GE Site
Yearly Performance Evaluation
GE Horizon LX
16-Jul-08

Table of Contents

MRI Equipment Evaluation Summary & Signature Page

Site Name: GE Site **MRAP #** 1981-01

Address: **Survey Date:** 7/16/08

City, State, Zip **Report Date:** 7/17/08

MRI Mfg: GE **Model:** Horizon LX **Field:** 1.5T

MRI Scientist: Moriel NessAiver, Ph.D. **Signature:** Moriel NessAiver, Ph.D.

Equipment Evaluation Tests	Pass	Fail *	N/A
1. Magnetic field homogeneity:	☒	☐	☐
2. Slice position accuracy:	☒	☐	☐
3. Table positioning reproducibility:	☒	☐	☐
4. Slice thickness accuracy:	☒	☐	☐
5. RF coils' performance:			
a. Volume QD Coils	☒	☐	☐
b. Phase Array Coils	☒	☐	☐
c. Surface Coils	☒	☐	☐
6. Inter-slice RF interference (Crosstalk):	☒	☐	☐
7. Soft Copy Display	☐	☒	☐
7. Hard Copy Display	☐	☒	☐

Evaluation of Site's Technologist QC Program	Pass	Fail *	N/A
1. Set up and positioning accuracy: (daily)	☒	☐	☐
2. Center frequency: (daily)	☒	☐	☐
3. Transmitter attenuation or gain: (daily)	☒	☐	☐
4. Geometric accuracy measurments: (daily)	☒	☐	☐
5. Spatial resolution measurements: (daily)	☒	☐	☐
6. Low contrast detectability: (daily)	☒	☐	☐
7. Head Coil SNR (daily)	☒	☐	☐
8. Body Coil SNR (weekly)	☒	☐	☐
9. Fast Spin Echo (FSE/TSE) ghosting levels: (daily)	☒	☐	☐
10. Film quality control: (weekly)	☒	☐	☐
11. Visual checklist: (weekly)	☒	☐	☐

*See comments page for description of any failures.

Specific Comments and Recommendations

1. Overall, the magnet homogeneity is pretty good for this generation magnet. There IS a small region of magnetic field distortion that appears to be located to the patient's Superior/Right/Posterior, maybe 15-20 cm from isocenter. There could be some sort of metal under the table or in the magnet bore. Look at Appendix A for contour plots that clearly indicate the location of the non-uniformity.
2. All of the ACR phantom measurements will pass ACR specs. However, please look at the axial diameters plot of the ACR T2. There is a significant dip in the plot which may be indicative of a local inhomogeneity possibly from some metal in the magnet. Additionally, last year the diameter plots were almost a straight line.
3. Channel 4 of the Phased Array Knee coil is about 10-15 lower than the other 3 channels. This is not enough of a drop that I would say it needs to be replaced, but we should keep an eye on it. This Knee PA coil has almost exactly the same SNR in the sagittal plane as the Knee/Foot coil and about 15% higher in the axial plane.
4. All of the Fire Extinguishers are magnetic. At least the closest units to the manget should be MRI compatible
5. Two of the small ball phantoms (CTL coil) have leaks. This is a potential health hazard. They should be replaced. (Not having them made testing the CTL coil rather difficult.)
6. The LCD monitor's power supply is dying. The monitor fails the ACR minimum brightness requirement.
7. There is very poor correspondence between the image on the screen and what is printed on film.
8. You now have a USAI CTL coil. This is SUPPOSED to come with a pair of phantoms for testing. I could not find these phantoms which made it difficult to test the coil.
9.
10.
11.
12.
13.

NOTE: Please be sure to read appendix D for an explanation of the format of this document.

MRI Equipment Performance Evaluation Data Form

Site Name: GE Site

Contact	Title	Phone	Fax	eMail
	Administrator			
	GE Service			

Equipment Information

MRI Manufacturer: GE Model: Horizon LX SN: 301662MR Software: 9.1.031b

Camera Manufacturer: GE Model: Drystr 8700 SN: Software:

PACS Manufacturer: IDXRad Model: SN: Software:

ACR Phantom Number used: J426

1. Table Positioning Reproducibility: **Pass**

Table motion out/in:	IsoCenter	Out/In	Out/In	Out/In
Measured Phantom Center	-2.3	-1.9	-1.7	-1.7

Comment:

2. Magnetic Field Homogeneity See appendix A for field plots. **PASS**

Last Year CF: **63,873,085** This Year CF: **63,872,927** CF Change: **-158**

GRE TR: 500, TE: 10 & 20 Flip Angle: 40, FOV: 40

10 mm skip 10 mm, BW: 10.4KHz, 256x128, 2nex

	15 cm	20 cm	25 cm
Axial:	0.27	0.43	0.7
Coronal:	0.28	0.42	0.61
Sagittal:	0.2	0.31	0.45

Comments: In general, a good shim. However, there is a region with significant field change in the Right/Superior/Posterior (patient relative) of the magnet. See appendix A.

3. Slice Thickness Accuracy

FOV: 250mm Matrix: 256x256 (Slice #1 from ACR Phantom) All values in mm

Sequence	TR	TE	Flip	NSA	Calc	Target	% Error
SE (ACR)	500	20	90	1	5.01	5	0.2%
SE (Site T1)	500	15	90	1	5.07	5	1.4%
SE (20/80)	2000	20	90	1	5.10	5	2.0%
SE (20/80)	2000	80	90	1	5.07	5	1.4%
FSE(16)	6000	96.6	90	2	5.35	5	7.0%
FSE(2)	450	9	90	2	5.11	5	2.2%

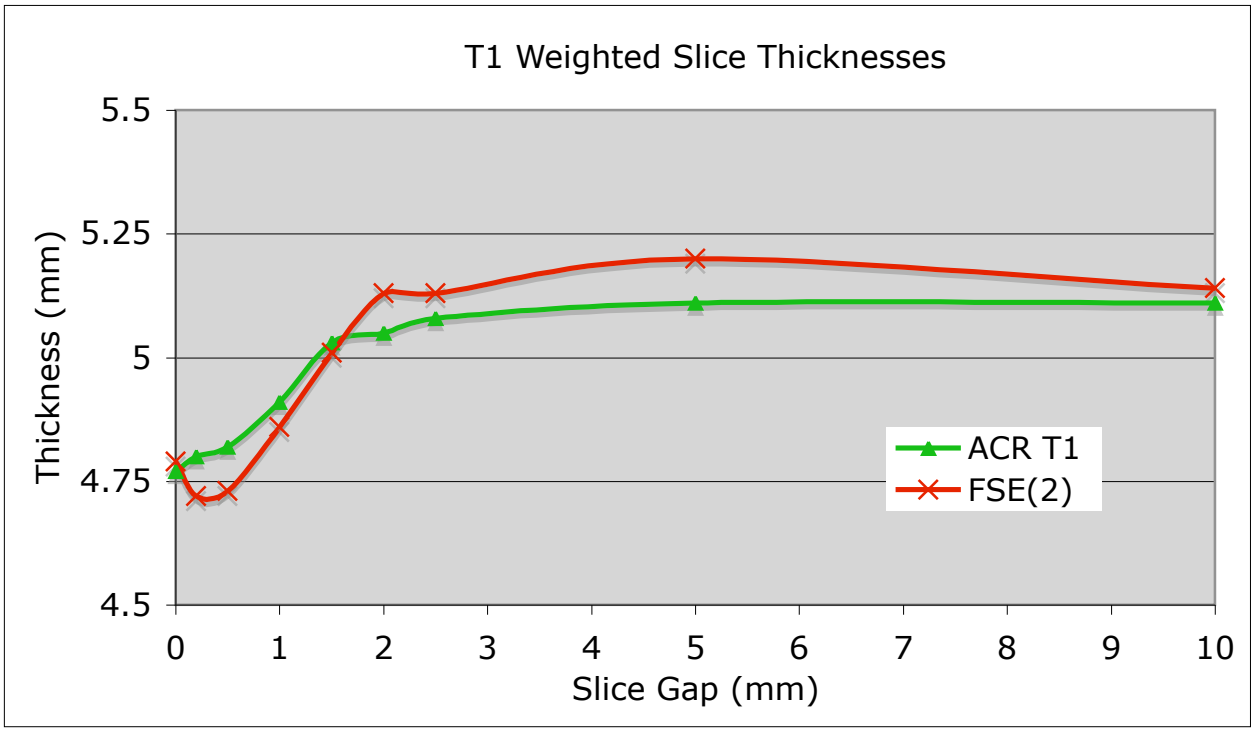
Comments:

4. Slice Crosstalk (RF interference)

The following data were obtained using the ACR phantom slice thickness wedges to measure the slice profile of a two common T1 weighted sequences when the slice gap varies from 200% down to 0% (contiguous) As the slices get closer together it is expected that the edges of the slices will overlap causing a deterioration of the slice profile. The data shown below clearly demonstrates this effect. Once the slice gap reaches 40% (FSE) or 30% (SE) of the slice thickness, the measured slice profile begins to drop. The FSE curve is rather strange, normally one would expect to see a steady drop, not a levelling off. All of the slice profiles can be seen in Appendix B. In those plots, it is easy to see that the simple SE sequence has a much squarer pulse profile than the FSE(2) sequence which will improve SNR while minimizing slice crosstalk.

Sequence Type	450	TE	FOV (cm^2)	Matrix	NSA	Thickness	# of slices	Slice Measured
SE	450	20	25	256x256	1	5	11	6
FSE(2)	450	9	25	256x256	2	5	9	5

Skip	ACR T1	FSE(2)
0	4.77	4.79
0.2	4.8	4.72
0.5	4.82	4.73
1	4.91	4.86
1.5	5.03	5.01
2	5.05	5.13
2.5	5.08	5.13
5	5.11	5.2
10	5.11	5.14



5. Soft & Hard Copy Displays

Luminance Meter Make/Model: Tektronix J16 Digital Photometer Cal Expires: 4/6/06

Monitor Description: Efilm workstation

Luminance Measured: Ft. lamberts

Measured Data					
Which Monitor	Center of Image Display	Top Left Corner	Top Right Corner	Bottom Left Corner	Bottom Right Corner
Console	17.6	15.8	15.2	16.3	15.3

Uniformity		
MAX	MIN	Percent Delta
17.6	15.2	15%

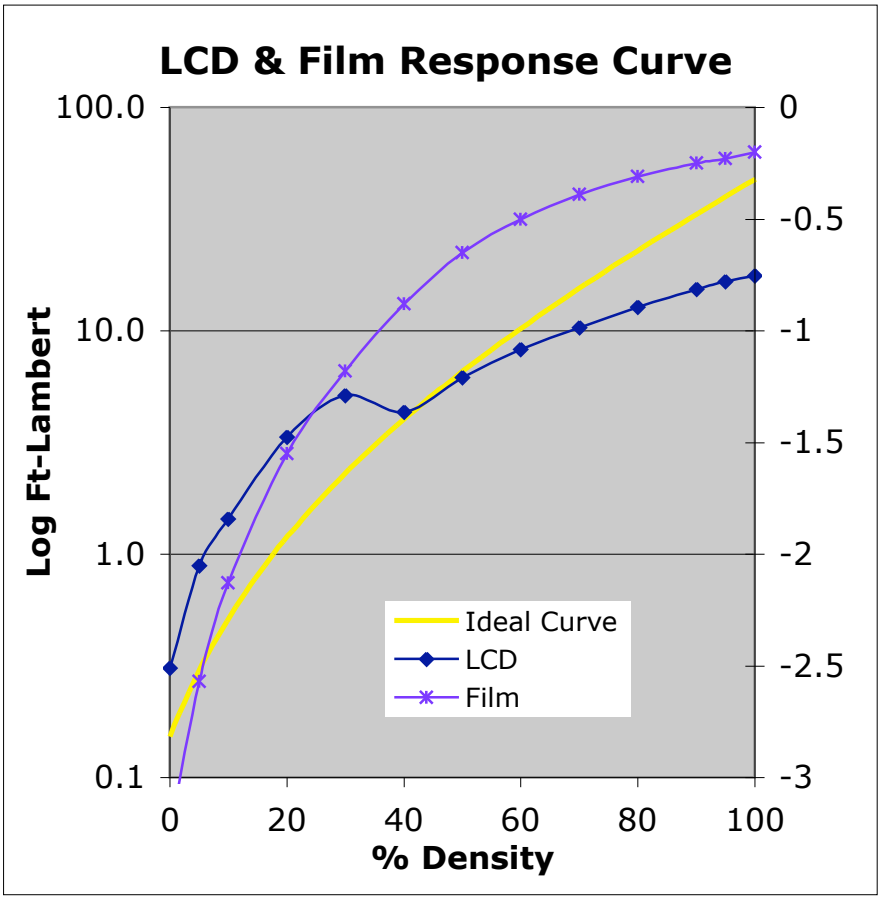
SMPTE
OK?
Y

% delta =200% x (max-min)/(max+center) (>30% is action limit)

Minimum Brightness must be > 26.24 Ft. Lamberts

The display's power supply is not capable of generating enough current to maintain a large percentage of white on the screen. The signal sent to the laser camera does not well match what is seen on the screen.

Density	Ft-Lamberts	Film Density
0	0.31	-3.23
5	0.89	-2.57
10	1.44	-2.13
20	3.35	-1.55
30	5.13	-1.18
40	4.32	-0.88
50	6.18	-0.65
60	8.24	-0.5
70	10.4	-0.39
80	12.8	-0.31
90	15.4	-0.25
95	16.7	-0.23
100	17.6	-0.2



Coil and Other Hardware Inventory List

Site Name GE Site

ACR Magnet # 01 Nickname GE Horizon

Active	Coil Description	Manufacturer	Model	Rev.	Mfg. Date	SN	Channels
☐	Torso Array	Gore	2104700			#2	4
☐	Shoulder Array	Medrad	87305-T-466		Mar, 1998	SPAA0171	3
☒	Anterior Neck Coil	Medical Advances	310GE-64		Dec, 1998	22440	1
☒	Body - Integrated						1
☒	CTL Phased Array	GE	2074799		Apr, 1996	29730VP9	4
☒	CTL Phased Array USA	USA Instrument	222545-6		May, 2000	1436	4
☒	Dual 3 inch	GE	M1085GA		Apr, 2005	1116oWH9	2
☒	GP Flex	GE	2128554		Apr, 1998	981662	1
☒	GP Flex	GE	2128554		Apr, 1998	981686	1
☒	Head Quad	GE	4628211862		Apr, 1998	141761MR7	1
☒	Knee Phased Array	Medical Advances	46-320406P1		Apr, 1998	KPA0518	4
☒	Knee/Foot	Medical Advances	472GE-64		Mar, 2001	29035	1
☒	Shoulder Array	Medrad	2100937-17		Apr, 1998	SPAA0188	3
☒	Torso Array	Gore	2104700			#1	4
☐							

RF Coil Performance Evaluation

Coil: Anterior Neck Coil
Mfg.: Medical Advances
Mfg. Date: 12/7/1998 Coil ID: 802
Phantom: Volume Neck Phantom Jug

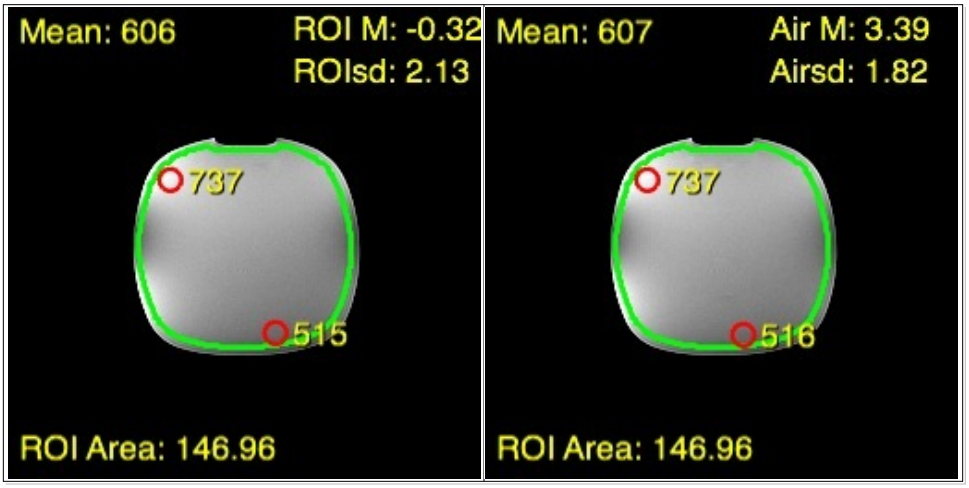
Test Date: 7/16/2008
Model: 310GE-64
Revision:
SN: 22440
# of Channels 1

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	30	256	256	15.6	1	3	-

Coil Mode: ANTNECK TX gain: 139 R1: 11 R2: 29

Analysis of Test Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	606	737	515	-0.3	2.13	NEMA	201.2	201.2	244.7	82.3%
A	607	737	516	3.4	1.82	Air	218.6	218.6	265.4	82.4%



RF Coil Performance Evaluation

Coil: Body - Integrated

Mfg.:

Mfg. Date: Coil ID: 804

Phantom: 32 cm sphere

Test Date: 7/16/2008

Model:

Revision:

SN:

# of Channels 1

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	48	256	256	15.6	1	3	-

Coil Mode: Body - Isocenter

TX gain: 164 R1: 11 R2: 30

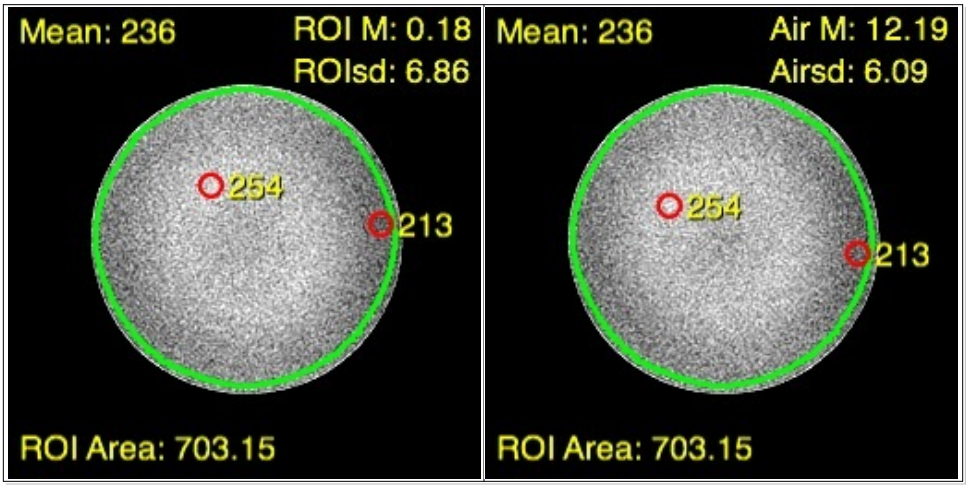
Analysis of Test Image

Measured Data

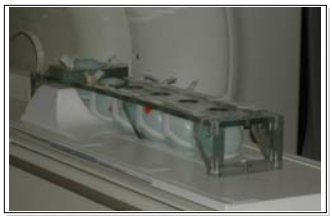
Label	Mean	Max	Min	Background	Noise SD	Noise Type
N	236	254	213	0.2	6.86	NEMA
A	236	254	213	12.2	6.09	Air

Calculated Results

Label	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	24.3	9.5	26.2	91.2%
A	25.4	9.9	27.3	91.2%



RF Coil Performance Evaluation



Coil: CTL Phased Array
Mfg.: GE
Mfg. Date: 4/1/1996 Coil ID: 801
Phantom: 6 small balls in CTL holder

