic
Patient Comfort Compressor	20 x 10 x 20 (508 x 254 x 508)	45 (21)	box

(Continued)

Note * Optional equipment

1 Approximate magnet shipping weight includes packaging material and weight of magnet with cryogens, Gradient coil, Enclosure, Electronics Module installed on magnet, lifting beams, crate (international full crate/skid, domestic rib crate):

International configuration: 98 x 117 x 109 (2489 x 2972 x 2769) 24,000 lbs 10,886 kg [International crate 1850 lbs (841 kg)]

Domestic configuration: 95 x 96 x 98 (2413 x 2438 x 2489) 22,000 lbs 9979 [rib crate 270 lbs (123 kg)]

2 The Main Disconnect Panel and System Cooling Cabinet equipment (SCC, Shield/Cryo Cooler Compressor Cabinets, and Remote Condenser Unit (option if planned)) must be installed and operational prior to magnet arrival. Water cooling is required immediately upon magnet arrival. Continuous water cooling is critical for the Shield/Cryo Cooler Compressors and therefore MUST be available 24 hours per day / 7 days per week to maximize proper uninterrupted magnet operation.

TABLE 8–2 (Continued)
SHIPPING DATA

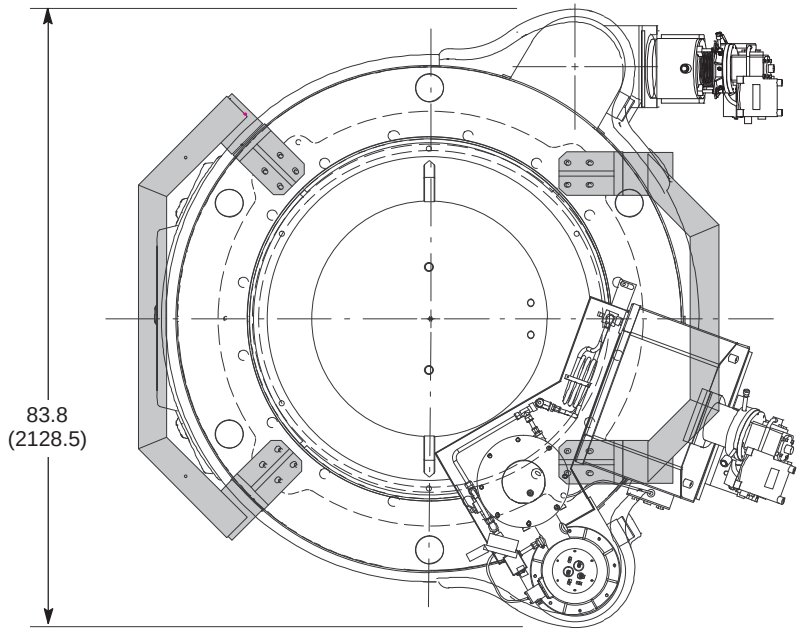
MR COMPONENT	APPROXIMATE W x D x H inches (mm)	APPROXI-MATE WEIGHT lbs (kg)	METHOD OF SHIPMENT
Phantom Set	34 x 32.5 x 60 (864 x 826 x 1524)	350 (159)	on cart casters with box cover
Operator Workspace Cabinet	25 x 38 x 34 (635 x 965 x 864)	200 (91)	skid
Operator Workspace LCD Color Monitor	27 x 33 x 27 (686 x 838 x 686)	125 (57)	skid
Operator Workspace equipment	32 x 32 x 23 (813 x 813 x 584)	100 (45)	box
*150 KVA 208–480Y277 VOLT, 60 Hz GE Transformer – E4500AS	51 x 39 x 62 (1295 x 991 x 1575)	915 (416)	crate
*150 KVA 200–400Y230 VOLT, 50/60 Hz GE Transformer – R4500BD	54 x 44 x 64 (1372 x 1118 x 1626)	1200 (545)	crate
Note * Optional equipment			

NOTE:

- ALL DIMENSIONS ARE IN INCHES ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.
- MAGNET WITH CRYOGENS, ENCLOSURE COVERS, ELECTRONICS MODULE & CABLES, GRADIENT COILS IN MAGNET, AND HANDLING RAILS & BRACKETS: 19,780 lbs (8991 kg)

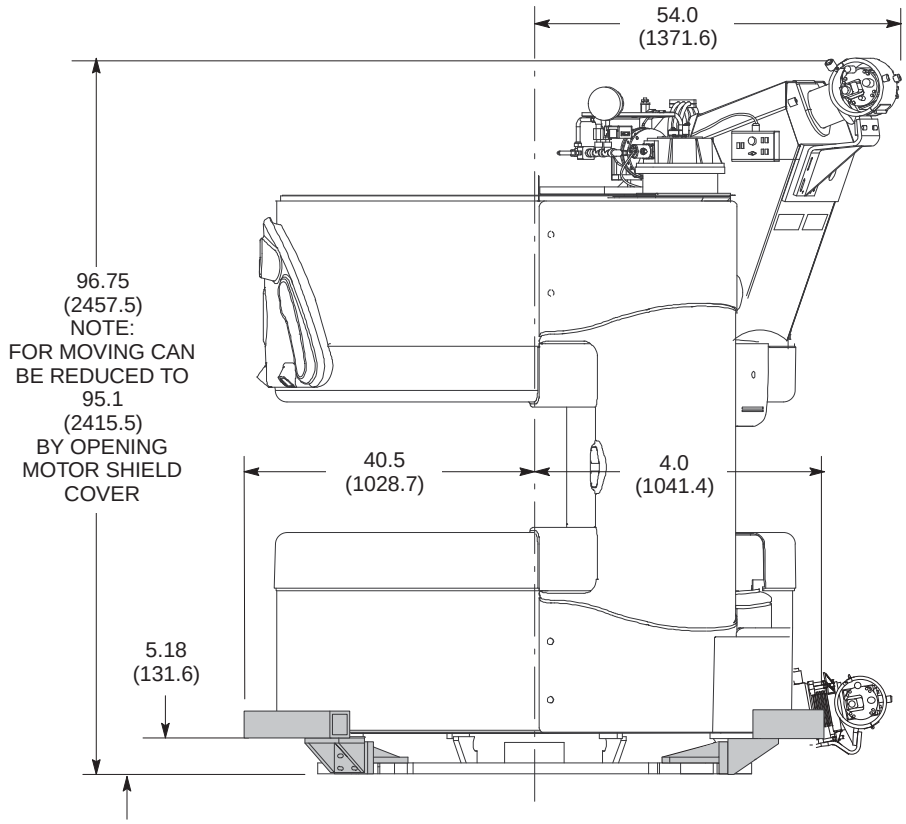
CAUTION

Refer to *Direction 2243897, GE 0.7T OpenSpeed Magnet Delivery / Installation* for magnet moving and lifting requirements and details.



CAUTION

Final magnet moving dimensions are dependent on rigger equipment requirements.



0.7T MAGNET WITH ENCLOSURE MOVING DIMENSIONS
ILLUSTRATION 8–1

SECTION 9 – PRE–INSTALLATION CHECKLIST

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9–1 INTRODUCTION

"Preinstallation" refers to work necessary to plan and prepare a site for delivery and installation of equipment. Delay, confusion, and waste of manpower can be avoided by completing preinstallation work. It is recommended to have GE Service Representative make on–site inspections during construction.

