Specifications for the CMI 2409 Magnetocardiograph

Revision date April 14, 2006

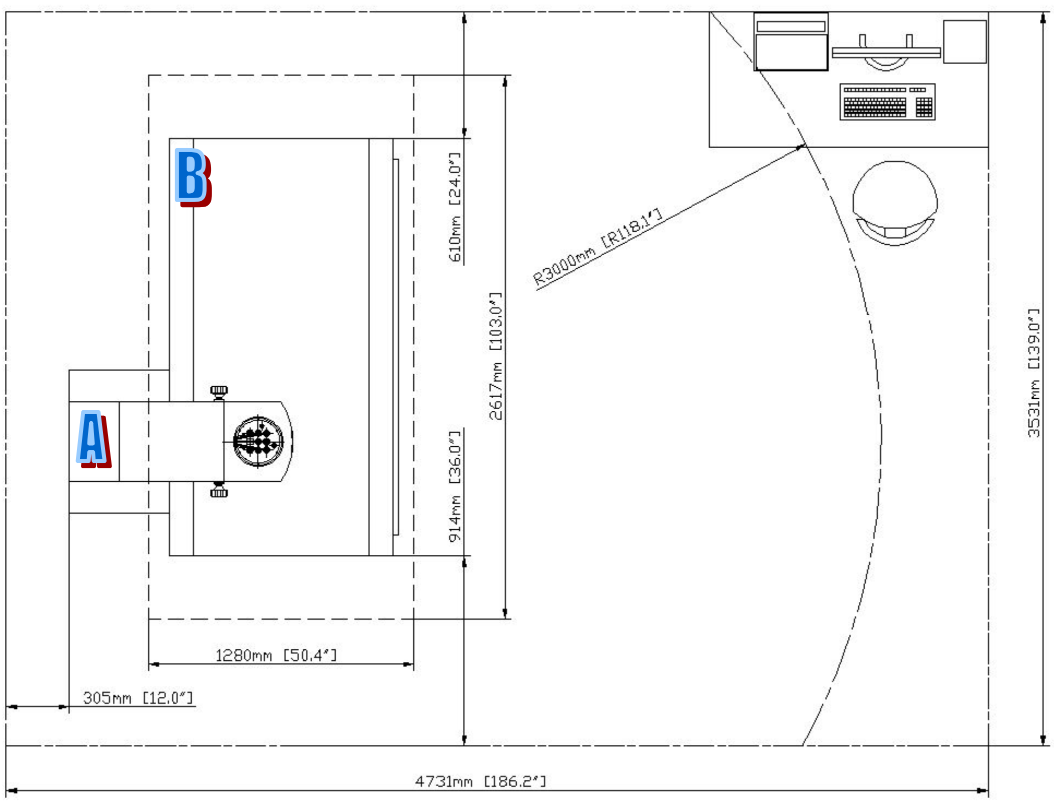
The CMI-2409 system consists of a holder (A), a patient bed (B) and a workstation (not shown in the picture below). The workstation consists of a computer, monitor, keyboard, printer and SQUID system electronics power supply. Nine MCG sensors are housed in a cryostat (see "Cryostat" below) and the cryostat is supported in the holder. The patient lies directly below the cryostat.

Location Requirements

- The system should be located as far as possible (at least 20 meters) from working elevators and parking lots.
- The system should be located as far away as possible from various sources of RF interference, e.g. ultrasound and MRI machines, microwave ovens, etc.
- To avoid interference with a patient measurement the minimum distance by which various items (from any direction: above, below, etc.) must be separated from the MCG Sensors is summarized in the following table.

Distance	Item
1.5 meters	Fluorescent lights
3 meters	Computer, printer, LCD monitor, MCG power supply, PDA, pager, mobile phone, small immobile metallic objects
4 meters	Small fans and motors, treadmills, furnishings with movable metallic parts
8 meters	Lab Centrifuges Oscillating ventilators, etc.
20 meters	MRI, elevators, moving vehicles, heaters and air conditioners

- The recommended floor space is approximately 5 m x 4 m (see drawing below: note that an LCD monitor is recommended; CRT monitors could generate electromagnetic interference; the chair shown should not contain metallic parts.)
- The height of the holder is approximately 2.1 m; during liquid helium refill (see "Cryostat" below) a recess in the ceiling (60 cm x 60 cm x 60 cm) somewhere in the MCG room is needed to facilitate insertion of a rigid tube into the liquid helium storage tank..
- For floor loading considerations the weights of the main components are:
  - Holder (with cryostat and electronics) 160 kg
  - Patient bed 115 kg
  - The patient bed is designed to accommodate a maximum weight of 160 kg