Test Date: 7/16/2008
Model: 2074799
Revision:
SN: 29730VP9
# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	S	48	256	256	15.6	1.5	3	-

Coil Mode: a CTLTOP TX gain: 160 R1: 11 R2: 30

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Background	Noise SD	Noise Type
1	1,727	2,299	1,260	2.8	0.79	Air
2	789	1,068	516	2.8	0.79	Air
3	923	1,517	508	2.8	0.79	Air
4	1,614	2,126	992	2.8	0.79	Air

Calculated Results

Mean SNR	Normal-ized	Max SNR	Uni-formity
1432.6	456.9	1907.0	70.8%
654.5	208.7	885.9	65.2%
765.6	244.2	1258.4	50.2%
1338.8	427.0	1763.5	63.6%

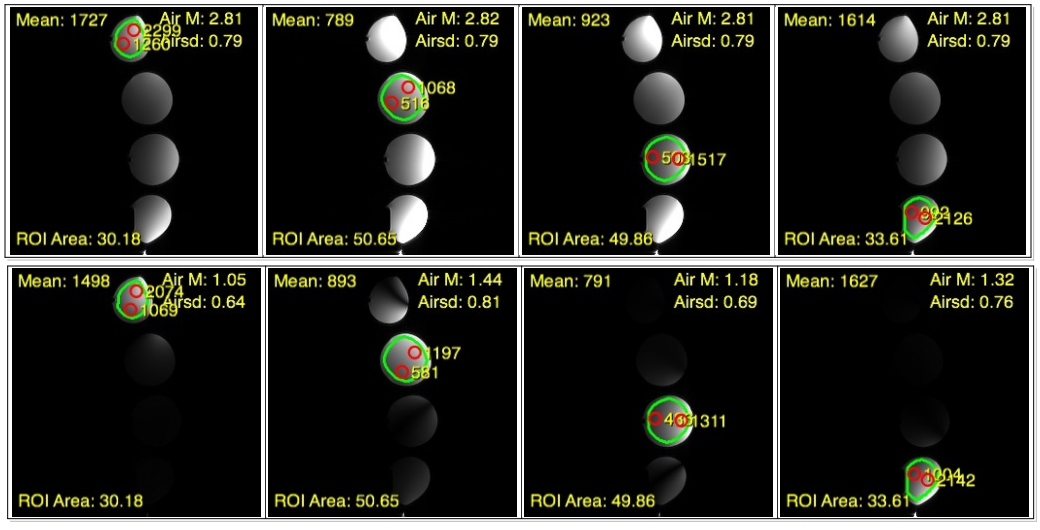
Analysis of Uncombined Images

Measured Data

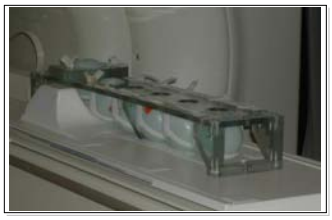
Ch	Mean	Max	Noise SD	Noise Type
1	1,498	2,074	0.64	Air
2	893	1,197	0.81	Air
3	791	1,311	0.69	Air
4	1,627	2,142	0.76	Air

Calculated Results

Mean SNR	% of Mean	Max SNR	% of Max
1533.8	100%	2123.6	100%
722.5	47%	968.4	46%
751.2	49%	1245.1	59%
1402.9	91%	1846.9	87%



RF Coil Performance Evaluation



Coil: CTL Phased Array
Mfg.: GE
Mfg. Date: 4/1/1996 Coil ID: 801
Phantom: 6 small balls in CTL holder

Test Date: 7/16/2008
Model: 2074799
Revision:
SN: 29730VP9
# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	S	48	256	256	15.6	1.5	3	-

Coil Mode: b CTLMID TX gain: 159 R1: 11 R2: 30

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Background	Noise SD	Noise Type
2	1,390	2,032	850	3.0	0.84	Air
3	995	1,618	541	3.0	0.84	Air
4	978	1,535	571	3.0	0.84	Air
5	1,695	2,273	1,009	3.0	0.84	Air

Calculated Results

Mean SNR	Normal-ized	Max SNR	Uni-formity
1084.4	345.9	1585.2	59.0%
776.2	247.6	1262.2	50.1%
763.0	243.3	1197.5	54.2%
1322.3	421.7	1773.2	61.5%

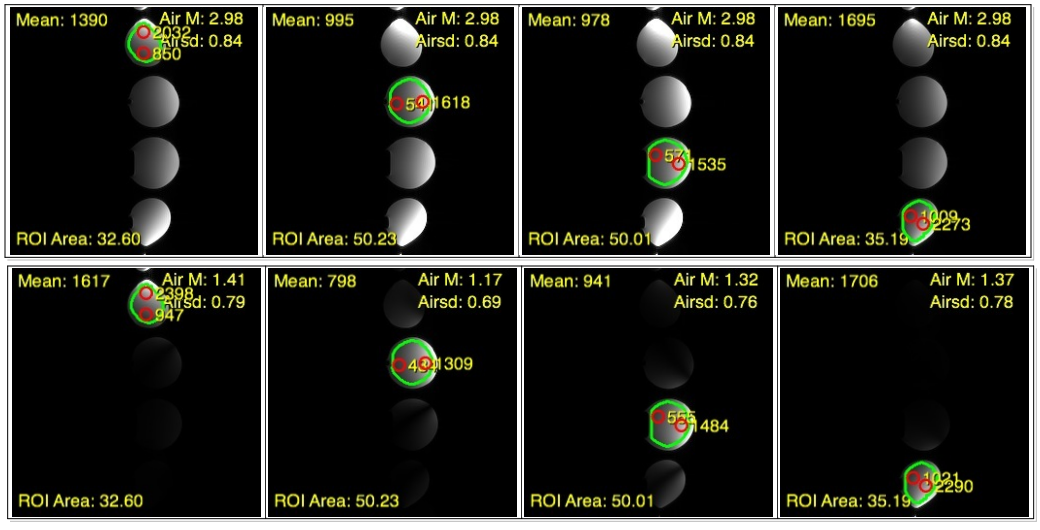
Analysis of Uncombined Images

Measured Data

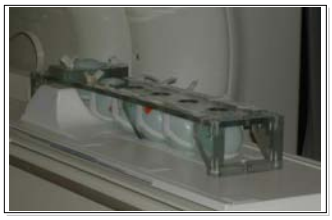
Ch	Mean	Max	Noise SD	Noise Type
2	1,617	2,398	0.79	Air
3	798	1,309	0.69	Air
4	941	1,484	0.76	Air
5	1,706	2,290	0.78	Air

Calculated Results

Mean SNR	% of Mean	Max SNR	% of Max
1341.3	94%	1989.2	100%
757.9	53%	1243.2	62%
811.4	57%	1279.6	64%
1433.3	100%	1923.9	97%



RF Coil Performance Evaluation



Coil: CTL Phased Array
Mfg.: GE
Mfg. Date: 4/1/1996 Coil ID: 801
Phantom: 6 small balls in CTL holder

Test Date: 7/16/2008
Model: 2074799
Revision:
SN: 29730VP9
# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	S	48	256	256	15.6	1.5	3	-

Coil Mode: c CTLBOT TX gain: 158 R1: 11 R2: 30

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Background	Noise SD	Noise Type
3	1,452	1,964	884	3.0	0.83	Air
4	928	1,454	554	3.0	0.83	Air
5	935	1,534	524	3.0	0.83	Air
6	1,822	2,480	1,092	3.0	0.83	Air

Calculated Results

Mean SNR	Normal-ized	Max SNR	Uni-formity
1146.4	365.6	1550.6	62.1%
732.7	233.7	1148.0	55.2%
738.2	235.4	1211.1	50.9%
1438.5	458.8	1958.0	61.1%

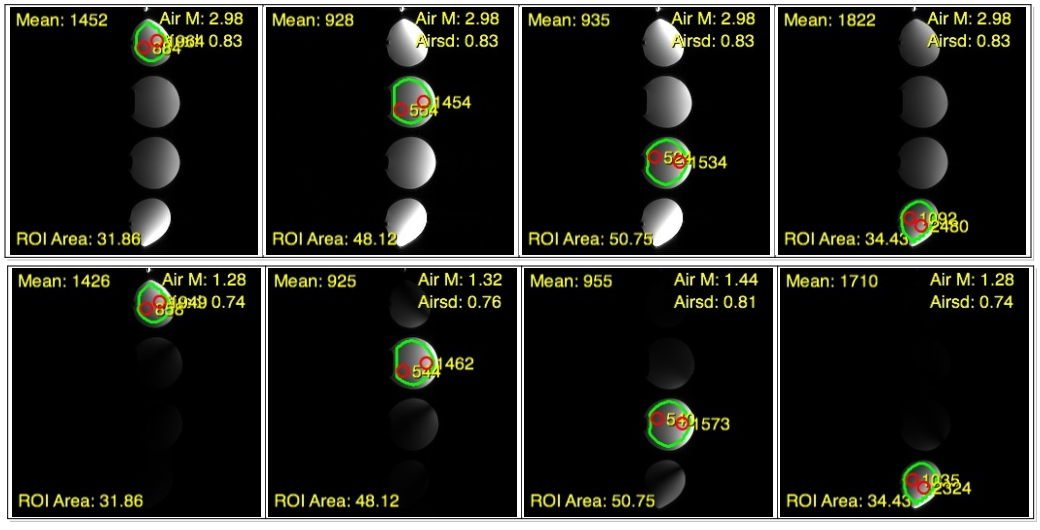
Analysis of Uncombined Images

Measured Data

Ch	Mean	Max	Noise SD	Noise Type
3	1,426	1,949	0.74	Air
4	925	1,462	0.76	Air
5	955	1,573	0.81	Air
6	1,710	2,324	0.74	Air

Calculated Results

Mean SNR	% of Mean	Max SNR	% of Max
1262.8	83%	1725.9	84%
797.6	53%	1260.6	61%
772.6	51%	1272.6	62%
1514.3	100%	2058.0	100%



RF Coil Performance Evaluation

Coil: CTL Phased Array USA
Mfg.: USA Instrument
Mfg. Date: 5/26/2000 Coil ID: 1722
Phantom: 5 small balls in CTL holder

Test Date: 7/16/2008
Model: 222545-6
Revision:
SN: 1436
# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	S	48	256	256	25.6	1.5	3	-

Coil Mode: a USCS123 TX gain: 156 R1: 10 R2: 29

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Background	Noise SD	Noise Type
N	2,208	4,100	1,012	0.9	2.89	NEMA
A	2,207	4,100	1,011	5.2	1.67	Air

Calculated Results

Mean SNR	Normalized	Max SNR	Uniformity
540.3	220.8	1003.3	39.6%
866.0	353.8	1608.8	39.6%

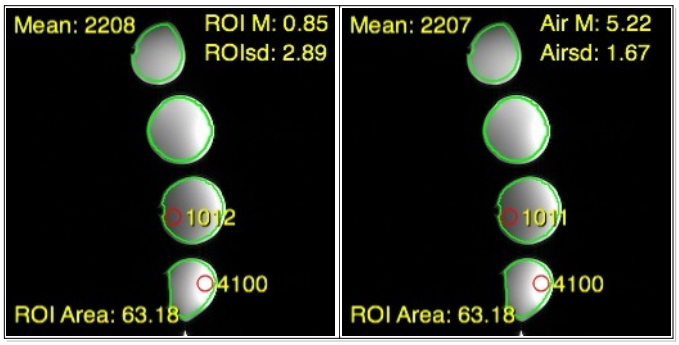
Analysis of Uncombined Images

Measured Data

Ch	Mean	Max	Noise SD	Noise Type
1	725	1,458	0.98	Air
2	1,576	4,323	2.01	Air
3	1,167	3,429	1.36	Air

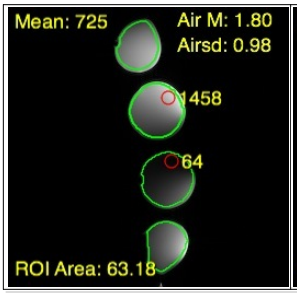
Calculated Results

Mean SNR	% of Mean	Max SNR	% of Max
484.8	86%	974.9	59%
513.8	91%	1409.4	85%
562.3	100%	1652.2	100%

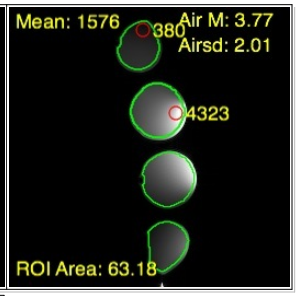


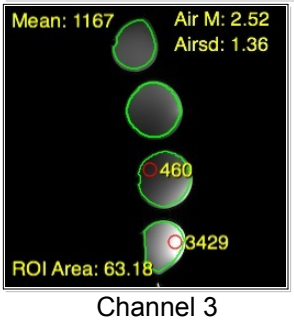
Composites

Channel 1



Channel 2





Channel 3

RF Coil Performance Evaluation

Coil: CTL Phased Array USA
Mfg.: USA Instrument
Mfg. Date: 5/26/2000 Coil ID: 1722
Phantom: 5 small balls in taped to coil

Test Date: 7/16/2008
Model: 222545-6
Revision:
SN: 1436
# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	S	48	256	256	25.6	1.5	3	-

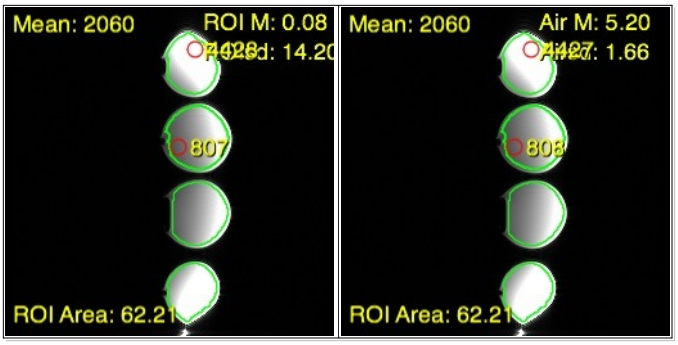
Coil Mode: b USCTLTMID TX gain: 157 R1: 10 R2: 29

Analysis of Composite Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	2,060	4,428	807	0.1	14.20	NEMA	102.6	41.9	220.5	30.8%
A	2,060	4,427	808	5.2	1.66	Air	813.2	332.3	1747.6	30.9%

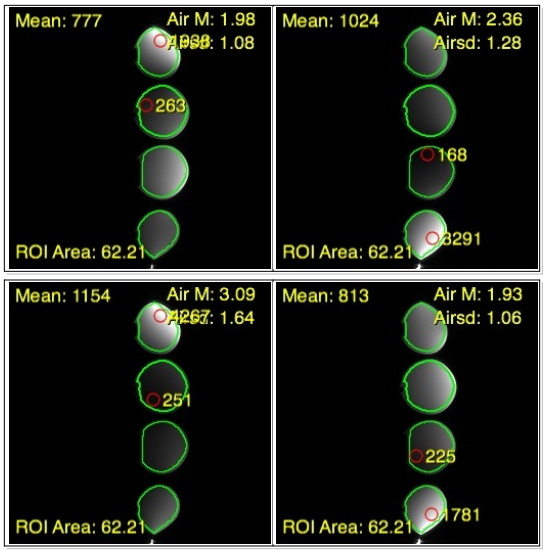
Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	777	1,938	1.08	Air	471.5	90%	1175.9	69%
2	1,024	3,291	1.28	Air	524.2	100%	1684.9	99%
3	1,154	4,267	1.64	Air	461.1	88%	1705.0	100%
4	813	1,781	1.06	Air	502.6	96%	1101.0	65%



Composites

Channel 1 Channel 2



Channel 3 Channel 4

RF Coil Performance Evaluation

Coil: CTL Phased Array USA
Mfg.: USA Instrument
Mfg. Date: 5/26/2000 Coil ID: 1722
Phantom: 5 small balls in taped to coil

Test Date: 7/16/2008
Model: 222545-6
Revision:
SN: 1436
# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	S	48	256	256	25.6	1.5	3	-

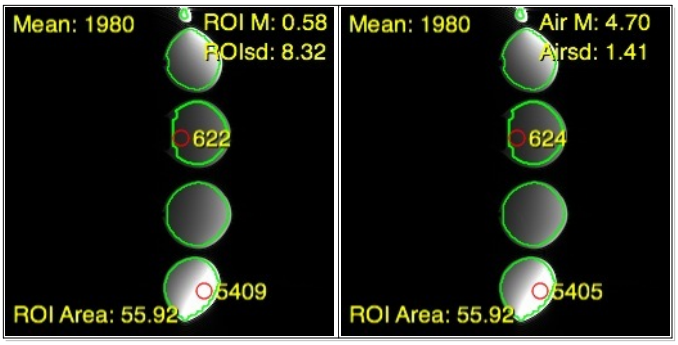
Coil Mode: c USCTLTBOT TX gain: 159 R1: 10 R2: 29

Analysis of Composite Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
159	10	29	622	0.6	8.32	NEMA	0.9	0.3	2.5	191.1%
A	1,980	5,405	624	4.7	1.41	Air	920.2	376.0	2512.0	20.7%

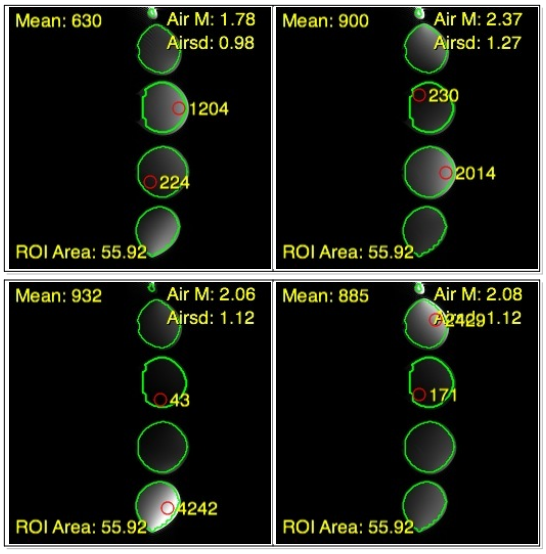
Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	630	1,204	0.98	Air	421.3	77%	805.1	32%
2	900	2,014	1.27	Air	464.4	85%	1039.2	42%
3	932	4,242	1.12	Air	545.3	100%	2482.0	100%
4	885	2,429	1.12	Air	517.8	95%	1421.2	57%



Composites

Channel 1 Channel 2



Channel 3 Channel 4

RF Coil Performance Evaluation

Coil: Dual 3 inch
Mfg.: GE
Mfg. Date: 4/01/2005 Coil ID: 800
Phantom: Head TLT sphere

Test Date: 7/16/2008
Model: M1085GA
Revision:
SN: 1116oWH9
# of Channels 2

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	36	256	256	15.6	1	3	-

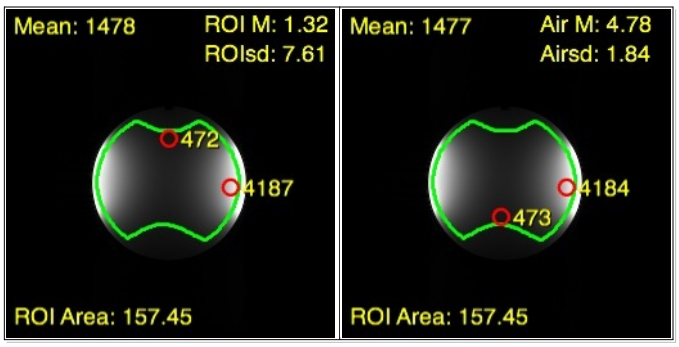
Coil Mode: DUAL TX gain: 145 R1: 11 R2: 29