The purpose of this section is to outline key areas of concern in the preparation of a customer's site for magnetic resonance. It is intended as a guide for GE's Installation Specialists and/or Installation Leaders when making on–site inspections during the construction phase of an MR project. Note that these inspections by GE are intended to aid the overall site preparation process. They do not relieve the customer and project architect from responsibility for the design, engineering, and coordination efforts necessary to ensure a successful MR project.

During the course of the site preparation process, GE's Installation Specialists and/or Installation Leaders may observe that the requested arrival date (RAD) for the MR equipment is not realistic. If this is the case, appropriate actions must be taken by the GE Field Sales/Service Team to adjust the RAD accordingly.

All work must be in compliance with national and local safety codes.

9–2 GENERAL PRE–INSTALLATION REMINDERS

☐ 1. Has the customer's architect fully reviewed final site construction drawings using the guidelines provided by MR Siting?

☐ 2. Has the vibration study been completed per **Section 4–15, VIBRATION**? It is the customer's responsibility to contract a vibration consultant or qualified engineer to implement design modifications to meet the specified limits.

☐ 3. If there were vibration issues; has local GE Field Service verified, with the vibration consultant present, the elimination/reduction of all identified sources?

☐ 4. Have vehicle parking arrangements been made for installation personnel?

☐ 5. Is temporary storage space available for use during installation?

☐ 6. What is hospital smoking policy?

☐ 7. Are a first aid kit and non–ferrous fire extinguishers available at site?

☐ 8. Have facility arrangements been made for refuse disposal during installation?

9–3 SAFETY

WARNING!

THE FOLLOWING SAFETY ITEMS MUST BE ADHERED TO PRIOR TO MOVING THE MAGNET FROM THE TRUCK INTO THE ROOM. THE MAGNET WILL BE EXHAUSTING HELIUM GAS DURING THIS TIME. GASEOUS HELIUM IS AN INVISIBLE, ODORLESS GAS THAT CAN CAUSE ASPHYXIATION WHEN DEPLETING THE AMBIENT OXYGEN SUPPLY. HELIUM GAS IS LIGHTER THAN AIR AND WILL RISE TO THE CEILING.

☐ 1. Have all of the required room ventilation items been installed and tested to make sure sufficient ventilation is available? Is exhaust fan and fan control installed and functional? The customer is to supply a copy of the Exhaust Fan Test Report to GE Medical Systems for the customers record file. Refer to **Section 4–8 ROOM VENTILATION** for specific requirements.

☐ 2. Are a first aid kit and non–ferrous fire extinguishers available at site?

☐ 3. Are removable chain or strap available for securing cryogen gas cylinders in an upright position to prevent the cylinders from falling which may cause injury or damage?

☐ 4. Are functioning telephones as defined in **Section 2–7–5 System Monitoring & Support Connectivity Requirements** available at site for duration of installation? Phone lines are needed to dial out in case of an emergency.

☐ 5. Has the cryogenic vent been installed complete from the Magnet Room RF shield penetration to the final exit and been inspected to final exit outside of the building? The customer is to supply a copy of the Vent Inspection Report to GE Medical Systems for the customers record file. Refer to **Section 4–9, CRYOGENIC VENTING**.

☐ 6. Have plans been made to connect the cryogenic vent to the magnet after magnet installation in the room? Refer to **Section 4–9, CRYOGENIC VENTING**.

☐ 7. Is there adequate ventilation for helium dewar storage area. Refer to **Section 4–8, ROOM VENTILATION**.

9–4 PREPARATIONS REQUIRED IN ADVANCE OF MAGNET DELIVERY AND MOVING INTO MAGNET ROOM

The following items must be completed prior to magnet delivery. A site inspection by GE Service Representative must be completed prior to magnet delivery to ensure site readiness.

☐ 1. For Slab On Grade Sites: Have 0.7T Magnet Floor Preparation Kit anchors been installed in Magnet Room floor, integrated with RF Shielded Room, and successfully tested? Refer to **Section 7–7 MAGNET MOUNTING REQUIREMENTS INSIDE RF SHIELDED ROOM.**

☐ 2. For Suspension Foundation Sites: Have 0.7T Magnet Mounting Plate and anchors been installed in Magnet Room floor, integrated with RF Shielded Room, and plate mounting epoxy cured? Refer to **Section 7–7 MAGNET MOUNTING REQUIREMENTS INSIDE RF SHIELDED ROOM.**

☐ 3. For all magnet room anchors, has ground impedance test been performed? Test results recorded by RF Shield Room Vendor and documentation given to GE Medical Systems for the customers record file? Refer to **Section 7–7–6 Electrical Isolation.**

☐ 4. Has Main DIsconnect Panel been installed, electrician wiring complete, MDP operational with power available? Refer to **Table 5–1 REQUIRED CUSTOMER POWER.**

☐ 5. **Is 24 hour/day, 7 days/week power and air cooling available for Main Disconnect Panel (MDP) for powering the System Cooling Cabinet (SCC) with Shield/Cryo Cooler Compressor cabinets, Temperature Control Unit (TCU) and Magnet Monitor equipment?**

☐ 6. **If MR system configuration is utilizing SCC with Remote Condenser Unit (RCU) located outside then is RCU ready for operation (plumbing installed/connected and 24 hour/day, 7 days/week power available) to support SCC operation?**

☐ 7. **If MR system configuration is utilizing water cooled SCC then is 24 hour/day, 7 days/week water cooling available?**

☐ 8. Is SCC installed and operational?

☐ 9. Is air conditioning running in equipment room?

☐ 10. Are all walls and ceiling in magnet room essentially complete except for removable section?

☐ 11. Has a clear route to the magnet room been defined for magnet installation (refer to **Section 2–4, MINIMUM DOOR SIZES**)?

☐ 12. Is a secure space available to store equipment on site?

☐ 13. Have arrangements been made for the use of special rigging equipment for moving the magnet into the magnet room?

9–4 PREPARATIONS REQUIRED IN ADVANCE OF MAGNET DELIVERY AND MOVING INTO MAGNET ROOM (Continued)

☐ 14. Has work in the magnet room been completed or suspended and the magnet room closed off to provide a dust–free, closed environment?

☐ 15. Has all equipment been removed from the magnet room to allow space for the magnet with rigging equipment and cryogen dewars?

9–5 PREPARATIONS REQUIRED IN ADVANCE OF CRYOGEN TRANSFER/MAGNET FILL

☐ 1. Have arrangements been made for cryogen delivery and storage?

☐ 2. Does a clear path exist to magnet room for delivery of cryogens?

☐ 3. Is the magnet room adequately vented to allow exhaust of cryogen boil–off?

☐ 4. Is the magnet room clear to provide room for cryogen dewars during filling?

9–6 PREPARATIONS REQUIRED IN ADVANCE OF SYSTEM DELIVERY/INSTALLATION

The following items must be completed prior to system delivery. A site inspection by GE Service Representative must be completed prior to system delivery to ensure site readiness.

