ESAOTE

THE IMAGE OF INNOVATION

C-SCAN DEDICATED MRI

DEDICATED MRI ARTOSCAN-C

[redacted] MR

Service Manual

Planning Guide

Replaces: 8300096009 VER.A

English
Doc. Gen. Dec/2001

8300096009 VER.B

Document revision level

The document corresponds to the version/revision level effective at the time of system delivery. Revisions to hardcopy documentation are not automatically distributed.

Please contact your local ESAOTE office to order current revision levels.

Disclaimer

The installation and service of equipment described herein is to be performed by qualified personnel who are employed by ESAOTE or one of its affiliates or who are otherwise authorized by ESAOTE or one of its affiliates to provide such services.

Assemblers and other persons who are not employed by or otherwise directly affiliated with or authorized by ESAOTE or one of its affiliates are directed to contact one of the local offices of ESAOTE or one of its affiliates before attempting installation or service procedures.

Part 0 Table of Contents

Page intentionally left blank.

Part 1 Introduction

General

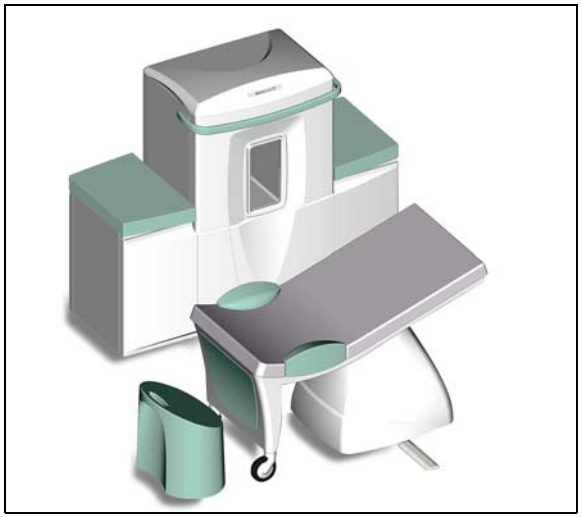
This planning guide provides a description of the items to be considered when planning the installation of the system in order to assure its safe operation.

Like other MR systems, the system is sensitive to RF interference even if the close architecture shields magnetic field fluctuations better than an open architecture system.

Up to a certain limit, the system's EFI unit can compensate for these fluctuations.

To ensure that the external RF noise and the magnetic field fluctuation do not exceed the specified limits, site survey measurement has to be performed (see also RF and Magnetic Field Interference and Annex 2, Preliminary Site Survey). Refer to Annex 1 for an overview of actions to be taken while planning a system installation.

Fig. 1: System Layout



System Basic Components

- Magnet unit, including a horizontal magnetic field type permanent magnet and the system electronic modules
- Patient seat
- Operating Console (including Modem and Network boards)

System Configuration 1

- System Basic Components
- CRT Monitor
- Static Leg Lock

System Configuration 2

- System Basic Components
- CRT Monitor
- Operating Table Comfort Version
- Static Leg Lock

System Configuration 3

- System Basic Components
- TFT Monitor
- Operating Table High Version
- CD Writer
- Cinematic Tools

System Options

- Operating Table High Version (shown in the next figure)
- Operating Table Comfort Version
- EFI unit to compensate for magnetic field fluctuations
- Connection Cable Set 20 m length
- Wrist Cinematic Device
- Optical Link Laser Connection
- DPA Coils

Fig. 2: Operating Table High Version

Safety Notes

The magnet installed in the scan room is always under field and attracts magnetic material. The apparatus and instruments to be carried into the pavilion should be non-magnetic. Gurneys, stretchers or other large metallic objects, which may possibly be attracted to the magnet, can be dangerous. It could be useful to differentiate these objects from the standard furnishings through the use of color-coding.

Items must not be brought into the pavilion unless they are made of non-magnetic material.

In general, people must be prohibited from entering the scan room. Local regulations require that warning signs be posted with respect to possible malfunctioning of instruments or pacemakers due to the fringe magnetic field. Preventive measures must be taken with regard to this.

A warning sign calling the attention of the hospital workers and patients entering the scan room must be posted (refer also to next figure). Carrying a watch, credit card, etc., into the pavilion may cause them to malfunction.

Generally the attraction exerted on a magnetic material is felt in a magnetic field of 100 gauss or more. The area reached by the fringe magnetic field may be seen from the distribution in the reference data furnished.

