GE Site
Yearly Performance Evaluation
GE Open Speed - 0.7T
31-Aug-08

Table of Contents

MRI Equipment Evaluation Summary & Signature Page

Site Name: GE Site **MRAP #** 04342-01

Address: **Survey Date:** 8/31/08

City, State, Zip **Report Date:** 9/4/08

MRI Mfg: GE **Model:** OpenSpeed **Field:** 0.7T

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	☐	☒	☐

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. The head coil has significantly lower SNR due to channel #1 being effectively dead.
2. All of the other coils are functioning properly.
3. Magnet homogeneity is fair. Comparable or a little worse than other OpenSpeed systems.
4.
5. Overall… system status is pretty good.
6.
7.
8.
9.
10.
11.
12.
13.

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

MRI Equipment Performance Evaluation Data Form

Site Name: GE Site

Contact	Title	Phone	eMail

Equipment Information

MRI Manufacturer: GE Model: OpenSpeed SN: T105 Software: 3.0320.a

Camera Manufacturer: ADGFA Model: Drystar 3000 SN: Software:

PACS Manufacturer: Model: SN: Software:

ACR Phantom Number used: J5603

1. Table Positioning Reproducibility: **Pass**

Table motion out/in:	IsoCenter	Out/In	Out/In	Out/In
Measured Phantom Center	0.97	0.64	0.65	0.7

Comment:

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

Last Year CF: **29,801,500** This Year CF: **29,798,100** CF Change: **-3400**

GRE TR: 500, TE: 10 & 15 Flip Angle: 45, FOV: 40

5 mm skip 5 mm, BW: 10.4KHz, 256x128, 4nex

	15 cm	20 cm	25 cm
Axial:	**1.14**	**2.24**	**4.22**
Coronal:	**0.37**	**0.86**	**1.85**
Sagittal:	**2.43**	**4.11**	**6.93**

Comments: The shim is comparable to a little worse than other GE OpenSpeeds that I support. Problably within GE Spec.

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	5.43	5	8.6%
SE (Site T1)	500	20	90	1	5.25	5	5.0%
SE (20/80)	2000	20	90	1	5.43	5	8.6%
SE (20/80)	2000	80	90	1	5.21	5	4.2%
FSE(14)	3000	80	90	1	4.58	5	-8.4%
FSE(2)	516	16	90	2	4.78	5	-4.4%
FSE(2) TRF	516	16	90	2	4.20	5	-16.0%

Comments:

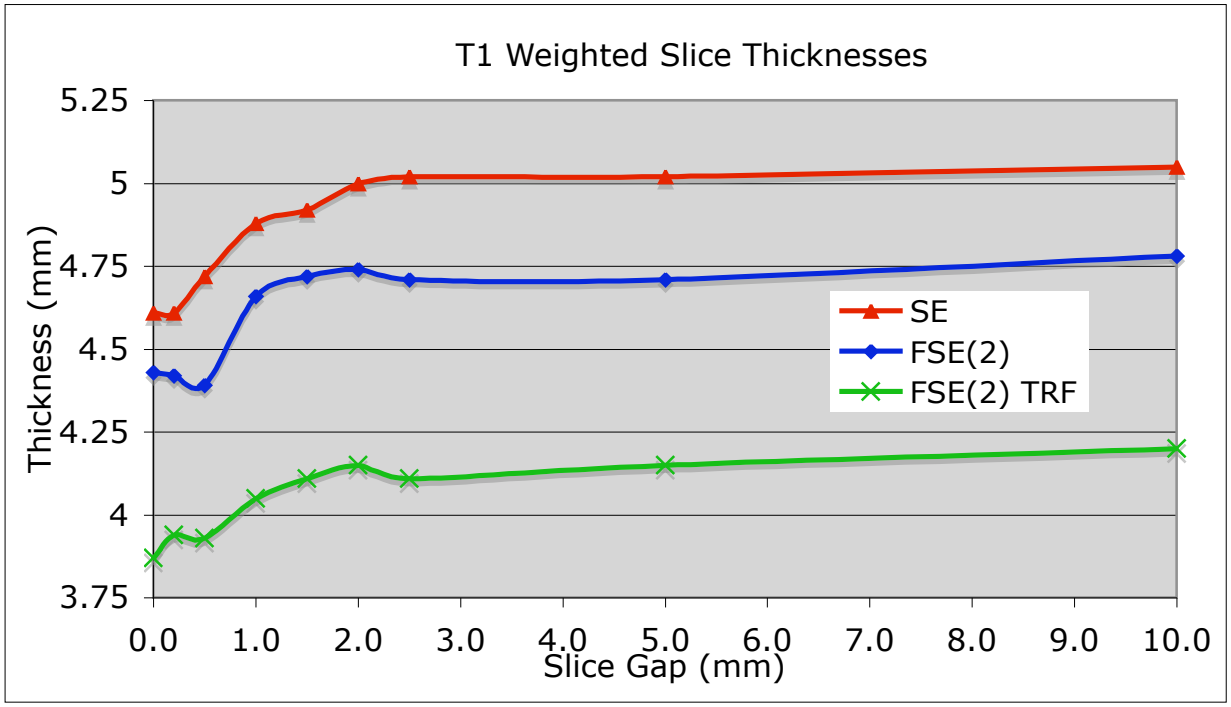
4. Slice Crosstalk (RF interference)

The following data were obtained using the ACR phantom slice thickness wedges to measure the slice profile of a three 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 drops below 40% of the slice thickness, the measured slice profiles begin to drop. The tailing off at very small slice gaps is strange, normally one would expect to see a steady drop, not a levelling off. The slice profile with TRF is very poor - it reduces the ghosting but it also reduces the SNR by about 8-12%.

All of the slice profiles can be seen in Appendix B.slice crosstalk.

Sequence Type	TR	TE	FOV (cm^2)	Matrix	NSA	Thickness	# of slices	Slice Measured
SE	450	19	25	256x256	1	5	11	6
FSE(2)	516	16	25	256x256	2	5	11	6
FSE(2) TRF	516	16	25	256x256	2	5	11	6

Skip	SE	FSE(2)	FSE(2) TRF
0.0	4.61	4.43	3.87
0.2	4.61	4.42	3.94
0.5	4.72	4.39	3.93
1.0	4.88	4.66	4.05
1.5	4.92	4.72	4.11
2.0	5	4.74	4.15
2.5	5.02	4.71	4.11
5.0	5.02	4.71	4.15
10.0	5.05	4.78	4.20



5. Soft & Hard Copy Displays

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

Monitor Description: NEC Multisync LCD 1850X

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	34.9	31.8	24	36.1	27.5

Uniformity		
MAX	MIN	Percent Delta
36.1	24	40%

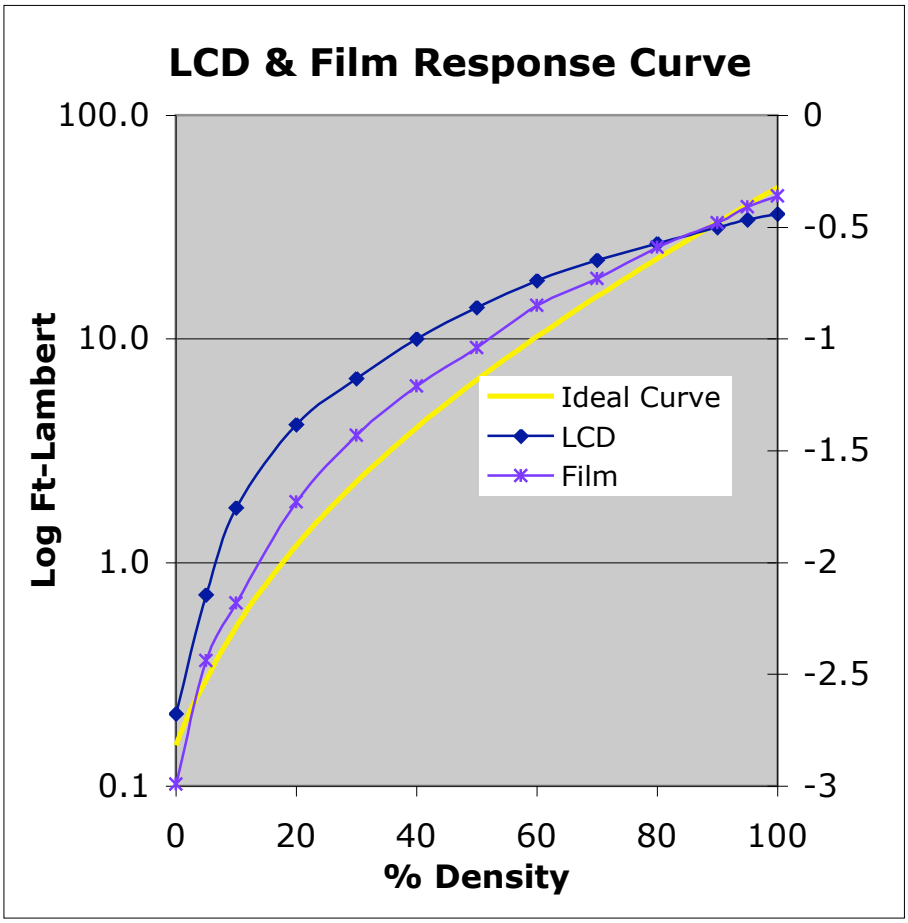
SMPTE
OK?
Y

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

Minimum Brightness must be > 26.24 Ft. Lamberts

The center of the monitor is 'ok'. The right side of the monitor is noticebly dim and fails ACR spec for signal uniformity. This is a common problem with these monitors. The agreement between the monitor and the film is fair.

Density	Ft-Lamber	Film Density
0	0.21	-2.99
5	0.72	-2.44
10	1.76	-2.18
20	4.13	-1.73
30	6.67	-1.43
40	10.00	-1.21
50	13.84	-1.04
60	18.20	-0.85
70	22.5	-0.73
80	26.8	-0.59
90	31.6	-0.48
95	34.1	-0.41
100	36.2	-0.36



Coil and Other Hardware Inventory List

Site Name GE Site

ACR Magnet # 1 Nickname GE HFO

Active	Coil Description	Manufacturer	Model	Rev.	Mfg. Date	SN	Channels
☐	Body Flex - Large	GE	2273180-2		Oct, 2002	897591M4	1
☐	Body Flex - Medium	GE	2273181-2		Oct, 2002	897679YM7	1
☒	Body - Integrated	GE					1
☒	Body Flex - Large	GE	2273180-2		Apr, 2006	3844YR8	1
☒	Body Flex - Medium	GE	2273181-3		Mar, 2006	966351YM9	1
☒	CTL Phased Array	USA Instr.	Magna 5000		Jun, 2003	505	6
☒	Head PA	MRI Devices	101463	1	Jun, 2002	U7284	4
☒	Knee - Large	USA Instr.	Legend 5000	B	Sep, 2002	421	2
☒	Knee - Medium	USA Instr.	Legend 5000	B	Sep, 2002	427	2
☒	Knee/Foot - Standard	USA Instr.	Legend 5000		Sep, 2002	427	3
☒	Shoulder - Phased Array	USA Instr.	Mark 5000	C	May, 2003	464	2
☒	Wrist Coil	MRI Devices		0	Sep, 2002	U8469	3
☐							

RF Coil Performance Evaluation

Coil: Body - Integrated

Mfg.: GE

Mfg. Date: _____ Coil ID: 662

Phantom: Shim sphere

Test Date: 8/31/2008

Model: _____

Revision: _____

SN: _____

# of Channels 1

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	40	256	256	15.6	2	5	-

Coil Mode: Body

TX gain: 185 R1: 11 R2: 30

Analysis of Test Image

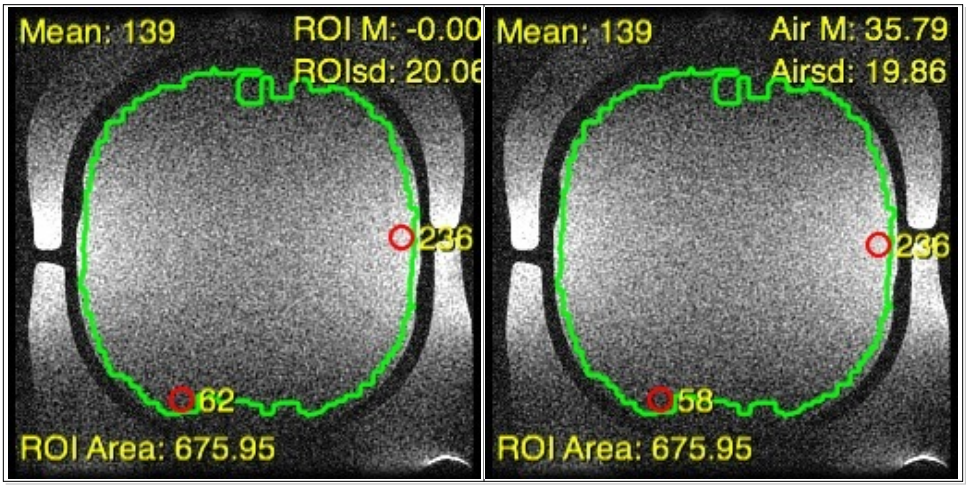
Measured Data

Label	Mean	Max	Min	Background	Noise SD	Noise Type
N	139	236	62	0.0	20.06	NEMA
A	139	236	58	35.8	19.86	Air

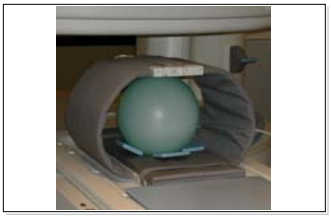
Calculated Results

Mean SNR	Normal-ized	Max SNR	Uni-formity
4.9	1.2	8.3	41.6%
4.6	1.1	7.8	39.5%

The overall SNR is close to the same as last year... but the uniformity is about half. The TX gain is 35 points higher.



RF Coil Performance Evaluation



Coil: Body Flex - Large
Mfg.: GE
Mfg. Date: 4/1/2006 Coil ID: 1151
Phantom: Body phantom sphere (27cm)

Test Date: 8/31/2008
Model: 2273180-2
Revision:
SN: 3844YR8
# of Channels 1

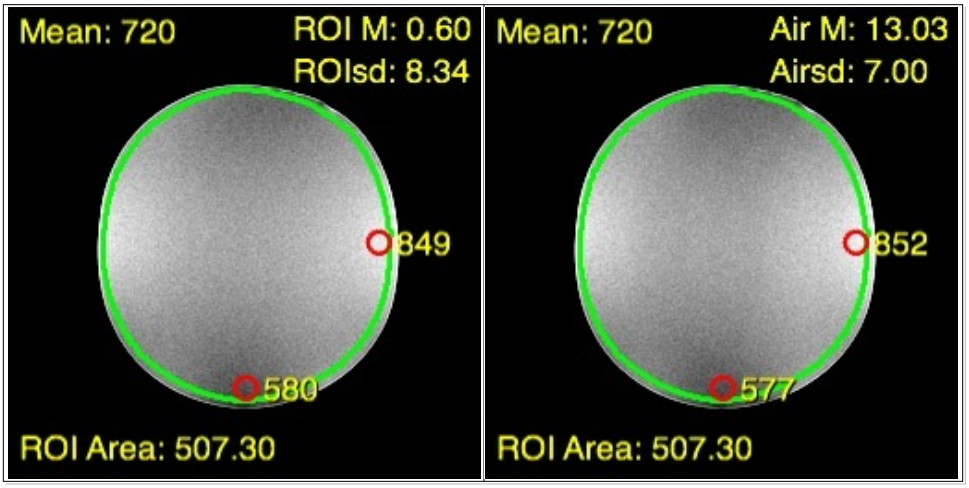
Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	40	256	256	15.6	1	3	-

Coil Mode: BODYFLEXL TX gain: 159 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	720	849	580	0.6	8.34	NEMA	61.1	34.3	72.0	81.2%
A	720	852	577	13.0	7.00	Air	67.4	37.9	79.8	80.8%

SNR is up by 88%



RF Coil Performance Evaluation

Coil: Body Flex - Medium

Mfg.: GE

Mfg. Date: 3/1/2006 Coil ID: 1152

Phantom: Body phantom sphere (27cm)

Test Date: 8/31/2008

Model: 2273181-3

Revision:

SN: 966351YM9

# of Channels 1

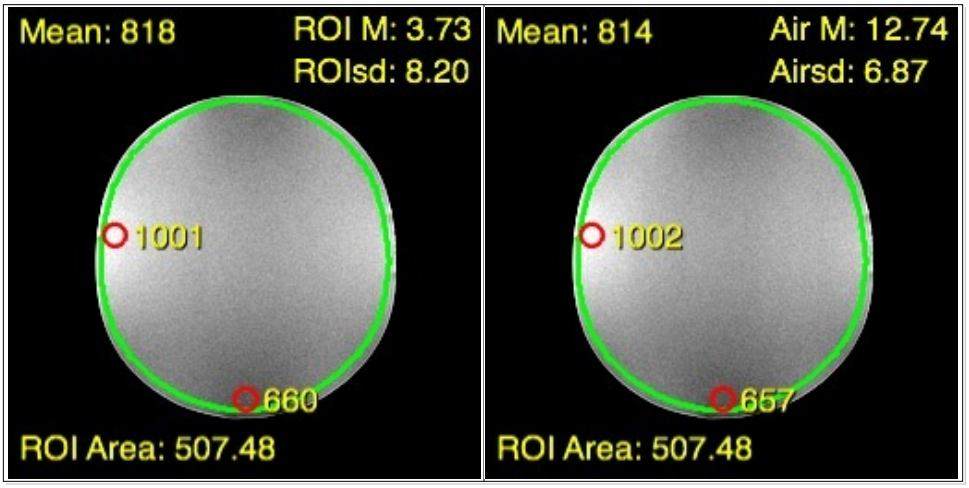
Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	40	256	256	15.6	1	3	-

Coil Mode: BODYFLEXM TX gain: 153 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	818	1,001	660	3.7	8.20	NEMA	70.5	39.7	86.3	79.5%
A	814	1,002	657	12.7	6.87	Air	77.6	43.7	95.6	79.2%

SNR is identical to last year.