Analysis of Composite Image

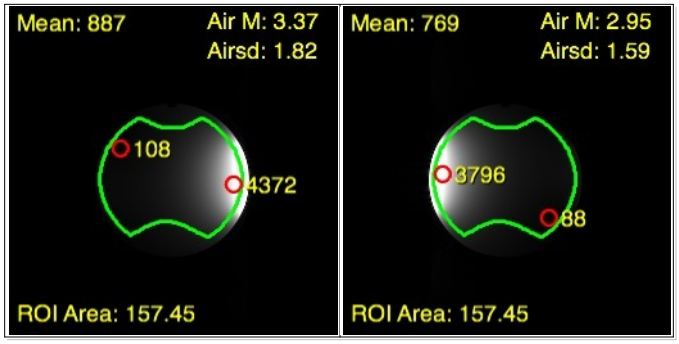
Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	1,478	4,187	472	1.3	7.61	NEMA	137.4	95.4	389.1	20.3%
A	1,477	4,184	473	4.8	1.84	Air	526.0	365.3	1490.1	20.3%

Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	887	4,372	1.82	Air	319.4	100%	1574.2	100%
2	769	3,796	1.59	Air	316.9	99%	1564.5	99%



Composites



Channel 1 Channel 2

RF Coil Performance Evaluation

Coil: GP Flex
Mfg.: GE
Mfg. Date: 4/16/1998 Coil ID: 805
Phantom: 1 gallon Volume Neck jug

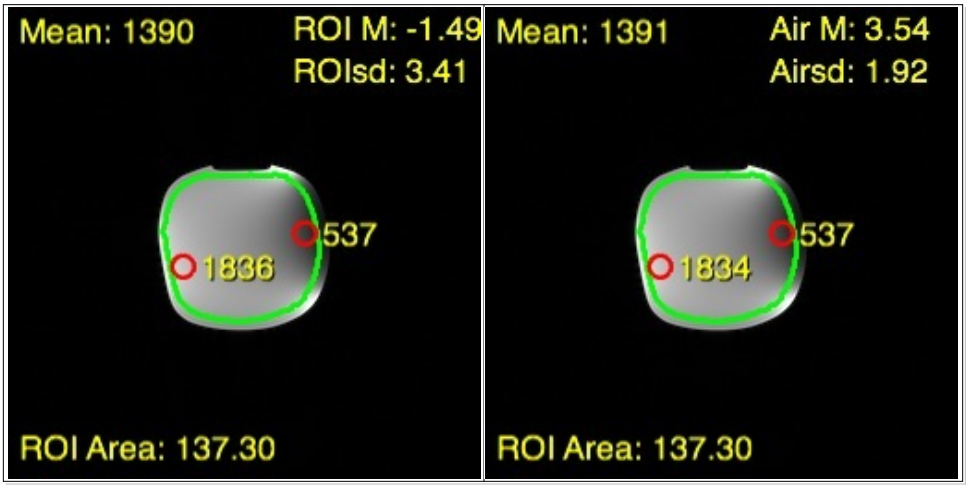
Test Date: 7/16/2008
Model: 2128554
Revision:
SN: 981662
# of Channels 1

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	40	256	256	15.6	1	3	-

Coil Mode: GPFLEX TX gain: 126 R1: 10 R2: 29

Analysis of Test Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	1,390	1,836	537	-1.5	3.41	NEMA	288.3	162.2	380.8	45.3%
A	1,391	1,834	537	3.5	1.92	Air	474.8	267.1	626.0	45.3%



RF Coil Performance Evaluation

Coil: GP Flex
Mfg.: GE
Mfg. Date: 4/16/1998 Coil ID: 806
Phantom: 1 gallon Volume Neck jug

Test Date: 7/16/2008
Model: 2128554
Revision:
SN: 981686
# of Channels 1

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	40	256	256	15.6	1	3	-

Coil Mode: GPFLEX TX gain: 125 R1: 10 R2: 29

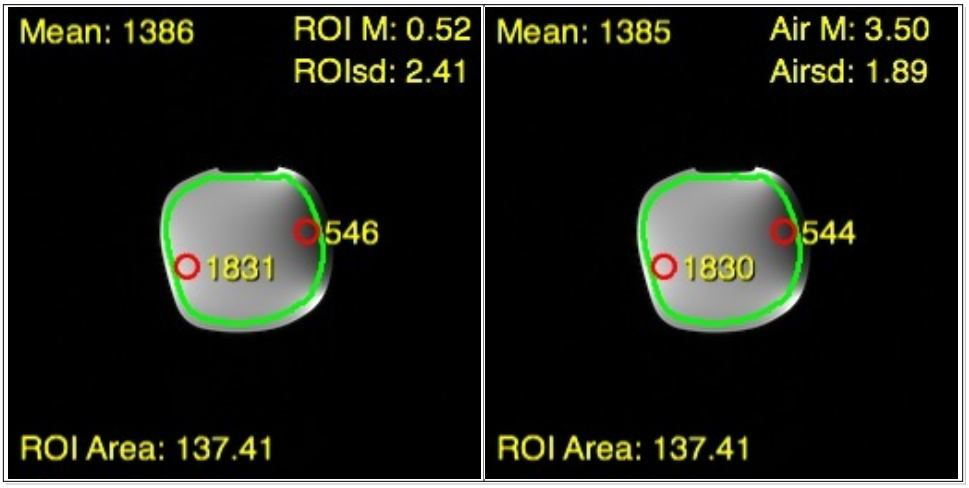
Analysis of Test Image

Measured Data

Label	Mean	Max	Min	Background	Noise SD	Noise Type
N	1,386	1,831	546	0.5	2.41	NEMA
A	1,385	1,830	544	3.5	1.89	Air

Calculated Results

Label	Mean SNR	Normalized	Max SNR	Uniformity
N	406.7	228.8	537.3	45.9%
A	480.2	270.1	634.5	45.8%



RF Coil Performance Evaluation

Coil: Head Quad

Mfg.: GE

Mfg. Date: 4/01/1998 Coil ID: 796

Phantom: ACR Phantom - use flood region

Test Date: 7/16/2008

Model: 4628211862

Revision:

SN: 141761MR7

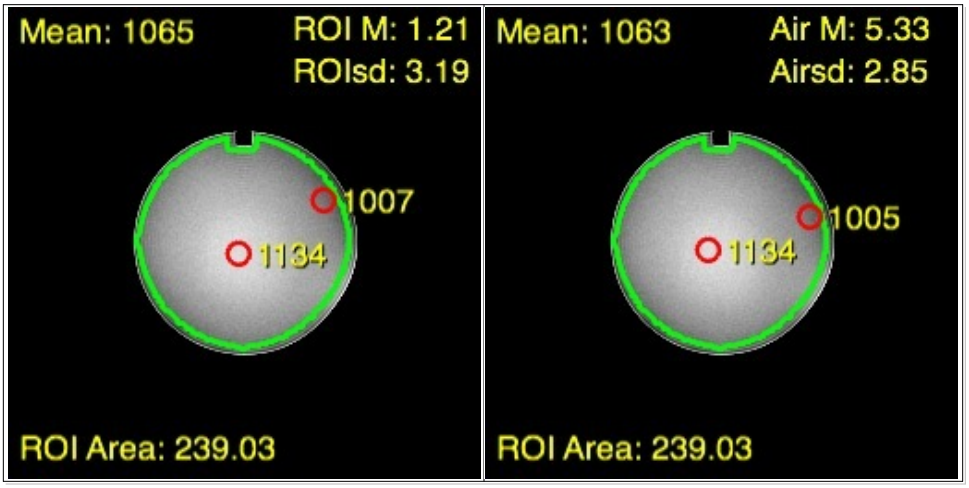
# of Channels 1

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	40	256	256	15.6	1	3	-

Coil Mode: HEAD TX gain: 121 R1: 10 R2: 29

Analysis of Test Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	1,065	1,134	1,007	1.2	3.19	NEMA	236.1	132.8	251.4	94.1%
A	1,063	1,134	1,005	5.3	2.85	Air	244.4	137.5	260.7	94.0%



RF Coil Performance Evaluation

Coil: Knee Phased Array
Mfg.: Medical Advances
Mfg. Date: 4/01/1998 Coil ID: 803
Phantom: Head TLT sphere

Test Date: 7/16/2008
Model: 46-320406P1
Revision:
SN: KPA0518
# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	36	256	256	15.6	1	3	-

Coil Mode: KNEEPA TX gain: 151 R1: 11 R2: 29

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Background	Noise SD	Noise Type
N	915	977	840	0.4	1.51	NEMA
A	915	976	839	4.6	1.31	Air

Calculated Results

Mean SNR	Normalized	Max SNR	Uniformity
428.5	297.6	457.6	92.5%
457.7	317.9	488.2	92.5%

Analysis of Uncombined Images

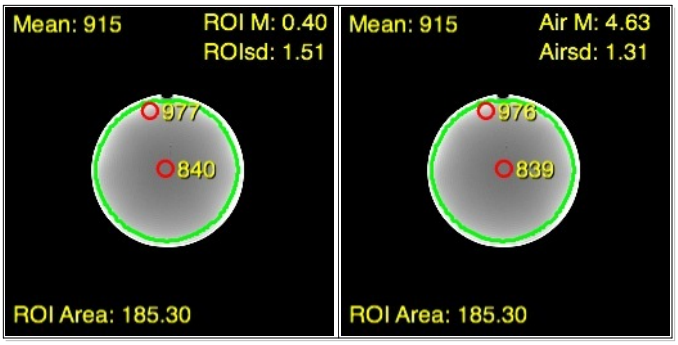
Measured Data

Ch	Mean	Max	Noise SD	Noise Type
1	517	672	1.19	Air
2	498	643	1.21	Air
3	480	542	1.22	Air
4	324	373	1.00	Air

Calculated Results

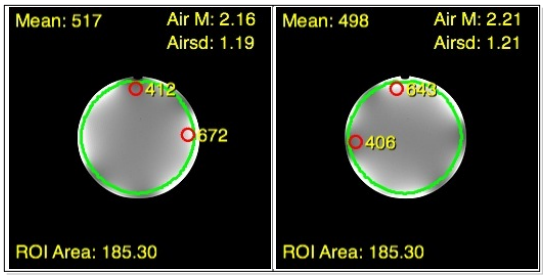
Mean SNR	% of Mean	Max SNR	% of Max
284.7	100%	370.1	100%
269.7	95%	348.2	94%
257.8	91%	291.1	79%
212.3	75%	244.4	66%

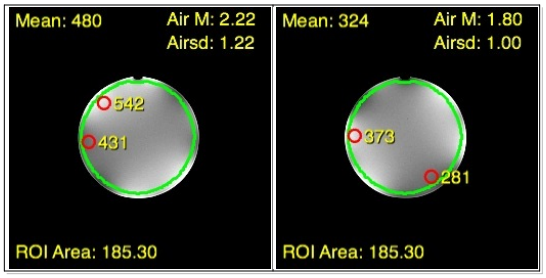
Channel 4 is a little low, not bad enough to replace



Composites

Channel 1 Channel 2





Channel 3 Channel 4

RF Coil Performance Evaluation

Coil: Knee Phased Array
Mfg.: Medical Advances
Mfg. Date: 4/01/1998 Coil ID: 803
Phantom: Head TLT sphere

Test Date: 7/16/2008
Model: 46-320406P1
Revision:
SN: KPA0518
# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	S	36	256	256	15.6	1	3	-

Coil Mode: KNEEPA TX gain: 154 R1: 11 R2: 30

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Background	Noise SD	Noise Type
N	869	1,065	677	-0.1	3.84	NEMA
A	869	1,071	677	4.5	1.26	Air

Calculated Results

Mean SNR	Normalized	Max SNR	Uniformity
160.0	111.1	196.1	77.7%
452.0	313.9	557.0	77.5%

Analysis of Uncombined Images

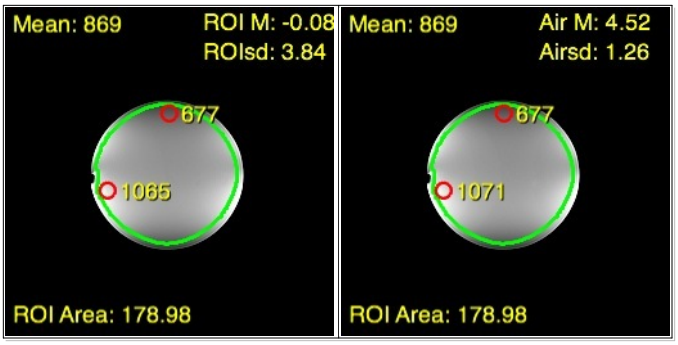
Measured Data

Ch	Mean	Max	Noise SD	Noise Type
1	391	659	1.16	Air
2	413	870	1.18	Air
3	444	831	1.20	Air
4	284	481	0.99	Air

Calculated Results

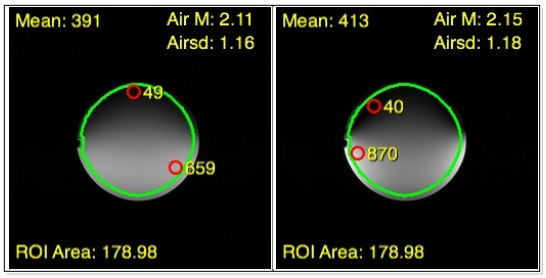
Mean SNR	% of Mean	Max SNR	% of Max
220.9	91%	372.3	77%
229.4	95%	483.2	100%
242.5	100%	453.8	94%
188.0	78%	318.4	66%

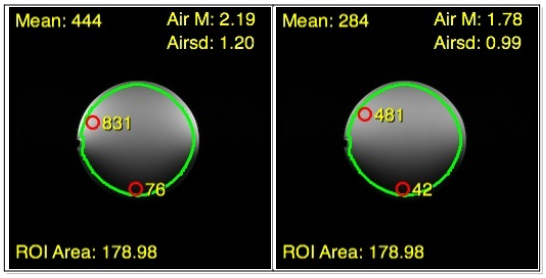
Channel 4 is a little low, not bad enough to replace



Composites

Channel 1 Channel 2





Channel 3 Channel 4

RF Coil Performance Evaluation

Coil: Knee Phased Array
Mfg.: Medical Advances
Mfg. Date: 4/01/1998 Coil ID: 803
Phantom: Head TLT sphere

Test Date: 7/16/2008
Model: 46-320406P1
Revision:
SN: KPA0518
# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	C	36	256	256	15.6	1	3	-

Coil Mode: KNEEPA TX gain: 151 R1: 11 R2: 29

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Background	Noise SD	Noise Type
N	870	1,009	684	0.4	1.33	NEMA
A	870	1,009	685	4.6	1.30	Air

Calculated Results

Mean SNR	Normalized	Max SNR	Uniformity
462.6	321.3	536.5	80.8%
438.6	304.6	508.6	80.9%

Analysis of Uncombined Images

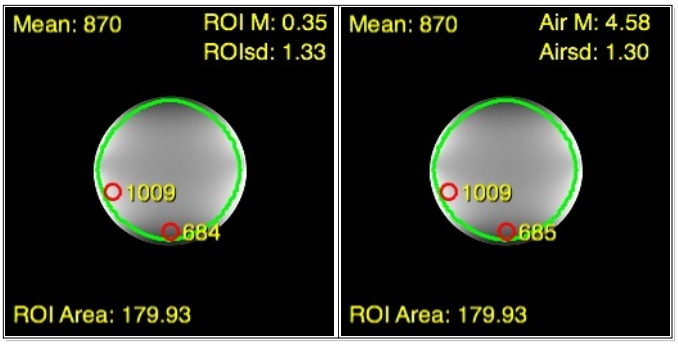
Measured Data

Ch	Mean	Max	Noise SD	Noise Type
1	428	834	1.18	Air
2	375	598	1.19	Air
3	416	667	1.20	Air
4	310	597	1.00	Air

Calculated Results

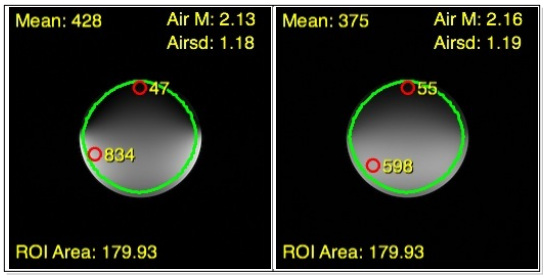
Mean SNR	% of Mean	Max SNR	% of Max
237.7	100%	463.2	100%
206.5	87%	329.3	71%
227.2	96%	364.2	79%
203.1	85%	391.2	84%

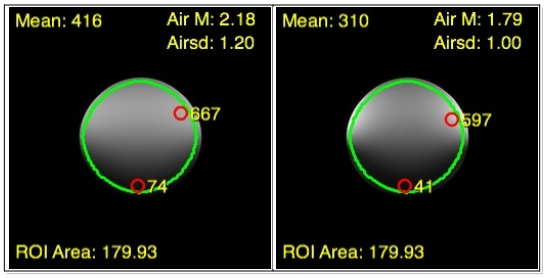
Channel 4 is a little low, not bad enough to replace



Composites

Channel 1 Channel 2





Channel 3 Channel 4

RF Coil Performance Evaluation

Coil: Knee Phased Array
Mfg.: Medical Advances
Mfg. Date: 4/01/1998 Coil ID: 803
Phantom: Knee/Foot bottle (for comparison to Knee/Foot results)

Test Date: 7/16/2008
Model: 46-320406P1
Revision:
SN: KPA0518
# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	40	256	256	15.6	1	3	-

Coil Mode: KNEEPA TX gain: 151 R1: 11 R2: 29

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Background	Noise SD	Noise Type
N	508	517	495	-0.0	1.51	NEMA
A	508	516	495	4.0	1.12	Air

Calculated Results

Mean SNR	Normalized	Max SNR	Uniformity
237.9	133.8	242.1	97.8%
297.2	167.2	301.9	97.9%

Analysis of Uncombined Images

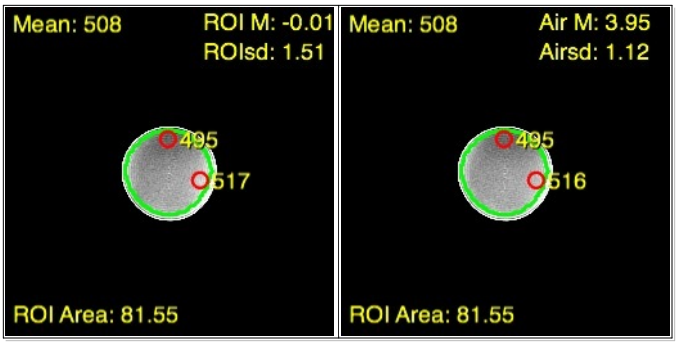
Measured Data

Ch	Mean	Max	Noise SD	Noise Type
1	264	289	0.97	Air
2	269	295	1.03	Air
3	284	308	1.07	Air
4	187	203	0.87	Air

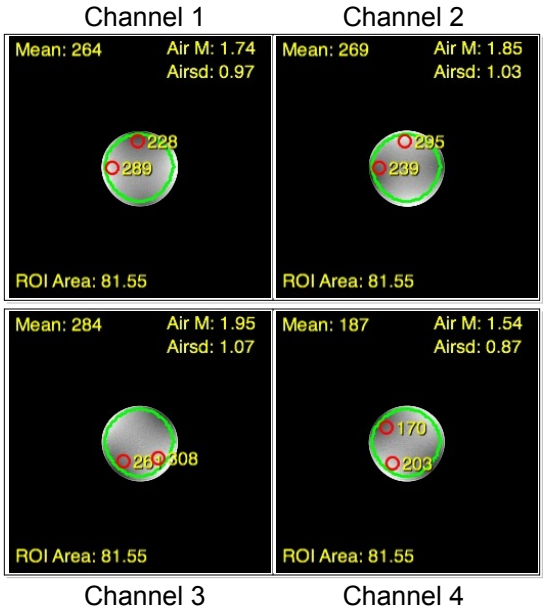
Calculated Results

Mean SNR	% of Mean	Max SNR	% of Max
178.4	100%	195.2	100%
171.1	96%	187.7	96%
173.9	98%	188.6	97%
140.9	79%	152.9	78%

Channel 4 is a little low, not bad enough to replace.
In this plane, this coil has about 16% higher SNR.