Fig. 3: Warning Sign

Part 2 Planning

Room

Room Size

Only one room is required to install the system.

The minimum space required for the installation of the system, including the pavilion, is 3 m x 3.2 m x 2.4 m.

Tab. 1: Minimum Space Requirements

Minimum Space Requirements
2.8 m x 3.2 m x 2.4 m

Floor

Floor Load

The floor must be able to support the weight of the magnet unit (1150 kg), Patient Seat (60 kg), Operating Console (30 kg) and three people (250 kg). Therefore, the floor may have to be reinforced to sustain a total load of 1500 kg.

Tab. 2: Floor Load Requirements

Floor Load Requirements
1500 kg

Recommended Room Configuration

Fig. 4: Recommended Room Configuration

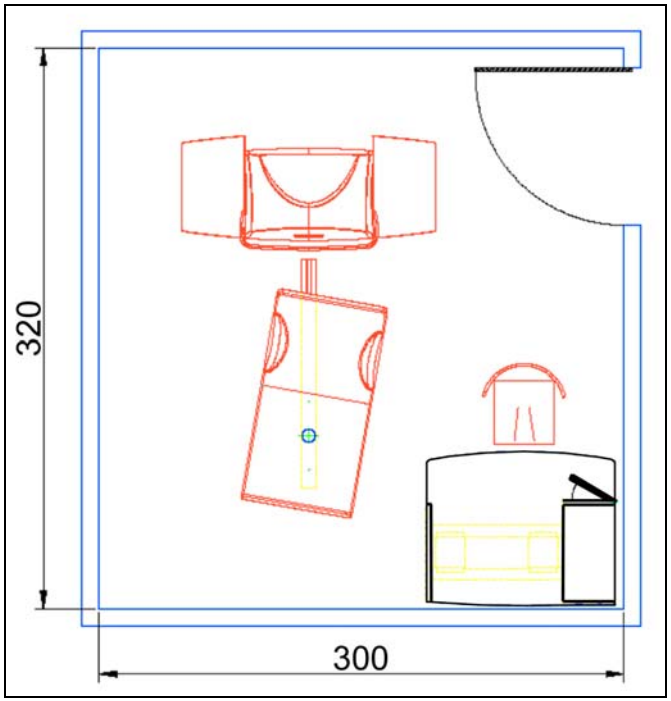


Fig. 5: Room Configuration Without Operating Console

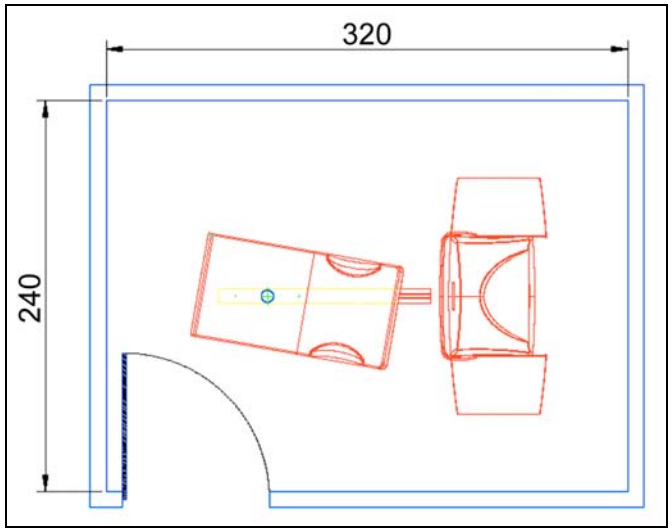


Fig. 6: Other example of installation

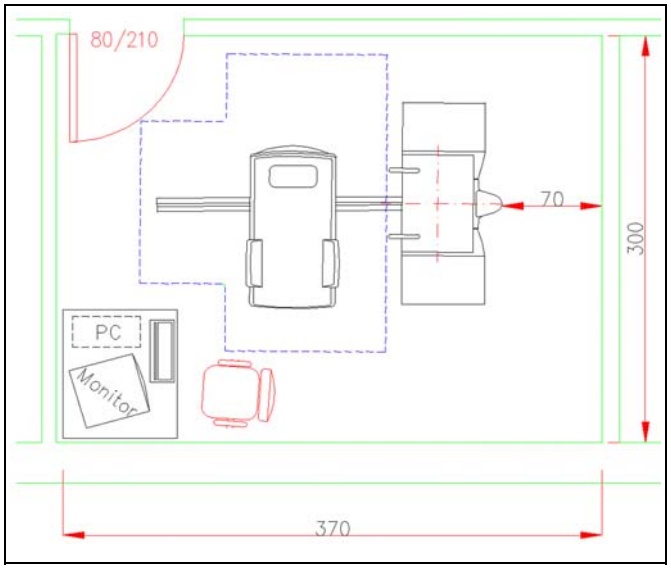
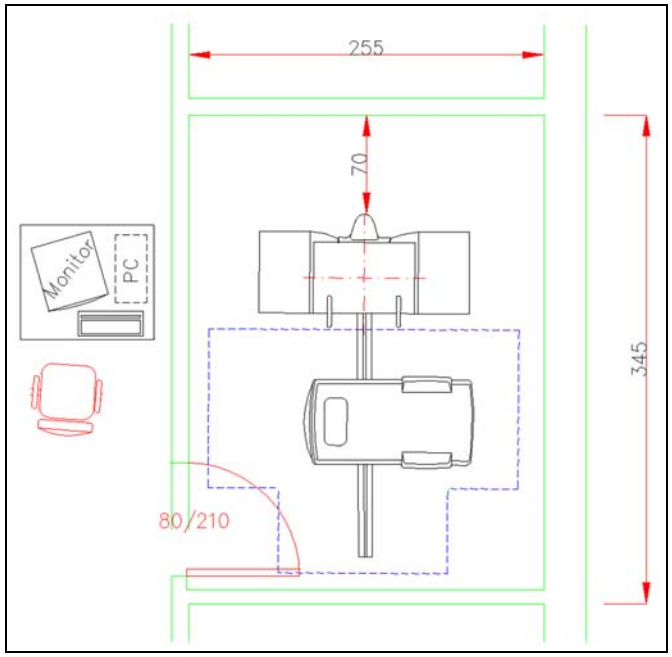


Fig. 7: Other example of installation



RF & Magnetic Field Interference

The surroundings of any MR-site must be examined very carefully. In the case of Artoscan C sites, it is imperative to check for external magnetic and RF interference (EMI and EFI) at an early stage of the project. This check is called a "site survey" and consists of a set of measurements that must be performed by a site survey specialist. These results are then compared to the corresponding specifications (refer also to table 5 and to table 6).

The first step is to complete the Preliminary Site Survey Report (refer to Annex 2) during the sales phase of the project, and to return it to your site survey specialist. This information is needed in order to estimate installation costs, the costs associated with the measurement, and to determine whether or not the system can be installed at that particular location. However, the final decision on the suitability of the site depends on the results of site measurements, and not on the Preliminary Site Survey Report.