Room Layout

System Power Requirements

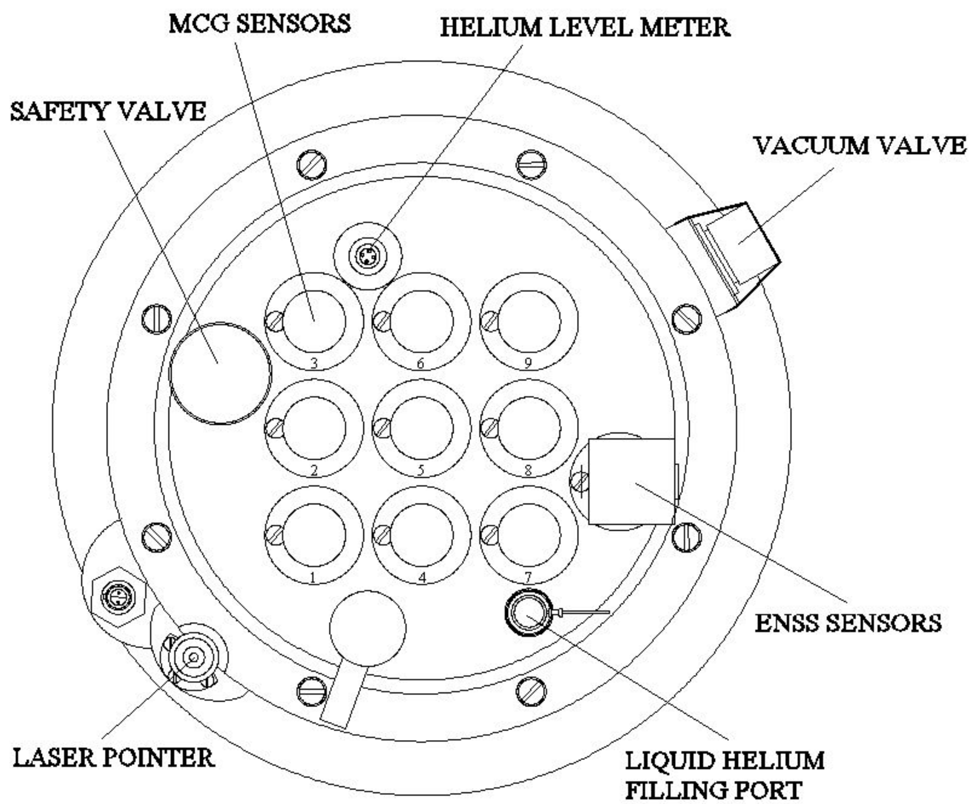
- The complete system power consumption, including the computer and monitor, is 250 - 260 W (@ 100,120, 230, or 240V/50-60Hz).

System Communication Requirements

- A 512 kbps or faster LAN connection is recommended to receive software updates and to access a secure location on the CardioMag server for remote service.

Magnetic Field Sensors

- System uses nine axial second-order gradiometers, each connected to its own SQUID (superconducting quantum interference device). The gradiometers are arranged in a uniform 3 x 3 grid providing 80 mm x 80 mm coverage.
- An MCG scan using the CMI 2409 involves four adjacent measurements to produce a 6 x 6 output with a corresponding 200 mm x 200 mm coverage area.
- An electronic noise suppression system (ENSS) which utilizes output from three additional SQUIDS (not linked to a gradiometer) enhances the quality of the magnetic field measurements.