RF Coil Performance Evaluation

Coil: CTL Phased Array
Mfg.: USA Instr.
Mfg. Date: 6/18/2003 Coil ID: 640
Phantom: CTL Phantoms

Test Date: 8/31/2008
Model: Magna 5000
Revision:
SN: 505
# of Channels 6

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

Coil Mode: a Cervical CTL TX gain: 159 R1: 11 R2: 29

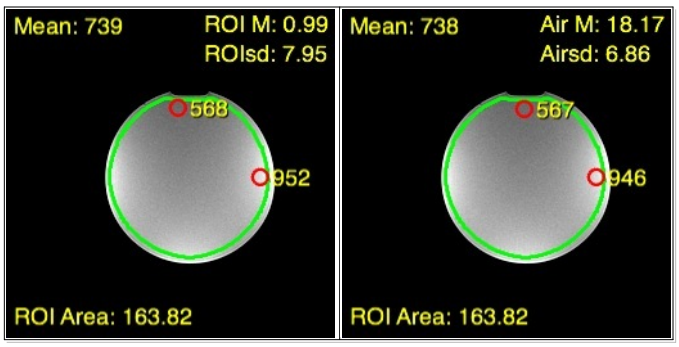
Analysis of Composite Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	739	952	568	1.0	7.95	NEMA	65.7	65.7	84.7	74.7%
A	738	946	567	18.2	6.86	Air	70.5	70.5	90.4	75.0%

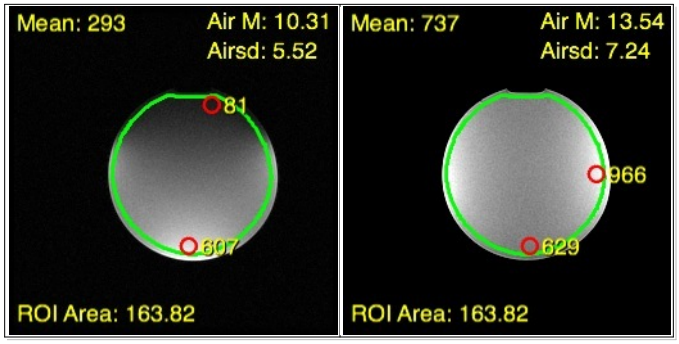
Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	293	607	5.52	Air	34.8	52%	72.1	82%
2	737	966	7.24	Air	66.7	100%	87.4	100%

SNR is up by 80% (back to where it should be.)



Composites



Channel 1 Channel 2

RF Coil Performance Evaluation

Coil: CTL Phased Array
Mfg.: USA Instr.
Mfg. Date: 6/18/2003 Coil ID: 640
Phantom: CTL Phantoms

Test Date: 8/31/2008
Model: Magna 5000
Revision:
SN: 505
# of Channels 6

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	40	256	256	15.6	1	3	100

Coil Mode: b Thoracic CTL
TX gain: 163 R1: 11 R2: 30

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Back ground	Noise SD	Noise Type
N	214	446	115	-0.4	4.40	NEMA
N	307	514	248	0.1	5.27	NEMA
N	286	559	212	-0.4	4.63	NEMA

Calculated Results

Mean SNR	Normal-ized	Max SNR	Uni-formity
34.4	19.3	71.7	41.0%
41.2	23.2	69.0	65.1%
43.7	24.6	85.4	55.0%

Analysis of Uncombined Images

Measured Data

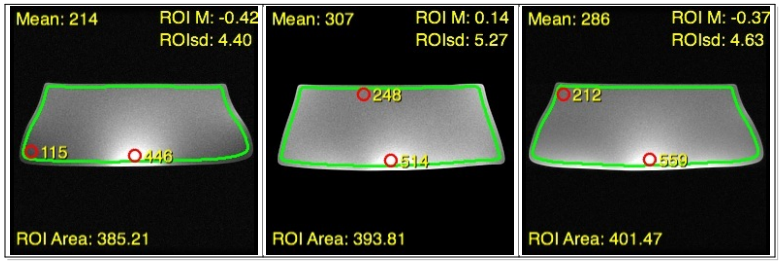
Ch	Mean	Max	Noise SD	Noise Type
1	91	343	3.46	Air
2	223	319	3.89	Air
3	146	366	2.76	Air
4	188	575	4.51	Air

Calculated Results

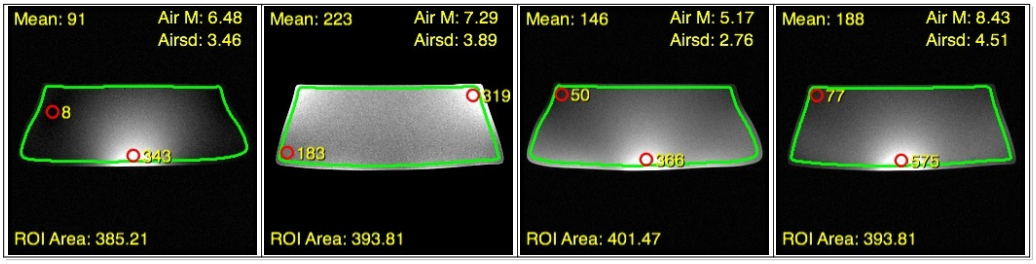
Mean SNR	% of Mean	Max SNR	% of Max
17.2	46%	65.0	75%
37.6	100%	53.7	62%
34.7	92%	86.9	100%
27.3	73%	83.5	96%

The uncombined images came from images # 1, 7, 13 and 9 and correspond to elements 5, 6, 7 & 8 as defined by USAI QC documents. The SNR values are comparable to or better than last year.

Composites



Channels



Channel 1 Channel 2 Channel 3 Channel 4

RF Coil Performance Evaluation

Coil: CTL Phased Array
Mfg.: USA Instr.
Mfg. Date: 6/18/2003 Coil ID: 640
Phantom: CTL Phantoms

Test Date: 8/31/2008
Model: Magna 5000
Revision:
SN: 505
# of Channels 6

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	40	256	256	15.6	1	3	100

Coil Mode: c Lumbar CTL
TX gain: 163 R1: 11 R2: 30

Analysis of Composite Image

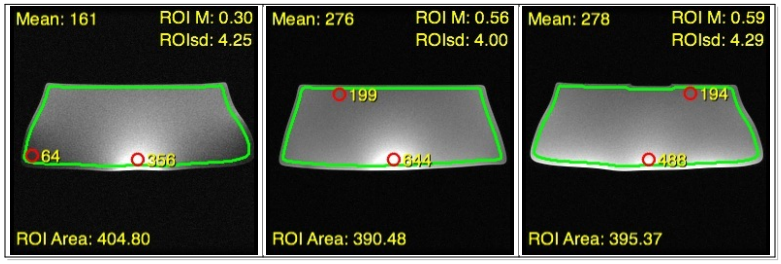
Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	161	356	64	0.3	4.25	NEMA	26.8	15.1	59.2	30.5%
N	276	644	199	0.6	4.00	NEMA	48.8	27.4	113.9	47.2%
N	278	488	194	0.6	4.29	NEMA	45.8	25.8	80.4	56.9%

Analysis of Uncombined Images

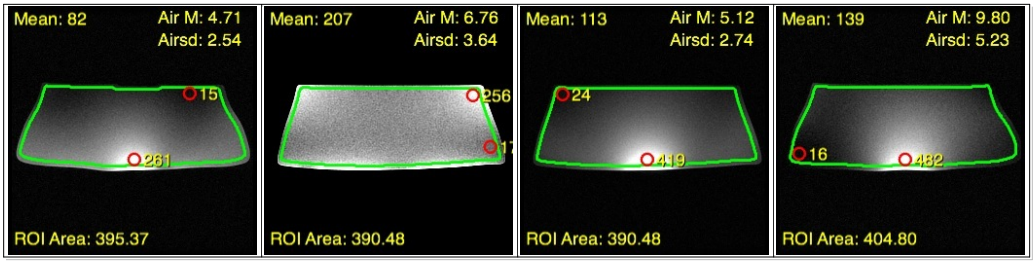
Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
3	82	261	2.54	Air	21.2	57%	67.3	67%
4	207	256	3.64	Air	37.3	100%	46.1	46%
7	113	419	2.74	Air	27.0	73%	100.2	100%
8	139	482	5.23	Air	17.4	47%	60.4	60%

The uncombined images came from images # 11, 7, 8 and 4 and correspond to elements 3, 4, 7 & 8 as defined by USAI QC documents. The SNR values are better than last year.

Composites

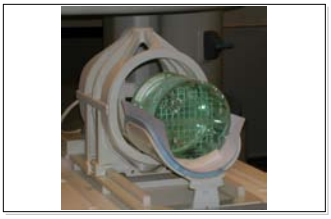


Channels



Channel 1 Channel 2 Channel 3 Channel 4

RF Coil Performance Evaluation



Coil: Head PA
Mfg.: MRI Devices
Mfg. Date: 6/01/2002 Coil ID: 636
Phantom: ACR Phantom

Test Date: 8/31/2008
Model: 101463
Revision: 1
SN: U7284
# 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: a Head TX gain: 91 R1: 11 R2: 29

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Background	Noise SD	Noise Type
N	606	682	556	6.5	8.74	NEMA
A	599	674	548	20.2	5.86	Air

Calculated Results

Mean SNR	Normalized	Max SNR	Uniformity
49.0	27.6	55.2	89.8%
67.0	37.7	75.4	89.7%

Analysis of Uncombined Images

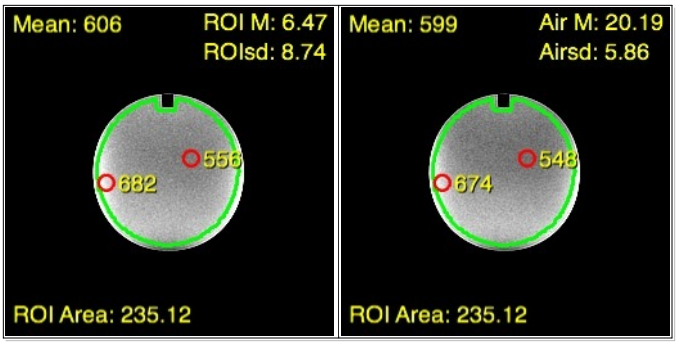
Measured Data

Ch	Mean	Max	Noise SD	Noise Type
1	10	12	0.82	Air
2	232	307	6.05	Air
3	406	597	5.74	Air
4	647	787	7.51	Air

Calculated Results

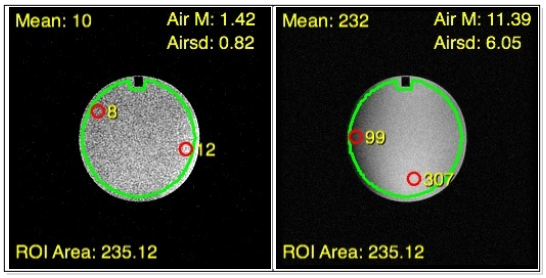
Mean SNR	% of Mean	Max SNR	% of Max
8.0	14%	9.6	14%
25.1	45%	33.3	48%
46.4	82%	68.2	99%
56.5	100%	68.7	100%

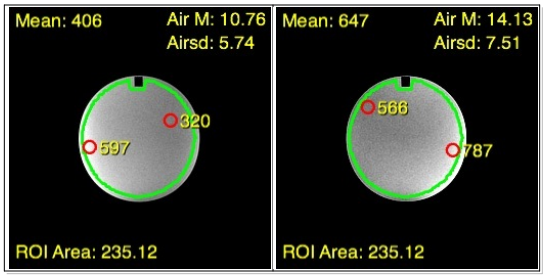
The SNR is 30% lower than last year due to channel #1 being effectively dead.



Composites

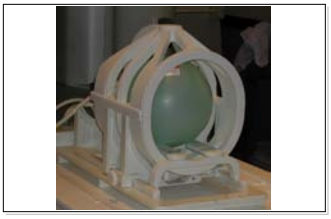
Channel 1 Channel 2





Channel 3 Channel 4

RF Coil Performance Evaluation



Coil: Head PA
Mfg.: MRI Devices
Mfg. Date: 6/01/2002 Coil ID: 636
Phantom: Head Sphere

Test Date: 8/31/2008
Model: 101463
Revision: 1
SN: U7284
# 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: Head TX gain: 86 R1: 11 R2: 29

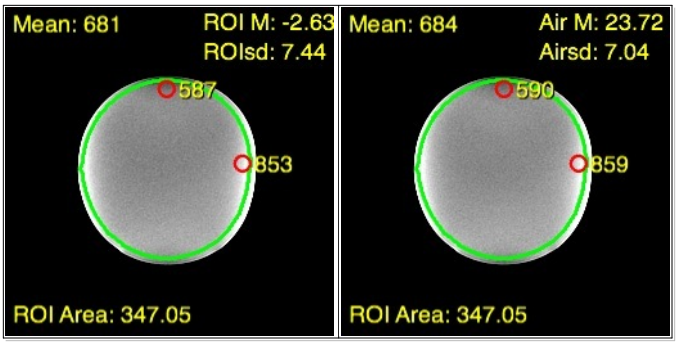
Analysis of Composite Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	681	853	587	-2.6	7.44	NEMA	64.7	36.4	81.1	81.5%
A	684	859	590	23.7	7.04	Air	63.7	35.8	80.0	81.4%

Analysis of Uncombined Images

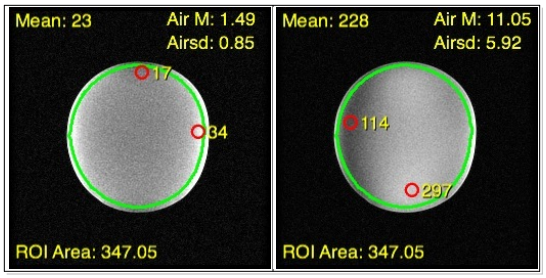
Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	23	34	0.85	Air	17.7	30%	26.2	34%
2	228	297	5.92	Air	25.2	43%	32.9	43%
3	501	708	6.03	Air	54.4	92%	76.9	100%
4	703	842	7.81	Air	59.0	100%	70.6	92%

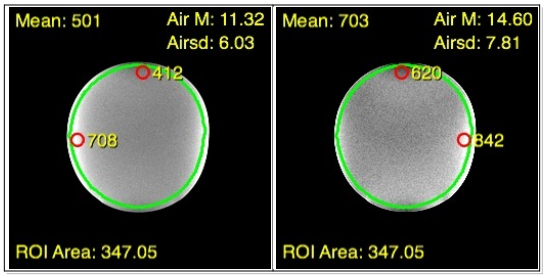
The SNR is 43% lower than last year due to channel #1 being effectively dead.



Composites

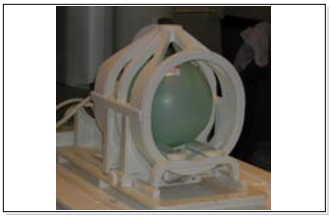
Channel 1 Channel 2





Channel 3 Channel 4

RF Coil Performance Evaluation



Coil: Head PA
Mfg.: MRI Devices
Mfg. Date: 6/01/2002 Coil ID: 636
Phantom: Head Sphere

Test Date: 8/31/2008
Model: 101463
Revision: 1
SN: U7284
# 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: Head TX gain: 85 R1: 11 R2: 29

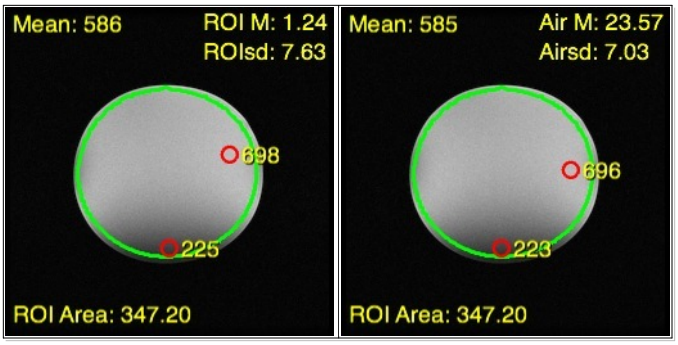
Analysis of Composite Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	586	698	225	1.2	7.63	NEMA	54.3	30.6	64.7	48.8%
A	585	696	223	23.6	7.03	Air	54.5	30.7	64.9	48.5%

Analysis of Uncombined Images

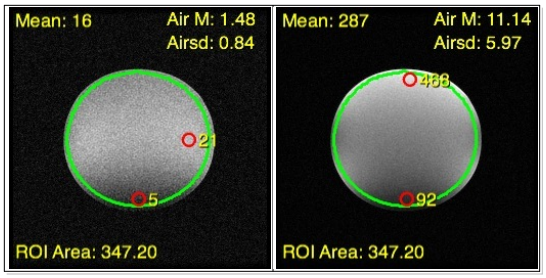
Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	16	21	0.84	Air	12.5	25%	16.4	27%
2	287	468	5.97	Air	31.5	63%	51.4	83%
3	394	488	6.05	Air	42.7	85%	52.9	86%
4	595	731	7.76	Air	50.2	100%	61.7	100%

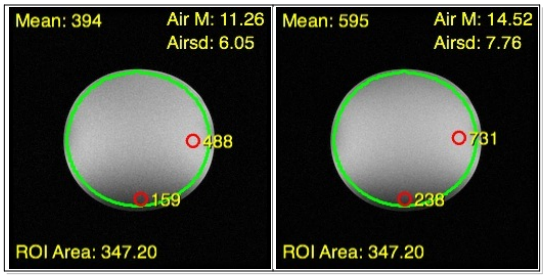
The SNR is 36% lower than last year due to channel #1 being effectively dead.



