

Acceptance Testing - GE Signa Excite Echosped 1.5T Scanner

Location: Perth Royal Infirmary, NHS Tayside

1 Safety Checklist

Date of check: started 10/12/2003 ended 07/01/2004

Checks performed by: Dr. S. Gandy, Dr. S. Nicholas, Mr. K. Armoogum

2 Fringe field survey

Mark points on the diagram below along with gaussmeter readings. Note additional readings above and below floor in margin.

Doors controlled by keypad system & sign

MR technical room

MRI control room

0.05mT

Corridor

MRI scanner room

0.07 mT

0.09 mT

Mortuary

Bare roof above.

Below – plant room 2199 at 0.18mT.

Suspended mesh ceiling. Sign affixed to locked gate in mesh.

GE Signa Excite

0.38 mT

0.05 mT

0.11 mT

0.02 mT

0.02 mT



MRI Safety Sign

0.14 mT

B

0.09 mT

A

	Checked	By (Initials)	Comments
Positions of warning signs on doors (mark on diagram)	Yes	KA	None
Operation of door controls (point A on diagram)	Yes	KA	None
Operation of scanner room door interlock (point B)		KA	None
Engineer to confirm operation of the emergency power off button	Yes	KA	None

Table B- 1: Cross checks.

3

### Determination of 0.5mT isomagnetic contour

As a part of the acceptance testing at Perth Royal Infirmary, I was required to determine the location of the 0.5mT isomagnetic contour around a GE Signa Excite Ecospeed 1.5T Scanner .

#### 1 Manufacturers' data

When the MRI unit is installed, the manufacturers will provide plans showing the extent of the isomagnetic contours from the static magnetic field.

There are many factors that could affect the position of the theoretical gausslines, such as the presence of:

- Metal girders in the fabric of the building
- Nearby heavy plant machinery e.g. lifts

By making periodic independent checks of the fringe fields, it may be verified that the controlled area fully protects patients, staff and members of the public.

#### 2 What was measured

Periodic measurements of the stray magnetic field strengths at key positions around the MRI unit should be made. This must include the field strengths at:

- Key positions in the console room
- Adjacent corridors/prep rooms/plant rooms
- Outside areas (where applicable)
- Rooms above and below the scan room (where applicable)
- All adjacent areas accessible by members of the public

#### 3 Equipment Used

- Hall Probe
- A 5m length of thin nylon cord
- Calibrated MRI-safe measuring device

#### 4 Experimental Procedure

- All local safety rules (Section 54) relating to entry of personnel into the inner controlled area were observed.
- This procedure was done by myself, Dr. S. Gandy and Dr. S. Nicholas.

#### 5 Results

The isomagnetic contour map below shows the readings obtained after the procedure was repeated.

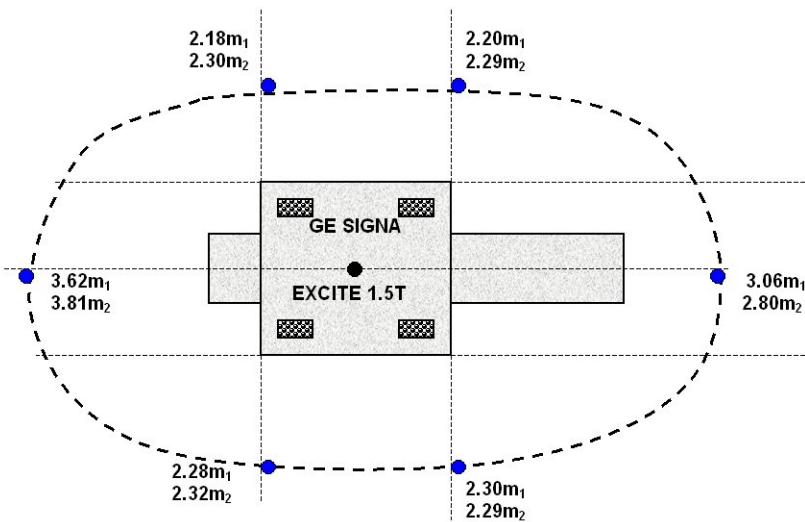


Figure B- 1: The 0.5 mT isocontour around GE Signa Excite Echospeed 1.5T Scanner  
 Table 1 below shows the average repeatability of the isocontour measurements.