NOTICE	Both RF noise and magnetic field fluctuations are determined during the site survey using specially designed measuring equipment (SMD, Site Measurement Device).

RF Noise

The external RF noise must be no more than 40 dB μV/m for the linear coils and no more than 30 dB μV/m for the DPA coils.

Tab. 3: Maximum RF Noise

Maximum RF Noise
40 dB μV/m (linear coils)
30 dB μV/m (DPA coils)

Magnetic Field Fluctuation

The need for EFI compensation and the shielding method must be determined according to the quasi-static (DC, < 5 Hz) and slow-changing magnetic field fluctuation (AC, 16-20 Hz; AC, 50-60 Hz),

All the values below refer to peak/peak fluctuation in the proposed position of the magnet center.

The DC values, measured by SMD, to be considered are the peak/peak variations within a window of ten minutes. When measuring Ac fluctuation you must consider if RMS of peak/peak values has been recorded.

A very important parameter to take into consideration is the time stability of AC disturbance. The more stable the level of the disturbance, the simpler a good compensation will be.

Tab. 4: Maximum Values without EFI

Maximum Values without EFI	
DC (< 5 Hz)	100 nT pkpk (1 mG)
AC (16.7 Hz)	60 nT pkpk (0.1 mG)
AC (50-60 Hz)	150 nT pkpk (0.6 mG)

Tab. 5: Maximum Values with EFI

Maximum Values with EFI	
DC (< 5 Hz)	4000 nT pkpk (40 mG)
AC (16.7 Hz)	2500 nT pkpk (25 mG)
AC (50-60 Hz)	4000 nT pkpk (40 mG)

In order to keep these values valid, no more than one source must be present within the limit shown in the Maximum Values without EFI table.