Composites

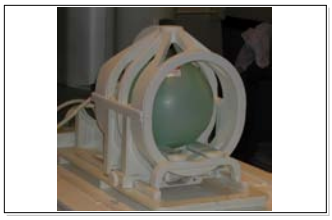
Channel 1 Channel 2





Channel 3 Channel 4

RF Coil Performance Evaluation



Coil: Head PA
Mfg.: MRI Devices
Mfg. Date: 6/01/2002 Coil ID: 636
Phantom: Head Sphere

Test Date: 8/31/2008
Model: 101463
Revision: 1
SN: U7284
# of Channels 4

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

Coil Mode: Head TX gain: 96 R1: 11 R2: 29

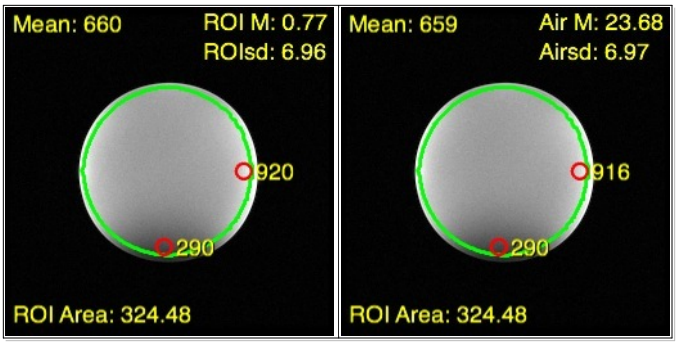
Analysis of Composite Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	660	920	290	0.8	6.96	NEMA	67.1	37.7	93.5	47.9%
A	659	916	290	23.7	6.97	Air	62.0	34.9	86.1	48.1%

Analysis of Uncombined Images

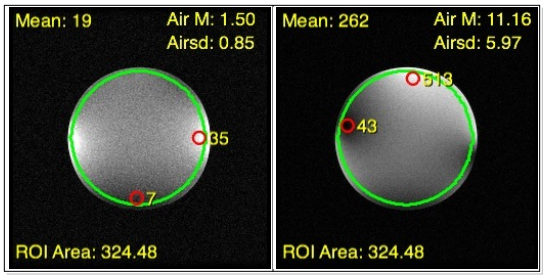
Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	19	35	0.85	Air	14.6	27%	27.0	29%
2	262	513	5.97	Air	28.8	52%	56.3	60%
3	454	841	6.09	Air	48.9	89%	90.5	97%
4	660	1,115	7.84	Air	55.2	100%	93.2	100%

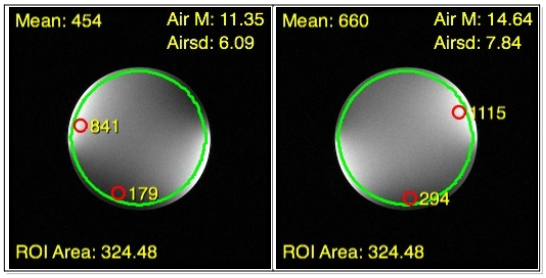
The SNR is 37% lower than last year due to channel #1 being effectively dead.



Composites

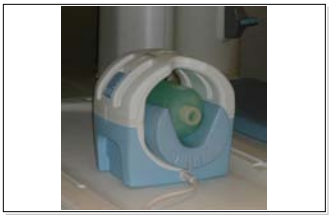
Channel 1 Channel 2





Channel 3 Channel 4

RF Coil Performance Evaluation



Coil: Knee - Large
Mfg.: USA Instr.
Mfg. Date: 9/20/2002 Coil ID: 633
Phantom: Knee Phantom (bottle) - Site is missing phantom holder

Test Date: 8/31/2008
Model: Legend 5000
Revision: B
SN: 421
# of Channels 2

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	25	256	256	15.6	1	3	-

Coil Mode: LargeKnee TX gain: 167 R1: 11 R2: 29

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Background	Noise SD	Noise Type
N	1,888	2,028	1,773	-5.6	15.29	NEMA
A	1,893	2,036	1,763	33.2	12.70	Air

Calculated Results

Mean SNR	Normal-ized	Max SNR	Uni-formity
87.3	125.7	93.8	93.3%
97.7	140.7	105.1	92.8%

Analysis of Uncombined Images

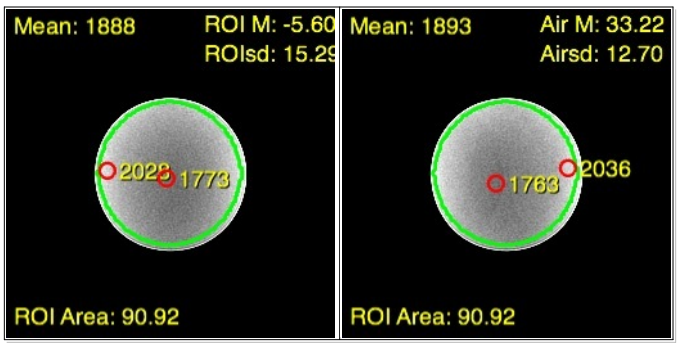
Measured Data

Ch	Mean	Max	Noise SD	Noise Type
1	1,587	1,725	11.27	Air
2	750	830	11.95	Air

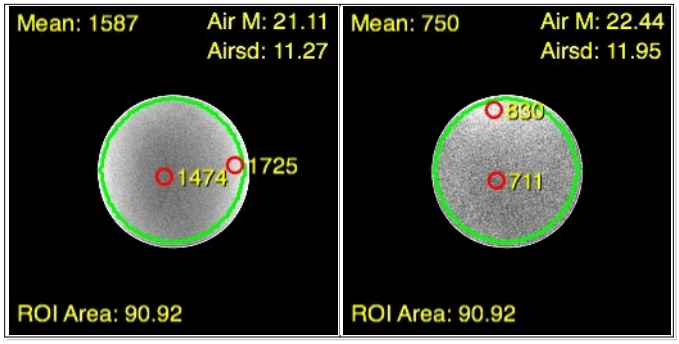
Calculated Results

Mean SNR	% of Mean	Max SNR	% of Max
92.3	100%	100.3	100%
41.1	45%	45.5	45%

The SNR is up roughly 10%

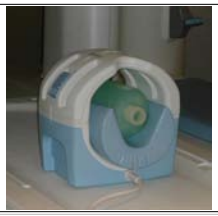


Composites



Channel 1 Channel 2

RF Coil Performance Evaluation



Coil: Knee - Large
Mfg.: USA Instr.
Mfg. Date: 9/20/2002 Coil ID: 633
Phantom: Knee Phantom (bottle) - Site is missing phantom holder

Test Date: 8/31/2008
Model: Legend 5000
Revision: B
SN: 421
# of Channels 2

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

Coil Mode: LargeKnee TX gain: 167 R1: 11 R2: 29

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Background	Noise SD	Noise Type
N	1,487	1,981	871	3.9	8.20	NEMA
A	1,483	1,970	867	16.0	6.28	Air

Calculated Results

Mean SNR	Normal-ized	Max SNR	Uni-formity
128.2	89.1	170.9	61.1%
154.7	107.5	205.6	61.1%

Analysis of Uncombined Images

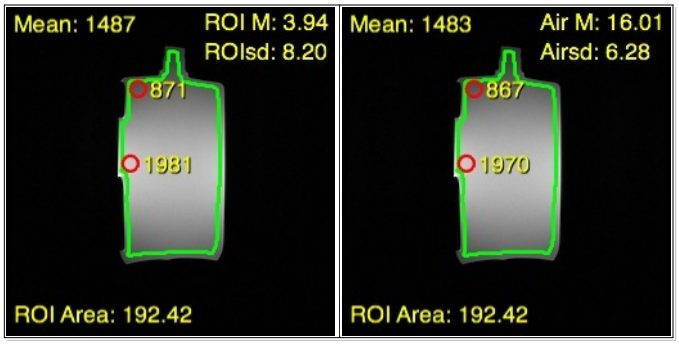
Measured Data

Ch	Mean	Max	Noise SD	Noise Type
1	1,170	1,549	5.43	Air
2	580	791	5.70	Air

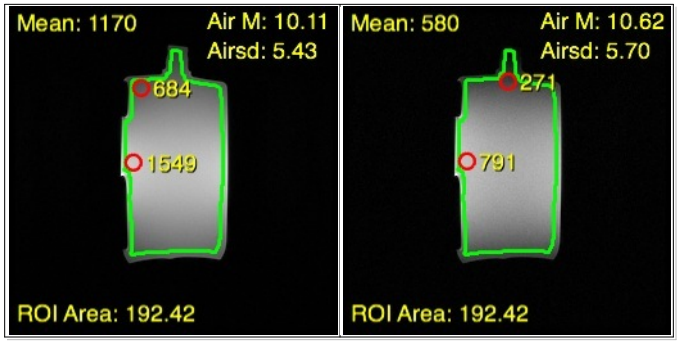
Calculated Results

Mean SNR	% of Mean	Max SNR	% of Max
141.2	100%	186.9	100%
66.7	47%	90.9	49%

The SNR is up roughly 14%



Composites



Channel 1 Channel 2

RF Coil Performance Evaluation

Coil: Knee - Medium
Mfg.: USA Instr.
Mfg. Date: 9/13/2002 Coil ID: 637
Phantom: Knee Bottle phantom

Test Date: 8/31/2008
Model: Legend 5000
Revision: B
SN: 427
# of Channels 2

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	25	256	256	15.6	1	3	-

Coil Mode: Small Knee TX gain: 163 R1: 11 R2: 29

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Background	Noise SD	Noise Type
N	1,628	1,807	1,491	-3.1	10.92	NEMA
A	1,631	1,814	1,502	26.1	9.98	Air

Calculated Results

Mean SNR	Normal-ized	Max SNR	Uni-formity
105.4	151.8	117.0	90.4%
107.1	154.2	119.1	90.6%

Analysis of Uncombined Images

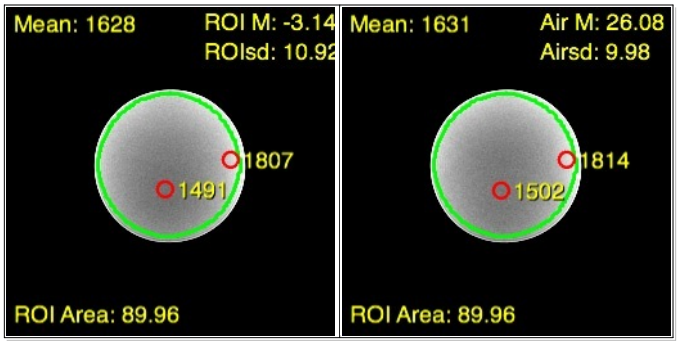
Measured Data

Ch	Mean	Max	Noise SD	Noise Type
1	1,615	1,864	9.59	Air
2	691	776	8.53	Air

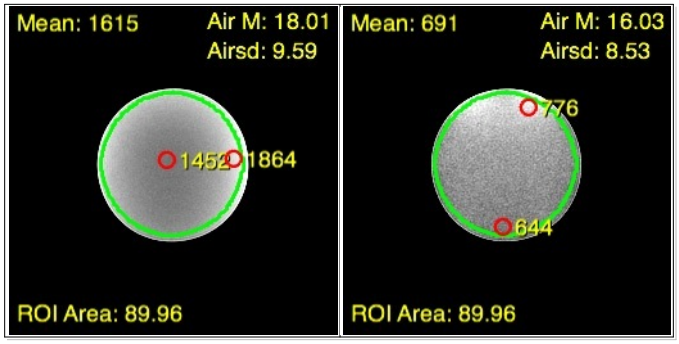
Calculated Results

Mean SNR	% of Mean	Max SNR	% of Max
110.4	100%	127.4	100%
53.1	48%	59.6	47%

The SNR is up roughly 5%



Composites



Channel 1 Channel 2

RF Coil Performance Evaluation

Coil: Knee - Medium
Mfg.: USA Instr.
Mfg. Date: 9/13/2002 Coil ID: 637
Phantom: Knee Bottle phantom

Test Date: 8/31/2008
Model: Legend 5000
Revision: B
SN: 427
# of Channels 2

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

Coil Mode: Small Knee TX gain: 163 R1: 11 R2: 29

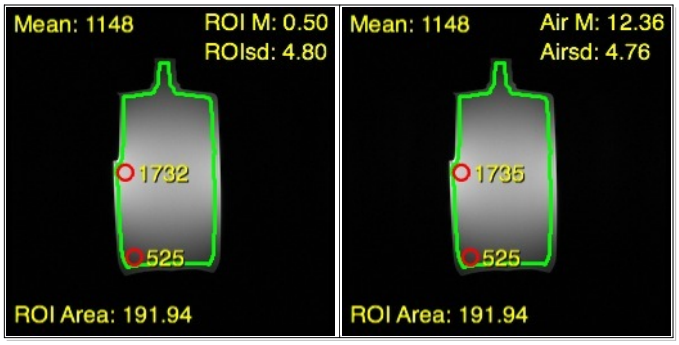
Analysis of Composite Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	1,148	1,732	525	0.5	4.80	NEMA	169.1	117.5	255.2	46.5%
A	1,148	1,735	525	12.4	4.76	Air	158.0	109.8	238.9	46.5%

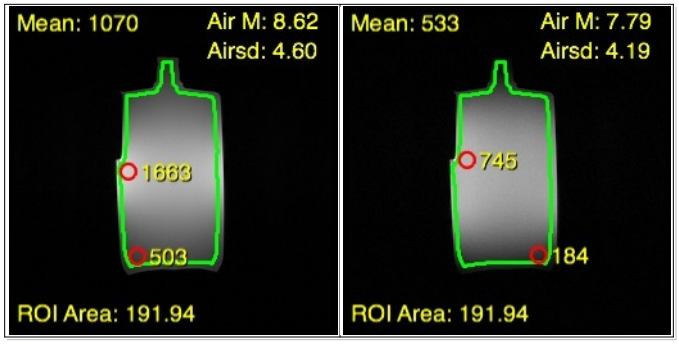
Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	1,070	1,663	4.60	Air	152.4	100%	236.9	100%
2	533	745	4.19	Air	83.4	55%	116.5	49%

The SNR is up roughly 18%



Composites



Channel 1 Channel 2

RF Coil Performance Evaluation

Coil: Knee/Foot - Standard
Mfg.: USA Instr.
Mfg. Date: 9/13/2002 Coil ID: 663
Phantom: Foot phantom

Test Date: 8/31/2008
Model: Legend 5000
Revision:
SN: 427
# of Channels 3

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	S	40	256	256	15.6	2	3	-

Coil Mode: Foot TX gain: 161 R1: 11 R2: 29

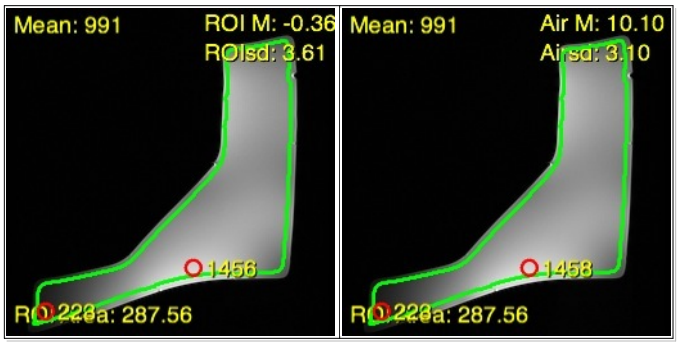
Analysis of Composite Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	991	1,456	223	-0.4	3.61	NEMA	194.1	77.2	285.2	26.6%
A	991	1,458	223	10.1	3.10	Air	209.5	83.3	308.2	26.5%

Analysis of Uncombined Images

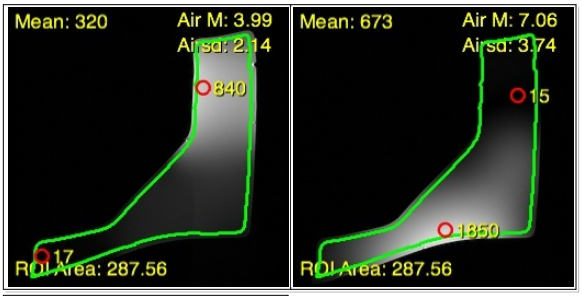
Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	320	840	2.14	Air	98.0	82%	257.2	79%
2	673	1,850	3.74	Air	117.9	99%	324.1	100%
3	441	817	2.43	Air	118.9	100%	220.3	68%

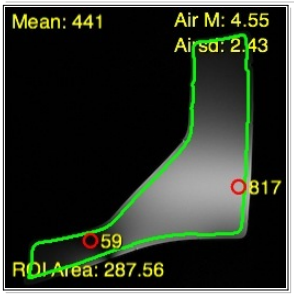
The values are comparable to or just a little lower than last year



Composites

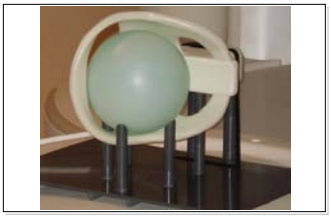
Channel 1 Channel 2





Channel 3

RF Coil Performance Evaluation



Coil: Shoulder - Phased Array
Mfg.: USA Instr.
Mfg. Date: 5/15/2003 Coil ID: 638
Phantom: Shoulder sphere

Test Date: 8/31/2008
Model: Mark 5000
Revision: C
SN: 464
# of Channels 2

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

Coil Mode: Shoulder TX gain: 164 R1: 11 R2: 30

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Background	Noise SD	Noise Type
N	653	1,113	340	-0.8	4.54	NEMA
A	654	1,114	348	7.2	2.76	Air

Calculated Results

Mean SNR	Normal-ized	Max SNR	Uni-formity
101.7	70.6	173.4	46.8%
155.3	107.8	264.5	47.6%

Analysis of Uncombined Images

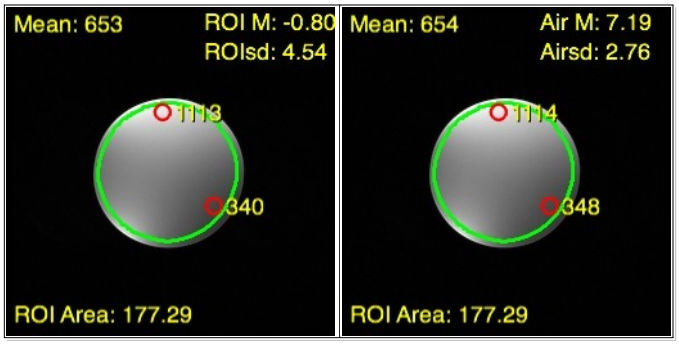
Measured Data

Ch	Mean	Max	Noise SD	Noise Type
1	470	749	2.50	Air
2	416	943	2.62	Air

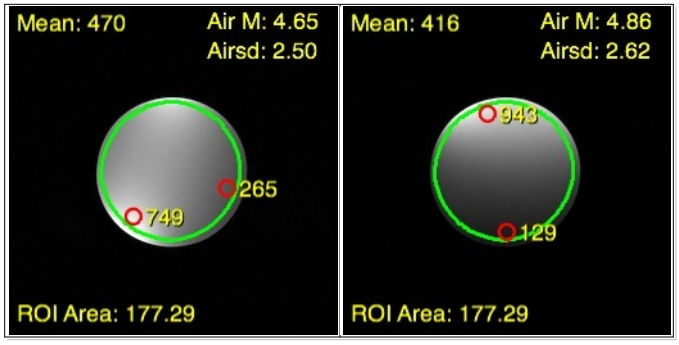
Calculated Results

Mean SNR	% of Mean	Max SNR	% of Max
123.2	100%	196.3	83%
104.0	84%	235.9	100%

The values are comparable to or just a little lower than last year.