Composites



RF Coil Performance Evaluation

Coil: Knee Phased Array
Mfg.: Medical Advances
Mfg. Date: 4/01/1998 Coil ID: 803
Phantom: Knee/Foot bottle (for comparison to Knee/Foot results)

Test Date: 7/16/2008
Model: 46-320406P1
Revision:
SN: KPA0518
# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	S	40	256	256	15.6	1	3	-

Coil Mode: KNEEPA TX gain: 151 R1: 11 R2: 29

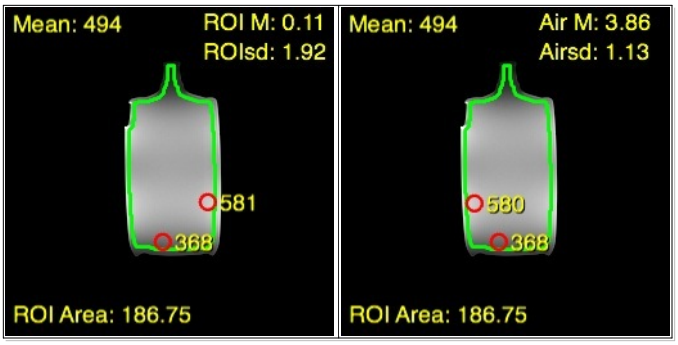
Analysis of Composite Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	494	581	368	0.1	1.92	NEMA	182.0	102.4	214.0	77.6%
A	494	580	368	3.9	1.13	Air	286.5	161.1	336.4	77.6%

Analysis of Uncombined Images

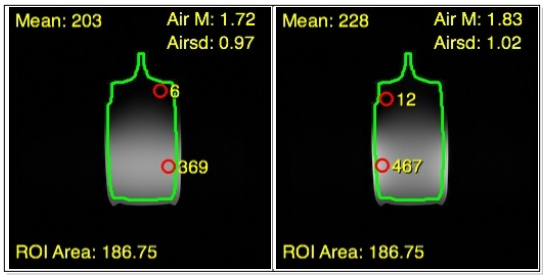
Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	203	369	0.97	Air	137.1	94%	249.3	83%
2	228	467	1.02	Air	146.5	100%	300.0	100%
3	235	478	1.07	Air	143.9	98%	292.7	98%
4	162	318	0.87	Air	122.0	83%	239.5	80%

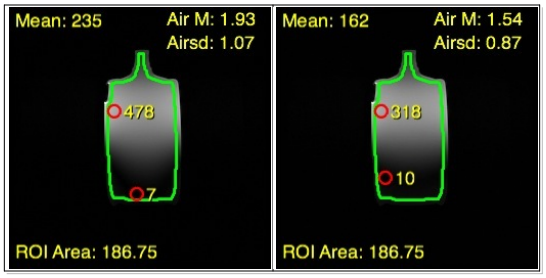
Channel 4 is a little low, not bad enough to replace. Interestingly, the SNR of this coil is almost identical to the knee portion of the knee/foot coil.



Composites

Channel 1 Channel 2





Channel 3 Channel 4

RF Coil Performance Evaluation

Coil: Knee/Foot
Mfg.: Medical Advances
Mfg. Date: 3/15/2001 Coil ID: 797
Phantom:

Test Date: 7/16/2008
Model: 472GE-64
Revision:
SN: 29035
# of Channels 1

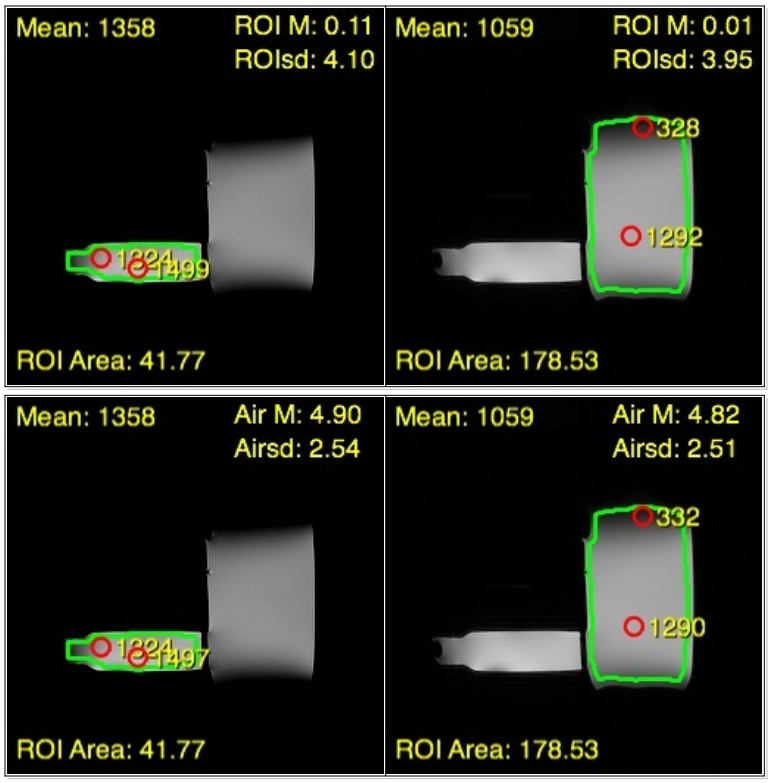
Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	S	40	256	256	15.6	1	3	-

Coil Mode: EXTREM
TX gain: 95 R1: 11 R2: 29

Analysis of Test Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	1,358	1,499	1,324	0.1	4.10	NEMA	234.2	131.8	258.6	93.8%
N	1,059	1,292	328	0.0	3.95	NEMA	189.6	106.7	231.3	40.5%
A	1,358	1,497	1,324	4.9	2.54	Air	350.4	197.1	386.2	93.9%
A	1,059	1,290	332	4.8	2.51	Air	276.5	155.5	336.8	40.9%

Test Images



RF Coil Performance Evaluation

Coil: Knee/Foot

Mfg.: Medical Advances

Mfg. Date: 3/15/2001 Coil ID: 797

Phantom:

Test Date: 7/16/2008

Model: 472GE-64

Revision:

SN: 29035

# of Channels 1

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	40	256	256	15.6	1	3	-

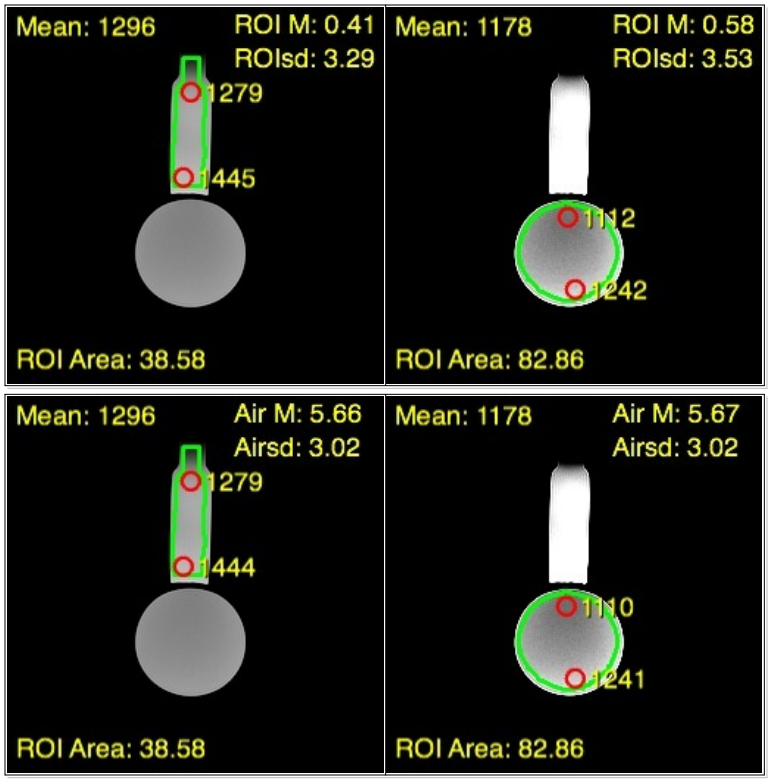
Coil Mode: EXTREM

TX gain: 96 R1: 11 R2: 28

Analysis of Test Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	1,296	1,445	1,279	0.4	3.29	NEMA	278.6	156.7	310.6	93.9%
N	1,178	1,242	1,112	0.6	3.53	NEMA	236.0	132.8	248.8	94.5%
A	1,296	1,444	1,279	5.7	3.02	Air	281.2	158.2	313.3	93.9%
A	1,178	1,241	1,110	5.7	3.02	Air	255.6	143.8	269.3	94.4%

Test Images



RF Coil Performance Evaluation

Coil: Shoulder Array
Mfg.: Medrad
Mfg. Date: 4/1/1998 Coil ID: 1721
Phantom: Body Sphere

Test Date: 7/16/2008
Model: 2100937-17
Revision:
SN: SPAA0188
# of Channels 3

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	48	256	256	15.6	1	3	-

Coil Mode: SHOPA3 TX gain: 130 R1: 11 R2: 29

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Background	Noise SD	Noise Type
N	469	1,071	141	0.3	1.26	NEMA
A	469	1,070	141	2.7	0.92	Air

Calculated Results

Mean SNR	Normalized	Max SNR	Uniformity
263.2	102.8	601.1	23.3%
334.1	130.5	762.2	23.3%

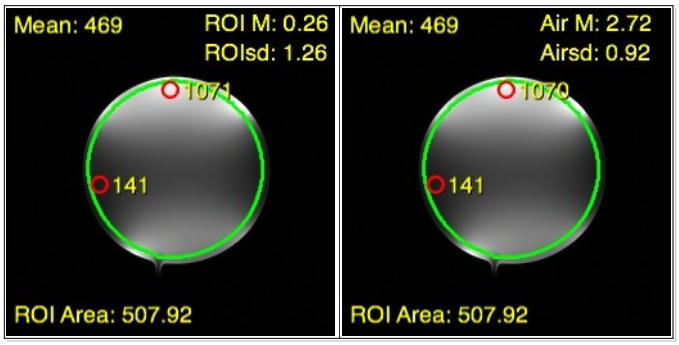
Analysis of Uncombined Images

Measured Data

Ch	Mean	Max	Noise SD	Noise Type
1	229	989	0.85	Air
2	180	729	0.73	Air
3	236	791	0.88	Air

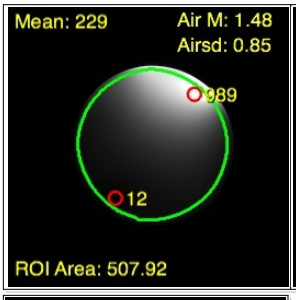
Calculated Results

Mean SNR	% of Mean	Max SNR	% of Max
176.5	100%	762.5	100%
161.6	92%	654.4	86%
175.7	100%	589.0	77%

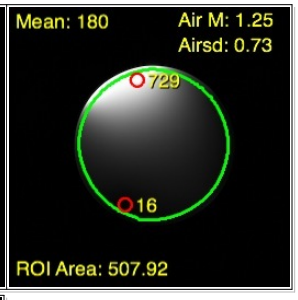


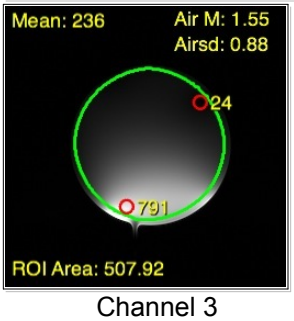
Composites

Channel 1



Channel 2





Channel 3

RF Coil Performance Evaluation

Coil: Shoulder Array
Mfg.: Medrad
Mfg. Date: 4/1/1998 Coil ID: 1721
Phantom: Body Sphere

Test Date: 7/16/2008
Model: 2100937-17
Revision:
SN: SPAA0188
# of Channels 3

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	S	48	256	256	15.6	1	3	-

Coil Mode: SHOPA3 TX gain: 130 R1: 11 R2: 29

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Background	Noise SD	Noise Type
N	485	1,123	192	0.3	1.52	NEMA
A	485	1,121	192	2.7	0.92	Air

Calculated Results

Mean SNR	Normalized	Max SNR	Uniformity
225.7	88.1	522.5	29.2%
345.5	134.9	798.5	29.2%

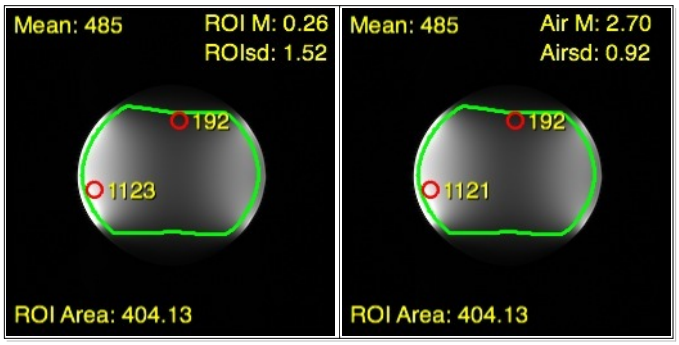
Analysis of Uncombined Images

Measured Data

Ch	Mean	Max	Noise SD	Noise Type
1	232	799	0.84	Air
2	204	733	0.73	Air
3	251	714	0.88	Air

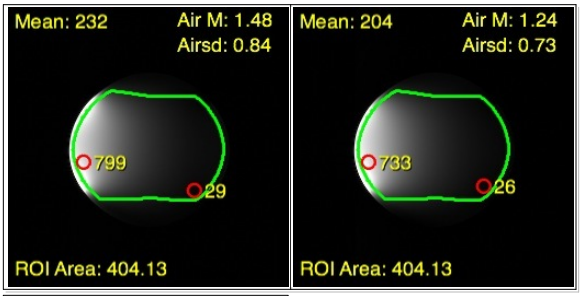
Calculated Results

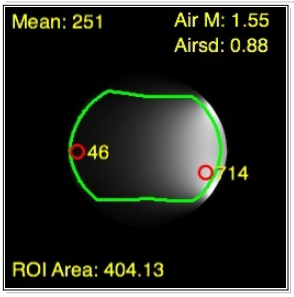
Mean SNR	% of Mean	Max SNR	% of Max
181.0	97%	623.3	95%
183.1	98%	658.0	100%
186.9	100%	531.7	81%



Composites

Channel 1 Channel 2





Channel 3

RF Coil Performance Evaluation

Coil: Torso Array
Mfg.: Gore
Mfg. Date: _____ Coil ID: 798
Phantom: Body sphere in loading ring

Test Date: 7/16/2008
Model: 2104700
Revision: _____
SN: #1
# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	48	256	256	15.6	1	3	-

Coil Mode: TORSO (not TORSOPA) TX gain: 142 R1: 11 R2: 30

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Background	Noise SD	Noise Type
N	279	468	129	0.1	1.66	NEMA
A	279	470	129	5.4	1.51	Air

Calculated Results

Mean SNR	Normalized	Max SNR	Uniformity
118.9	46.4	199.4	43.2%
121.1	47.3	204.0	43.1%

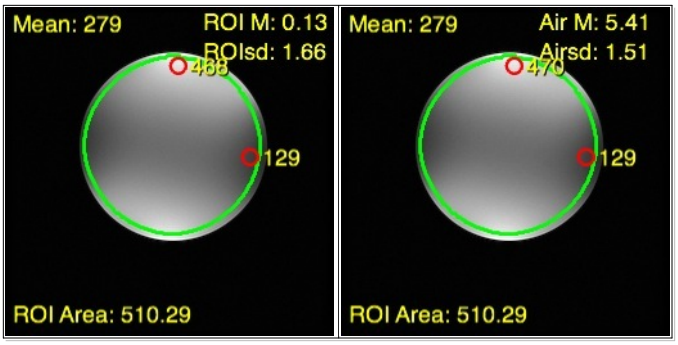
Analysis of Uncombined Images

Measured Data

Ch	Mean	Max	Noise SD	Noise Type
1	118	369	1.37	Air
2	118	352	1.39	Air
3	121	370	1.40	Air
4	105	302	1.14	Air

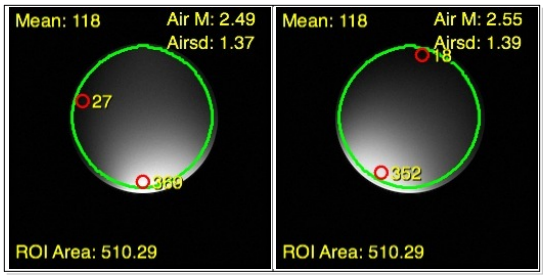
Calculated Results

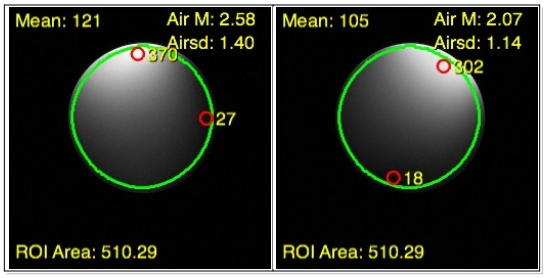
Mean SNR	% of Mean	Max SNR	% of Max
56.4	94%	176.5	100%
55.6	92%	165.9	94%
56.6	94%	173.2	98%
60.4	100%	173.6	98%



Composites

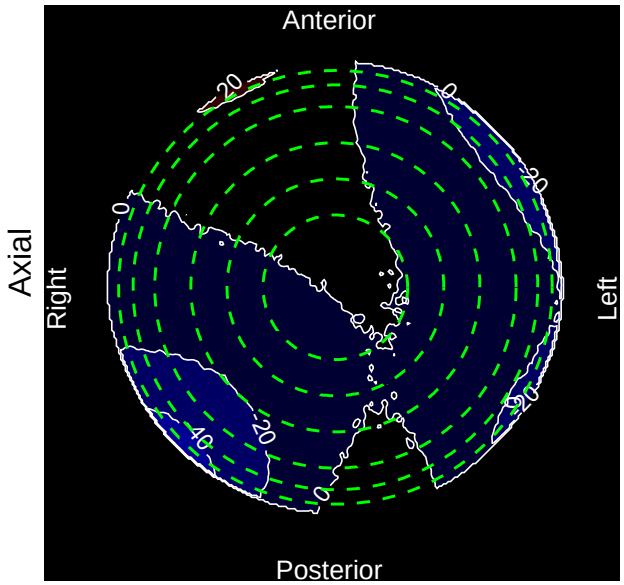
Channel 1 Channel 2





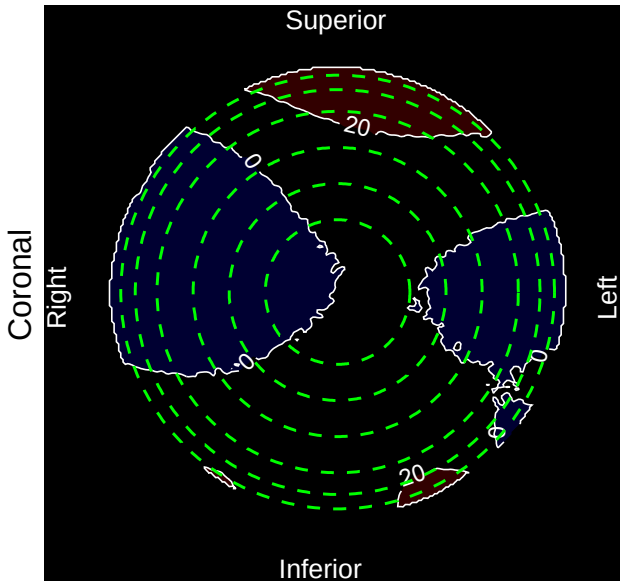
Channel 3 Channel 4

Appendix A: Magnet Homogeneity Field Maps GE Site
GE Signa LX 1.5T - 3 central planes
Measured July 16, 2008