☐ 1. Has the equipment/computer room raised floor been installed if not previously completed?

☐ 2. Has area under the raised floor been vacuum cleaned and free of all debris?

☐ 3. Have any necessary conduits or raceway for power cables been installed?

☐ 4. Has delivery route been defined for equipment (refer to **Section 2–4, MINIMUM DOOR SIZES**) including plans for protecting flooring for heavy equipment & carts (ie. System Cooling Cabinet)?

☐ 5. **Is wiring for Power Distribution Unit power available for connection to the Main Disconnect Panel**?

☐ 6. Does incoming power have all the specified safety precautions and remote disconnects?

☐ 7. Is the operator's area complete to provide a dust–free environment for installation of the Operator Workspace or Operator Console equipment?

☐ 8. Are the areas for optional equipment complete to provide a dust–free environment for installation of equipment?

9–7 PREPARATIONS REQUIRED IN ADVANCE OF MAGNET RAMP–UP

☐ 1. Is the crygenic vent connected to the magnet?

☐ 2. Has the magnet room been completely closed (removable section closed up and sealed)?

☐ 3. Has the magnet room been tested to ensure that the RF shielding meets the electrical isolation and the100dB requirement for electric/plane waves and the 90dB requirement for magnetic waves refer to **Section 7–1, RF SHIELDED ROOM INTRODUCTION**? The customer is to supply a copy of RF shielded room vendor test reports.

☐ 4. Have all ferrous metal objects been removed from the magnet room?

☐ 5. Have adequate signs (Safety and Exclusion Zones) been posted to warn personnel about dangers of magnetic field?

☐ 6. Have hospital personnel been informed of magnet safety precautions and procedures?

☐ 7. Has power been connected to the Power Distribution Unit?

☐ 8. Has the penetration panel been installed?

☐ 9. Is all contractor construction work completed?

☐ 10. Has all contractor equipment that could affect shimming been removed from within the three gauss zone?

☐ 11. Have precautions been taken to prevent movement of large metal objects within the three gauss zone?

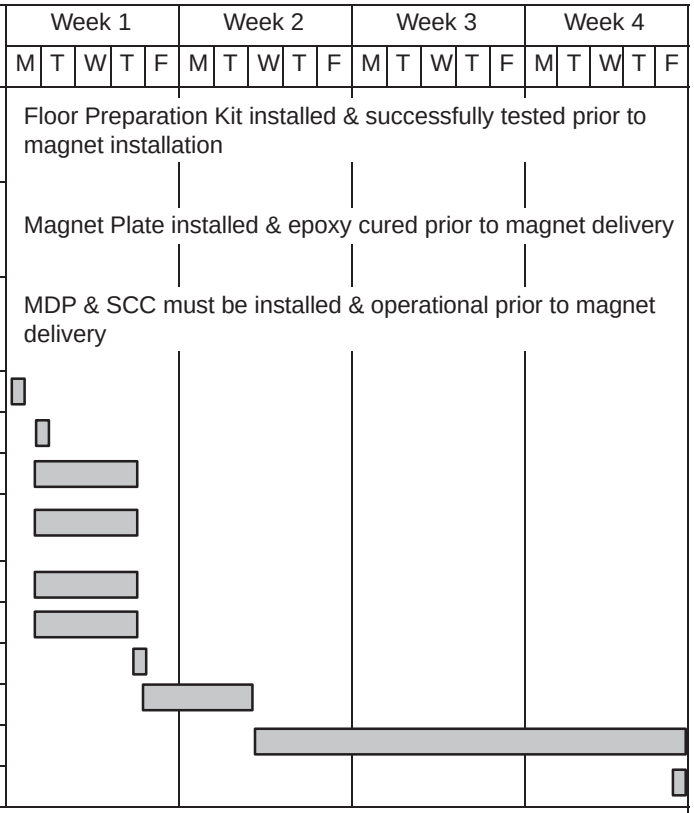
☐ 12. Have local fire department(s) and police department(s) been informed of unique characteristics (e.g. strong magnetic field, cryogens, etc.) of magnet and correct precautions to take in event of emergencies?

9–8 TYPICAL SIGNA OPENSPEED INSTALLATION PROJECT SCHEDULE

The MR Project schedule shown below depicts a typical MR 0.7T installation. The purpose of this project schedule is to provide a guide for your MR project in regards to tasks which need to be completed, duration of each task and who is primarily responsible for completion of the task. This project schedule starts at magnet delivery which occurs when your site construction is completed, except for magnet room opening. Your GE Installation Specialist can provide more detailed information if needed.

Typical Signa Open*Speed* Installation Project Schedule

Typical MR Installation Schedule	Duration	Responsibility
For Slab On Grade Sites: Magnet mounting plate installed	See Note 1	Installation Specialist & Contractor
For Suspension Foundation Sites: Magnet mounting plate installed	See Note 1	Installation Specialist & Contractor
MDP & SCC equipment installed & operational	See Note 2	Installation Specialist & Contractor
Magnet delivered	0.5 day	GE
Magnet mechanical / electrical	0.5 day	GE
Magnet room closure	3 days	Contractor
Shielding is completed and tested		Contractor
Complete magnet room opening		Contractor
Flooring completed		Contractor
MR system delivered	0.5 day	GE
Mechanical Installation of system	3 days	GE
Calibration of system	12 days	GE
MR system available to customer		



Note 1 Installation of Magnet Floor Preparation Kit or Magnet Mounting Plate 2 weeks prior to Magnet delivery is required. Magnet Mounting Plate installation requires at least 3 days to allow for the epoxy to cure.

2 Installation Specialist is responsible for date specific delivery selection and coordination with customer's contractor of delivery and install of MDP and SCC equipment.

SECTION 10– TOOLS AND TEST EQUIPMENT

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10–1 INTRODUCTION

The following tables lists the tools and test equipment needed to install and calibrate a Signa system.

10–2 MOVING METAL MEASUREMENT EQUIPMENT

TABLE 10–1
MOVING METAL MEASUREMENT EQUIPMENT

ITEM	GE PART NUMBER	DESCRIPTION
1	——	Magnetometer sensitive to 50 μ gauss Flux gate or equivalent Example: Barrington Instruments Ltd. Model Mag–03MC 500 μT
2	——	Spectrum analyzer capable of moving metal measurements include the GenRad 2515, B&K 2032 or HP 3560A Dynamic Signal Analyzer.
3	——	Accelerometer capable of measuring from 0.2 Hz beyond 250 Hz.

10–3 RIGGER/CUSTOMER SUPPLIED EQUIPMENT

10–3–1 Slab On Grade Sites

Note

Table 10–2 contains an overview of equipment for initial planning purposes refer to Direction 2243897 GE 0.7T OpenSpeed Magnet Delivery And Installation for details of equipment and requirements.