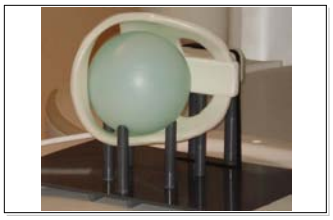


Composites



Channel 1 Channel 2

RF Coil Performance Evaluation



Coil: Shoulder - Phased Array
Mfg.: USA Instr.
Mfg. Date: 5/15/2003 Coil ID: 638
Phantom: Shoulder sphere

Test Date: 8/31/2008
Model: Mark 5000
Revision: C
SN: 464
# 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: Shoulder TX gain: 160 R1: 11 R2: 30

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Background	Noise SD	Noise Type
N	566	690	427	-0.1	3.13	NEMA
A	566	689	428	7.1	2.73	Air

Calculated Results

Mean SNR	Normalized	Max SNR	Uniformity
127.9	88.8	155.9	76.5%
135.9	94.3	165.4	76.6%

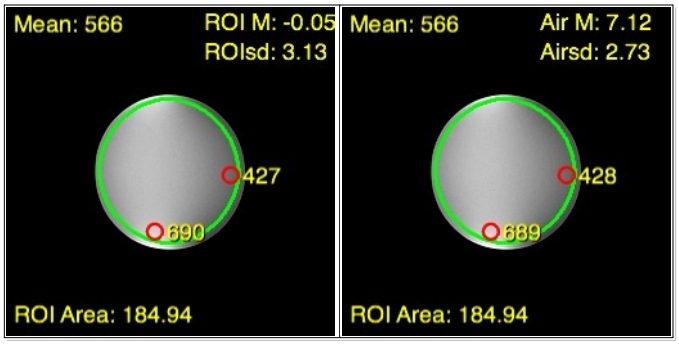
Analysis of Uncombined Images

Measured Data

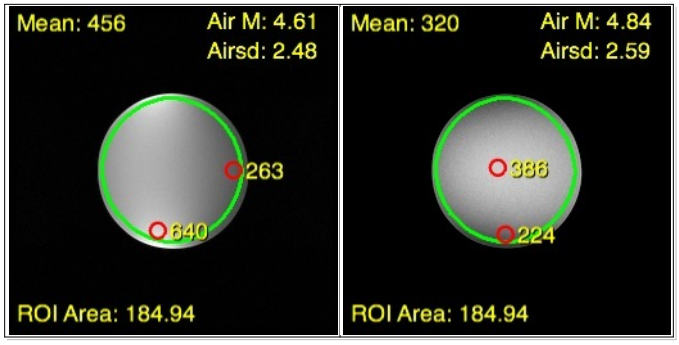
Ch	Mean	Max	Noise SD	Noise Type
1	456	640	2.48	Air
2	320	386	2.59	Air

Calculated Results

Mean SNR	% of Mean	Max SNR	% of Max
120.5	100%	169.1	100%
81.0	67%	97.7	58%



Composites



Channel 1 Channel 2

RF Coil Performance Evaluation

Coil: Wrist Coil
Mfg.: MRI Devices
Mfg. Date: 9/01/2002 Coil ID: 639
Phantom: Wrist coil phantom

Test Date: 8/31/2008
Model:
Revision: 0
SN: U8469
# of Channels 3

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

Coil Mode: Wrist - Horizontal TX gain: 137 R1: 11 R2: 29

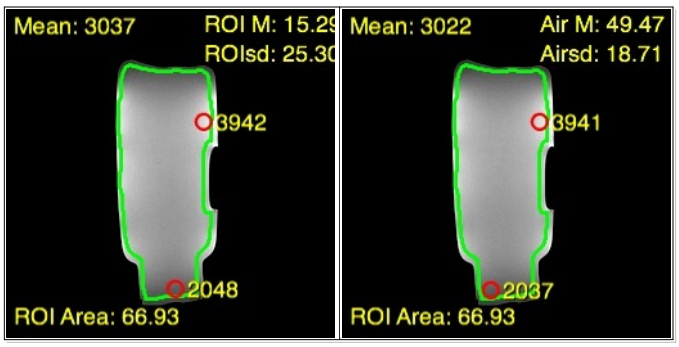
Analysis of Composite Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	3,037	3,942	2,048	15.3	25.30	NEMA	84.9	191.0	110.2	68.4%
A	3,022	3,941	2,037	49.5	18.71	Air	105.8	238.1	138.0	68.1%

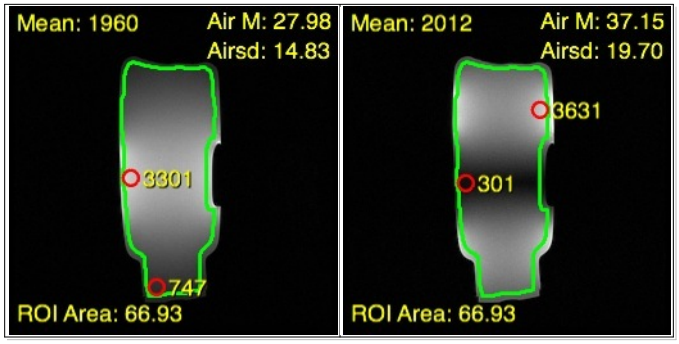
Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	1,960	3,301	14.83	Air	86.6	100%	145.9	100%
2	2,012	3,631	19.70	Air	66.9	77%	120.8	83%

When choosing the horizontal mode, the system seems to only use two channels.



Composites



Channel 1 Channel 2

RF Coil Performance Evaluation

Coil: Wrist Coil
Mfg.: MRI Devices
Mfg. Date: 9/01/2002 Coil ID: 639
Phantom: Wrist coil phantom

Test Date: 8/31/2008
Model:
Revision: 0
SN: U8469
# of Channels 3

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

Coil Mode: Wrist - Horizontal TX gain: 138 R1: 10 R2: 29

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Background	Noise SD	Noise Type
N	3,254	4,102	2,013	7.9	22.86	NEMA
A	3,246	4,091	2,011	49.2	18.94	Air

Calculated Results

Mean SNR	Normal-ized	Max SNR	Uni-formity
100.7	226.5	126.9	65.8%
112.3	252.7	141.5	65.9%

Analysis of Uncombined Images

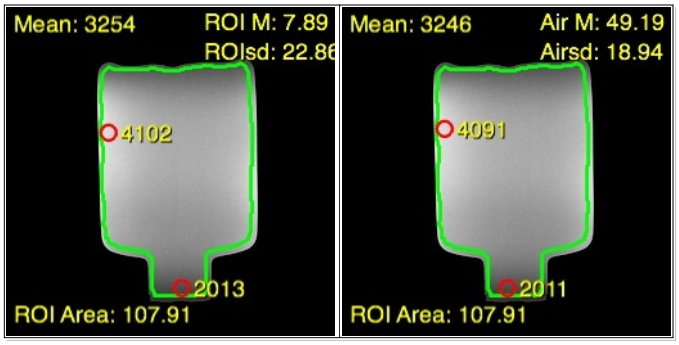
Measured Data

Ch	Mean	Max	Noise SD	Noise Type
1	2,158	3,353	14.90	Air
2	2,074	3,784	19.98	Air

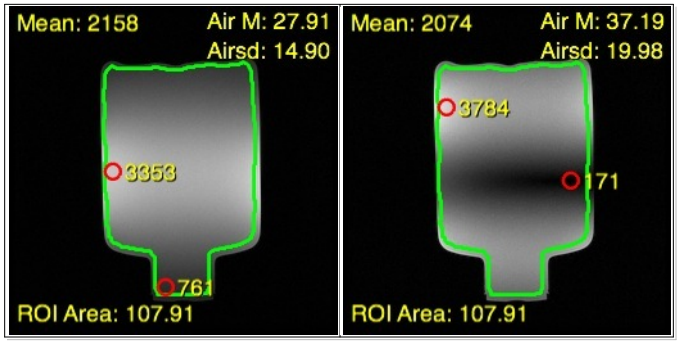
Calculated Results

Mean SNR	% of Mean	Max SNR	% of Max
94.9	100%	147.5	100%
68.0	72%	124.1	84%

When choosing the horizontal mode, the system seems to only use two channels.



Composites



Channel 1 Channel 2

RF Coil Performance Evaluation

Coil: Wrist Coil
Mfg.: MRI Devices
Mfg. Date: 9/01/2002 Coil ID: 639
Phantom: Wrist coil phantom

Test Date: 8/31/2008
Model:
Revision: 0
SN: U8469
# of Channels 3

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

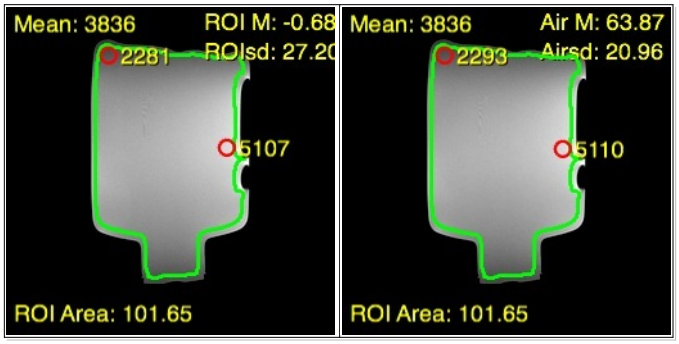
Coil Mode: Wrist - Vertical TX gain: 139 R1: 11 R2: 28

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	3,836	5,107	2,281	-0.7	27.20	NEMA	99.7	224.4	132.8	61.7%
A	3,836	5,110	2,293	63.9	20.96	Air	119.9	269.8	159.8	61.9%

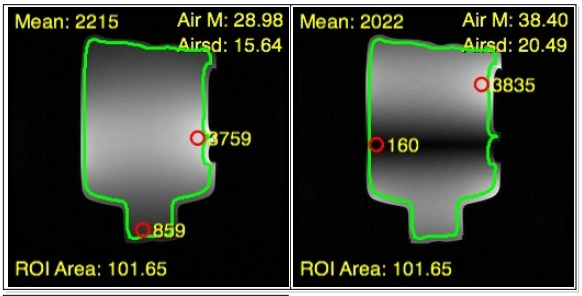
Analysis of Uncombined Images

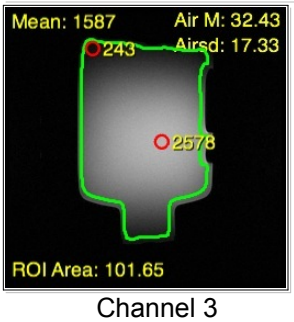
Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	2,215	3,759	15.64	Air	92.8	100%	157.5	100%
2	2,022	3,835	20.49	Air	64.7	70%	122.7	78%
3	1,587	2,578	17.33	Air	60.0	65%	97.5	62%



Composites

Channel 1 Channel 2





Channel 3

RF Coil Performance Evaluation

Coil: Wrist Coil

Mfg.: MRI Devices

Mfg. Date: 9/01/2002 Coil ID: 639

Phantom: Wrist coil phantom

Test Date: 8/31/2008

Model:

Revision: 0

SN: U8469

# of Channels 3

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

Coil Mode: Wrist - Vertical TX gain: 140 R1: 11 R2: 29

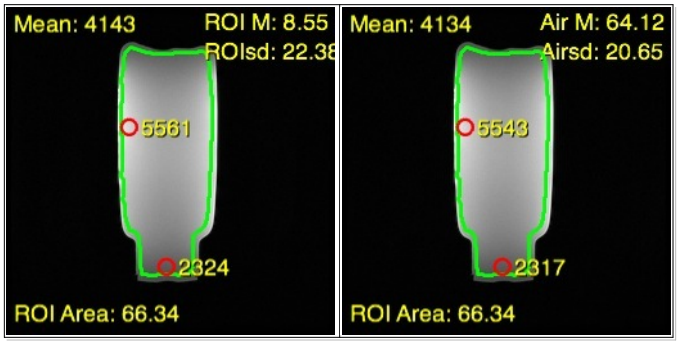
Analysis of Composite Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	4,143	5,561	2,324	8.6	22.38	NEMA	130.9	294.6	175.7	58.9%
A	4,134	5,543	2,317	64.1	20.65	Air	131.2	295.2	175.9	59.0%

Analysis of Uncombined Images

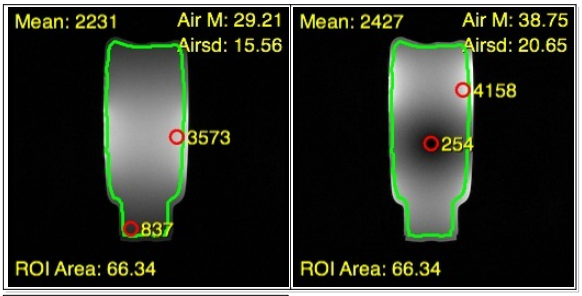
Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	2,231	3,573	15.56	Air	94.0	100%	150.5	100%
2	2,427	4,158	20.65	Air	77.0	82%	132.0	88%
3	1,999	3,189	17.55	Air	74.6	79%	119.1	79%

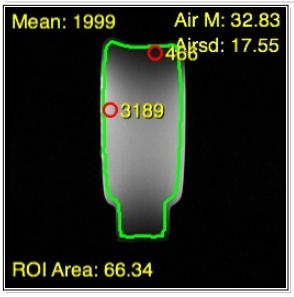
The values are comparable to last year



Composites

Channel 1 Channel 2

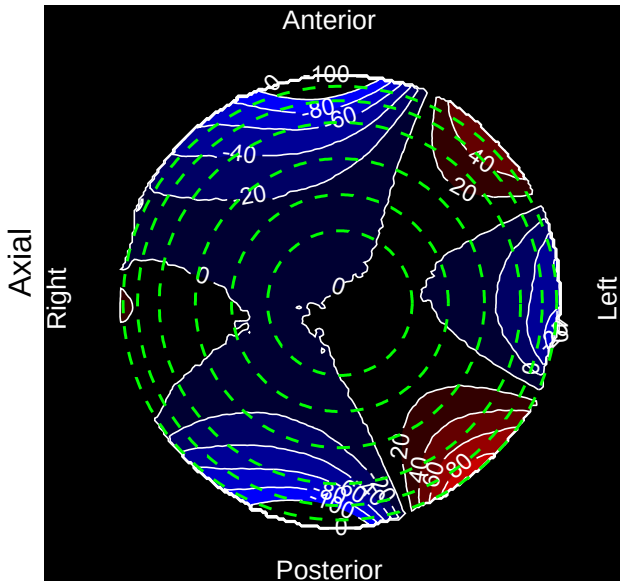




Channel 3

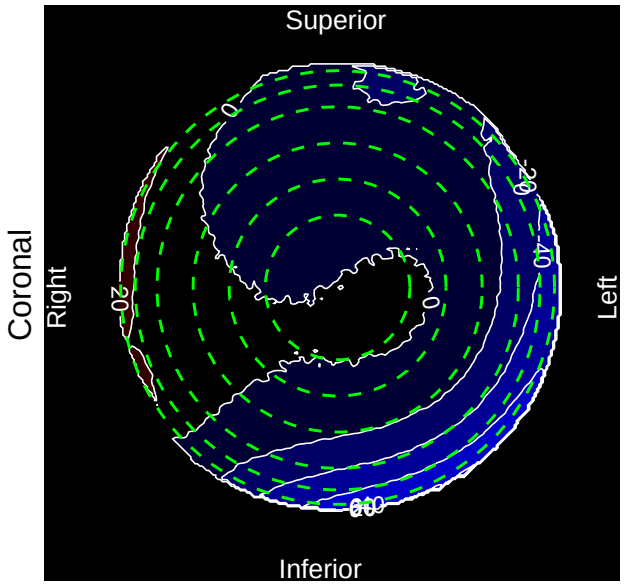
Appendix A: Magnet Homogeneity - Measured August 31, 2008

GE OpenSpeed 0.7T - 3 central planes



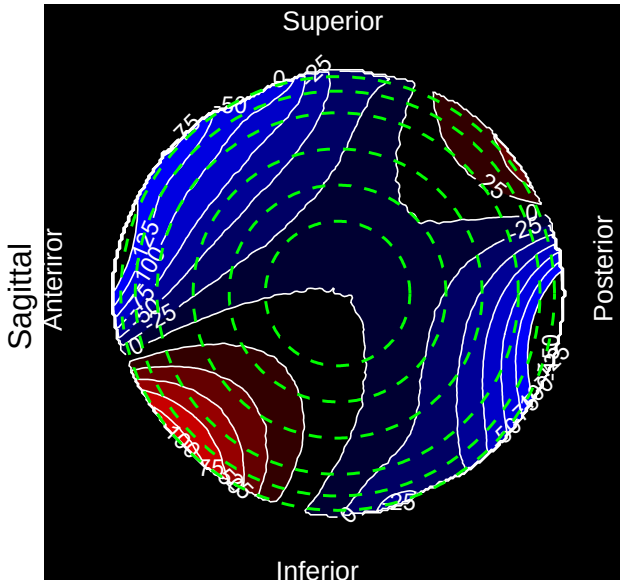
Axial

DIAMETER	MIN	MAX	RANGE	PPM	MEAN	STDEV
10	-9.1	6.8	15.9	0.54	-0.04	3.0
15	-20.5	13.3	33.8	1.14	-1.56	5.4
20	-40.2	26.2	66.5	2.24	-3.99	9.7
25	-75.1	50.0	125.1	4.22	-7.67	17.4
28	-109.3	71.6	180.9	6.09	-10.78	24.6
30	-138.5	90.1	228.6	7.70	-13.17	30.4



Coronal

DIAMETER	MIN	MAX	RANGE	PPM	MEAN	STDEV
10	-5.2	2.7	7.9	0.27	-0.16	1.8
15	-8.4	2.8	11.1	0.37	-1.21	2.5
20	-19.4	6.2	25.7	0.86	-3.25	4.6
25	-42.7	12.1	54.8	1.85	-6.50	9.5
28	-61.4	19.2	80.7	2.72	-8.98	14.0
30	-74.9	29.5	104.4	3.52	-10.60	17.6