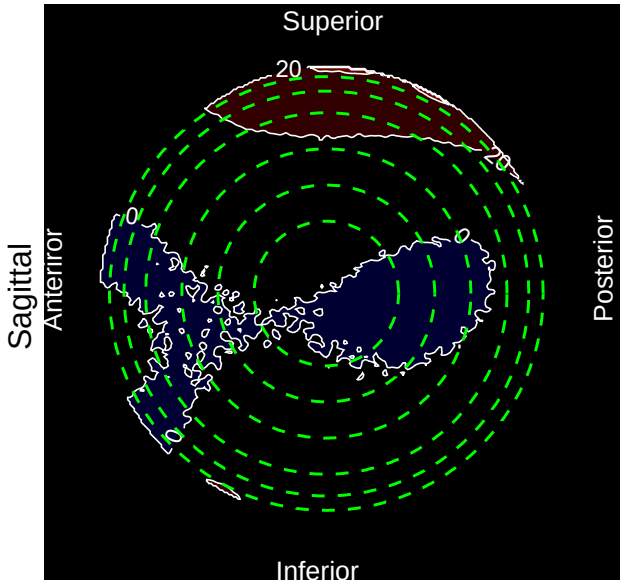
Axial

DIAMETER	MIN	MAX	RANGE	PPM	MEAN	STDEV
10	-6.2	2.6	8.9	0.14	-0.28	1.7
15	-12.5	4.4	16.9	0.27	-1.14	2.9
20	-20.6	6.8	27.4	0.43	-2.34	4.6
25	-32.0	12.5	44.6	0.70	-3.86	6.9
28	-39.4	16.6	56.0	0.88	-4.95	8.8
30	-44.6	21.4	65.9	1.04	-5.72	10.2



Coronal

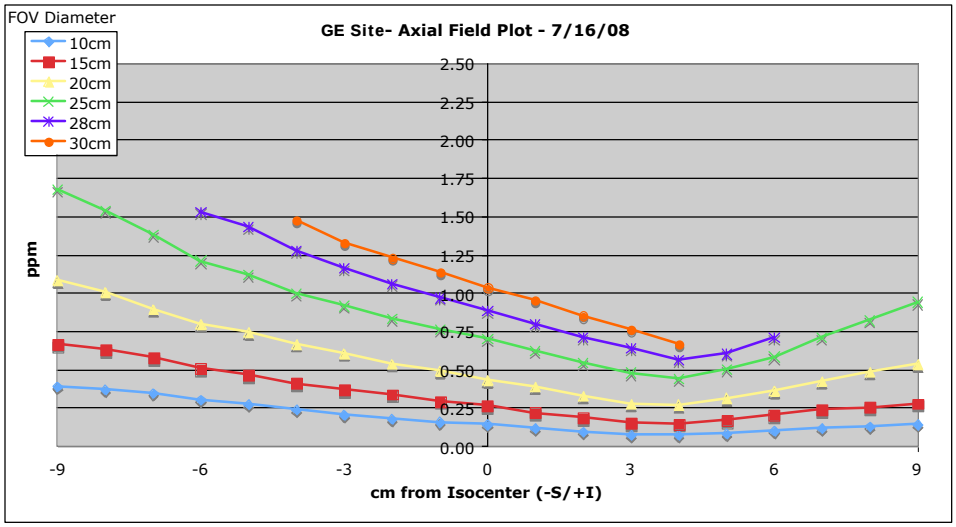
DIAMETER	MIN	MAX	RANGE	PPM	MEAN	STDEV
10	-5.1	4.0	9.1	0.14	0.34	1.8
15	-8.3	9.2	17.5	0.28	0.70	3.2
20	-11.3	15.3	26.5	0.42	1.29	5.0
25	-14.6	24.2	38.9	0.61	2.22	7.1
28	-17.0	30.5	47.5	0.75	3.01	8.5
30	-18.4	35.3	53.7	0.84	3.64	9.5

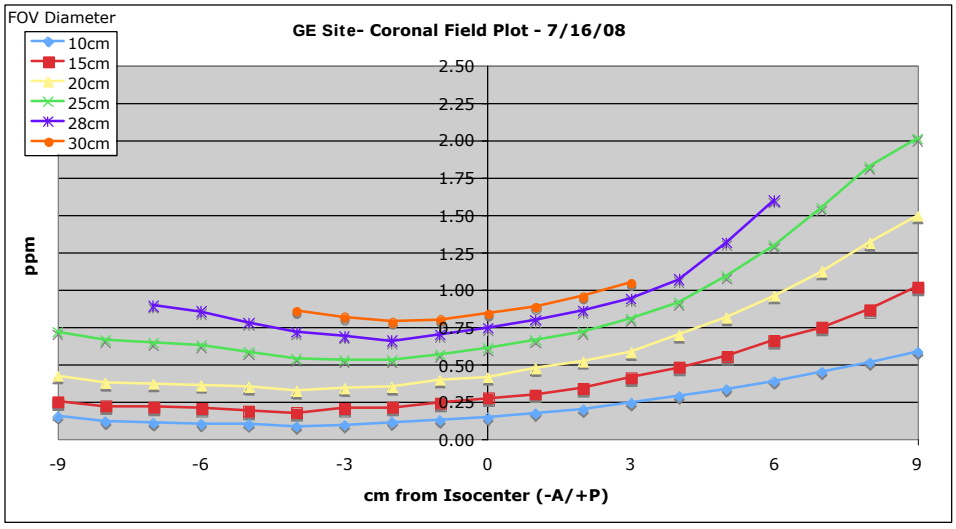


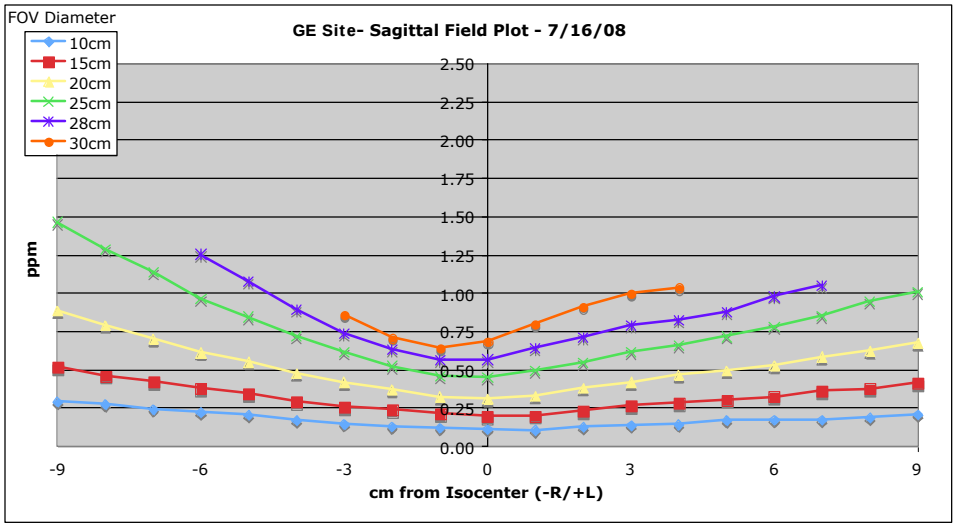
Sagittal

DIAMETER	MIN	MAX	RANGE	PPM	MEAN	STDEV
10	-2.0	5.0	7.0	0.11	0.45	1.4
15	-2.5	10.1	12.5	0.20	1.15	2.4
20	-2.5	17.1	19.6	0.31	2.22	3.7
25	-2.5	26.0	28.5	0.45	3.71	5.5
28	-2.9	33.1	36.0	0.57	4.89	6.9
30	-5.5	38.0	43.4	0.68	5.79	8.0

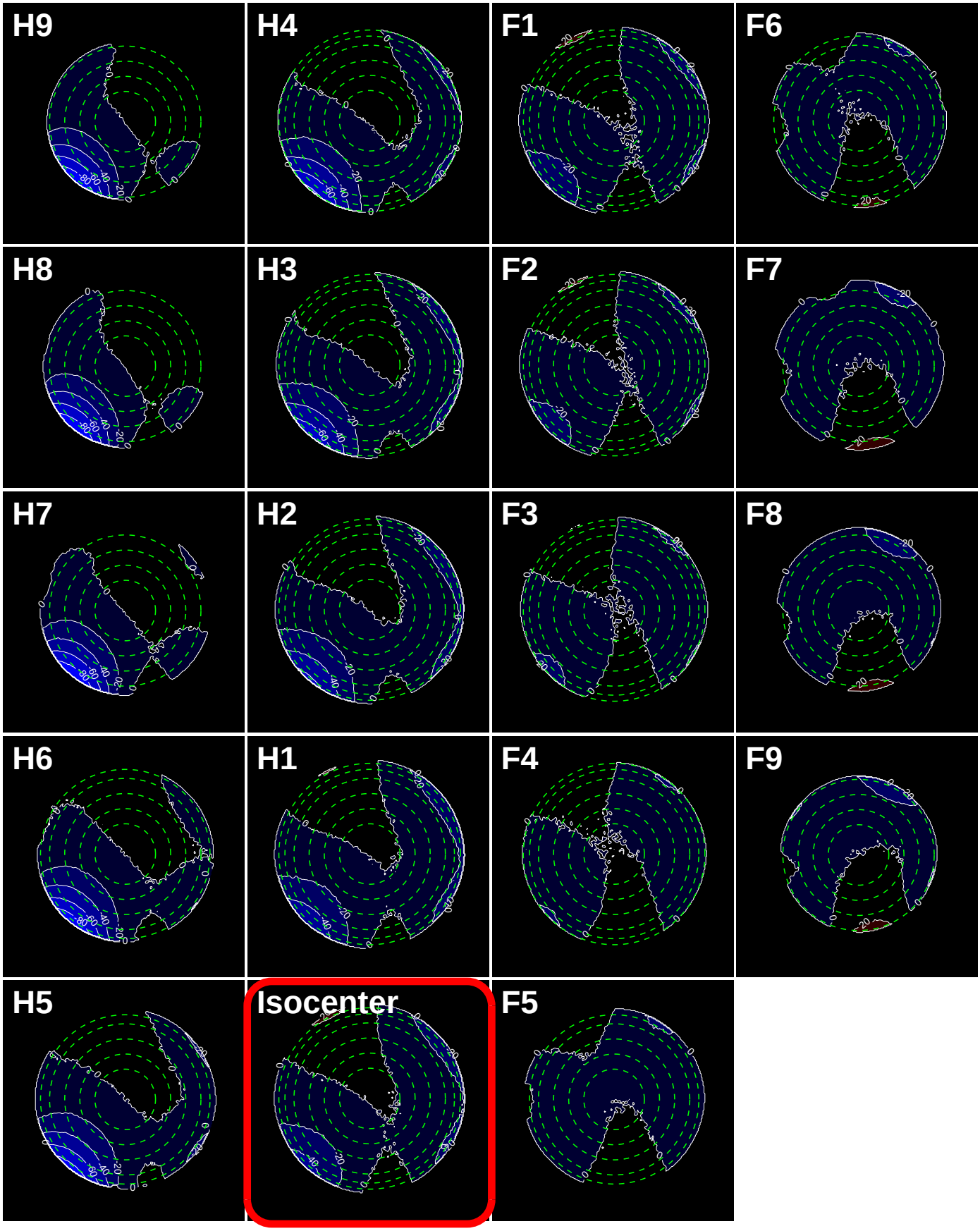
Appendix A: Magnet Homogeneity Field Maps GE Site
GE Signa LX 1.5T
Measured July 16, 2008



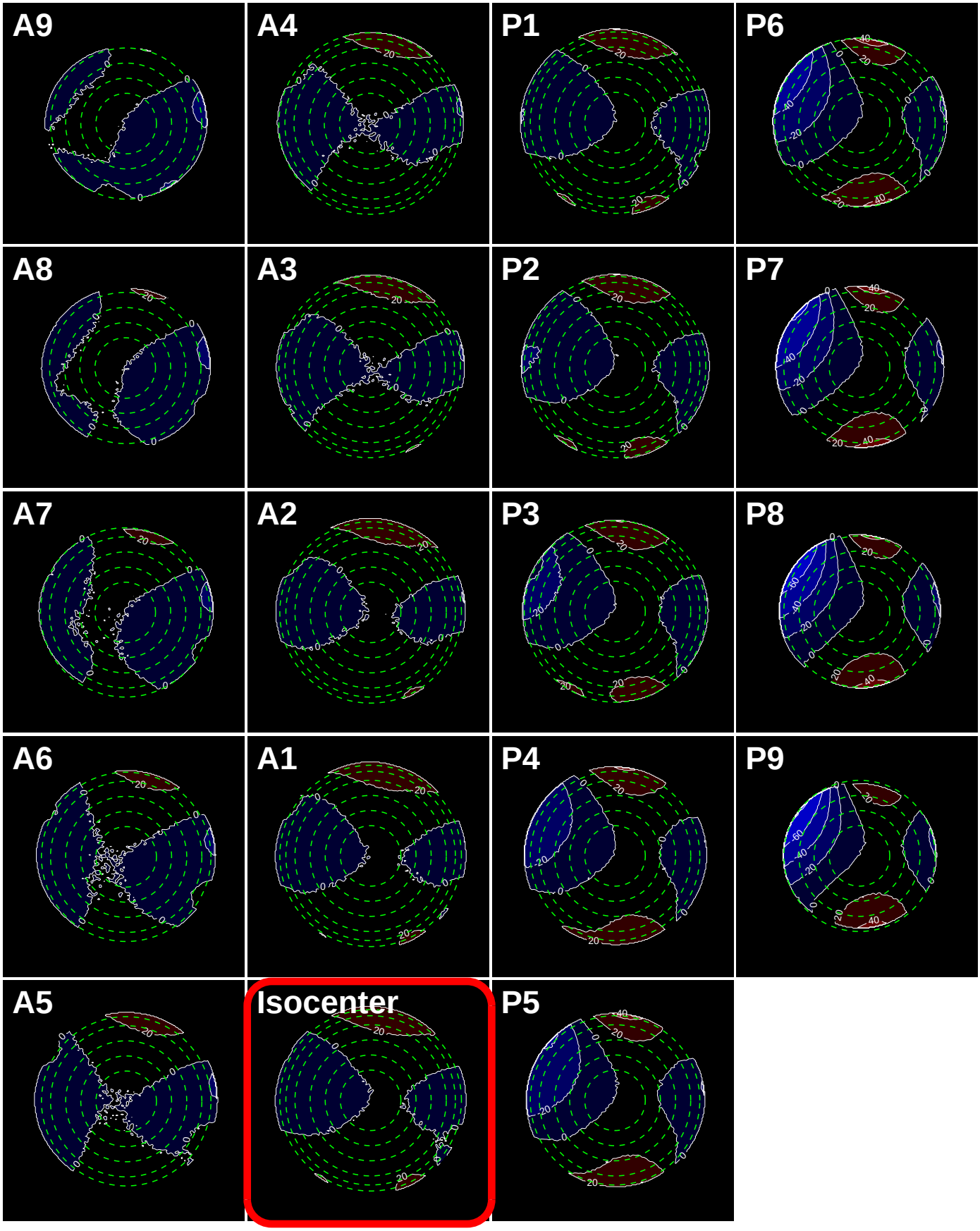




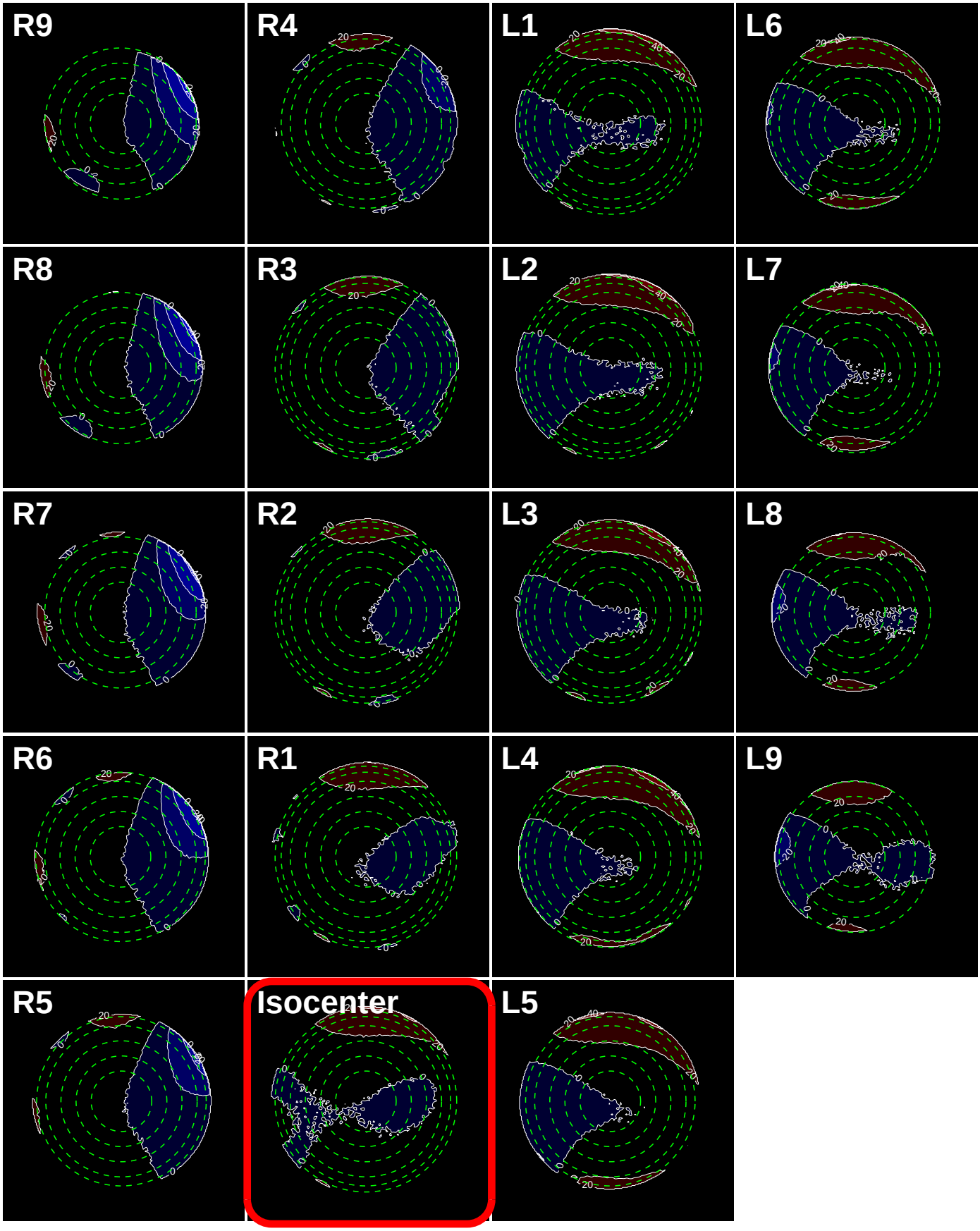
Axial Field Plots



Coronal Field Plots

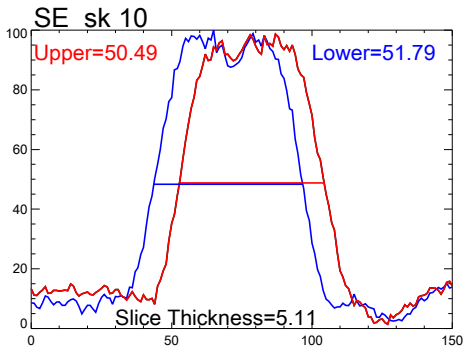


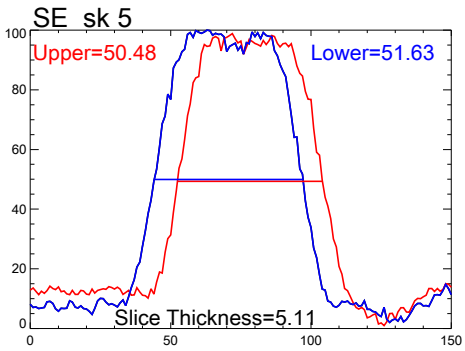
Sagittal Field Plots

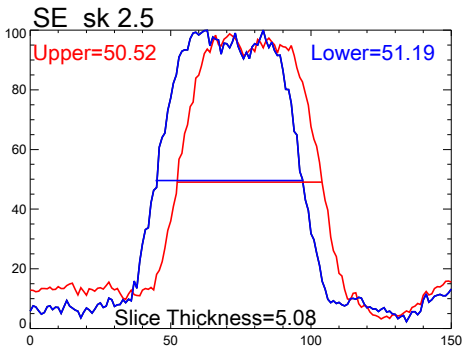


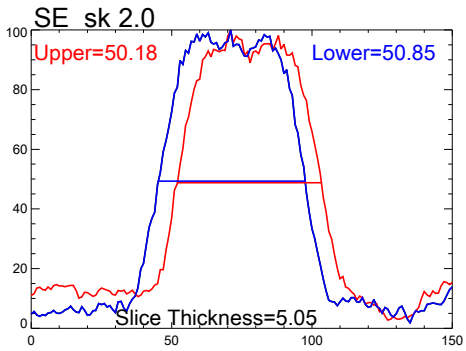
Appendix B: RF Crosstalk and Slice Profiles