TABLE 10–2
RIGGER/CUSTOMER SUPPLIED EQUIPMENT FOR MAGNET INSTALLATION

SUPPLIED BY	ITEM	DESCRIPTION
Customer/ Contractor	1	Resistance meter: • Megger Insulation Tester **– PREFERRED TEST UNIT** • Analog d'Arsonval Meter (meter must have test source >9 VDC per specifcation in **Appendix A–6 ENCLOSURE POWER REFERENCE INSOLATION**)
	2	0.75 in. (19 mm) chucked hammer drill with depth gauge
	3	0.5 in. (12.7 mm) masonry bit
	4	1.0 in. (25.4 mm) masonry bit
	5	2 pound (1 kg) hammer
	6	Vacuum cleaner with nozzle attachment
	7	wrenches (as required)
	8	Isopropyl alcohol, lint–free cloth rags and rubber gloves
	9	leather gloves, safety shoes and safety glasses / goggles

10–3–2 Seismic Zone & Suspension Foundation Sites

Note

Table 10–3 contains an overview of equipment for initial planning purposes, for details of equipment and requirements refer to both of the following documents:

Direction 2268297 GE 0.7T OpenSpeed Magnet Mounting Plate Installation
Direction 2243897 GE 0.7T OpenSpeed Magnet Delivery And Installation

TABLE 10–3
RIGGER/CUSTOMER SUPPLIED EQUIPMENT FOR MAGNET MOUNTING PLATE INSTALLATION

SUPPLIED BY	ITEM	DESCRIPTION
Rigger	1	All lifting equipment (chains, hoist, gantry, forklift, etc.) rated for 3500 pounds (1588 kg) or greater to move and position the magnet mounting plate
Customer/ Contractor	2	Ridge Pattern Trowels for spreading epoxy grout 0.15 inch to 0.20 inch (3.81 mm to 5.00 mm) thick – Quantity 2
	3	Carpenter Level x 72.00 inches (2.00 meters) long
	4	Vacuum Cleaner with nozzle attachment for cleaning holes
	5	Portable Grinder for anchor studs
	6	Metal Files – Quantity 2
	7	Clean Rags (lint free) – minimum 12 inch x 24 inch (304 mm x 700 mm) size – Quantity 10
	8	Alcohol (Isopropyl) – Quantity 1 quart (1 liter)
	9	Scotch–Brite or 000 steel wool pads – Quantity 10
	10	0.75 inch x 8.00 inch (19.1 mm x 203.2 mm) Masonry Drill Bits – Quantity 2
	11	0.75 inch (19.1 mm) Chucked Hammer Drill
	12	2 lb. (0.91 kg) Hammer
	13	Tape Measure 12 feet (4 meters) with .062 inch (1.57 mm) divisions
	14	Ruler 12 inches (300 mm) long with 0.04 inch (1 mm) divisions
	15	150 ft./lb. (200 N–M) capacity Torque Wrench
	16	5 gallon (25 liter) Container for mixing epoxy – Quantity 2
	17	Mixing Paddles for mixing epoxy grout – Quantity 3
	18	Drill for mixing paddles
	19	Rubber (chemical handling) Gloves per person handling epoxy / isopropyl
	20	Leather Gloves for each person handling magnet mounting plate
	21	Safety Shoes per person handling magnet mounting plate
	22	Safety Glasses per person handling epoxy / isopropyl or anchor stud assembly
	23	Resistance meter: • Megger Insulation Tester **– PREFERRED TEST UNIT** • Analog d'Arsonval Meter (meter must have test source >9 VDC per specifcation in **Appendix A–6 ENCLOSURE POWER REFERENCE INSOLATION**)

10–3 RIGGER/CUSTOMER SUPPLIED EQUIPMENT (Continued)

TABLE 10–4
RIGGER/CUSTOMER SUPPLIED EQUIPMENT FOR MAGNET & SYSTEM ELECTRONICS INSTALLATION

SUPPLIED BY	ITEM	DESCRIPTION
Rigger	1	Crane for removing magnet crate from delivery truck: 12 ton (10,909 kg)
	2	Motorized tow vehicle for pushing/pulling magnet when it is on dollies (e.g. an electric fork lift).
	3	Steel floor plates (8) to cover floors while transporting magnet, 36 in. x 12 in. x 0.25 in. (914 mm x 305 mm x 6.4 mm).
	4	Wood blocks, assorted sizes.
	5	Jacks and accessories for lifting magnet: 22,000 lbs (9979 kg) total capacity
	6	Spreader Beam
	7	Magnet Lifting straps which meet specifications in *Direction 2243897 GE 0.7T OpenSpeed Magnet Delivery / Installation Manual*
Customer	8	Equipment for off loading electronics and other miscellaneous components. (e.g. fork lift, hand trucks, straps, etc.)
	9	Panel lifters for computer flooring: Smooth floor — Indicon Industries PL2DC; Standard carpeted floor — Indicon Industries PL30P; Level loop carpet floor — Indicon Industries SCLV1.
	10	Air Compressor to inflate air isolators on SCC
	11	0–100 psi tire pressure gauge
	12	quantity 4: Toe jacks 500 lb (227 kg) to install air isolators under SCC frame

10–4 CRYOGENIC EQUIPMENT

TABLE 10–5
CRYOGENIC EQUIPMENT

ITEM	GE PART NUMBER	DESCRIPTION
1	46–306734G1	Low Pressure Regulator Kit (Non–magnetic gas cylinder regulator / hose assembly consisting of regulator, hose, and case) (See Note 2)
2	——	Liquid helium in non–magnetic dewars is needed for refilling the magnet (See Note 2). Refer to appropriate magnet manual for helium volume.
3	46–306717G1	Non–magnetic gaseous helium cylinder cart (See Note 2)
4	46–294705G1	Universal Fill Line Kit (See Note 2)
5	46–294511P1	250 Liter Dewar Stinger (See Note 2)
6	46–294511P2	500 Liter Dewar Stinger (See Note 2)
7	46–294512P1 (12 ft) 46–294512P2 (8 ft)	Transfer Line (See Note 2)
8	46–282336P2	Dewar stinger assembly (High Efficiency) (See Note 2)
9	46–306812G1	Dewar tube ”Thumper” tool (See Note 2)
10	2319285–2	Burst Disk and Gasket Assembly for 0.7T Magnet Helium Vessel (See Note 1)
11	46–271136G1	Dewar Adapting Kit including O–ring Kit for Dewar Adapting kit (46–271135P9) (See Note 2)
12	46–271137G1	Cryogen Safety Shield Kit (Includes gloves, face shield, and safety glasses.) (See Note 2)
13	46–294804G1	Non–magnetic Aeroquip wrench Set (See Note 2) includes the following: • 46–294800G1 case for bronze wrench kit • 46–294805P1 bronze 1 $^5/_8$ in. open end wrench • 46–294805P2 bronze 1 $^3/_8$ in. open end wrench • 46–294805P3 bronze 1 $^3/_{16}$ in. open end wrench • 46–294805P4 bronze 1 $^1/_8$ in. open end wrench • 46–294805P5 bronze 1 in. open end wrench
14	46–281088G3	Shield Cooler Installation / Maintenance Kit (See Note 2)
15		Liquid Helium Level Meter Kit (See Note 2)
16	46–306781G1	Helium Mechanical Gas Flowmeter (See Note 2)
17	46–301477G2	Cryogenic Thermometer, Lakeshore 208 Cryogenic Thermometer Kit or alternate Diode Temperature current source 46–317543G1 (See Note 2)
18	46–252210P1	3 Inch Valve Operator (vacuum break tool) (See Note 1)
19	46–294872G2	SAV–CON / Instrumentation Lead Service Kit (See Note 2)
20	46–318784G2	Shield Cooler Test Kit (See Note 2)
21	46–318696G1	Water Tee for Shield Cooler Water Samples access (See Note 2)
22	46–294052G1	Water Flow Meter Kit (for checking flow of water to Shield Cooler Compressor) (See Note 2)
23	2171219	RUO Temperature Monitor (included in Magnet Specialty Tools Kit 2183710)
24	46–294047G1	Shield Cooler Vacuum Pump Kit

Note 1 Supplied as part of Signa.