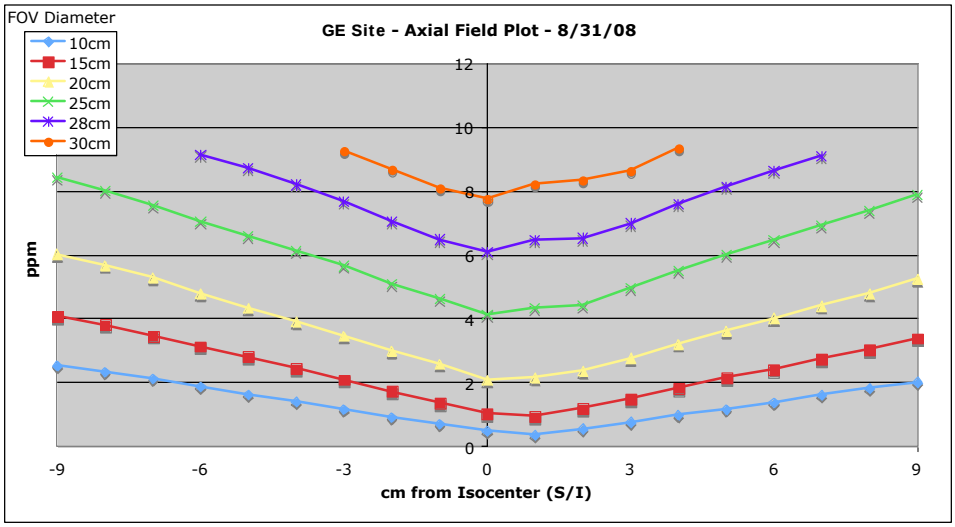


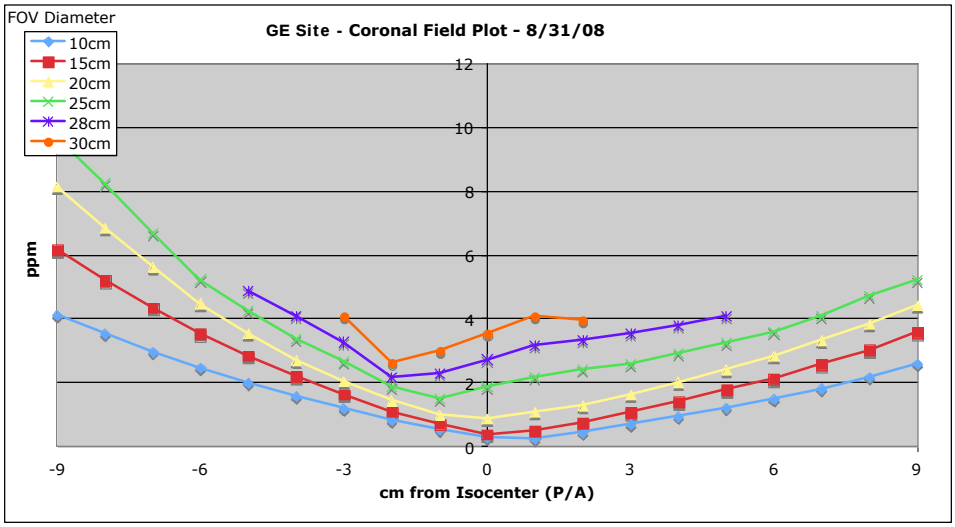
Sagittal

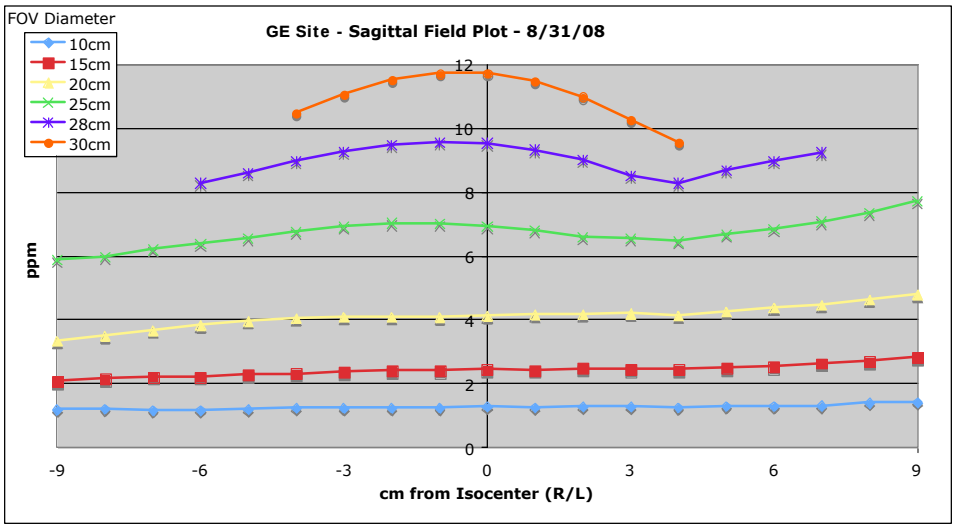
DIAMETER	MIN	MAX	RANGE	PPM	MEAN	STDEV
10	-19.6	17.9	37.5	1.26	-1.76	7.3
15	-38.4	33.7	72.1	2.43	-4.30	13.4
20	-65.2	56.9	122.1	4.11	-8.12	22.2
25	-114.8	90.9	205.7	6.93	-13.50	34.7
28	-165.3	117.2	282.5	9.52	-17.79	44.6
30	-210.3	137.3	347.5	11.71	-20.95	52.5

Appendix A: Magnet Homogeneity - Measured August 31, 2008

GE OpenSpeed 0.7T - Graph of PPM within ± 9cm from Isocenter

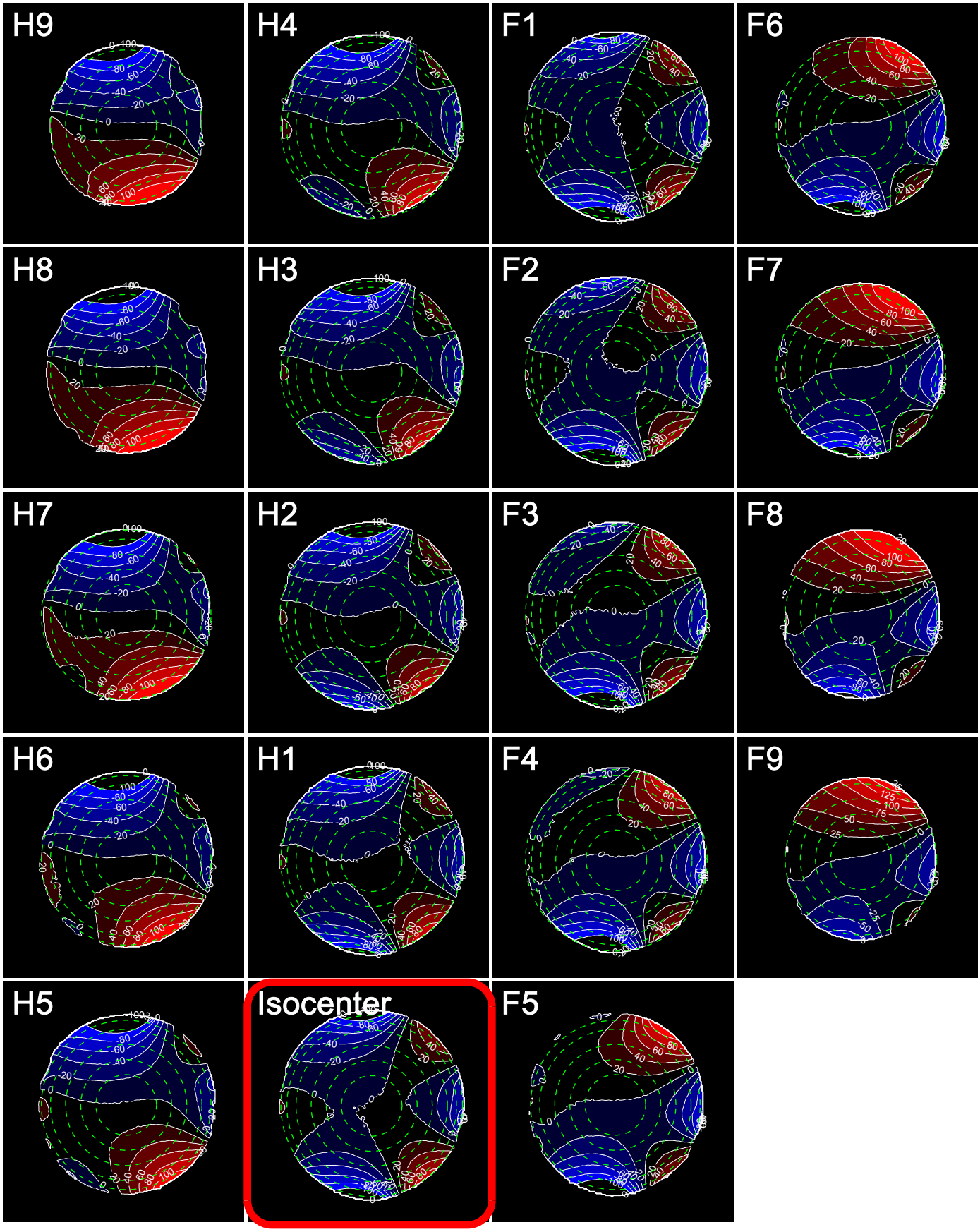






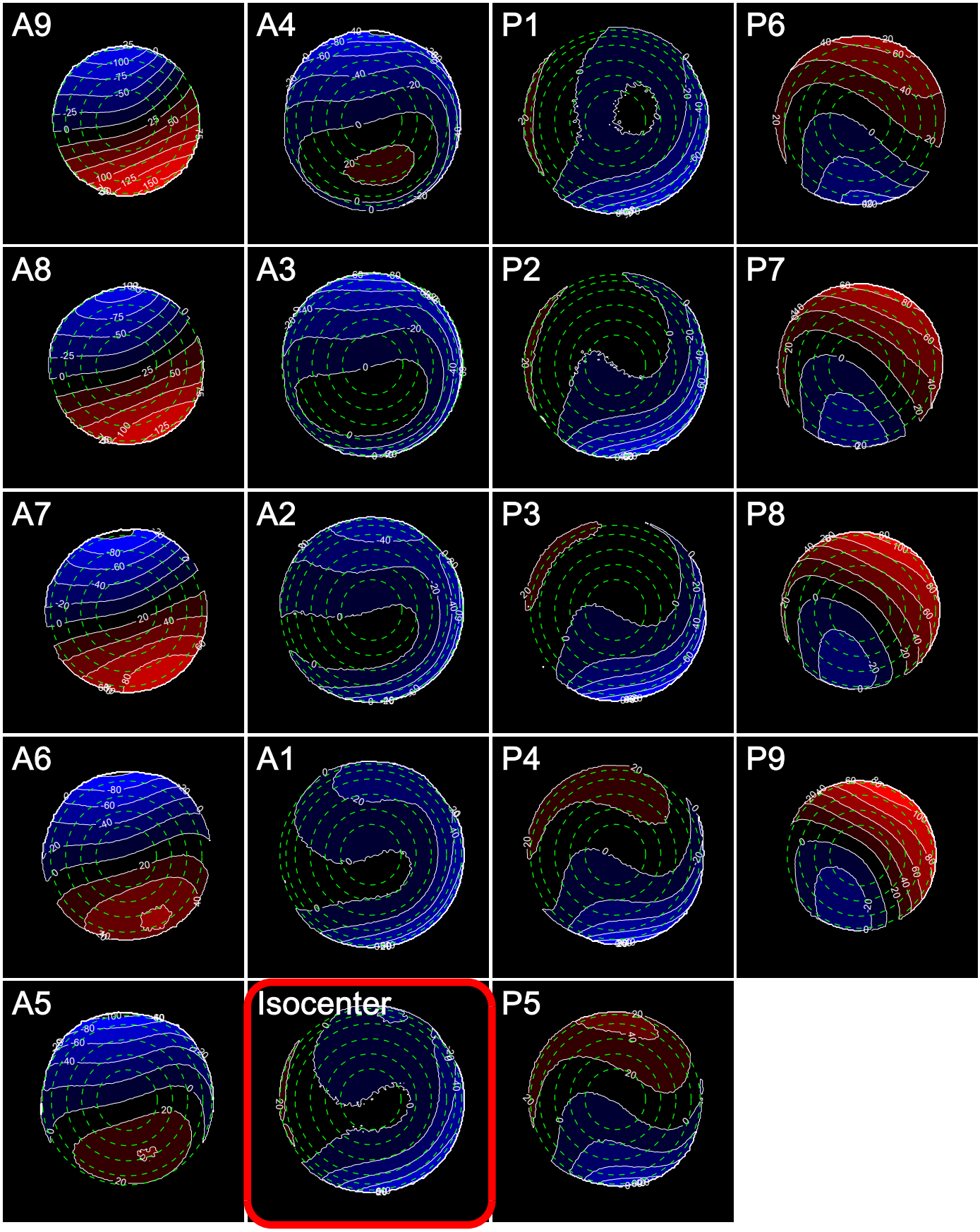
Appendix A: Magnet Homogeneity - Measured August 31, 2008

Axial Field Plots



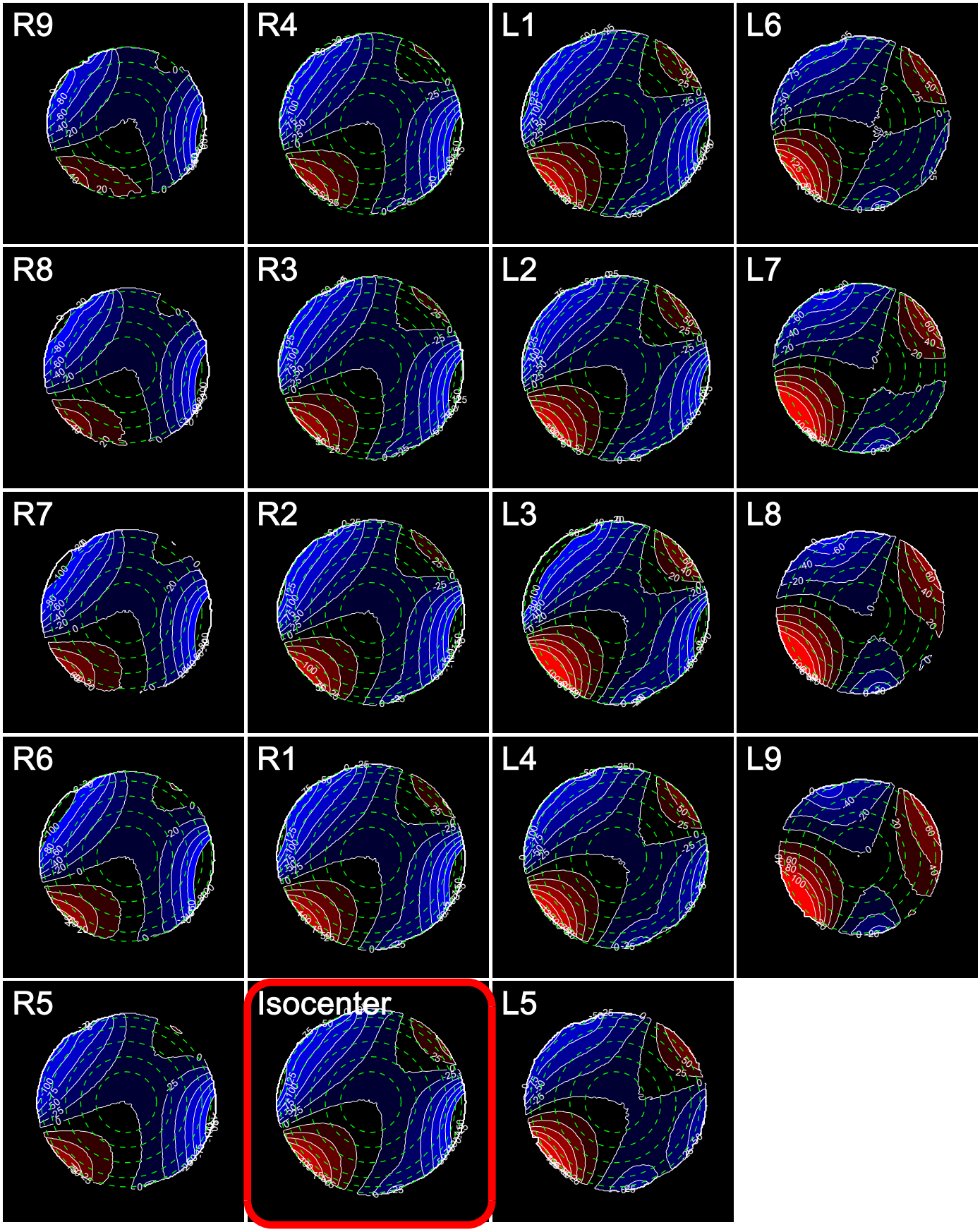
Appendix A: Magnet Homogeneity - Measured August 31, 2008

Coronal Field Plots



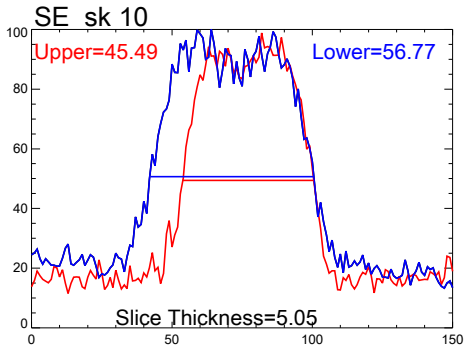
Appendix A: Magnet Homogeneity - Measured August 31, 2008

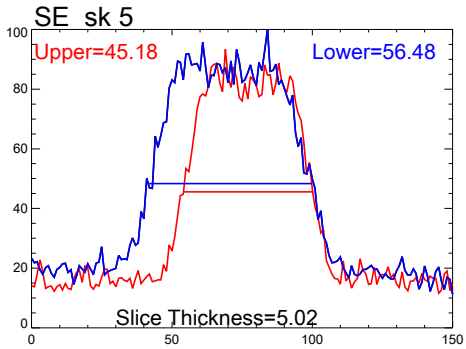
Sagittal Field Plots

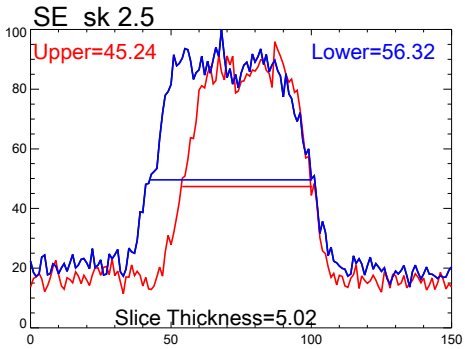


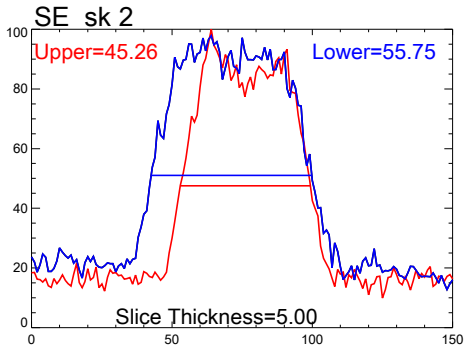
Appendix B: RF Slice Profiles and Crosstalk