Field intensity (mT)	1st Reading (R1) in m	2nd Reading (R2) in m	% difference between R2 and M
0.50	3.06	2.80	8.4%
0.50	3.62	3.81	4.9%
0.50	2.30	2.29	0.4%
0.50	2.28	2.32	1.7%
0.50	2.18	2.30	5.2%
0.50	2.20	2.29	3.9%
		AVERAGE	4.1%

Table B- 2: The percentage difference between experimental and manufacturer’s 0.50mT isomagetic contour line.

### 6 Acceptance Report

After all prescribed acceptance tests were performed, the following report was produced and copies circulated to the manufacturer, Perth Royal Infirmary and Ninewells Hospital.



Department of Medical Physics and Engineering  
Ninewells Hospital and Medical School  
Dundee DD1 9SY

GE Signa Excite  
1.5T MRI Scanner

System Serial No: 00545MRS01

Perth Royal Infirmary

Radiation Physics Acceptance  
Summary Report

29th January 2004

Perth Royal Infirmary

GE Signa Excite 1.5T MRI scanner

Summary of Acceptance Testing 19th—20th December 2003

Acceptance tests were performed to assess the safety and image quality aspects of the new MRI scanner installed in PRI. The tests were performed by Dr Stephen Gandy, Dr Stephen Nicholas (MRI physicists) and Mr Kris Armoogum (trainee medical physicist).

Workstation functionality, scanner connectivity and image quality aspects of specific imaging techniques were not tested.

Where possible, test results were compared against GE acceptance criteria or data contained in the MRHA 1.5T MRI comparison report (MRHA 03025). Other tests were performed as baseline measurements for future reference.

#### Matters outstanding

1. Several RF coils and sequence packages were not supplied by GE at the time of acceptance. A second flat screen monitor has not been provided for the Advantage workstation. Radiology must check outstanding items and verify that the full order has been met. Acceptance of RF coils will be subject to physics tests (note: GE claim only 1 flat screen monitor was ordered. RF coils are to be delivered within the next two weeks).
2. The remote diagnostics tools are still to be enabled by the service engineer.
3. There is a software bug on the system where a small popup window does not clear after completing its function. GE must resolve this problem in a free future software upgrade or patch.
4. The emergency magnet run down button needs to be moved into the control room and positioned adjacent to the oxygen monitor.
5. A high magnetic field warning sign should be placed on the hatch in the suspended ceiling in the room under the scanner (note: action Estates dept).
6. Estates have been asked to supply copies of the MRI scanner room plans to confirm the route and specifications of the quench pipe. GE should be approached for their specifications (note: GE specifications have been obtained. Awaiting Estates plans).
7. During loaded motion into the magnet, the couch emits a creaking sound and feels slightly unstable. GE service engineer to investigate further.
8. The torso phased-array coil was not found to be working during acceptance testing. (note: GE has replaced this coil).
9. Slice profile and thickness for the coronal plane was lower than expected for all slice thicknesses measured. As the gradient calibration was inside specifications, this has been put down to difficulties in phantom positioning for coronal scans. These measurements should be repeated in the near future (note: repeated measurements were found to be in spec).
10. Significant ghosting was seen on the single shot EPI test. This should not detract from routine image quality. Further tests need to be carried out.