Environment

To achieve optimum performance from the installed system, it is important to provide patients and operators with a comfortable environment, as well as to meet the temperature, humidity and other environmental conditions that each system component requires.

Tab. 6: Environmental Requirements

Environmental Requirements	
Temperature range	20 – 26 °C
Temperature stability	3 °C/h
Humidity range	45 – 80 %
Pressure	700 – 1060 hPa

Power and Grounding

Due to the sensitivity of the system to RF interference, great care should be taken when providing the power supply and when grounding the system.

To safely operate the installed system, dedicated power supplies must be provided for the MRI system and the air-conditioner, as well as any lighting equipment and convenience outlets.

A switch box should be provided on the wall of the room, with separate switches for each of the above power supplies to allow system maintenance and service. Simultaneous use of the power supply for the system with air-conditioning, lighting and other electrical equipment is not allowed.

Also, the on-site power installation must provide an emergency power switch.

The power requirements are listed in the following table.

Tab. 7: Power Requirements

Power Requirements	
Power requirements	AC 100/110/220/230/240 V ±10%
Frequency	50/60 Hz ±10%
Power (during quick magnet hating)	1.1 kVA
Power (during normal work)	0.6 kVA
Power (stand by)	0.15 kVA

Power supply cable

The power supply cable, provided with the system, is a three-wire (phase: brown, neutral: blue and earth: yellow-green), 10 m long, shielded cable with a 1.5 mm^2 section. See the next table for the characteristics of the power supply cable.

Tab. 8: Power Supply Cable Features

Power Supply Cable Features	
Section	1.5 mm^2
Length	10 m

System Grounding

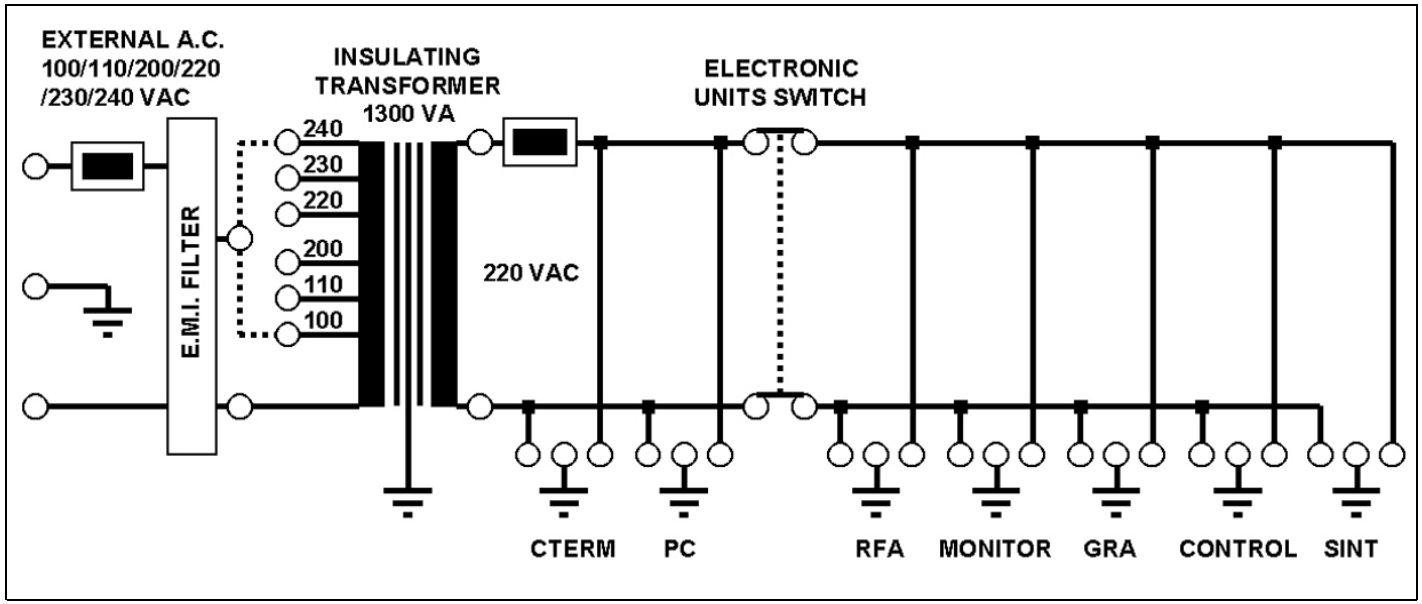
The grounding conductor must be insulated and must not be electrically connected to surrounding structures.