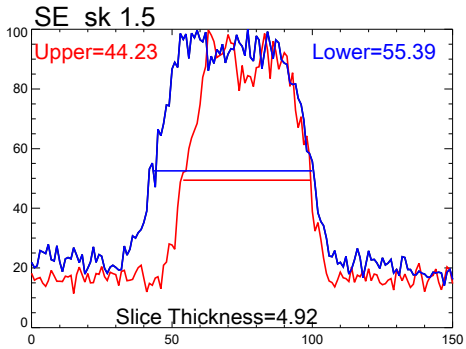
Spin Echo : Minimum Full
TR/TE = 450/19
BW = 10.4 KHz
nex = 1
Scan time: 1:55

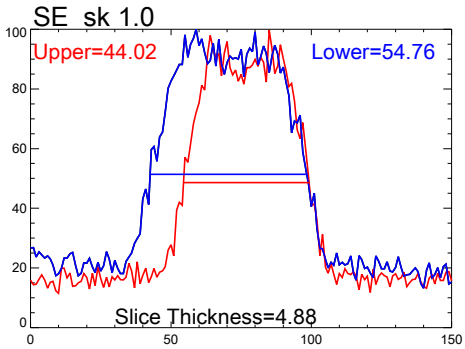


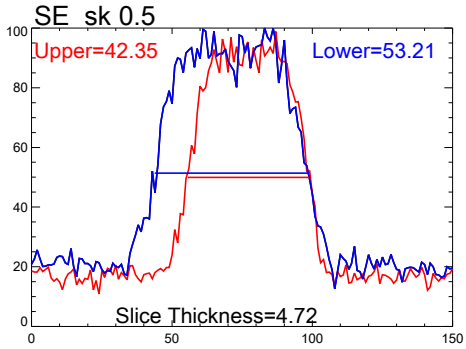


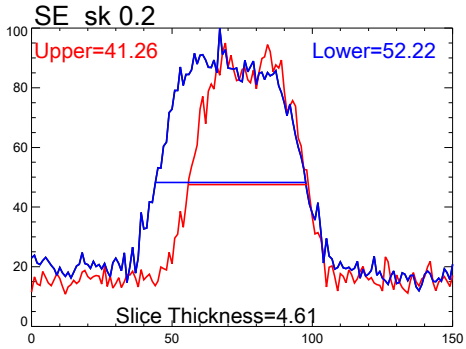


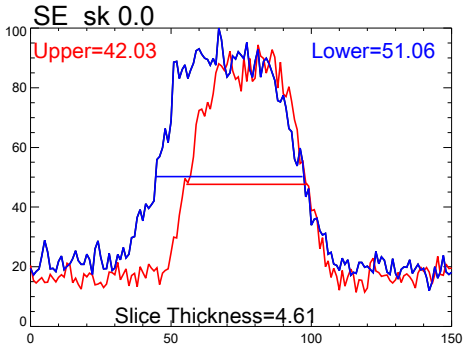


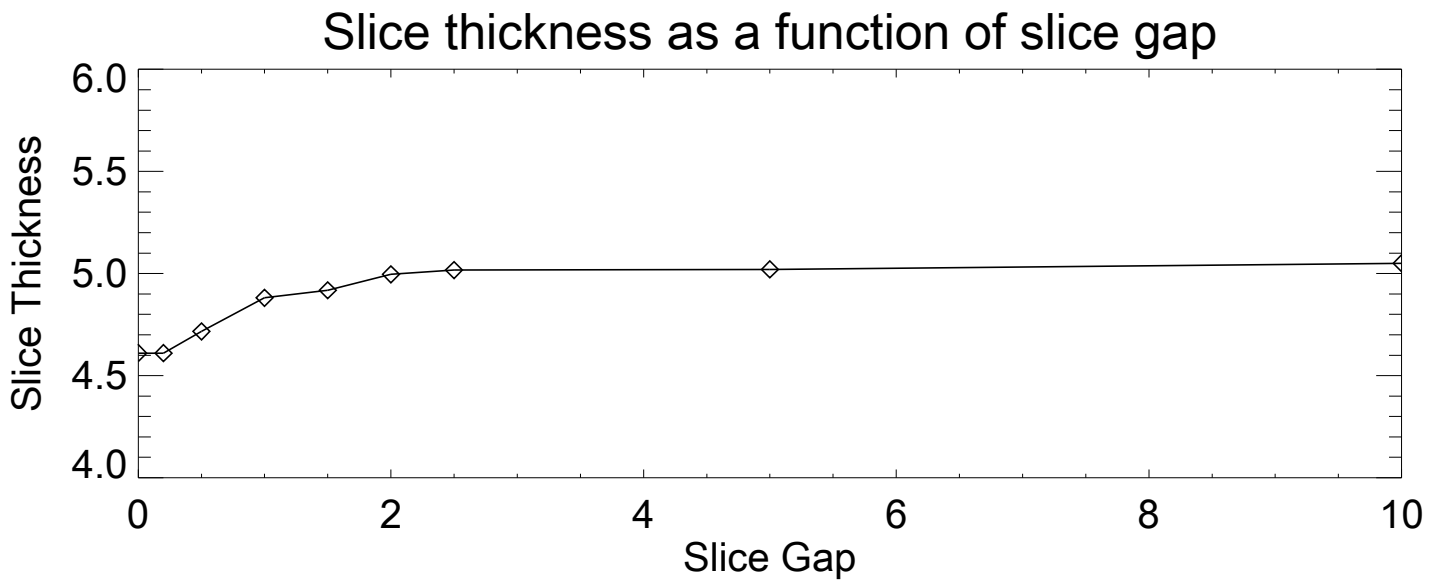






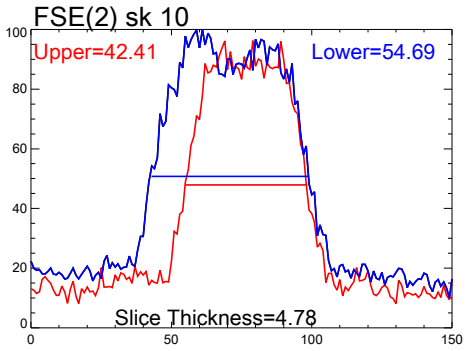


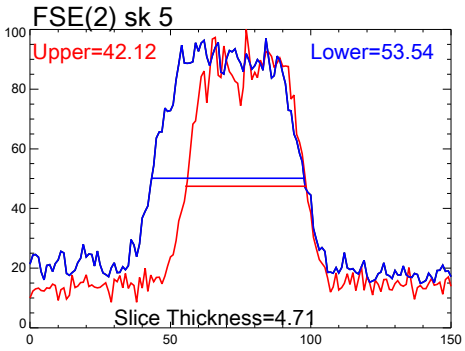


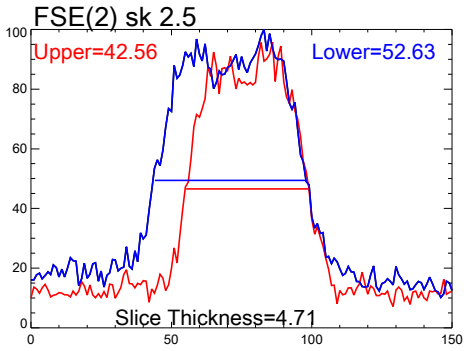


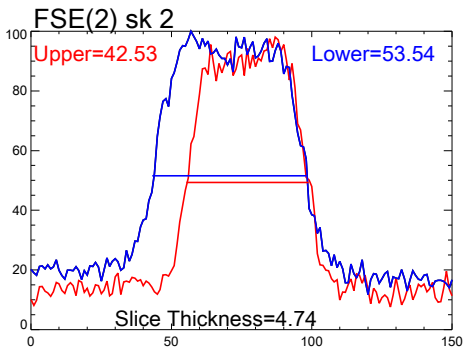
Appendix B: RF Slice Profiles and Crosstalk

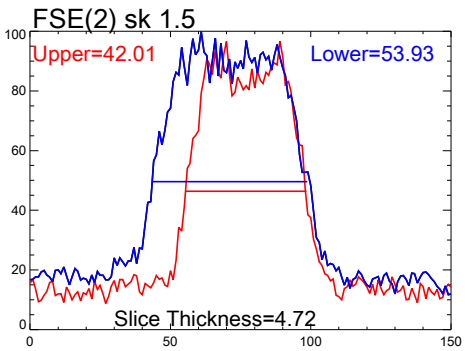
Fast Spin Echo
ETL = 2
TR/TE = 516/16
BW = 15.6 KHz
nex = 3
Scan time: 3:20

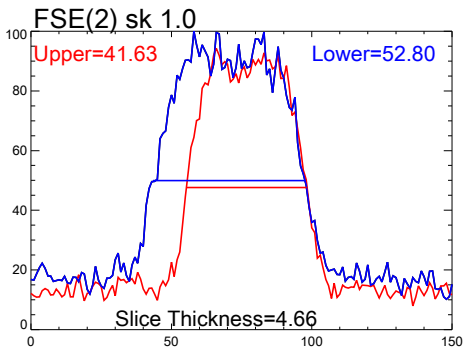


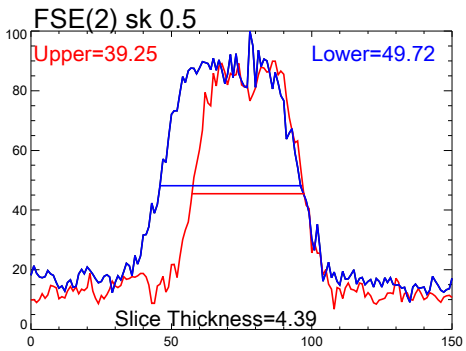


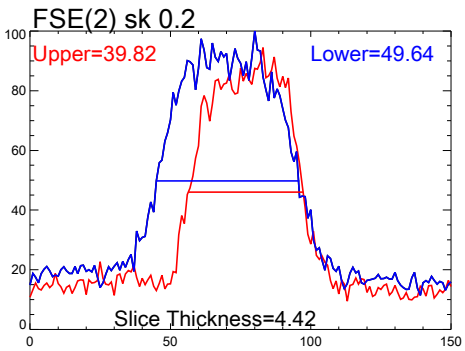


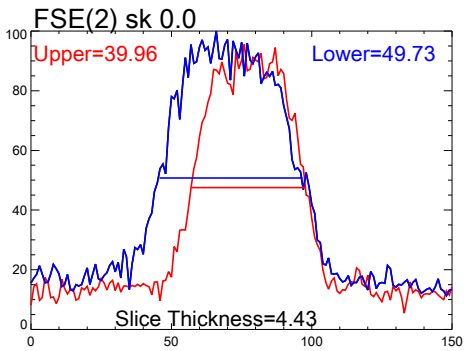


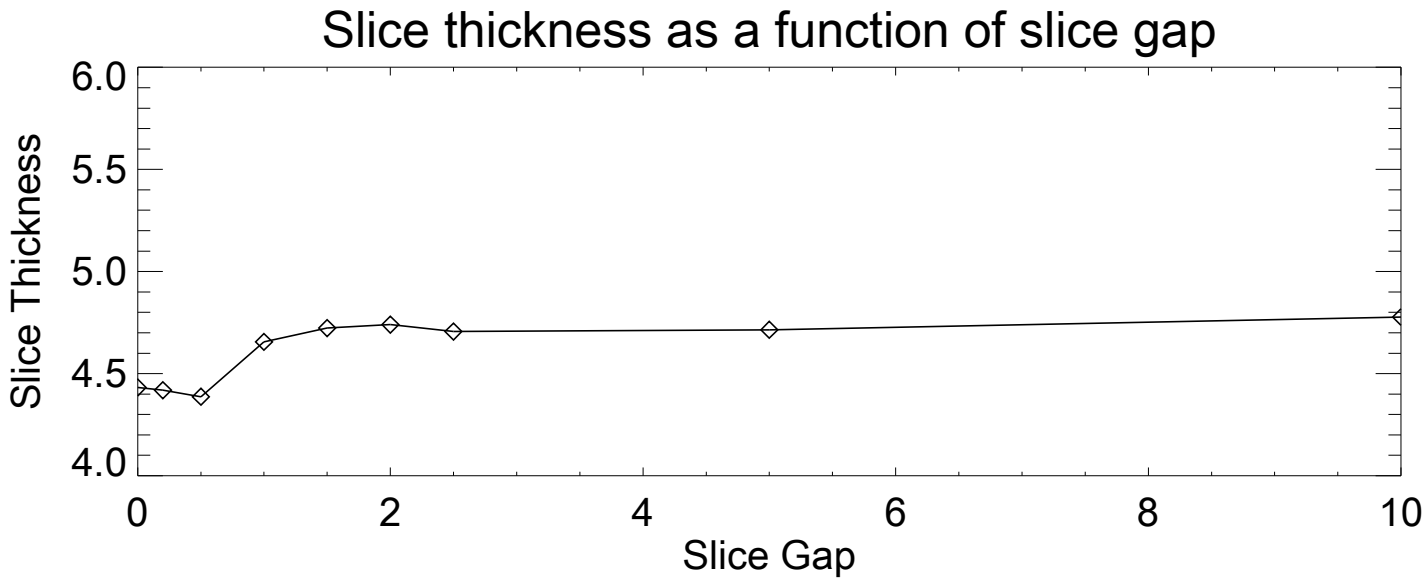






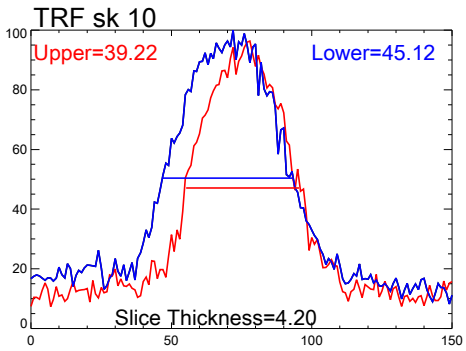


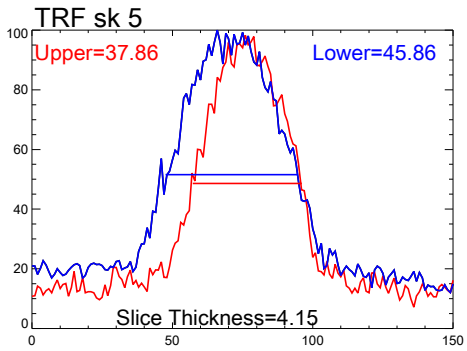


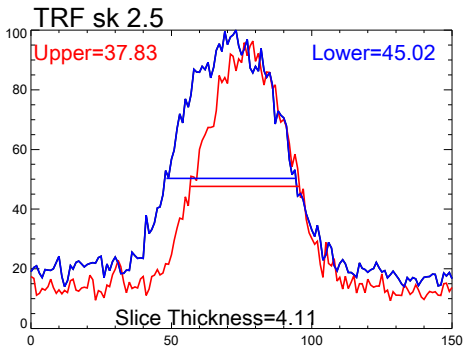


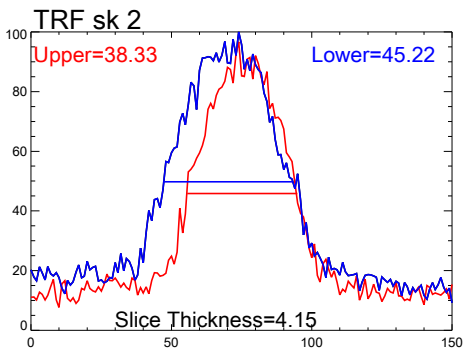
Appendix B: RF Slice Profiles and Crosstalk

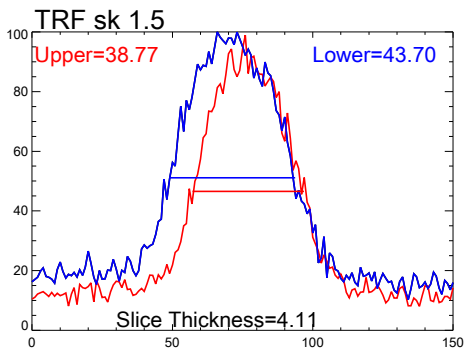
Fast Spin Echo - Tailored RF
ETL = 2
TR/TE = 516/16
BW = 15.6 KHz
nex = 2
Scan time: 3:20