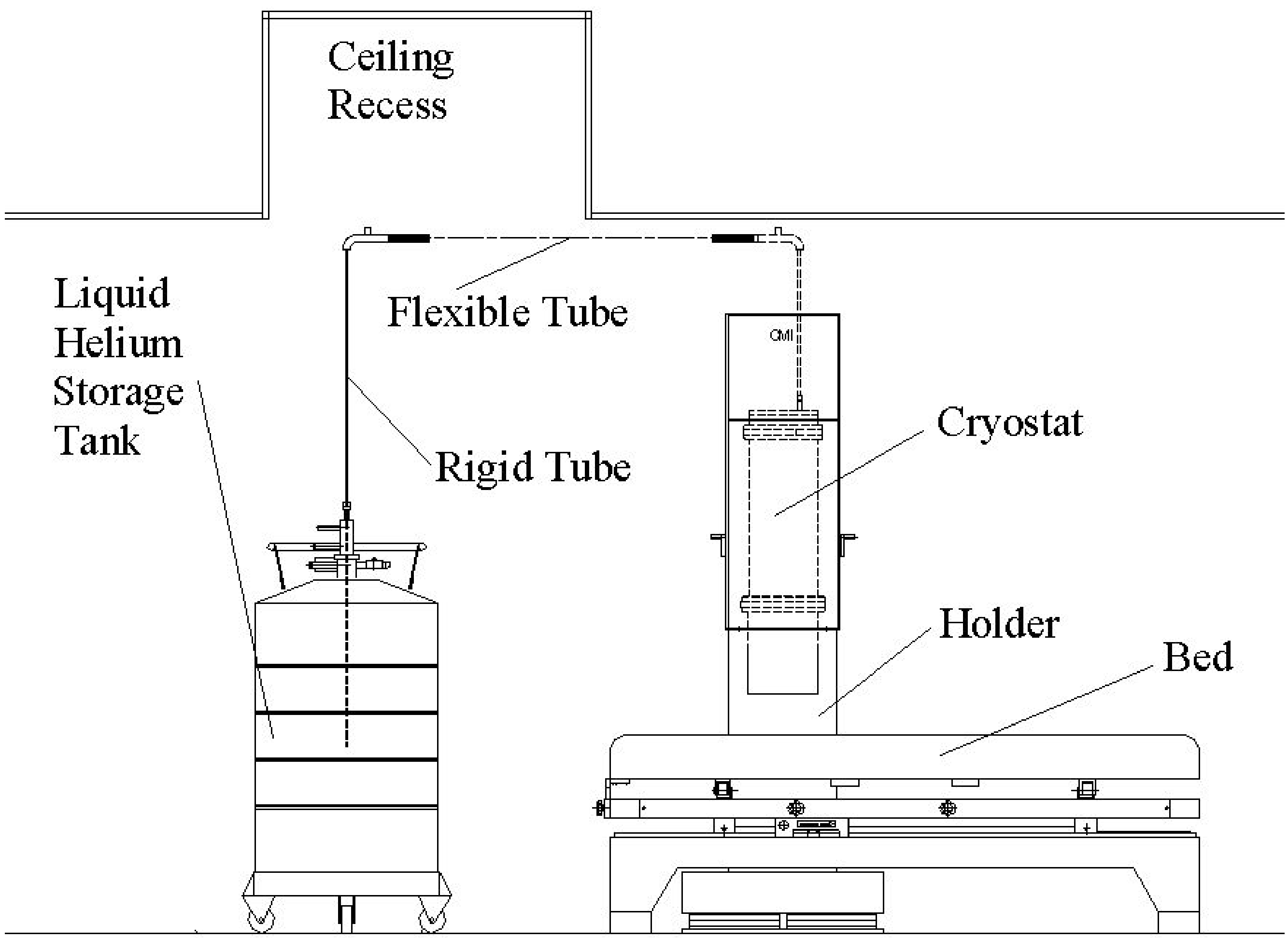
Top View of Cryostat

Electronics

- The SQUID electronics module operates with 24-bit resolution and communicates with:
    - A liquid helium level meter in the cryostat
    - An ECG module mounted inside the holder via fiber-optic interface (FOI)
    - Bed-positioning sensors
    - Computer workstation for data acquisition and system control via FOI
    - MCG power supply

Cryostat

- The cryostat is a specially constructed non-magnetic cylindrical vessel in which the MCG sensors are housed. It is designed to safely contain liquid helium (a fluid at a temperature of -269 C) which is necessary for sensor operation.
- The cryostat holds 12 liters of liquid helium (55 cm fill depth).
- The level of liquid helium should not fall below a depth of 15 cm; otherwise MCG sensor performance may deteriorate. Consequently, it is recommended that the user add liquid helium to the cryostat twice a week, but no longer than every five days, to ensure optimum system performance.
- Experience shows that the annual consumption of liquid helium is 800 liters (including losses due to transfer during refilling the cryostat).
- Losses from an external liquid helium storage container supplied by a cryogen supplier are additional and will vary depending on the cryogen supplier and the details of the contractual supply arrangement.
- The equipment used/furnished by the liquid helium supplier must be compatible with the fittings supplied by CMI for the liquid helium transfer tubes.



Software

- The MCG software is specially designed for Windows XP and performs system operation, sensor adjustment and control, data acquisition at a default of 1,000 Hz, database management, data analysis and output. The details of the software capabilities are amply illustrated in a separate document.

Highlighted features include

- Comprehensive database for patient registration and exam tracking
- Automatic instrument adjustment (SQUID channel adjustment)
- Real-time data acquisition for 13 CMI-2409 hardware channels (9 SQUID measurement, 3 SQUID reference, and 1 ECG time reference)
- Automatic processing of raw MCG data including temporal analysis, spectral analysis, and digital filtering
- Automatic time-averaging of MCG data with integrated heartbeat recognition, heartbeat template assignment, and Heartbeat comparison
- Two and Three-Dimensional Magnetic Field Map (MFM) Animation
- Magnetic Field Map Analysis Tools
- Inverse solver to determine Effective Magnetic Vector (EMV) source location and orientation
- Dynamic analysis of EMV behavior for detection of cardiac ischemia
- 3-D visualization of MCG Data, torso model, and heart model
- Analysis report printing
- Batch mode express processing of raw data files
- Batch mode EMV analysis of processed data files
- Conversion of MCG data to ASCII files