2 Supplied by GE until turnover of system to customer, then available as part of a GE Cryogen and/or Service Contract.

10–5 INSTALLATION EQUIPMENT

TABLE 10–6
INSTALLATION EQUIPMENT

ITEM	GE PART NUMBER	DESCRIPTION
1	——	Ramp for removing cabinets from pallets for International shipments (See Note 1)
2	——	Wrecking bar
3	——	Claw hammer, 3/4 lb
4	46–271138G1	Restricted Access Control Kit. Contains two plastic warning signs for posting at site during installation and service activity.
5	——	Magnet Log Book
6	——	Installation log book
7	——	4 foot or equivalent carpenter level
8	2134776	Gradient Cable Crimper/Stripper Kit (Note 2) consisting of: • 2134586 Cable stripping tool • 2134586–2 Stripping tool replacement blade • 2134587 Cable slicer • 46–282853P1 Ratcheting crimper • 2135839 1/2 inch terminals • 2135839–2 3/8 inch terminals
9	46–301450G1	Fiber optic connector repair kit (See Note 2)
10	46–306763G1	Subminiature–D Connector Removal/Re–termination Repair Kit for Robinson–Nugent Sub–D connectors
11	46–320273G3 or G4	Non–Magnetic Tool Kit – Universal (See Note 2) Both metric and inch Non–Magnetic Tool Kits needed. May substitute both of the following kits: • 46–320273G1 Non–Magnetic Tool Kit – Metric • 46–320273G2 Non–Magnetic Tool Kit – Inch
12	2256565	For Magnet: Aluminum platform ladder (See Note 1)
13	2224464–2 or alternate 46–260776G4	2224464–2 Magnet Service Tool Power Supply consisting of 2 cabinets Each cabinet dimensions W x D x H are 20 x 28 x 16 in. (508 x 711 x 406 mm) & weight 110 lbs (50 kg) for Ramp cabinet and 60 lbs (27 kg) for Controller cabinet. 46–260776G4 Magnet Service Tool 1000 Amp Power Supply Cabinet dimensions W x D x H is 24.5 x 31.5 x 35.75 in. (622 mm x 801 mm x 908 mm) & weight 375 lbs (170 kg).
14	46–260703G6	Magnet Ramping Equipment Kit
15	2250653	Hold–down Tool (See Note 1)
16	2180589	Ramp Cable Kit with Cart
17	46-251865G4	Magnetometer
18	2281754–2	Shim Camera Kit includes Shim Camera, mounting fixture & insertion tools
19	2254862–3	Field Shim Kit includes shim disks & pellets (See Note 1)
20	2247491	Coil Installation Tool
21	2141701	B0 Power Supply

(Continued)

10–5 INSTALLATION EQUIPMENT (Continued)

TABLE 10–6 (Continued)
INSTALLATION EQUIPMENT

ITEM	GE PART NUMBER	DESCRIPTION
22	—	ST–900 Preparation tool for LMR 900 (Heliax cable) [Cablematice–Ripley Co.]
23	—	ST–600–EZ Preparation tool for LMR 600 (Heliax cable) [Cablematice–Ripley Co.]
24	—	Color printer (Inkjet)
25	2298110–2	Table Template (available from GE Service Zone Support Engineer)
Note	1	Supplied as part of Signa.
	2	Supplied by GE until turnover of system to customer, then available as part of a GE Cryogen and/or Service Contract.

10–6 RF SURVEY APPARATUS

TABLE 10–7
RF SURVEY APPARATUS

ITEM	GE PART NUMBER	DESCRIPTION
1	46–265169P1	Tuned dipole antenna (two required)
2	46–265169P2	Tripod for dipole antenna (two required)
3	—	0.305 m diameter loop antenna
4	46–255835P2	Spectrum analyzer
5	46–265171P1	RF Preamplifier
6	46–265170P1	RF Linear Power Amplifier

10–7 TEST EQUIPMENT

TABLE 10–8
TEST EQUIPMENT

ITEM	GE PART NUMBER	DESCRIPTION
1	46–194427P226	Dual trace oscilloscope, 100 MHz bandwidth, 2 channel, digital storage, Textronic 2232
2	46–194427P222	Dual trace oscilloscope, 350 MHz bandwidth, 4 channel, Textronic 2465
3	46–194427P284	Battery operated digital multi–meter, Fluke 87, 4.5 digits with frequency counter and capacitance
4	46–208572P9	Clamp–on Ammeter, 1–200A, AC/DC
5	46–317724P14	Attenuator/ load, 200 Watt, 30 dB attenuator
6	46–317724G2	RF Power Measurement Kit with Attenuator/ load, 200 Watt, 30 dB attenuator 46–317724P14
7	2218826	RPM 1650 Power Analyzer Kit
8	2170280, 2170284, 2170281, or 2170285	Dranetz 656AH or 658 analyzer kit with 1 and 3 phase modules
9	Catalog E6320DA or 46–194427P144	Densitometer
10	46–328406G1	Dale 600 leakage tester for 120 V 60 Hz
11	46–328406G2	Dale 600E leakage tester for 220 V 50 Hz
12	46–306797G1	Fogg (ECG) Simulator and Memory Module
13	46–320433P1	Infrared Scanner 0 – 100° C
14	46–317830G1	Fiber Optic Light Meter Kit
15	46–251867G1	Main Vacuum Pump Down Kit