## APPENDIX B

## ACCEPTANCE TESTING

GE Signa Excite 1.5T MRI scanner

### Summary of Acceptance Results

1	General Checks		
2	Verification of order	Unsatisfactory outstanding 1)	(see matters
3	Electrical Safety	Acceptable	
4	Laser safety	Acceptable	
5	Remote Diagnostics tool operational	Unsatisfactory outstanding 2)	(see matters
6	Software platform functionality	Acceptable outstanding 3)	(see matters
7	GE System Performance Test (SPT) results in specification	Acceptable (see comment 1)	
1	Safety and magnetic fringe field survey		
1	Location of 0.5mT fringe field line	Acceptable	
2	Fringe field survey	Acceptable	
3	Location of warning signs	Acceptable outstanding 5)	(see matters
4	Location of quench pipe outlet	Acceptable outstanding 6)	(see matters
5	Restricted access to the controlled area	Acceptable	
6	Scanner room door interlock	Acceptable	
7	Emergency magnet run down button operation	Acceptable outstanding 4)	(see matters
8	Operation of O2 alarm and exhaust fans	Acceptable	
9	Operation of emergency power off buttons	Acceptable	
10	Local rules and operating procedures in place	Acceptable	
2	Table motions and patient comfort		
1	Table docking mechanism	Acceptable	
2	Table motions under load	Acceptable outstanding 7)	(see matters
3	Table movement accuracy over 30 cm	Acceptable	
4	Operation of couch motion emergency stop button	Acceptable	
5	Operation of patient alarm	Acceptable	
6	Operation of patient communication system	Acceptable	
7	Operation of bore lighting and ventilation	Acceptable	
8	Operation of in-room camera	Acceptable	
9	Operation of ECG	Acceptable	
10	Operation of Peripheral pulse monitor	Acceptable	
11	Operation of respiratory monitor	Acceptable	

## APPENDIX B

## ACCEPTANCE TESTING

3	Magnetic field		
1	GE shim within specification	Acceptable	
2	Field stability within specification	Acceptable	
4	Gradients		
1	Verification of GE gradient calibration	Acceptable	
2	GE SPT eddy current results	Acceptable	
5	RF		
1	RF cabin integrity	Acceptable	
2	GE SPT system gain and recon factor results	Acceptable	
3	All available RF coils operational	Unsatisfactory	(see matters outstanding 8)
4	GE SPT Head and body SNR results	Acceptable	
6	Image Quality		
1	SNR/uniformity baseline images for all coils	Acceptable	(see comment 2)
2	Slice thickness and profile measurements	Acceptable	(see matters outstanding 9)
3	Geometric linearity/distortion measurements	Acceptable	
4	Ghosting measurements	Acceptable	(see matters outstanding 10)
5	Resolution measurements	Acceptable	
6	Fat saturation measurements	Acceptable	
7	Contrast reference images	Acceptable	

### Comments

1. The service engineer runs SPT tests during Acceptance and routine service. Results are stored on the scanner but are only accessible to the service engineer. The scanner will not operate if any of the SPT tests are out of specification.
2. Comparison measurements for SNR were not in general possible due to the lack of appropriate phantoms. However, reference images and SNR values were obtained for all coils.

### Report Conclusion

This scanner is provisionally accepted as being fit for clinical use subject to the outstanding items as described on page 2 and any additional assessments not included as part of these acceptance tests.

Signed

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**APPENDIX B**

**ACCEPTANCE TESTING**

Dr Stephen Nicholas  
MRI Physicist

Date: \_\_\_\_\_

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Dr Stephen Gandy  
MRI Physicist

Date: \_\_\_\_\_

## 7 Conclusion

GE Signa Excite Echospeed 1.5T Scanner was successfully installed in December 2003 and is now functioning almost at full capacity. The process entailed a major capital investment and involved a significant number of personnel. Medical physicists played a major role throughout in particular the commissioning and the acceptance testing. In the six months that have elapsed since its installation, the scanner has been put through its paces and its performance carefully monitored. Two minor queries arose that were investigated further.

The first was that a zipper artefact appeared on images taken using a particular sequence. This was attributed to RF interference possibly from the lighting system in the inner controlled area. The second was that the volume of cryogen did not seem to decrease over time. Subsequent information from GE pointed out that a recondensing unit recycles most of the evaporated cryogen and therefore the rate of decrease will be much less than expected. A thorough monthly QA program is now in place and a weekly program is close to implementation.

These minor anomalies emphasised the need for post-installation monitoring of MRI scanners with patient safety the main priority.