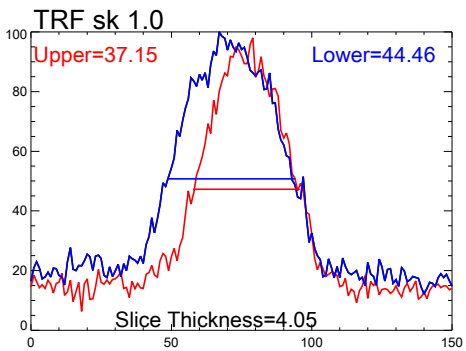


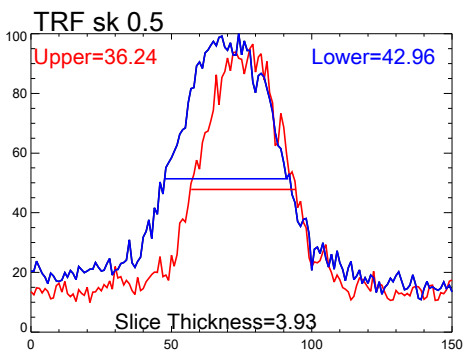


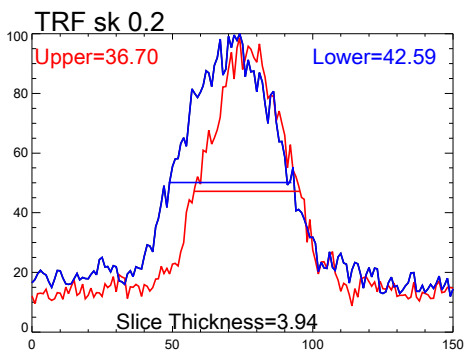


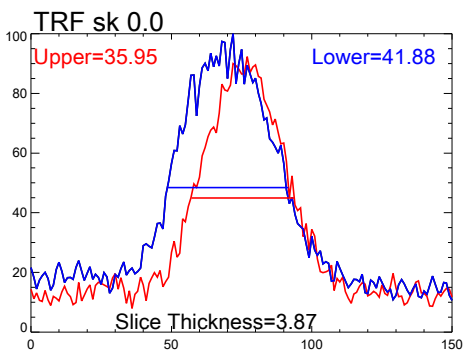


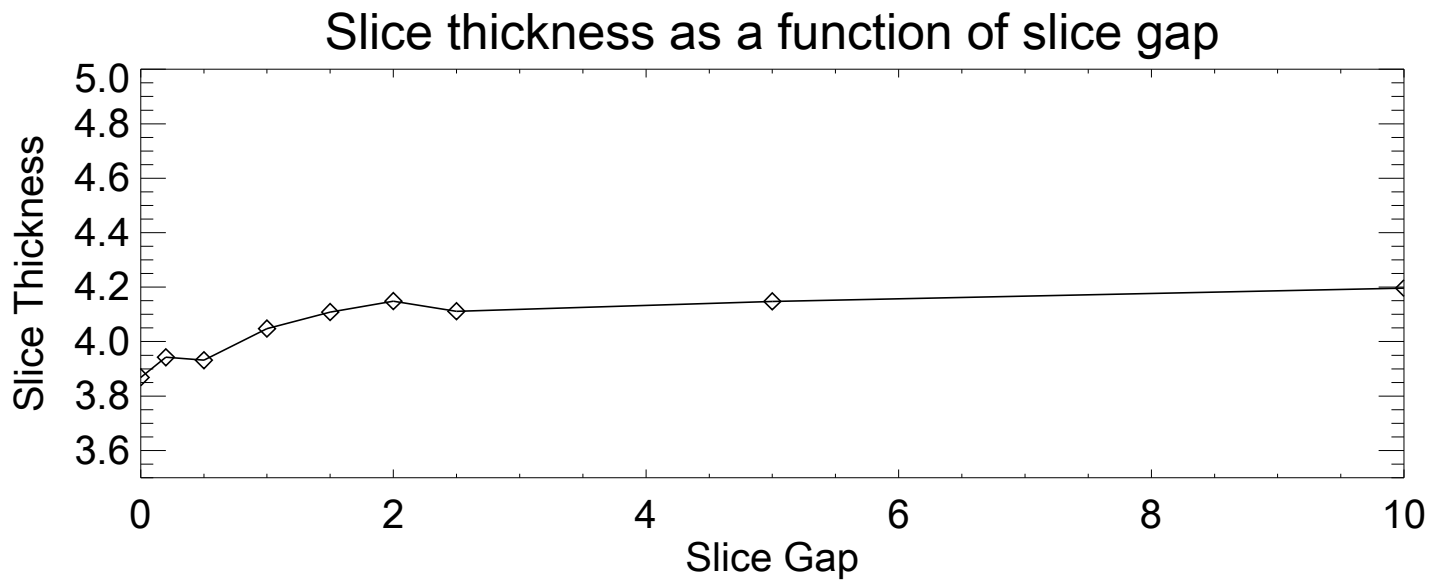












GE Site **GE HFO**

Coil Used: **Head PA** Test Date: **8/31/2008**

	Sagittal Locator	
1	Length of phantom, end to end (mn 148± 2)	146.0

= 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 (1.10, 1.00, 0.90 mm)	1.0	1.0	1.0	0.9	1.0
3		1.0	1.0	1.0	0.9	1.0
4	Slice Thickness (fwhm in mm) Top	62.1	62.4	57.0	60.5	51.5
5	Bottom	48.3	48.1	47.9	46.3	41.3
6	Calculated value 5.0±0.7	5.43	5.43	5.21	5.25	4.58
7	Wedge (mm) ◥ = + ◤ = -	0.6	0.5	0.4	1.5	2.0
8	Diameter (mm) (190±2) ⊕	190.8	190.7	190.7	190.7	190.4
9	⊖	188.7	188.8	188.7	188.8	189.2
	Slice Location #5					
10	Diameter (mm) (190±2) ⊕	189.7	189.8	189.7	189.7	189.9
11	⊖	188.0	188.1	187.9	188.0	188.5
12	⊘	188.8	188.8	188.7	188.8	189.1
13	⊘	188.7	188.8	188.6	188.8	189.2
	Slice Location #7					
14	Signal (mean only) Big ROI	764	799	481	754	382
15	High	881	925	558	864	449
16	Low	712	741	440	699	355
17	Uniformity (>87.5%)	89.4%	89.0%	88.2%	89.4%	88.3%
18	Background Noise Top	33.0 ± 8.57	36.0 ± 9.28	29.8 ± 7.28	26.1 ± 6.82	27.4 ± 7.10
19	Bottom	33.0 ± 8.66	36.0 ± 9.28	29.2 ± 7.28	25.5 ± 7.23	26.8 ± 6.79
20	(mean ±std dev) Left	27.8 ± 7.28	31.7 ± 7.99	24.6 ± 6.22	26.0 ± 6.62	24.7 ± 6.39
21	Right	27.7 ± 6.92	30.7 ± 8.03	24.1 ± 6.25	26.6 ± 6.99	24.6 ± 6.45
22	Ghosting Ratio (<2.5%)	0.7%	0.6%	1.1%	0.1%	0.6%
23	SNR (no spec)	108	100	77	111	60
	Low Con Detectability					
24	Slice Location #8 1.4%	0	0	0	0	0
25	Slice Location #9 2.5%	0	0	0	6	0
26	Slice Location #10 3.6%	4	6	0	8	0
27	Slice Location #11 5.1%	8	8	8	8	8
28	Total # of Spokes (>=9)	12	14	8	22	8
	Slice Location #11					
29	Wedge (mm) ◥ = + ◤ = -	-6.1	-6.1	-5.9	-5.2	-5.0
30	Slice Position Error	-6.7	-6.6	-6.3	-6.7	-7.0

GE Site

GE HFO

Sequence parameters

Test Date: **8/31/2008**

Coil Used:**Head PA**

Test ID **337**

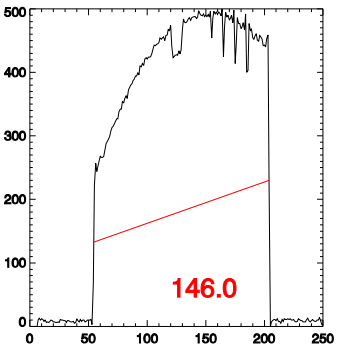
Study Description	Pulse Sequence (ETL)	TR (ms)	TE (ms)	FOV (cm)	Phase Sample Ratio	Number of Slices	Thick-ness (mm)	Slice Gap	NSA (Nex)	Freq Matrix	Phase Matrix	Band Width (kHz)	Scan Time (min:sec)
ACR T1	SE	500	20	25	1	11	5	5	1	256	256	10.4	2:09
ACR PD	Dual Echo SE	2000	20	25	1	11	5	5	1	256	256	12.4	8:32
ACR T2	Dual Echo SE	2000	80	25	1	11	5	5	1	256	256	8.92	8:32
Site T1	SE	450	14	24	1	11	5	5	2	256	256	10.4	3:51
Site T2	FSE(14)	3000	98	24	2	11	5	5	1.5	256	224	20.7	2:24

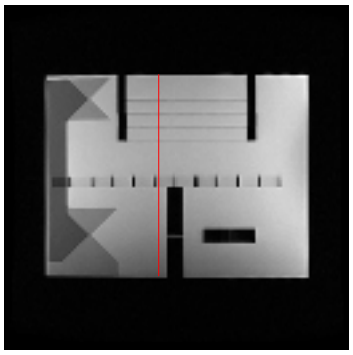
Magnet ID: **37** **Coil ID:** **636** **TestID:** **337**