10–8 CALIBRATION TOOLS/FIXTURES

TABLE 10–9
CALIBRATION TOOLS/FIXTURES

ITEM	GE PART NUMBER	DESCRIPTION
1	46–307500G1	Longitudinal Drive Force Gauge
2	2133388–10	System Performance Test (SPT) Phantom Set for Systems with 0.7T Magnet system (See Note 1) consisting of the following: • 2274392 HFO SPT Nesting Plate Assembly • 2125244 SPT Short Loader Assembly • 2134213–2 HFO SPT Shipping/Storage Cart • 2170481 EPI Foam Positioner • 2141454 Quick Shim Positioner • 2274999 DQA Phantom • 2274476 HFO Large Volume Shim Phantom Inner Sphere • 2274477 HFO Large Volume Shim Phantom Upper Half • 2274479 HFO Large Volume Shim Phantom Lower Half • 46–265826G6 Head TLT Sphere • 46–317586G1 one 100 mm NIckel Chloride sphere
3	46–255816G1	RF Test Cables Kit
4	46–265434G1	Magnet Rundown Unit Test Box
5	2309800	Host Software Release 8.5 & higher compatible 0.7T Eddy Current Measurement Test Kit (See Note 3) Case dimensions W x D x H is 17 in. x 24 in. x 20 in. (432 mm x 610 mm x 508 mm)
6	2274135	Host Software Release 8.3.1 compatible 0.7T Eddy Current Measurement Test Kit (See Note 3) Case dimensions W x D x H is 17 in. x 24 in. x 20 in. (432 mm x 610 mm x 508 mm)
7	46–320383G11	0.7T HSS / SST Coil Kit
8	46–328021G1	Enmet Oxygen Monitor Calibration consisting of the following: • 1800 PSI cylinder of 20.9% Oxygen in Nitrogen • 1800 PSI cylinder of 17% Oxygen in Nitrogen • Regulators with calibration adapter For use with portable or permanent Oxygen Monitor.
9	2106236	Portable Oxygen Monitor (Connecticut Analytical)
10	2107184	Permanent Oxygen Monitor (Enmet)
11	46–301549G1	TPS RF Test Cable/Adapter Kit
12	46–301927G1	TPS RF Service Interface Kit (See Note 2)
13	46–306712G1	Torque driver kit
14	46–306864G1	Magnet Helium Resistance Box Kit
15	2101360	Power Supply Calibration Kit
16	46–265826G3	Head Signal–to–noise (SNR) sphere (See Note 3)
17	46–265635G4	Body Signal–to–noise (SNR) sphere (See Note 3)
18	46–265635G2	Body T2 sphere (See Note 3)
19	46–328480G1	100 mm Nickel Chloride sphere (46–317586G1) and Universal Phantom Holder (46–328383P1) See Note 2

Note 1 Supplied as part of Signa.
2 Supplied by GE until turnover of system to customer, then available as part of a GE Service Contract.
3 Customer may purchase these items.

10–9 TOOL KIT

TABLE 10–10
TOOL KIT

ITEM	GE PART NUMBER	DESCRIPTION
1	——	Extension cords, with ground conductor
2	——	Power strip, grounded type, with minimum of five outlets
3	——	Soldering iron, pencil type with solder
4	——	Solder sucker
5	——	Assortment of Brady Quick labels
6	——	Micro clip leads
7	——	14 pin and 16 pin DIP clips
8	46–258218P3	Vinyl electrical tape
9	46–258218P4	Copper tape, 3 in. wide
10	46–258218P5	Copper tape, 2 in. wide
11	46–258218P6	Copper tape, 1 in. wide
12	——	Alcohol cleaning solution
13	——	Plastic or aluminum flashlight
14	——	Plastic or aluminum pen light
15	AMP No. 458994–1	Pin extractor, Universal Mate'n'Lock
16	AMP No. 305183–R	Pin extractor, M–series
17	46–237072P1	Pin extractor, Sub–D
18	46–307307G1	Crimping tool for coax cable and BNC connectors Inserts for RG8, 9, 11, 214 46–255841P103 RG58, 223 46–255841P100 RG59 46–255841P101 RG174 46–255841P102 Die Removal Tool 46–255841P201
19	——	Assorted crimp tools.
20	——	Non–magnetic level
21	——	Non–magnetic tape rule, 12 ft
22	——	Assorted drill bits
23	——	Inspection mirror
24	——	Tap set, standard, and tap handle, T–type
25	——	6 in. rule, standard and metric markings
26	——	Alignment tool (tweaker)
27	——	Hex/alignment tool
28	——	Hemostat, 5 in., curved
29	46–198094P1	Wrist grounding strap

(Continued)

10–9 TOOL KIT (Continued)

TABLE 10–7 (Continued)
TOOL KIT

ITEM	GE PART NUMBER	DESCRIPTION
30	46–400123P72	IC Extractor Tool
31	Xcelite 110CG	Diagonal Cutting Pliers, 4–1/2 in.
32	——	Screw Starter, aluminum or plastic shaft
33	——	Hobby and utility knives
34	——	Spring scales, 0–10 lbs and 0–50 lbs
35	46–287192P1	Extractor for EIMAC 3CX 800, 8877, 8874 Tubes
36	46–313413P1	Extactor for 20 – 100 pin PLCC Chips

APPENDIX A –RF SHIELDED ENCLOSURE TEST GUIDELINE

A–1 INTRODUCTION

This document describes the procedure and methodology of performing an RF shielding effectiveness verification test on enclosures which will house GE Medical Systems (GEMS) Magnetic Resonance Imaging (MRI) equipment. MRI equipment is sensitive to RF energy from sources outside of the shielded enclosure. To ensure proper operation of the MRI equipment, the shielded enclosure must attenuate local RF signals to levels that do not cause interference.

Note

RF Shielding Performance is based on **planewave** measurements. “H” field and “E” field tests are not required, but are allowed as needed for diagnostic purposes.

A–1–1 PURPOSE OF TEST PLAN

The purpose of this test plan is to describe a series of RF shielding effectiveness tests to demonstrate compliance of an MRI shielded enclosure to the requirements of GE Medical Systems.

The test procedure described in this guideline is a modification of MIL–STD–285 and IEEE Std 299–1991. This procedure provides a through evaluation of the shield integrity at the upper end of the frequency range of interest showing any RF leakage which may cause imaging problems. These test guidelines ensure that the electromagnetic environment inside of the enclosure will meet the requirements of General Electric Medical Systems.

A–2 APPLICABLE DOCUMENTS

MIL–STD–285	MILITARY STANDARD ATTENUATION MEASUREMENTS FOR ENCLOSURES, ELECTROMAGNETIC SHIELDING, FOR ELECTRONIC TEST PURPOSES, METHOD OF; 25 June 1956
IEEE Std 299–1991	IEEE STANDARD FOR MEASURING THE EFFECTIVENESS OF ELECTROMAGNETIC SHIELDING ENCLOSURES; 2 July 1991

A–3 TEST SAMPLE SETUP

The shielded enclosure under test shall be set–up in a normal configuration, which consists of the following:

1. Magnet installed including all floor mounting bolts
2. RF shielded door(s)
3. Waveguide penetrations, HVAC, vents, medical gas lines, etc.
4. AC power supplied through low–pass filters
5. Patient view window, skylights, windows, hatches, etc.
6. Blank penetration panel installed, dimensionally equivalent to the GE panel and the same mounting hardware to be used with the GE penetration panel.

For safety reasons, the enclosure shall be electrically grounded during the shielding effectiveness test. Any variances from the normal configuration shall be noted in the certification report.

A–4 SHIELDING EFFECTIVENESS

This test procedure determines the worst case shielding effectiveness based on the lowest test point reading obtained. The lowest reading obtained will be the reading of the room.

A–5 MEASUREMENT PROCEDURE

To simulate the effects of external RF sources, the transmit antenna shall be located outside the enclosure on a plane parallel to the face of the enclosure wall, at a distance of 6 feet (1.8 meters) unless physically constrained to a lesser separation. The areas of least effectiveness are located by searching the inside of enclosure with the antenna connected to the spectrum analyzer.