System Main power distribution

Main power distribution

The main power distribution diagram is shown in the next figure.

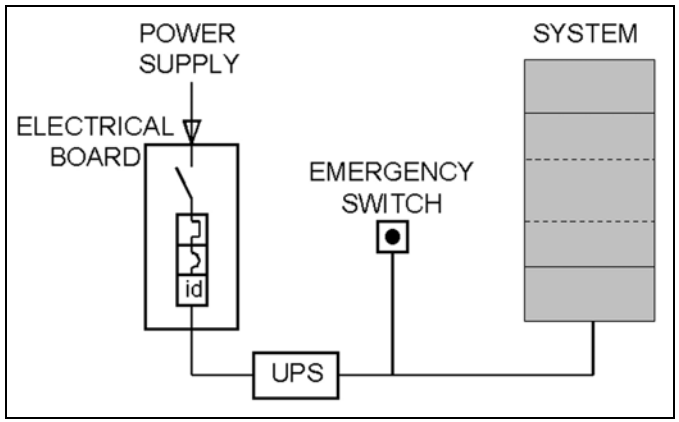
Fig. 8: Power distribution scheme



Main Power Distribution Scheme

The room's power distribution scheme is shown in the following picture. All the parts that the electrical circuits need are displayed in this scheme.

Fig. 9: Room Power Distribution Scheme



Uninterruptible Power Supply (UPS)

Line voltage stabilizers or UPS systems are required in countries with unreliable power supplies. As the magnet needs to be permanently heated to keep its temperature, you are highly recommended to use UPS in case the main power supply is not reliable.

One type of UPS has been tested and released for use with the system: ONEAC, model ON1300I-SN. It must be ordered from the UPS manufacturer.

Air-conditioning

Air-conditioning should be provided according to the environmental conditions of the room. (Refer to Tab. 6). No air-conditioning duct openings must be installed above the magnet or central control console.

WARNING	**To prevent magnetic field drifts, the magnet must not be exposed to direct airflow from any of the air duct openings**

Because the system has a small magnetic fringe field, standard air-conditioner items (galvanized sheet iron) may be used for the air-conditioning duct and accessories in the scan room.

The air-conditioner for the scan room must operate constantly. The temperature of the scan room must be maintained within a range from 20°C to 26°C and with a stability of at least 3 °C/h, even when the MRI system is not in operation. Otherwise, the system cannot be operated.

Modem, Network and Camera

Modem

The system includes an analog modem for Remote Diagnostics purposes. A direct analog phone line should be provided close to the console to connect the modem. The length of the modem cable is 2.15m.

Tab. 9: Length of Modem Cable

Length of Modem Cable
2.15 m

Network

The system includes an internal network card for LAN connection. An appropriate outlet should be provided to connect to the LAN. The network connection cable is not provided with the system.

NOTICE	The network connection cable is not provided with the system

Camera

The system can be connected to laser cameras in two different ways: analog (BNC cable) and digital (cable or optical link)

The printer board inside the PC provides both connections.

Please contact the customer to establish the type of camera connection.

NOTICE	The Camera cable (either analog or digital) is not provided with the system, it must be provided by the camera company/manufacturer

Analog Connection

The maximum length of RG 59 (75 Ω) cable for analog connection of the camera is 10 m, so you must provide the correct location for the camera when it is connected in this way.

The cable is not supplied with the system. Please contact the camera manufacturer for the required cable details.

Tab. 10: Maximum Cable Length for Analog Connection

Maximum Cable Length for Analog Connection
10 m

Digital Connection

The maximum length of cable for digital connection of the camera is 40 m. You must provide the correct location for the camera when it is connected in this way.

The cable is not supplied with the system. Please contact the camera manufacturer for the required cable details.

Tab. 11: Maximum Cable Length for Digital Connection

Maximum Cable Length for Digital Connection
40 m

Optical Link Connection

The maximum length of cable for optical link connection of the camera is 100 m. The Optical Link transmitter is connected to the digital output of the Print board.