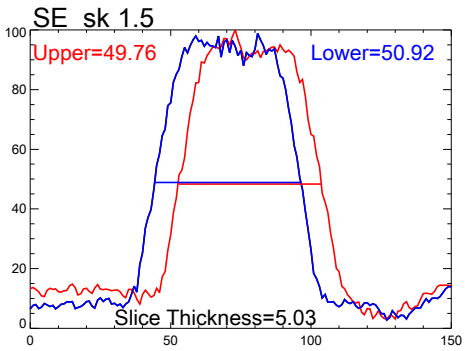
Spin Echo
TR/TE = 450/15
BW = 15.6 KHz
nex = 1
Scan time: 2:09

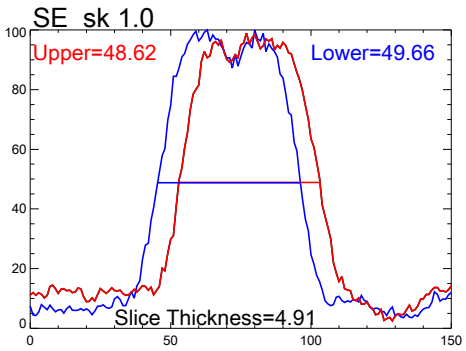


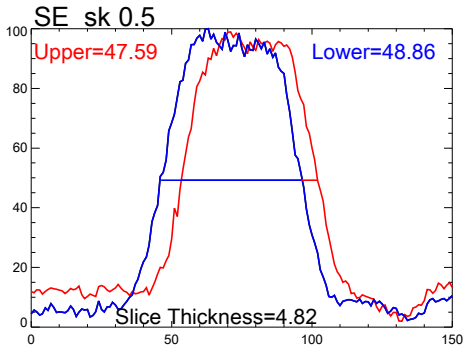


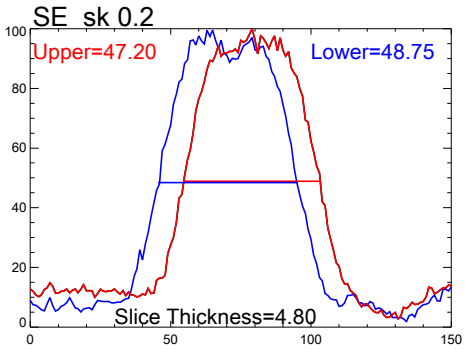


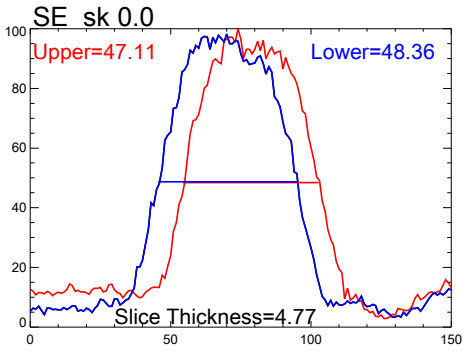


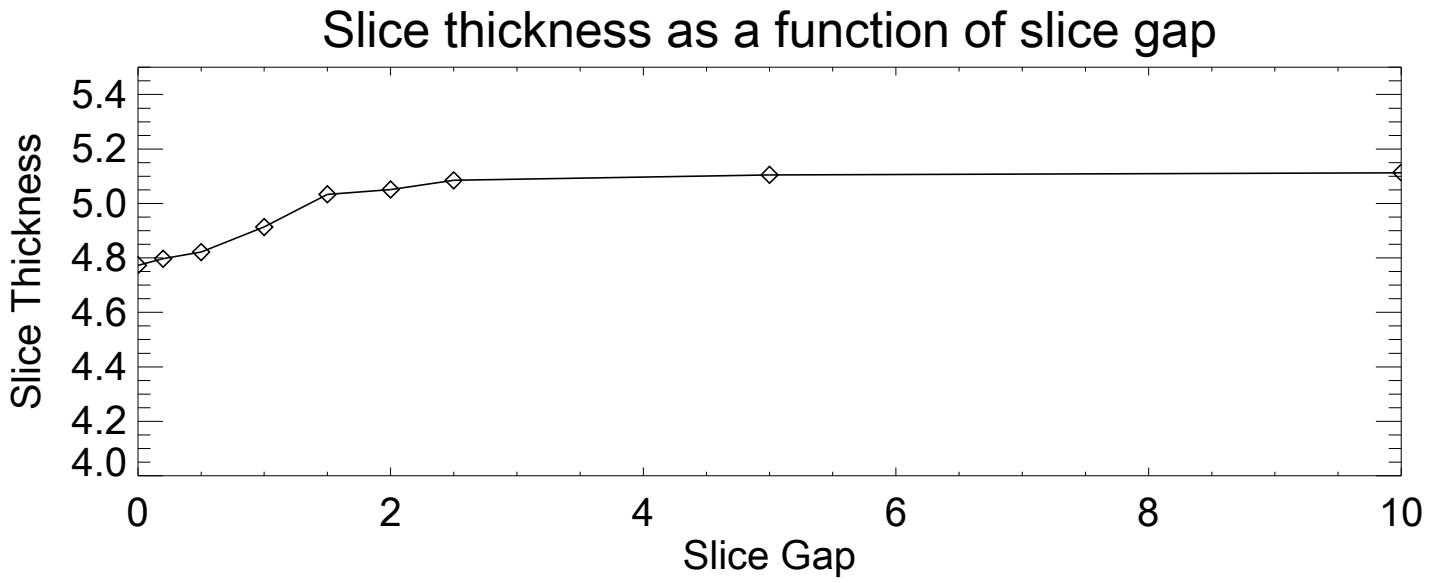






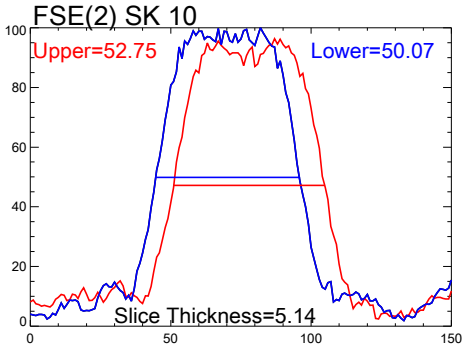


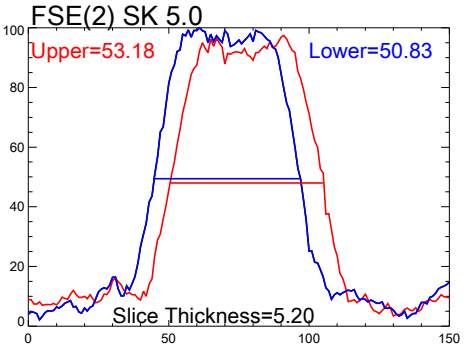


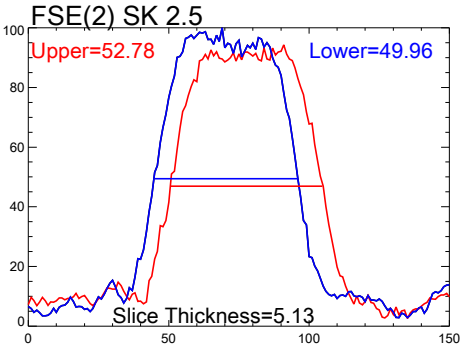


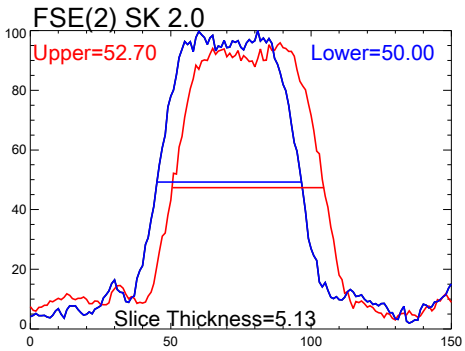
Appendix B: RF Crosstalk and Slice Profiles

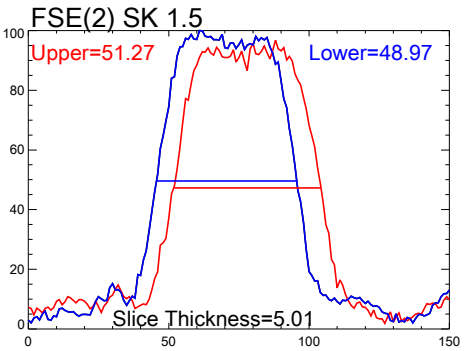
Fast Spin Echo
TR/TE = 450/9.2
BW = 31.2 KHz
nex = 2
ETL = 2
Scan time: 2:09

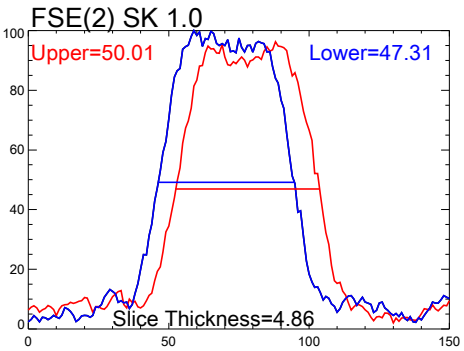


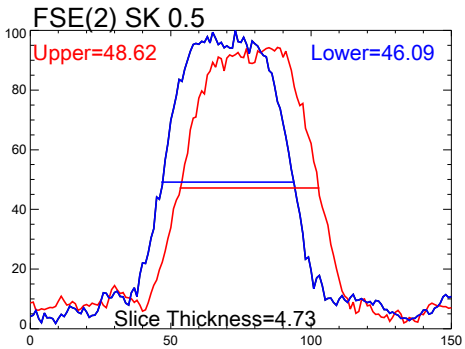


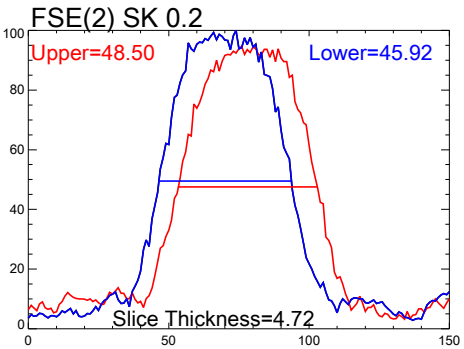


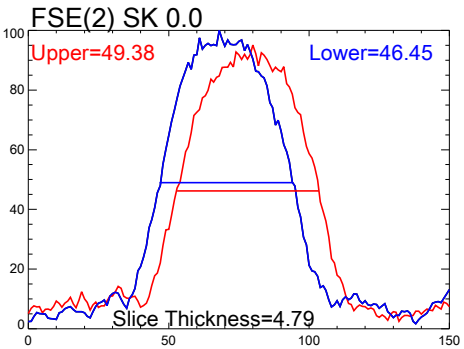


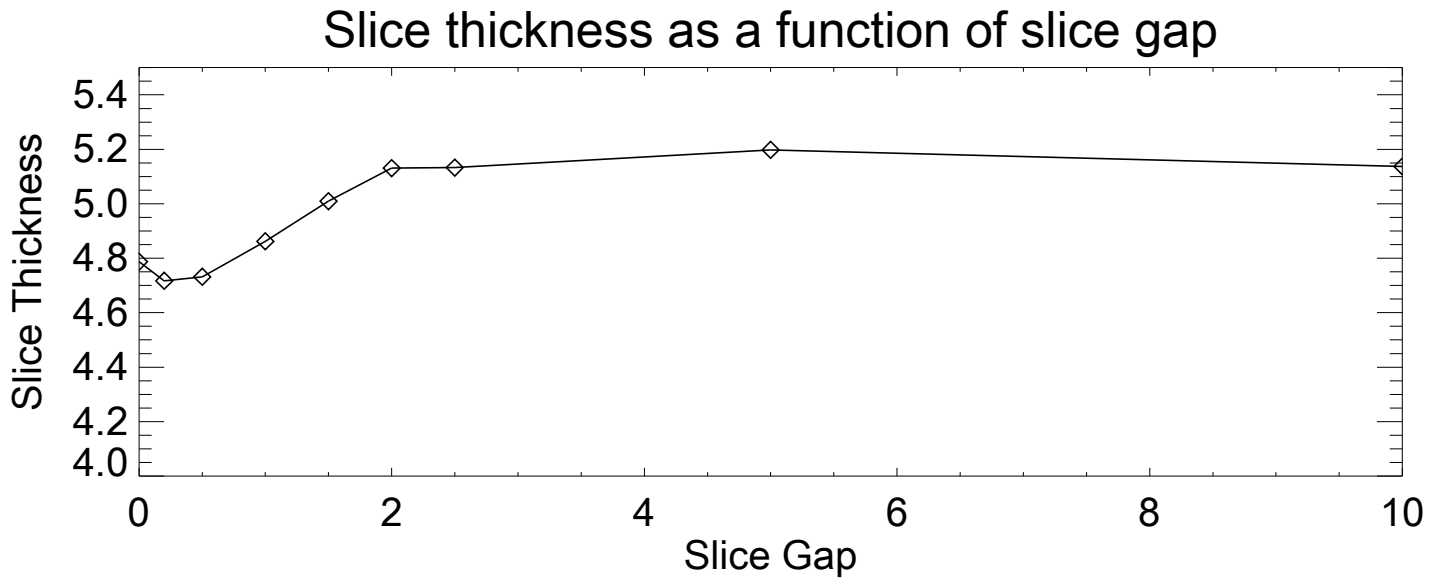












GE Site **GE Horizon**

Coil Used: **Head Quad** Test Date: **7/16/2008**

	Sagittal Locator	
1	Length of phantom, end to end (mn 148± 2)	147.1

= calculated field

		(SE 500/20)	(SE 2000/20)	(SE 2000/80)	(Site T1)	(Site T2)
	Slice Location #1	ACR T1	ACR PD	ACR T2	Site T1	Site T2
2	Resolution	1.0	1.0	1.0	0.9	0.9
3	(1.10, 1.00, 0.90 mm)	1.0	1.0	1.0	1.0	1.0
4	Slice Thickness Top	52.0	53.2	4.0	51.9	53.4
5	(fwhm in mm) Bottom	48.4	49.0	9.0	49.5	53.6
6	Calculated value 5.0±0.7	5.01	5.10	0.55	5.07	5.35
7	Wedge (mm) = + = -	-2.5	-2.6	10.0	-2.4	-2.7
8	Diameter (mm) (190±2)	190.2	190.1	1.0	190.0	189.9
9		189.1	189.1	189.1	189.0	189.4
	Slice Location #5					
10	Diameter (mm) (190±2)	190.2	190.0	190.3	190.0	189.9
11		189.1	189.0	189.1	189.0	189.3
12		189.0	189.0	189.0	189.2	189.5
13		187.9	188.4	187.8	188.4	188.6
	Slice Location #7					
14	Signal Big ROI	1262	1325	776	1305	801
15	(mean only) High	1316	1373	805	1362	843
16	Low	1187	1258	728	1221	745
17	Uniformity (>87.5%)	94.8%	95.6%	95.0%	94.5%	93.8%
18	Background Noise Top	9.6 ± 4.62	10.7 ± 4.89	7.5 ± 3.63	11.1 ± 5.30	8.5 ± 4.12
19	Bottom	9.5 ± 4.86	10.4 ± 4.81	7.8 ± 3.80	11.3 ± 5.64	8.8 ± 4.15
20	(mean ±std dev) Left	12.6 ± 6.37	12.9 ± 6.03	12.0 ± 5.64	17.2 ± 7.57	11.9 ± 5.75
21	Right	9.4 ± 4.57	14.4 ± 6.40	10.6 ± 5.03	13.9 ± 6.60	15.3 ± 7.07
22	Ghosting Ratio (<2.5%)	0.1%	0.2%	0.5%	0.3%	0.6%
23	SNR (no spec)	266	273	209	239	194
	Low Con Detectability					
24	Slice Location #8 1.4%	8	7	6	7	1
25	Slice Location #9 2.5%	10	10	9	10	9
26	Slice Location #10 3.6%	10	10	10	10	10
27	Slice Location #11 5.1%	10	10	10	10	10
28	Total # of Spokes (>=9)	38	37	35	37	30
	Slice Location #11					
29	Wedge (mm) = + = -	-1.4	-1.5	-1.4	-1.5	-1.5
30	Slice Position Error	1.1	1.1	-11.4	0.9	1.2

GE Site

GE Horizon

Sequence parameters

Test Date: **7/16/2008**

Coil Used:**Head Quad**

Test ID **313**

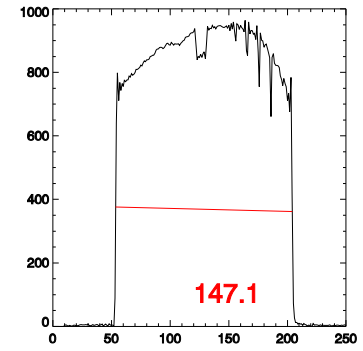
Study Description	Pulse Sequence (ETL)	TR (ms)	TE (ms)	FOV (cm)	Phase Sample Ratio	Number of Slices	Thick-ness (mm)	Slice Gap	NSA (Nex)	Freq Matrix	Phase Matrix	Band Width (kHz)	Scan Time (min:sec)
ACR T1	SE	500	20	25	1	11	5	5	1	256	256	12.4	2:09
ACR PD	Dual Echo SE	2000	20	25	1	11	5	5	1	256	256	15.6	8:32
ACR T2	Dual Echo SE	2000	80	25	1	11	5	5	1	256	256	10.4	8:32
Site T1	SE	500	14	24	1	11	5	5	1	256	256	15.6	2:09
Site T2	FSE(16)	6000	96.6	24	1	11	5	5	2	256	256	15.6	3:12