A–5–1 Test Position

The transmitting antenna will be positioned in front of all critical areas (doors, windows, filters, penetration areas, etc.) and at a minimum of every 20 feet (6.1 meters) of wall. The receiving antenna is scanned over all panel section joints (where accessible), at floor, wall, and ceiling for a minimum of 10 feet (3.05 meters) in all directions from the location of transmitting antenna. The receiving antenna shall be at a minimum of 1 foot (0.3 meters) from the shield. For areas that are inaccessible for direct location of the transmitting antenna, the inside of that area will still be scanned using the receiving antenna with the transmitting antenna positioned in front of the adjacent wall or adjacent test position.

A–5–2 Frequency Range

The standard frequency for shielding measurements shall be 100 MHz $\pm$ 10 MHz. This allows the frequency to be adjusted slightly to avoid interference from local active transmitters and/or RF noise from other sources. Test frequency utilized shall be noted in the certification report.

A–5–3 Free Field Calibration

The incident field, i.e. “free field”, is measured by the following procedure:

Position the transmit antenna parallel to the exterior wall of the enclosure at a distance of 6 feet (1.8 meters) (unless physically constrained to a lesser separation, in which case a separate reference will be established and documented at the new test distance), using horizontal polarization. The receive antenna shall be placed between the transmit antenna and 1 foot (0.3 meters) from the exterior wall of the enclosure. The receive antenna will be moved vertically and horizontally to achieve maximum signal strength. The receive antenna shall be placed no closer than 2 inches (51 mm) from the exterior wall of the enclosure and in line with the transmit antenna. The maximum received voltage at the test frequency will be recorded.

A–6 ENCLOSURE POWER REFERENCE INSOLATION

To prevent personnel hazard, it is necessary for the enclosure to be properly grounded.

To minimize common mode currents, the ungrounded enclosure should be isolated from ground with a minimum of 1000 ohms of DC resistance. The isolation measurement is performed by the following procedure:

All power to the enclosure is removed. For safety reasons, an AC voltage measurement will be made to verify that no power is connected. With electrical power and intentional ground disconnected, connect the test instrument between the shielded enclosure and AC power ground. Take a reading and record the value. This test shall be made using either an isolated, current limited high voltage (>150 VDC) DC source and DMM to read drop across the limiting resistor or a megger instrument capable of reading values less than 1000 ohms. Conventional resistance meters employing test sources of 9 VDC or less shall not be used.

A–7 TEST EQUIPMENT

Test equipment shall be selected to provide measuring capabilities as described in this test guideline. The signal source, amplifier, antennas, and receiver or spectrum analyzer shall be such that the difference between the induced reference voltage and the receiver sensitivity shall be at least 6 dB greater than the required attenuation specification.

The signal source and power amplifier shall output a CW signal for a nominal test frequency of 100 MHz. Receiver or spectrum analyzer and preamplifier (if required), shall provide adequate sensitivity to permit attenuation measurements to be made to the specified limits. Dipole antennas and other miscellaneous equipment required to transmit and receive the proper RF fields shall be used.

The absolute performance calibration, of the equipment requiring calibration, shall be performed on an as needed basis in accordance with MIL–STD–45662. The calibration period shall not exceed one year. The test equipment tolerances of at least $\pm$ 2% frequency and $\pm$ 2 dB amplitude shall be met. Equipment certifications shall be traceable to the National Institute of Standards and Technology (NIST). All equipment will be verified for proper operation between and after each series of tests by repeating the reference readings at the specified frequency(s).

A–8 DATA RECORDING AND VERIFICATION

Measurements shall be performed by qualified responsible EMC test personnel. The test must be performed in the presence of a GE representative unless other arrangements have been made by GEMS. All data collected during the course of the tests will be recorded on standardized data sheets. The data sheets will include the test location, frequency, reference level, measured enclosure level, and attenuation level.

A–9 TEST REPORT

A final certification report will be provided after the test is performed. This report will include all recorded data necessary for the evaluation of the shielded enclosure test results and will list any changes pertinent to the test set–up or the shielding effectiveness. The certification report will also include the test procedures and a list of the actual equipment used during the test.

Along with the data sheet, there will be a presentable drawing showing the shape of the enclosure, all test point locations, doors, filters, windows, and existing building walls.

APPENDIX B –

DO NOT PRINT THIS PAGE!!! Present for autonumbering purposes ONLY

See Direction 2241391 pdf file for theactual Appendix B contents of an Ellis & Watts document titled:
Prerequisites for Scheduled Start–up or Performance Verification of Ellis and Watts Chillers For Signa Open Speed

APPENDIX C – REQUIREMENTS FOR EQUIPMENT ROOM SHARED BY MULTIPLE MR SYSTEMS

C–1 INTRODUCTION

When the Equipment Room is shared by more than one MR system of the same field strength there is a potential for cross–talk of RF energy between the MR systems. RF cross–talk may cause noise artifacts in images.

The potential for cross–talk exists when the RF transmit cables and equipment of two or more MR systems are located in the same Equipment Room. For example, when one system is transmitting, the other system could be in receive mode and therefore pick up the RF energy being transmitted resulting in a cross–talk scenario.

Note

The potential for cross−talk exists for RF transmit cables and equipment that produces RF that are part of a non−GE MR System of the same field strength.

The following subsections provide requirements for shared Equipment Room design, layout, and installation which reduce the potential for RF cross–talk.