Tab. 12: Maximum Cable Length for Optical Link Connection

Maximum Cable Length for Optical Link Connection
100 m

Part 3 Technical Data

System Components

Weight of System Components

Tab. 13: Weight of system components

Weight of system components	
Part	Weight
Magnet and Electronic Unit	1150 kg
Patient Seat	60 kg
Operating Console	30 kg
CRT Monitor 19”	23.5 kg
TFT Monitor 17”	8 kg
PC Unit	7 kg

Dimension of System Components

Tab. 14: Dimension of system components

Dimension of system components			
	Dimension (mm)		
Part	Width	Depth	Height
Magnet and Electronic Unit	146 cm	66 cm	128 cm
Patient Seat	64 cm	123 cm	86 cm
Operating Console Table	108 cm	88 cm	74 cm
CRT Monitor 19”	46 cm	44 cm	47 cm
TFT Monitor 17”	45 cm	18 cm	47 cm
PC Unit	26 cm	44 cm	43 cm

Magnet Fringe Field

Tab. 15: Fringe Field Distribution

Fringe Field		Distance from the Magnetic Center in Direction of		
Gauss	**mTesla**	**X axis (m)**	**Y axis (m)**	**Z axis (m)**
30	3	0.5	0.6	0.6
10	1	0.8	1	0.8
5	0.5	1.2	1.1	1.2
1	0.1	2.3	1.7	1.8

Heat Dissipation

The system (without the laser camera or any other equipment) produces a maximum heat of 400W.

Tab. 16: Heat Dissipation of System Components

Heat Dissipation of System Components	
Magnet unit and console	400 W

Acoustic Noise

The system generates a noise of 58dB (A) measured in the operator position; in other words, in front of the monitor.

Tab. 17: Acoustic Noise

Acoustic Noise
58dB (A)

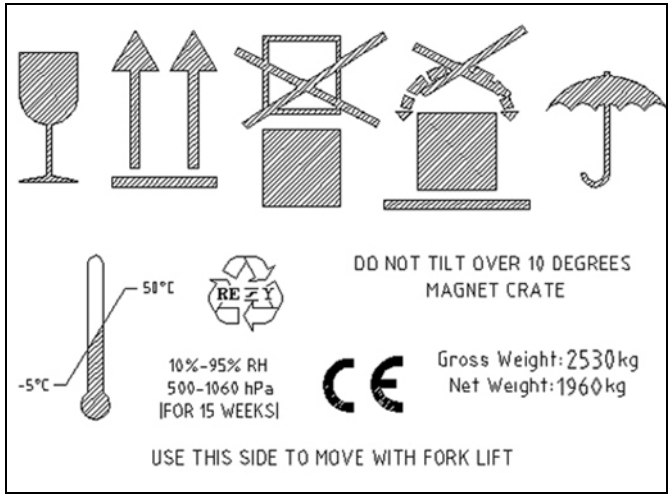
Part 4 Transport

Crates Dimensions

Tab. 18: Crates Dimensions

Content	Total weight	Size (LxWxH)
Magnet unit	1100 kg	93x83x163cm
PC Unit and Electronic Units	230 kg	147x77x148cm
Patient's Bed	172 kg	139x77x110cm
Covers	96 kg	123x78x55cm
Monitor	30 kg	58x55x63cm

Fig. 10: Magnet Crate Label



Magnet Platform Dimension

Tab. 19: Pallet Dimensions

Platform Size
L 90 x W 80 x H 16.5 cm

Carriage Device

Tab. 20: Carriage Device Dimensions

Carriage Device Dimensions
L 77 x W 120 x H 87 cm

Tab. 21: Carriage Device Weight

Carriage Device Weight
100 kg

Minimum Door Dimension

Depending on the way the magnet unit is transported, the minimum size for the doors must be at least 770 mm.

Tab. 22: Minimum Door Dimensions

Minimum Door Dimensions
80 cm

Transport Conditions

Temperature

When transporting and storing the magnet unit, never exceed the temperature range specified in the following table. Otherwise, the magnet will be damaged.

Tab. 23: Temperature Range during Transportation and Storage of the Magnet

Temperature Range During Transportation and Storage	
Minimum temperature	-5°C
Maximum temperature	50°C

Humidity

When transporting and storing the magnet unit, never exceed the humidity range specified in the following table. Otherwise, the magnet will be damaged.

Tab. 24: Humidity Range during Transportation and Storage of the Magnet

Humidity Range During Transportation and Storage	
Humidity range	10 ÷ 95%

Pressure

When transporting and storing the magnet unit, never exceed the pressure range specified in the following table. Otherwise, the magnet will be damaged.