Magnet ID: **89** **Coil ID:** **796** **TestID:** **313**

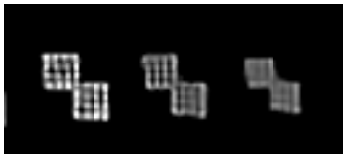
Appendix C: ACR Phantom Analysis

ACR T1

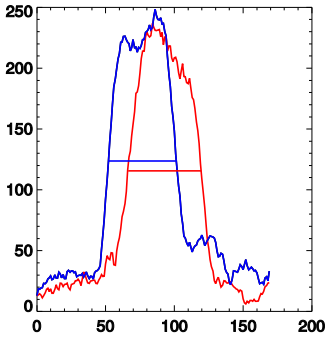
Sagital Length



High Contrast Resolution



Slice Thickness

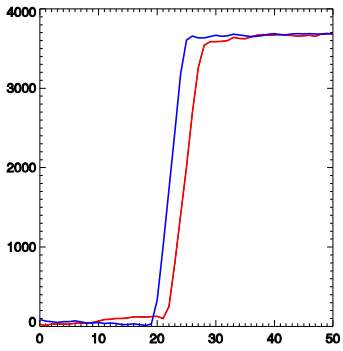


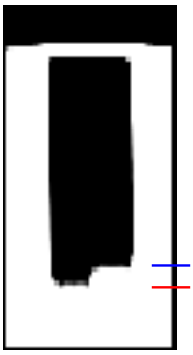
Upper=52.02

Lower=48.45

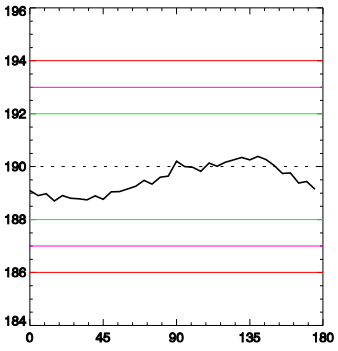
Slice Thickness=5.02

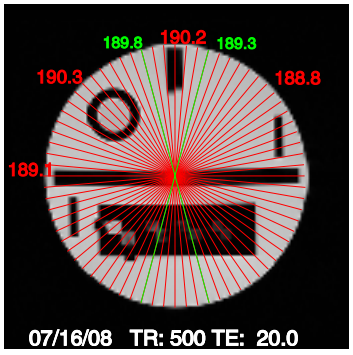
Slice Position - Inferior



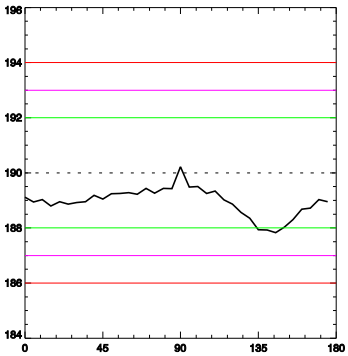


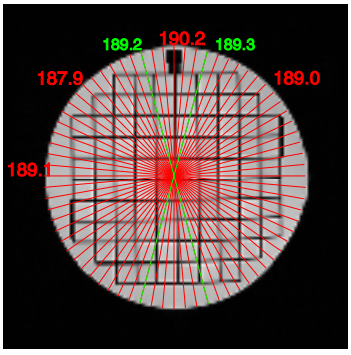
Axial Diameters - #1



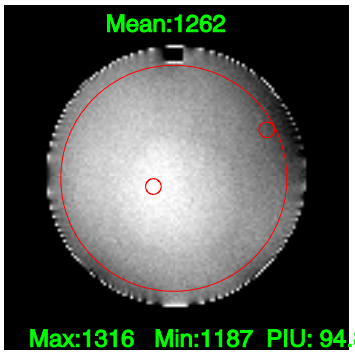


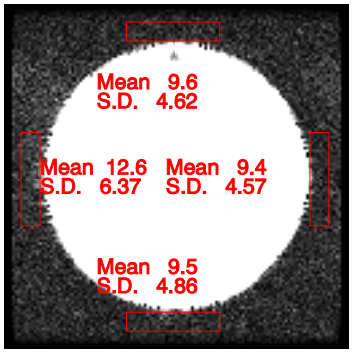
Axial Diameters - #5



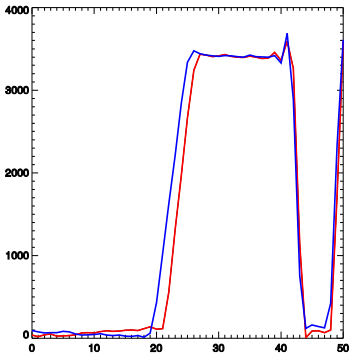


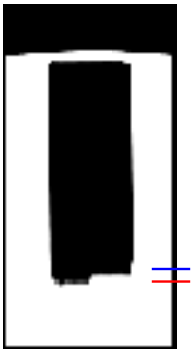
Uniformity & Ghosting - #7



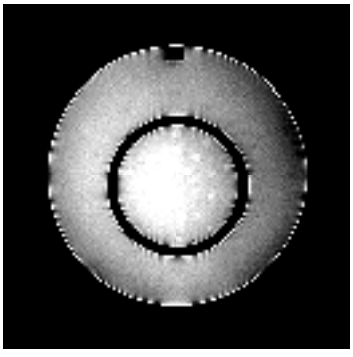


Slice Position - Superior

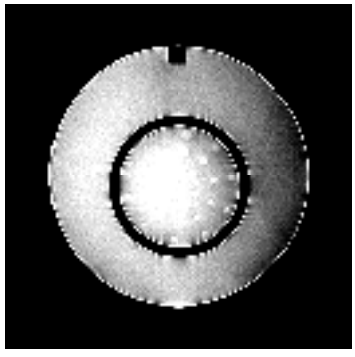




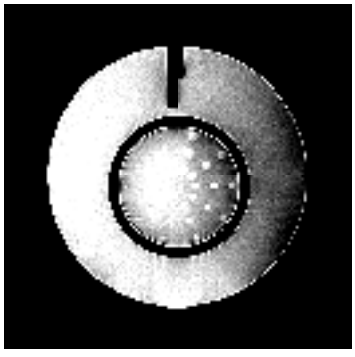
Low Contrast - #8



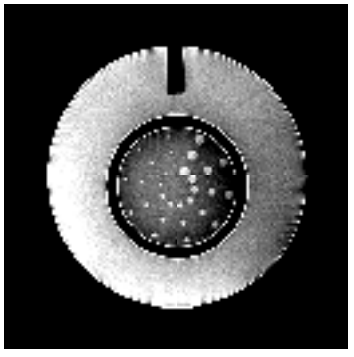
Low Contrast - #9



Low Contrast - #10



Low Contrast - #11

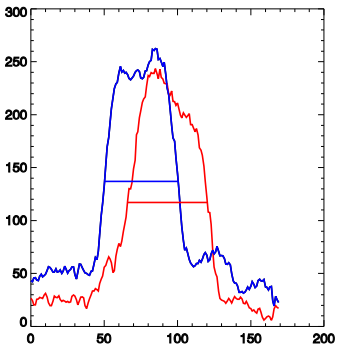


Appendix C: ACR Phantom Analysis

ACR PD

High Contrast Resolution

Slice Thickness

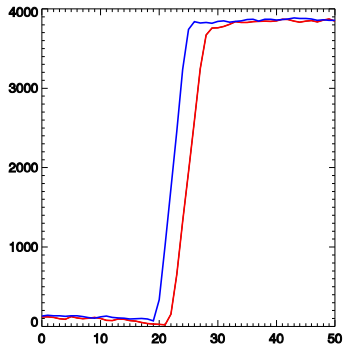


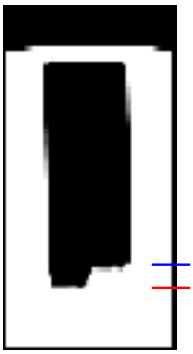
Upper=53.18

Lower=48.99

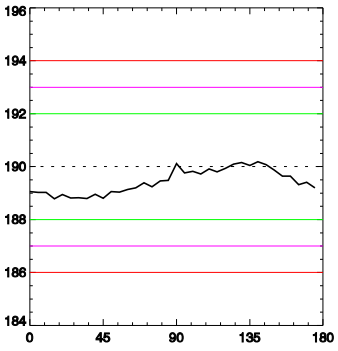
Slice Thickness=5.10

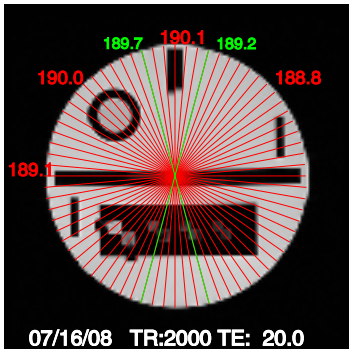
Slice Position - Inferior



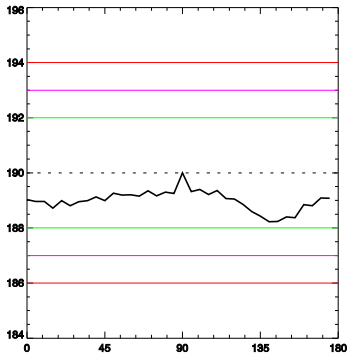


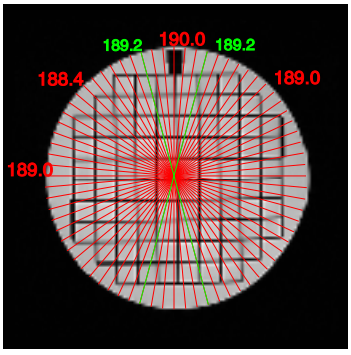
Axial Diameters - #1



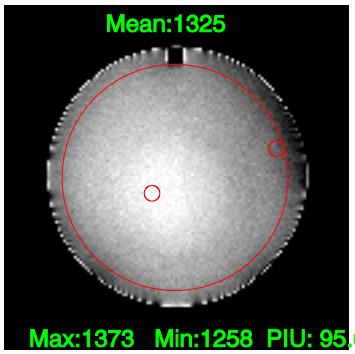


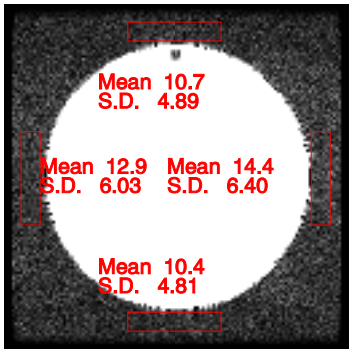
Axial Diameters - #5



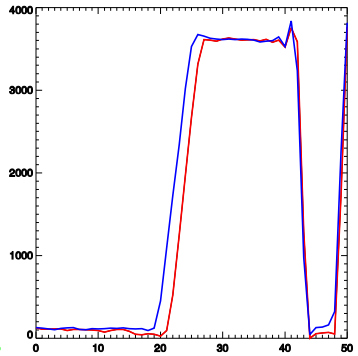


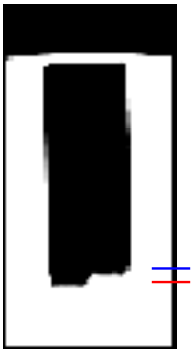
Uniformity & Ghosting - #7



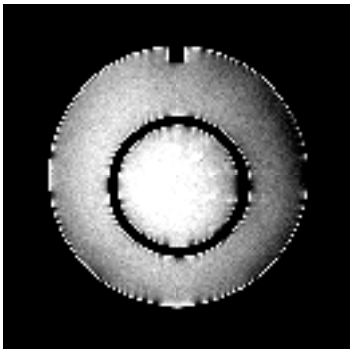


Slice Position - Superior

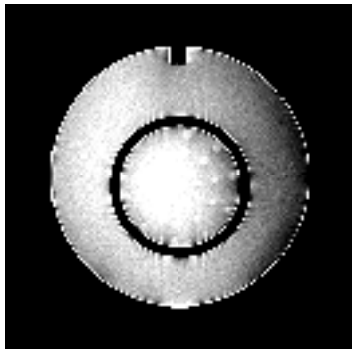




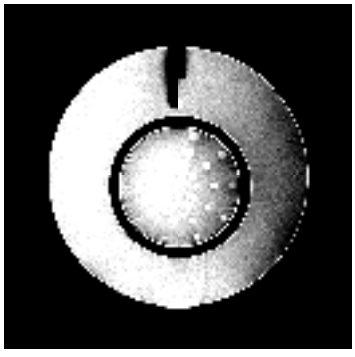
Low Contrast - #8



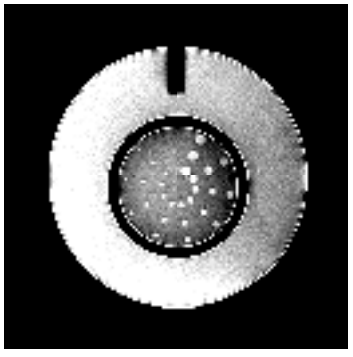
Low Contrast - #9



Low Contrast - #10



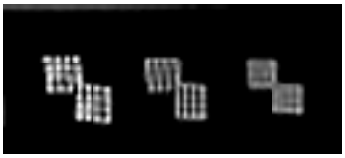
Low Contrast - #11



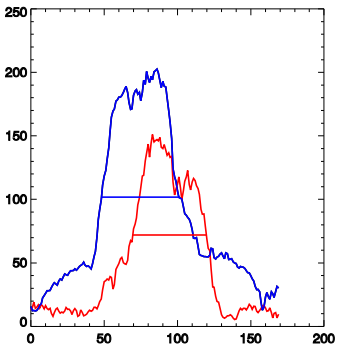
Appendix C: ACR Phantom Analysis

ACR T2

High Contrast Resolution



Slice Thickness

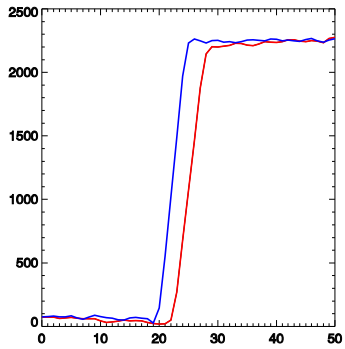


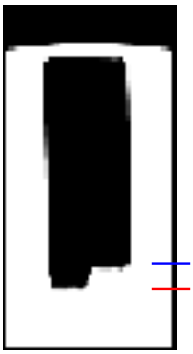
Upper=49.28

Lower=52.29

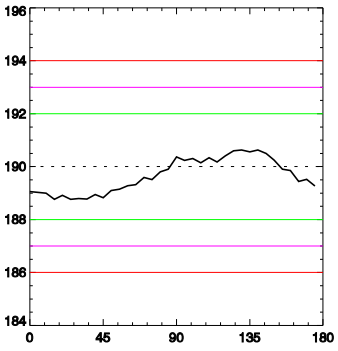
Slice Thickness=5.07

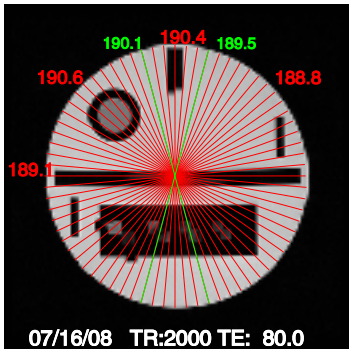
Slice Position - Inferior



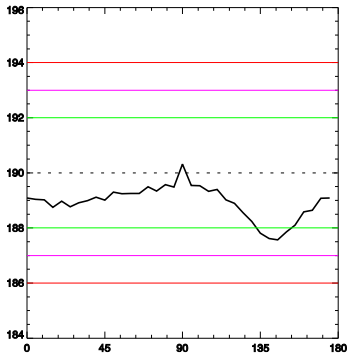


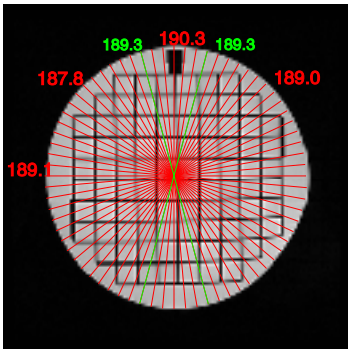
Axial Diameters - #1



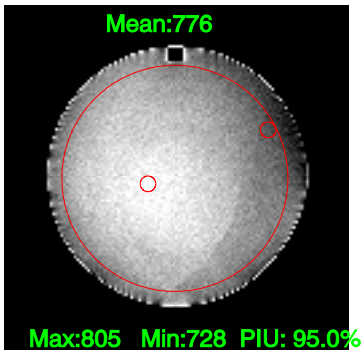


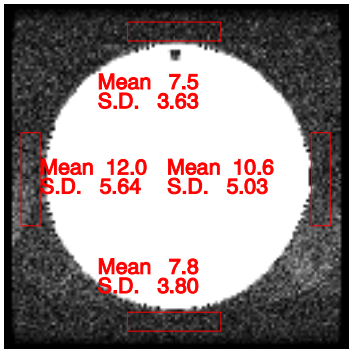
Axial Diameters - #5



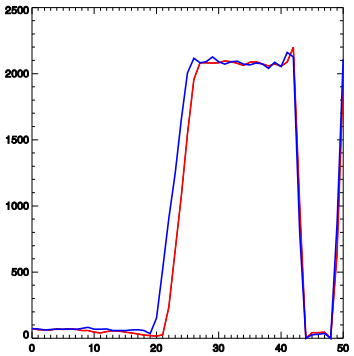


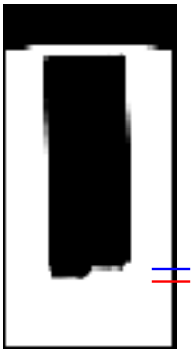
Uniformity & Ghosting - #7



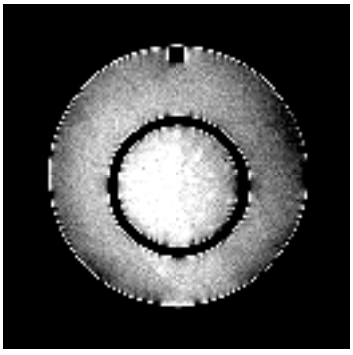


Slice Position - Superior

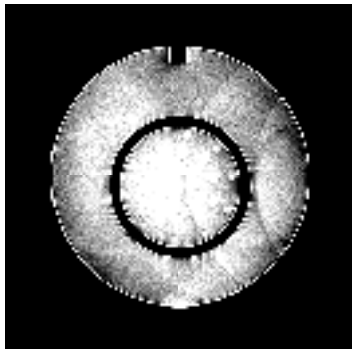




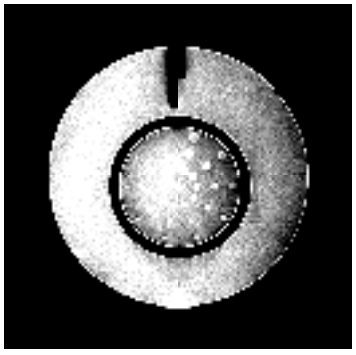
Low Contrast - #8



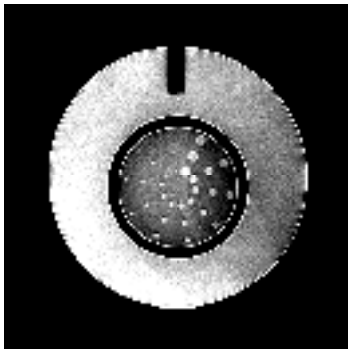
Low Contrast - #9



Low Contrast - #10



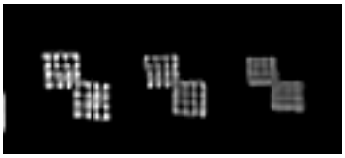
Low Contrast - #11



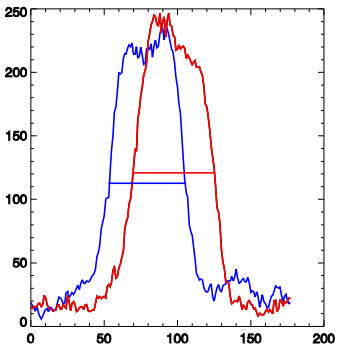
Appendix C: ACR Phantom Analysis

Site T1

High Contrast Resolution



Slice Thickness

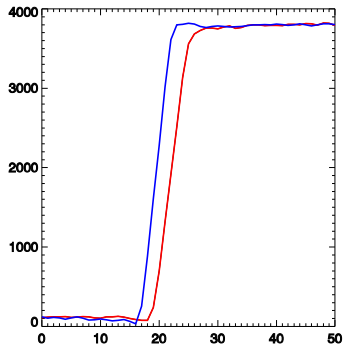


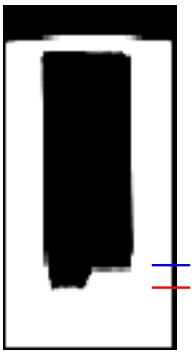
Upper=51.92

Lower=49.50

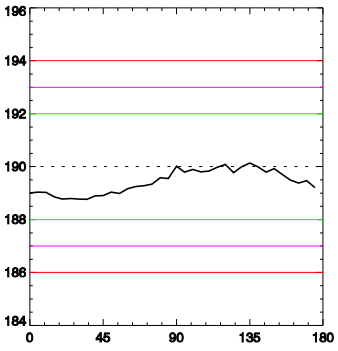
Slice Thickness=5.07

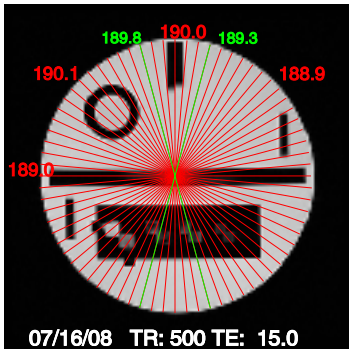
Slice Position - Inferior



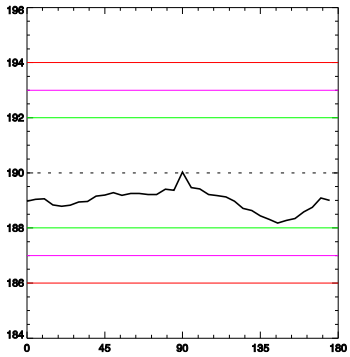


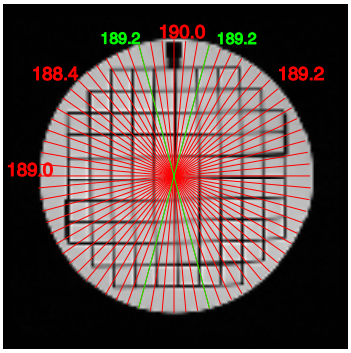
Axial Diameters - #1



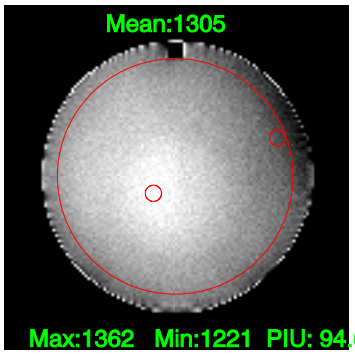


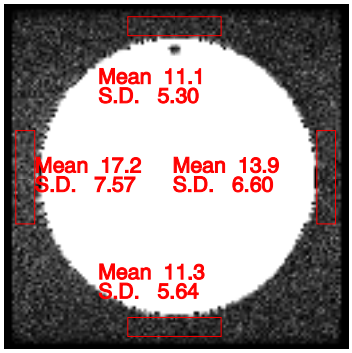
Axial Diameters - #5



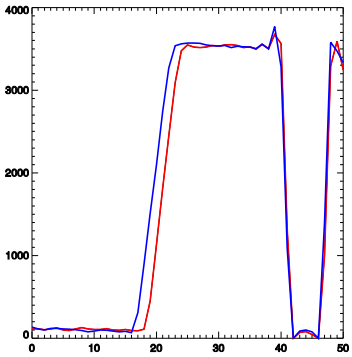


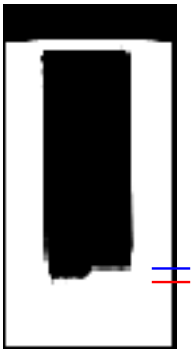
Uniformity & Ghosting - #7



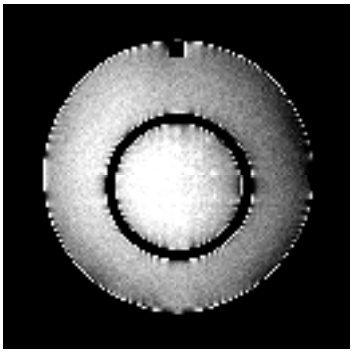


Slice Position - Superior

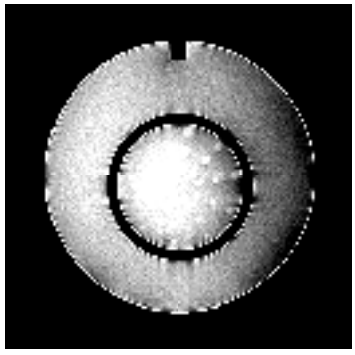




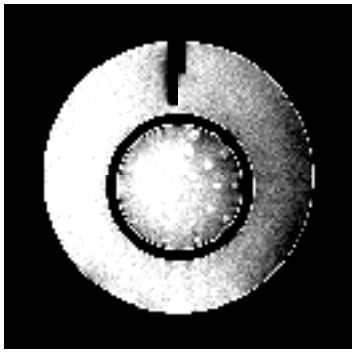
Low Contrast - #8



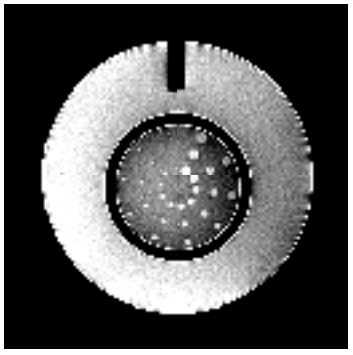
Low Contrast - #9



Low Contrast - #10



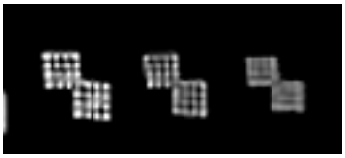
Low Contrast - #11



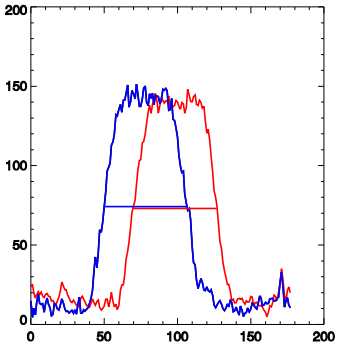
Appendix C: ACR Phantom Analysis

Site T2

High Contrast Resolution



Slice Thickness

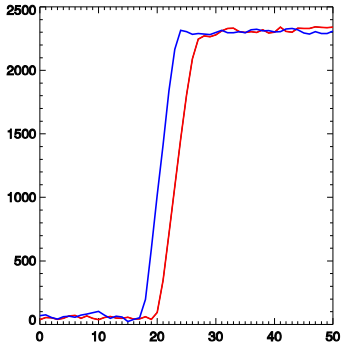


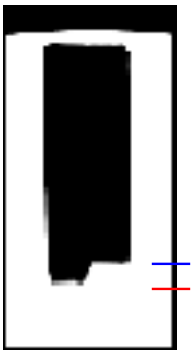
Upper=53.40

Lower=53.60

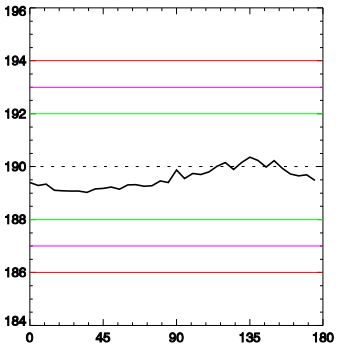
Slice Thickness=5.35

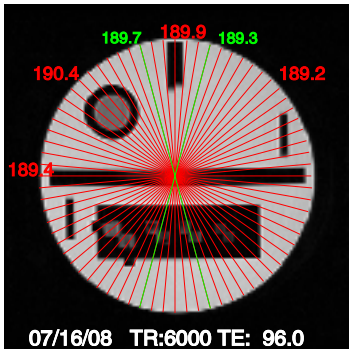
Slice Position - Inferior



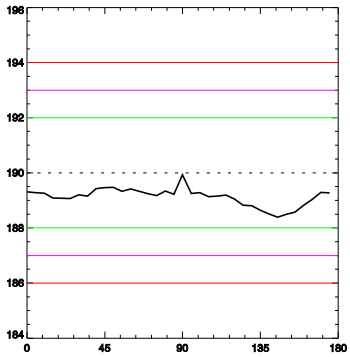


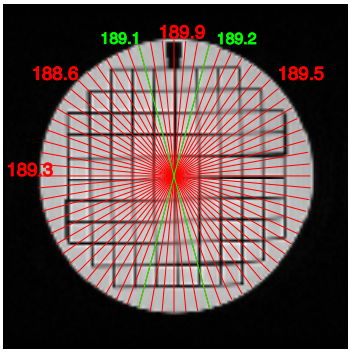
Axial Diameters - #1



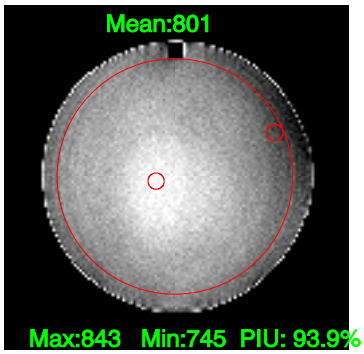


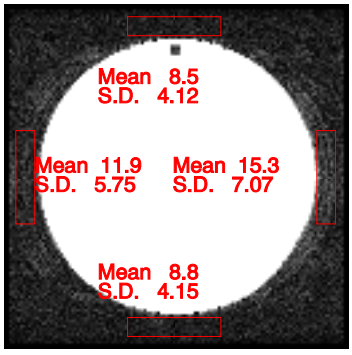
Axial Diameters - #5



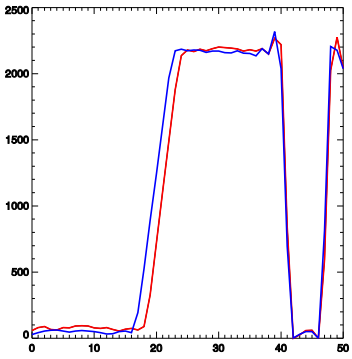


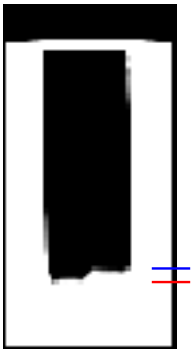
Uniformity & Ghosting - #7



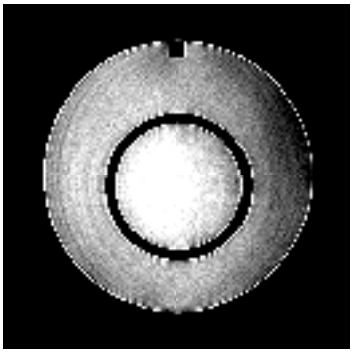


Slice Position - Superior

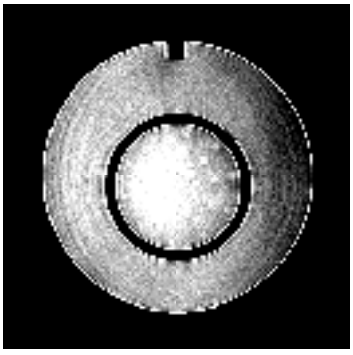




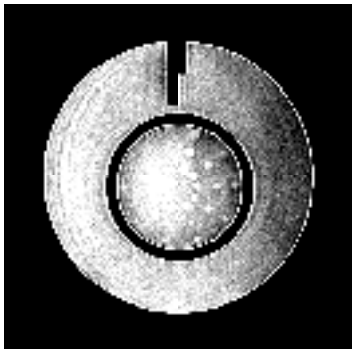
Low Contrast - #8



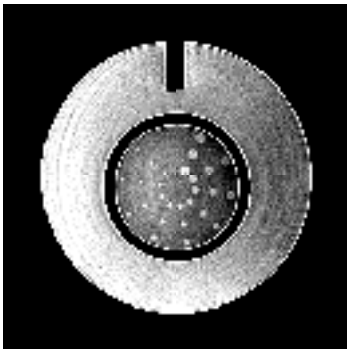
Low Contrast - #9



Low Contrast - #10



Low Contrast - #11



Appendix D:
Explanation of RF Coil Testing Report

Introduction

The primary goal of RF coil testing is to establish some sort of base line for tracking coil performance over time. The most common measure is the Signal to Noise Ratio or SNR. In addition, we can look at overall signal uniformity, ghosting level (or better - lack of ghosting) and in the case of phased array coils we look at the SNR of each and every channel and at symmetry between channels. Unfortunately, there is no single best method for measuring SNR. Below I explain the different methods used and the rationale for each.

SNR

One needs to measure the signal in the phantom (either mean or peak or both) and then divide that by the background noise. Measuring the signal is fairly straightforward, the noise can be more problematic. The simplest method is to measure the standard deviation (SD) in the background 'air'. However, MRI images are the magnitude of complex data. The noise in the underlying complex data is Gaussian but it follows a Rician distribution when the magnitude is used. The true noise can be estimated by multiplying the measured SD by 1.526.