C–2 EQUIPMENT CABINETS RELATIVE LOCATIONS

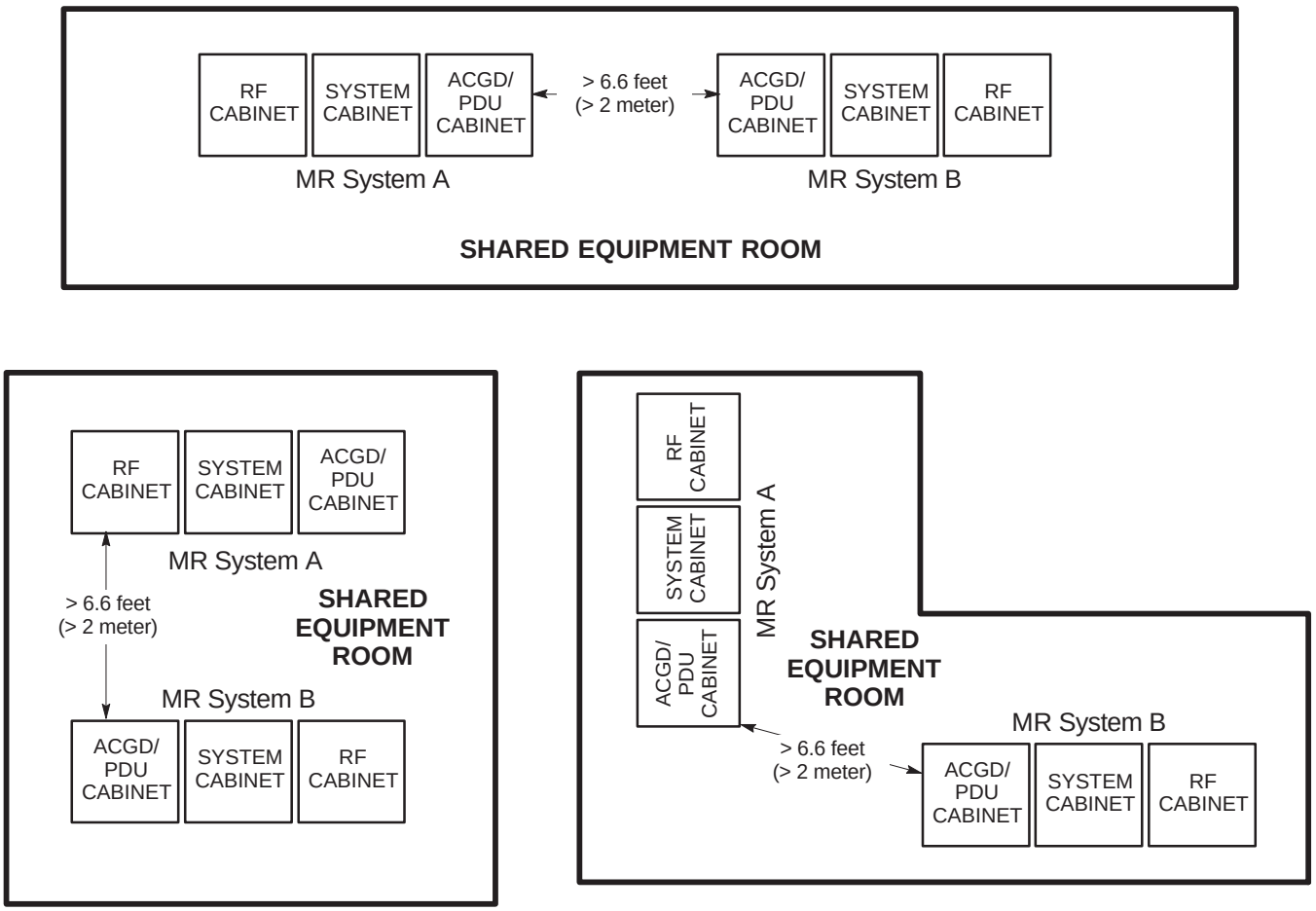
The following are requirements for locating equipment cabinet of one MR system relative to the other MR system equipment cabinets.

- Maximize separation distance between the RF Cabinet of one MR system and the System Cabinet of the other MR system.
- RF, System, or Gradient Cabinets of one MR system and RF, System, or Gradient Cabinets of the other MR system must be separated by a minimum of > 6.6 feet (2 meters) in all directions, see Illustration C–1.

Note

Relative placement should not be an issue for chillers, compressors, and other equipment which does not produce RF.

C–2 EQUIPMENT CABINETS RELATIVE LOCATIONS (Continued)

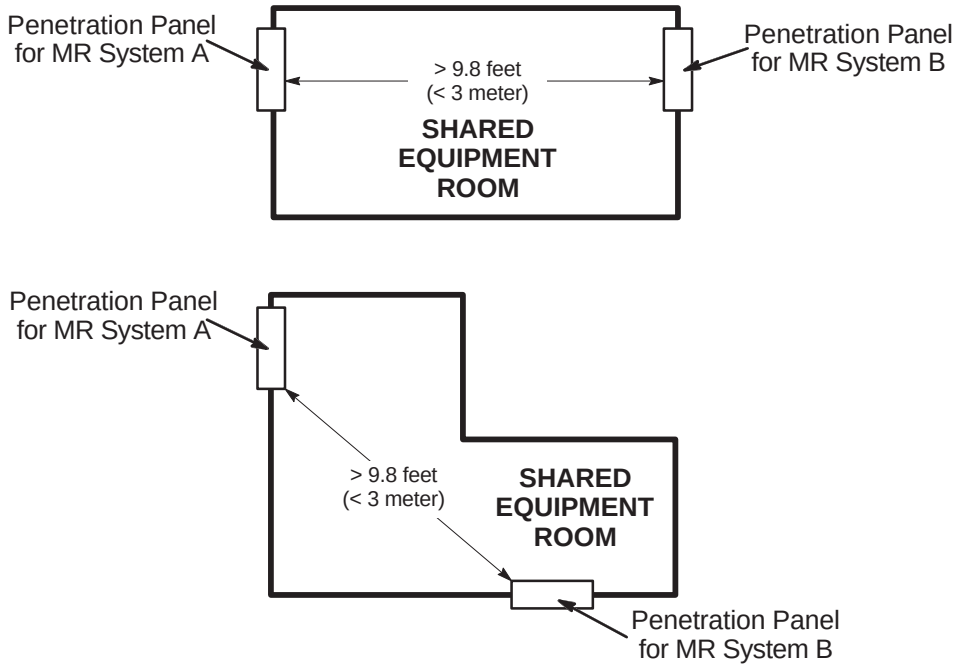


MULTIPLE MR SYSTEMS ELECTRONICS CABINETS SPACING
ILLUSTRATION C–1

C–3 PENETRATION PANELS LOCATION

The following are requirements for locating the RF Shielded Room Penetration Panel of one MR system relative to the other MR system RF Shielded Room Penetration Panel.

- There must be > 9.8 feet (3 meters) separation between the Penetration Panels of each system sharing the Equipment Room space, see Illustration C–2.

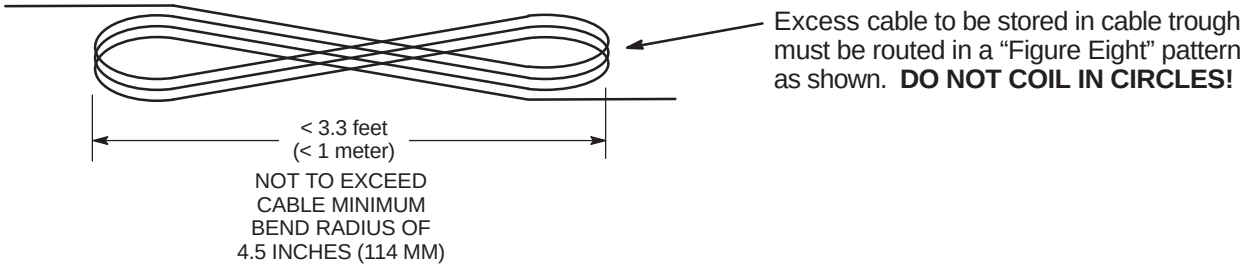


MULTIPLE MR SYSTEMS PENETRATION PANEL SPACING
ILLUSTRATION C–2

C–4 SYSTEM CABLES REQUIREMENTS

The following are requirements for locating and managing excess RF Receive and Transmit cables of the MR systems sharing the Equipment Room.

- In the shared Equipment Room there must be > 6.6 feet (2 meters) separation between the RF receive cables of one system and the RF transmit cable of the other system. Refer to **Section 6 SYSTEM INTERCONNECTS** for Receive and Transmit cable Run Numbers.
- There must be > 6.6 feet (2 meters) separation between the system interconnect cables of each system sharing the Equipment Room space.
- Transmit cables in the Equipment Room must be cut to length to minimize excess cable length reducing the potential for signal coupling with other cables. No excesss transmit cable can be stored in the Equipment Room.
- Receive cables excess length must be stored in a “figure 8” with overall dimension of < 3.3 feet (1 meter), see Illustration C–3.



PROPER STORAGE OF EXCESS RECEIVE CABLES
ILLUSTRATION C–3