Tab. 25: Pressure Range during Transportation and Storage of the Magnet

Pressure Range During Transportation and Storage	
Minimum pressure	500 hPa
Maximum pressure	1060 hPa

Maximum Tilt

If you have to use a ramp when transporting and storing the magnet unit, never exceed a maximum tilt of 10%. Otherwise, the magnet will be damaged.

Tab. 26: Maximum Tilt during Transportation and Storage of the Magnet

Maximum Tilt During Transportation and Storage	
Maximum tilt	10 %

7

Page intentionally left blank.

Part 5 Annex

Annex 1

Recommended Planning Actions

This is a list of recommended actions to be taken while planning a system installation:

1. Check the room size against the minimum space required for siting a system
2. Check whether the floor has to be reinforced to sustain the total load of a system
3. Make sure that the building vibration requirements are met
4. Check whether the fringe field of the magnet requires an external room shielding
5. Ensure that the minimum passage dimension required for carrying in the system as well as the minimum weight of the system components do not represent a problem for doors, floors, elevator, etc
6. Fill in the Preliminary Site Survey Report and send it to your site survey specialist
7. Arrange for a site measurement with your site survey specialist.
8. Check whether the floor leveling requirements are met
9. Check whether the air-conditioning system fulfills the room temperature requirements
10. Check whether the power, grounding and lighting requirements are met
11. Make sure that modem, network and camera connections are available
12. Find out whether convenience outlets (emergency lamp, smoke sensor, medical tubing) are to be installed
13. Define the room layout (position of modular shielding pavilion, doors and console). Allow at least 0.2 m distance against the wall for the filter panel and remember that the console must be placed within a distance range of 6 m from the filter panel

Annex 2

Preliminary Site Survey

Preliminary Site Survey Report must be filled in during the sales phase of the project and then returned to your site survey specialist.

Situation Report

The Situation Report is a brief description of the location of the proposed site. Check the rooms surrounding the location with respect to all six directions and enter the results into the Tab: Distance check: - Where are...?.

Sources of Interference

The Distance Check is a systematic analysis of existing sources of magnetic interference and the distance between these sources and the center of the magnet. Sources of magnetic interference may be associated with one or more of the following:

a) AC 50 Hz or 60 Hz: high current cables, etc.

b) AC 50 Hz or 60 Hz: transformers, motors, etc.

c) AC 16.6 Hz or 25 Hz: power cables used for trains

d) Moving iron objects: cars, trucks, elevators, patient beds, equipment, etc.

e) Switched DC: tram, subway, other MR-systems

f) RF noise: antennas, fans (even not magnetic), monitors, engines, transformers, ups, phone switch boards, medical systems, etc.

NOTICE	Fans can create AC noise even if they are not magnetic.

In addition, place a check in the corresponding box to indicate the distance range for any sources of interference. The mark(s) in the column with the lowest class number will determine the preliminary site status:

- Class 1: Very critical site, installation probably impossible
- Class 2: Critical site, installation probably possible but additional shielding required
- Class 3: Normal site, installation possible but additional shielding may be required
- Class 4: Uncritical site, installation probably possible, additional shielding not required

Remarks

Use this section to enter any comments you consider important regarding installing the system at that location.

General Information

Tab. 27: General Information

Sales representative:			
Project manager:			
Sales status:	sold: ☐	probable: ☐	possible: ☐
Customer name:			
City:			
Report issued by:			
Date and signature:			

Situation Report

Tab. 28: Situation Report - What is located where...?

Behind the magnet	+X	
In front of the magnet	-X	
Above the magnet	+Y	
Below the magnet	-Y	
Right of the magnet	+Z	
Left of the magnet	-Z	

Distance Check

Tab. 29: Distance check: - Where are...?