During the reconstruction process, most manufacturers perform various additional operations on the images, This could include geometric distortion correction, low pass filtering of the k-space data resulting in low signal at the edge of the images, RF coil intensity correction (PURE, CLEAR, SCIC, etc), and other processing during the combination of phased array data and parallel imaging techniques. All of these methods distort the background noise making it impossible to obtain an accurate (and reproducible) estimate of the image noise in the air region. The alternative is to use a method which I shall refer to as the NEMA (National Electrical Manufacturers Association) method. The signal in the phantom area is a sum of the proton signal and noise. Once the signal to noise ratio exceeds 5:1, the noise in the magnitude image is effectively Gaussian. To eliminate the proton signal, you acquire an image twice and subtract them. The measured SD in the phantom region should now be the true SD times the square root of 2. When determining the SNR using the NEMA method, calculate the mean signal of the average of the two source images then divide by .7071 x the SD measured in the same area as the mean signal.

Unfortunately, this doesn't always work. It is absolutely imperative that the RF channel scalings, both transmit and receive, be identical with both scans. Any ghosting in the system is not likely to repeat exactly for both scans and will cause a much higher SD. Finally, the phantom needs to be resting in place prior to the scan long enough for motion of the fluid to have died down. Depending on the size and shape of the phantom, this could take any where from 5 to 20 minutes.

One of the most common causes of ghosting is vibration from the helium cold-head. The best way to eliminate this artifact is to turn off the cold head, which will increase helium consumption. Because this vibration is periodic, the ghosting is usually of an N over 2 (N/2) nature. The affect inside the signal region of the phantom can be minimized by using a FOV that is twice the diameter of the phantom (measured in the PE direction.) If the noise is to be measured in the air, then be sure to NOT make measurements to either side of the phantom in the PE direction.

Scan parameters also significantly affect measured SNR. For most of the testing performed in this document I used a simple Spin Echo with a TR of 300, a TE of 20 and a slice thickness of 3mm and a receiver BW of 15.6 KHz. The FOV was varied depending on the size of the coil and the phantom used. All of the parameters used for each test can be found on each page immediately below the coil description.

Report Layout

Each page of this report lists the data from a single test. The top third of the page describes the coil and phantom information, followed by the scan parameters used. The middle third contains the numbers measured and calculated results. This section will contain one table if the coil being tested is a single channel coil (i.e. quadrature or surface coils) and two tables if it is a multi-channel phased array coil. The entries in the table will be described further below. The bottom section contains a few lines of comments (if necessary), a picture of the coil with the phantom as used for the testing and one or more of the images that were used for the measurements.

There is usually one image for each composite image measurement and one image for each separate channel measurement. Each image shows the ROI (red line) where the mean signal was measured and two smaller ROIs (green lines) where the signal minimum and maximum was found. In the top left corner of each image is the mean signal in the large ROI. The bottom left corner contains the large ROI's area (in mm^2). The top right corner contains two numbers a mean and a standard deviation. If the NEMA method was used, then the top right corner will list the mean and SD of the large ROI (labeled ROI M and ROIsd) applied to the subtraction image. If the noise was measured in the background air the the numbers are labeled Air M and AirSD.

Data Tables

The meaning of most of the entries in the data table are should be self evident with a few exceptions. The first column in each table is labeled "Label". In the composite analysis, this field may be empty or contain some sort of abbreviation to identify some aspect of the testing. Some possibilities are the letter N for NEMA, A for Air, L for Left, R for Right, C for CLEAR, NoC for No CLEAR. In the Uncombined Image table, the label usually contains the channel number or similar descriptor. The column labeled "Noise Type" will be either Air or SubSig which stands for Subtracted Signal, *i.e*. the NEMA method. Both tables contain a column for Mean SNR and Max SNR which are the Mean or Max signal divided by the SD of the noise scaled by either 1.526 (Air) or 0.7071 (NEMA).

Composite Image Table: The final two columns in this table are "Normalized" and "Uniformity". It can be rather difficult to compare the performance of different coils particularly if different scan parameters are used. (Of course, it's even more difficult from one scanner to another.) I have standardized most of my testing to use a spin echo with a TR/TE of 300/20msec and a thickness of 3 mm. The FOV changes to depending on the size of the phantom used although I try to use a FOV that is at least twice the diameter of the phantom as measured in the PE direction. For one reason or another, a change may be made in the scan parameters (either accidentally or intentionally such as turning on No Phase Wrap to eliminate aliasing, etc.). In order to make it easier to compare SNR values I calculate a "Normalized" SNR value. This value is theoretically what the SNR would be if a FOV of 30cm, 256x256 matrix, 1 average, receiver BW of 15.6 KHz and slice thickness of 3mm had been used. Obviously, the final number is affected by the T1/T2 values of the phantoms used as well as details of the coil and magnet field strength but it can be useful in certain situations.

The "Uniformity" value is defined by the ACR as 1 - (max-min)/(max+min). This is most important when looking at volume coils or for evaluating the effectiveness of surface coil intensity correction algorithms (such as PURE, CLEAR or SCIC).

Uncombined Image Table: This table has two columns labeled "% of Mean" and "% of Max". When analyzing multi-channel coils it is important to understand the relationship between the different channels, the inherent symmetry that usually exists between channels. In a 8 channel head or 4 channel torso phased array coil, all of the channels are usually have about the same SNR. These two columns list how the SNR (either Mean or Max) of each channel compares to the SNR of the channel with the maximum value.