Sources of interference	Class 1		Class 2		Class 3		Class 4		X	Y	Z
a) AC 50 Hz or 60 Hz: High current cables	< 1 m	☐	1 to 5 m	☐	5 to 10 m	☐	> 10 m	☐	☐	☐	☐
b) AC 50 Hz or 60 Hz: Transformers	< 4 m	☐	4 to 7 m	☐	7 to 10 m	☐	> 10 m	☐	☐	☐	☐
c) AC 16.6 Hz or other train frequencies	< 20 m	☐	20 to 100 m	☐	100 to 250 m	☐	> 250 m	☐	☐	☐	☐
d) Moving iron (dynamic interference)											
– <50 kg: Wheel chair, etc.	< 2 m	☐	2 to 4 m	☐	4 to 5 m	☐	> 5 m	☐	☐	☐	☐
– 200 kg: Patient bed, etc.	< 3 m	☐	3 to 6 m	☐	6 to 8 m	☐	> 8 m	☐	☐	☐	☐
– 900 kg: Car, small elevator, etc.	< 5 m	☐	5 to 9 m	☐	9 to 12 m	☐	> 12 m	☐	☐	☐	☐
– >4500 kg: Truck, large elevator, etc.	< 6 m	☐	6 to 11 m	☐	11 to 17 m	☐	> 17 m	☐	☐	☐	☐
e) DC cables from tram or subway	< 15 m	☐	15 to 40 m	☐	40 to 250 m	☐	> 250 m	☐	☐	☐	☐
f) Iron plates in floor	< 30 kg/m^2	☐									

Remarks

Tab. 30: Remarks

Annex 3

Planning summary

Minimum Space Requirements
3 m x 3.2 m x 2.4 m

Floor Load Requirements
1500 kg

Maximum RF Noise
40 dB μV/m (linear coils)
30 dB μV/m (DPA coils)

Maximum Values without EFI	
DC (< 5 Hz)	100 nT pkpk (1 mG)
AC (16.7 Hz)	60 nT pkpk (0.1 mG)
AC (50-60 Hz)	150 nT pkpk (0.6 mG)

Maximum Values with EFI	
DC (< 5 Hz)	4000 nT pkpk (40 mG)
AC (16.7 Hz)	2500 nT pkpk (25 mG)
AC (50-60 Hz)	4000 nT pkpk (40 mG)

Environmental Requirements	
Temperature range	20 – 26 °C
Temperature stability	3 °C/h
Humidity range	45 – 80 %
Pressure	700 – 1060 hPa

Power Requirements	
Power requirements	AC 100/110/220/230/240 V ±10%
Frequency	50/60 Hz ±10%
Power (during quick magnet hating)	1.1 kVA
Power (during normal work)	0.6 kVA
Power (stand by)	0.15 kVA

Power Supply Cable Features	
Section	1.5 mm^2
Length	10 m

Modem

Length of Modem Cable
2.15 m

Camera

Maximum Cable Length for Analog Connection
10 m

Maximum Cable Length for Digital Connection
40 m

Maximum Cable Length for Optical Link Connection
100 m

System Components

Dimension of system components			
Part	Width	Depth	Height
Magnet and Electronic Unit	146 cm	66 cm	128 cm
Patient Seat	64 cm	123 cm	86 cm
Operating Console	108 cm	88 cm	74 cm
CRT Monitor	46 cm	44 cm	47 cm
TFT Monitor	45 cm	18 cm	47 cm

Weight of system components	
Part	Weight
Magnet and Electronic Unit	1150 kg
Patient Seat	60 kg
Operating Console	30 kg
CRT Monitor	23.5 kg
TFT Monitor	8 kg

Dissipated Fringe Filed

Fringe Field		Distance from the Magnetic Center in Direction of		
Gauss	mTesla	X axis (m)	Y axis (m)	Z axis (m)
30	3	0.5	0.6	0.6
10	1	0.8	1	0.8
5	0.5	1.2	1.1	1.2
1	0.1	2.3	1.7	1.8

Heat Dissipation

Heat Dissipation of System Components	
Magnet unit and console	400 W

Acoustic Noise

Acoustic Noise
58dB (A)

Transport

Content	Content weight	Size (LxWxH)
Magnet unit	1100 kg	93x83x163cm
PC Unit and Electronic Units	230 kg	147x77x148cm
Patient's Bed	172 kg	139x77x110cm
Covers	96 kg	123x78x55cm
Monitor	30 kg	58x55x63cm

Platform Size
L 90 x W 80 x H 16.5 cm

Carriage Device Dimensions
L 77 x W 120 x H 87 cm

Carriage Device Weight
100 kg

Minimum Door Dimension
80 cm

Temperature Range During Transportation and Storage	
Minimum temperature	-5°C
Maximum temperature	50°C

Humidity Range During Transportation and Storage	
Humidity range	10 ÷ 95%

Pressure Range During Transportation and Storage	
Minimum pressure	500 hPa
Maximum pressure	1060 hPa

Maximum Tilt During Transportation and Storage	
Maximum tilt	10 %

Part 6 Index

N

O

P

R

S

T

U