Appendix C: ACR Phantom Analysis

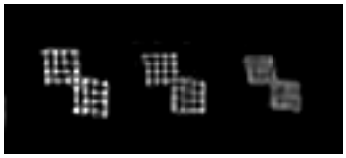
ACR T1

Sagital Length

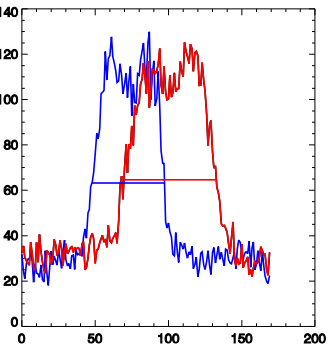




High Contrast Resolution



Slice Thickness

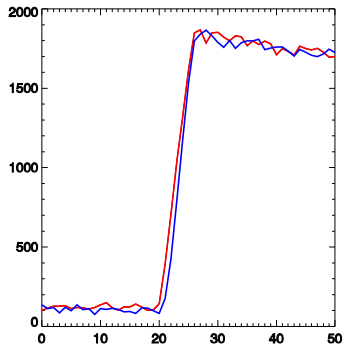


Upper=62.09

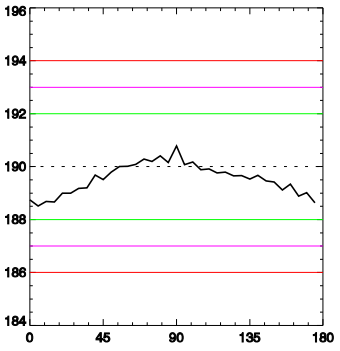
Lower=48.32

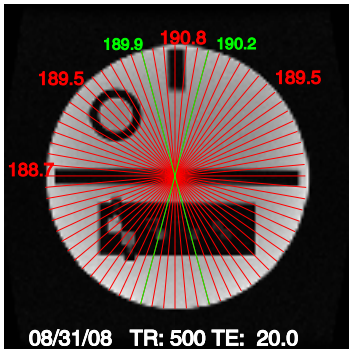
Slice Thickness=5.43

Slice Position - Inferior

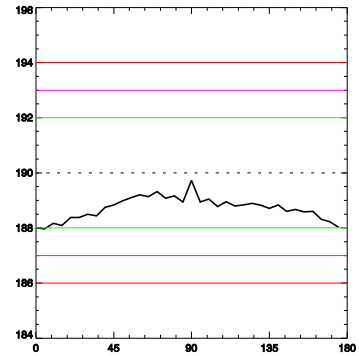


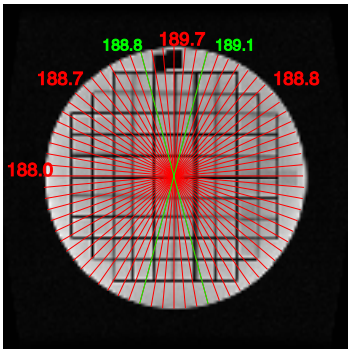
Axial Diameters - #1



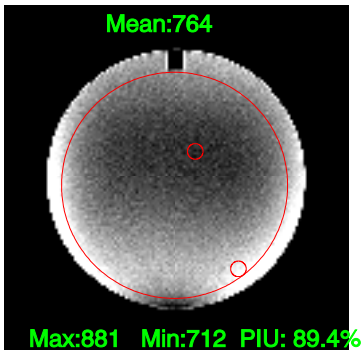


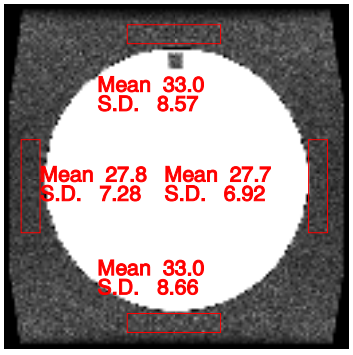
Axial Diameters - #5



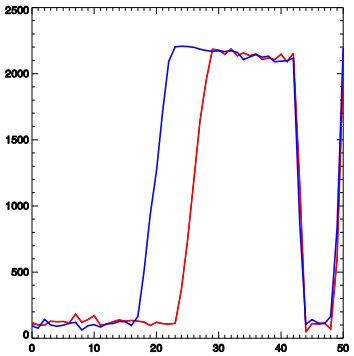


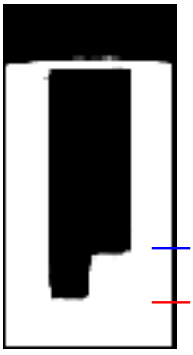
Uniformity & Ghosting - #7



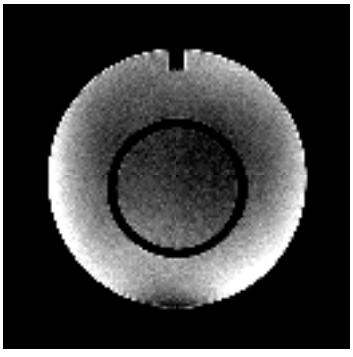


Slice Position - Superior

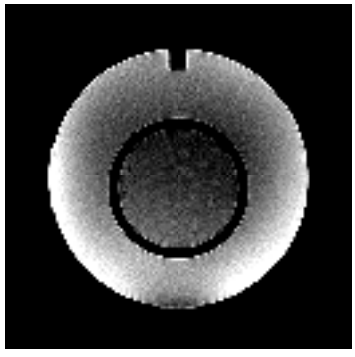




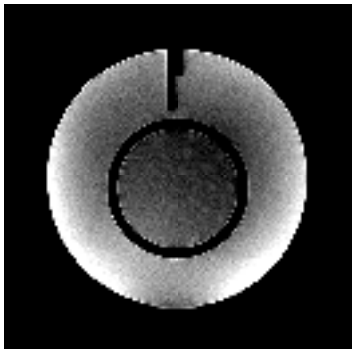
Low Contrast - #8



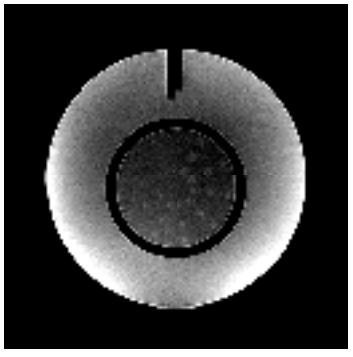
Low Contrast - #9



Low Contrast - #10



Low Contrast - #11

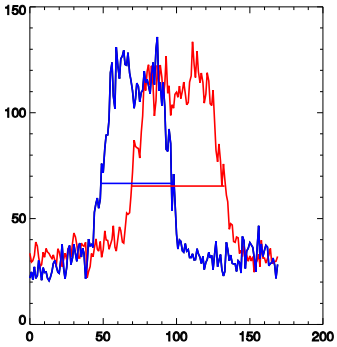


Appendix C: ACR Phantom Analysis

ACR PD

High Contrast Resolution

Slice Thickness

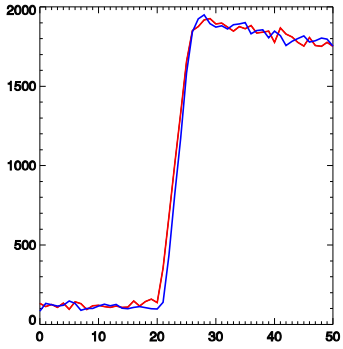


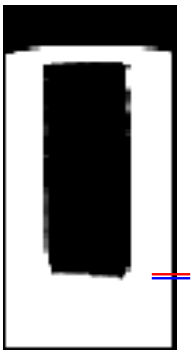
Upper=62.45

Lower=48.11

Slice Thickness=5.43

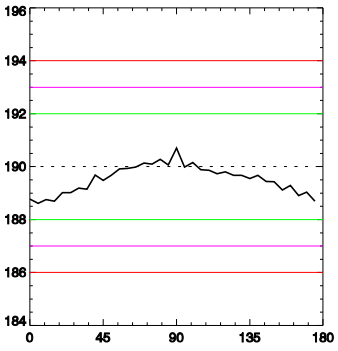
Slice Position - Inferior

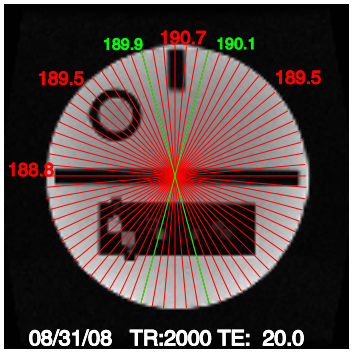




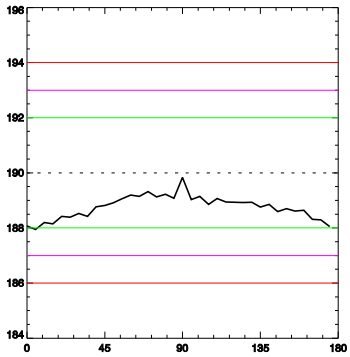
Diff.= 0.46

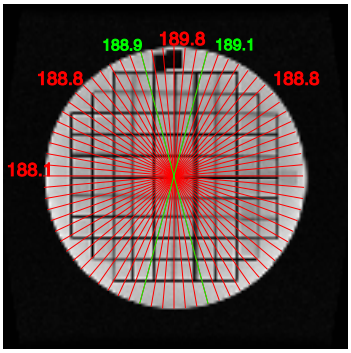
Axial Diameters - #1



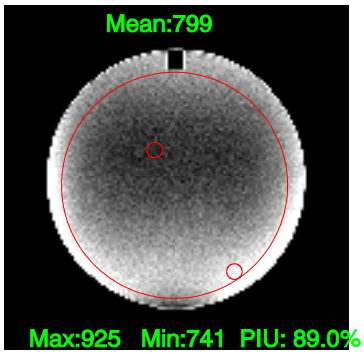


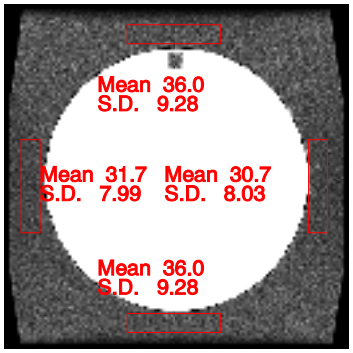
Axial Diameters - #5



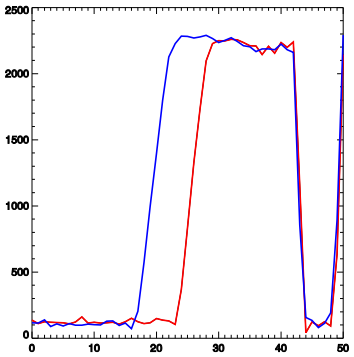


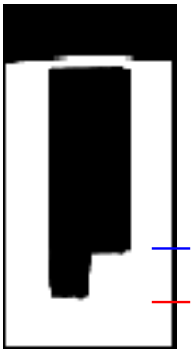
Uniformity & Ghosting - #7





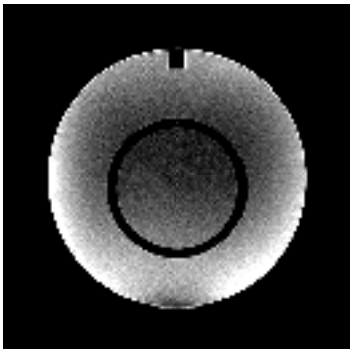
Slice Position - Superior



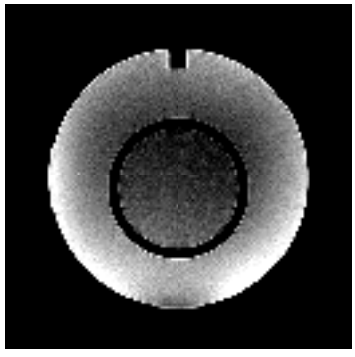


Diff.= -6.05

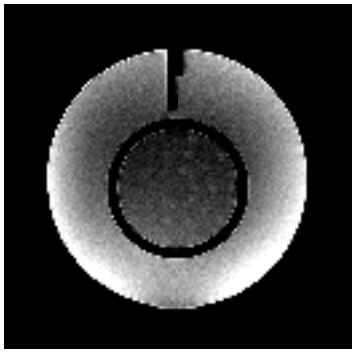
Low Contrast - #8



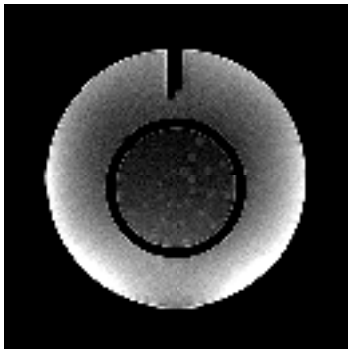
Low Contrast - #9



Low Contrast - #10



Low Contrast - #11

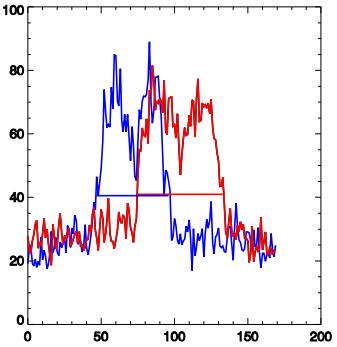


Appendix C: ACR Phantom Analysis

ACR T2

High Contrast Resolution

Slice Thickness

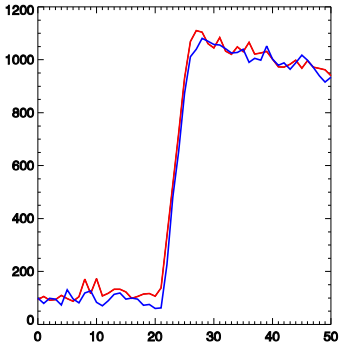


Upper=56.96

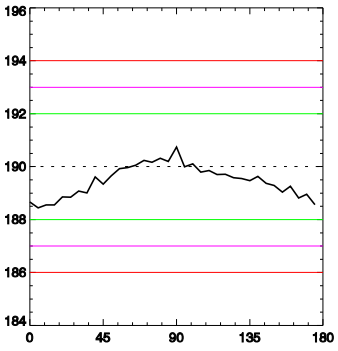
Lower=47.86

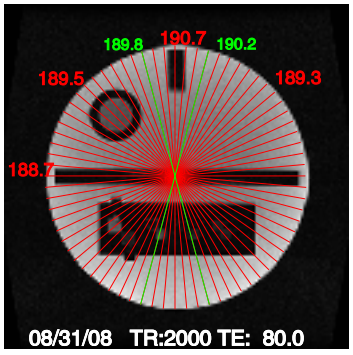
Slice Thickness=5.20

Slice Position - Inferior

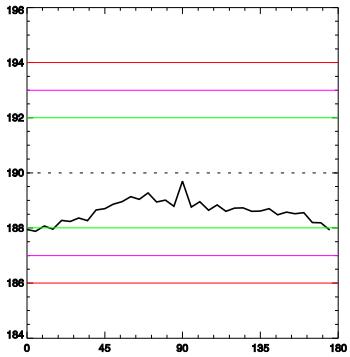


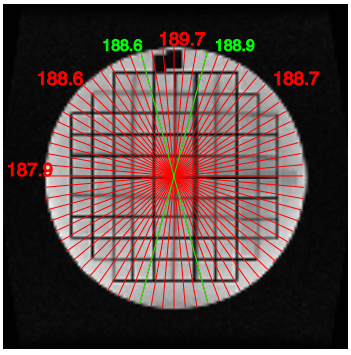
Axial Diameters - #1



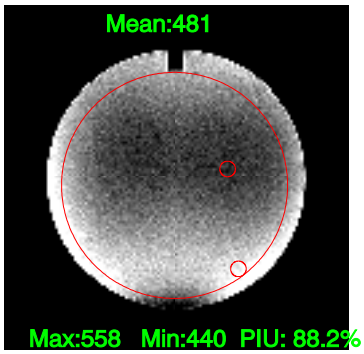


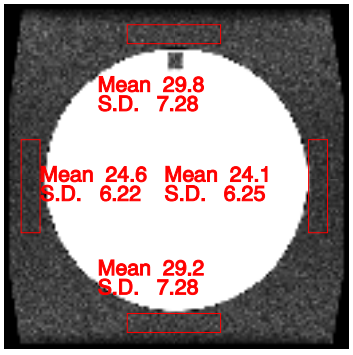
Axial Diameters - #5



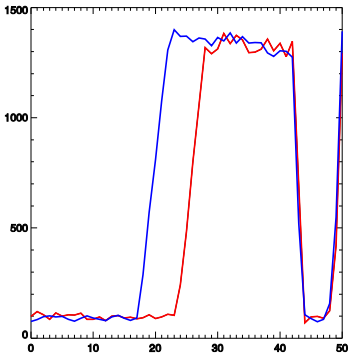


Uniformity & Ghosting - #7

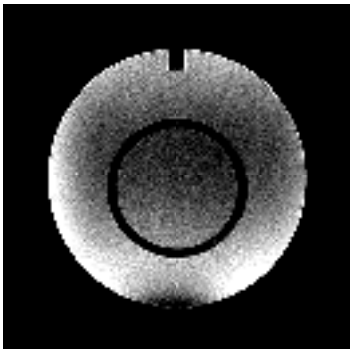




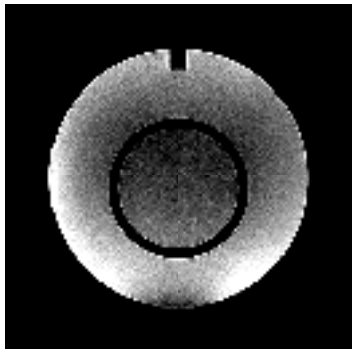
Slice Position - Superior



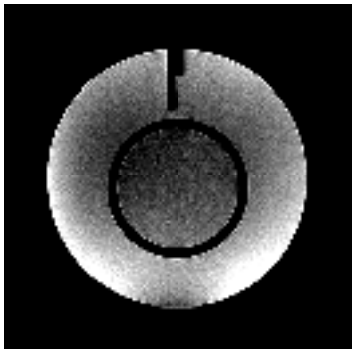
Low Contrast - #8



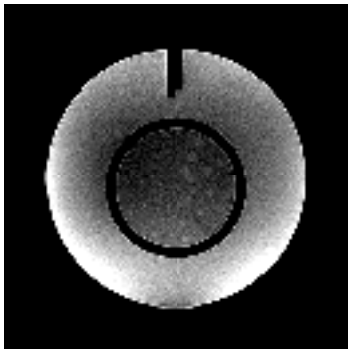
Low Contrast - #9



Low Contrast - #10



Low Contrast - #11

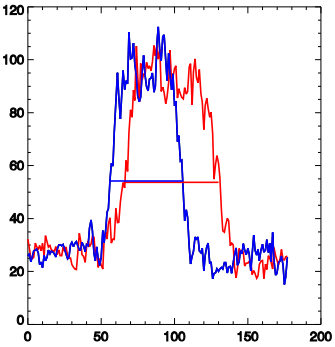


Appendix C: ACR Phantom Analysis

Site T1

High Contrast Resolution

Slice Thickness

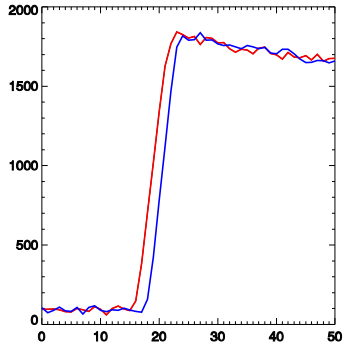


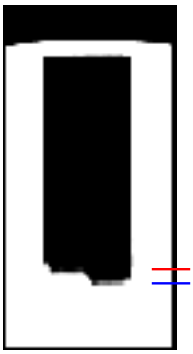
Upper=60.46

Lower=46.29

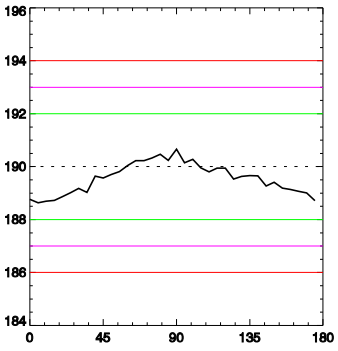
Slice Thickness=5.24

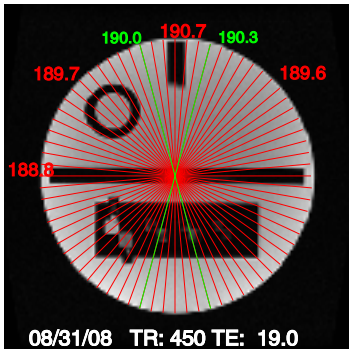
Slice Position - Inferior



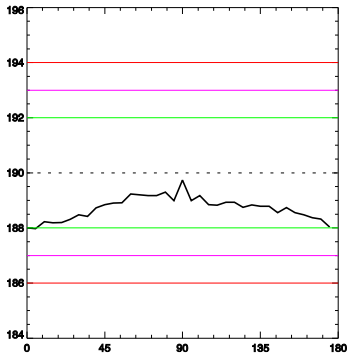


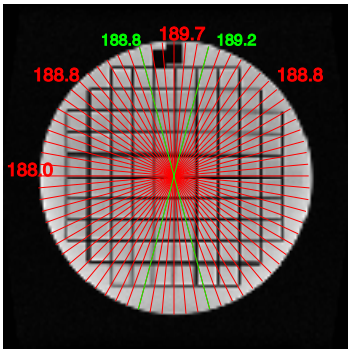
Axial Diameters - #1



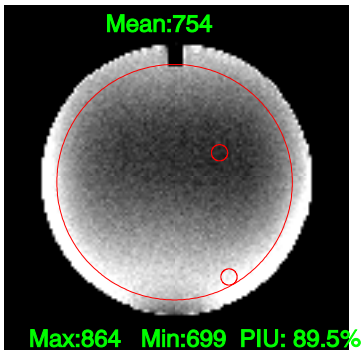


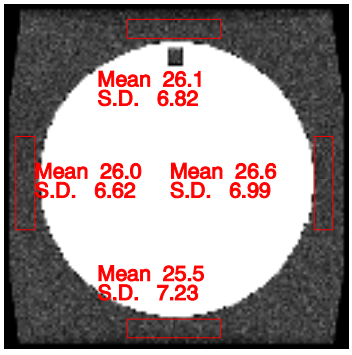
Axial Diameters - #5



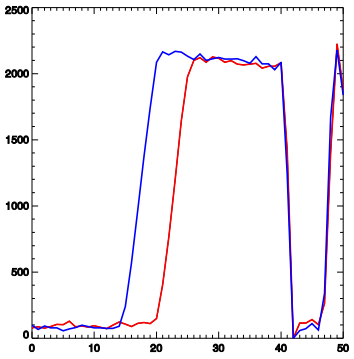


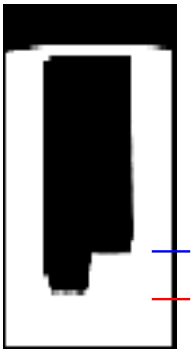
Uniformity & Ghosting - #7



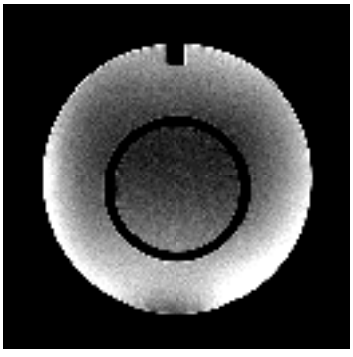


Slice Position - Superior

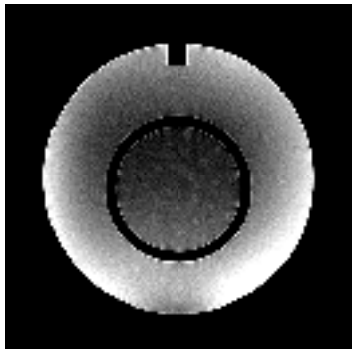




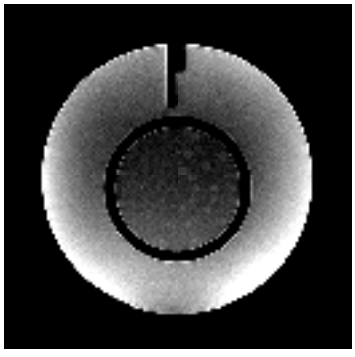
Low Contrast - #8



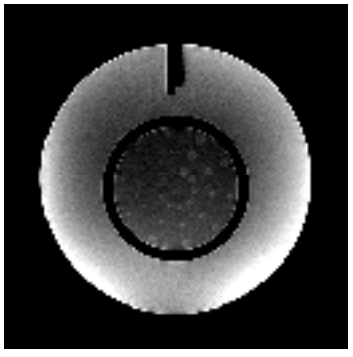
Low Contrast - #9



Low Contrast - #10



Low Contrast - #11

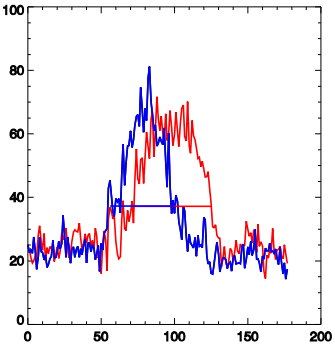


Appendix C: ACR Phantom Analysis

Site T2

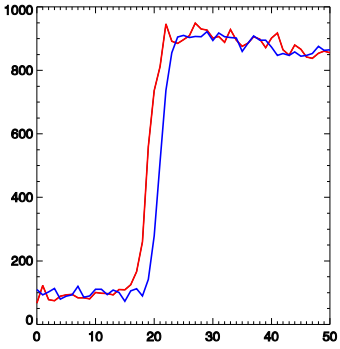
High Contrast Resolution

Slice Thickness

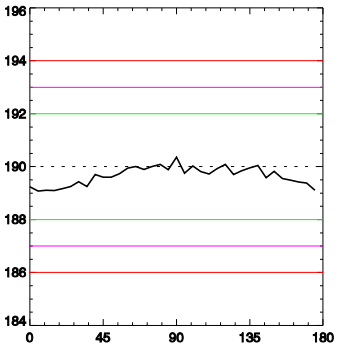


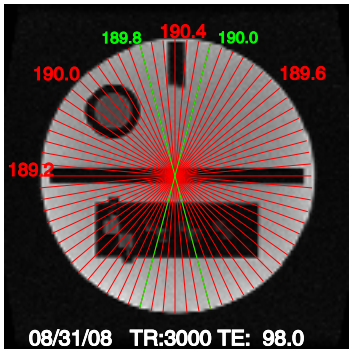
Upper=51.51
Lower=41.29
Slice Thickness=4.58

Slice Position - Inferior

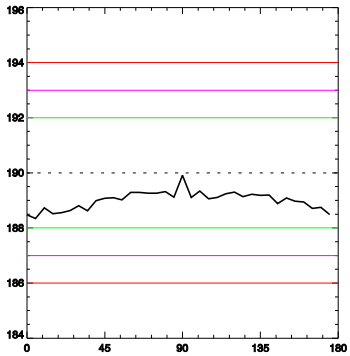


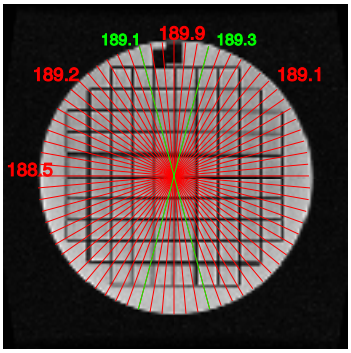
Axial Diameters - #1



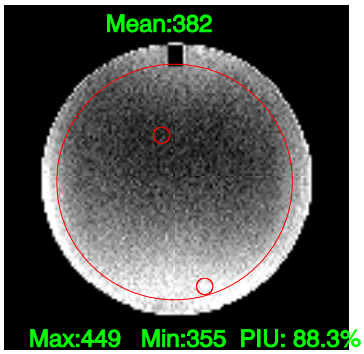


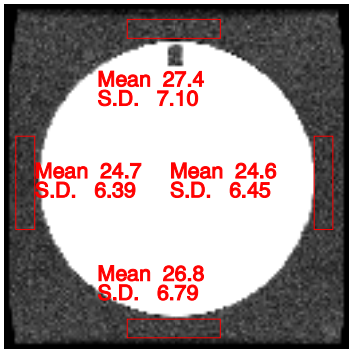
Axial Diameters - #5



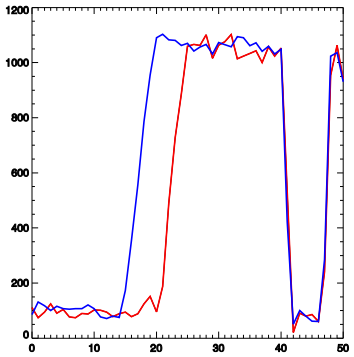


Uniformity & Ghosting - #7

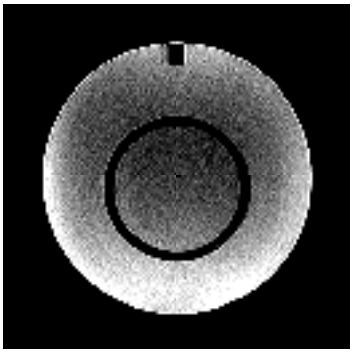




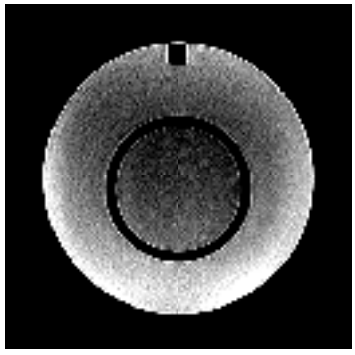
Slice Position - Superior



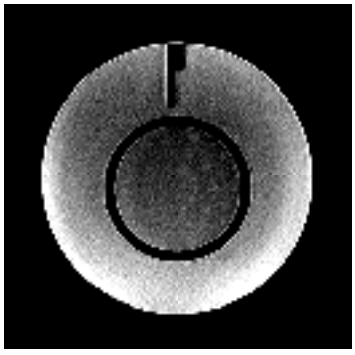
Low Contrast - #8



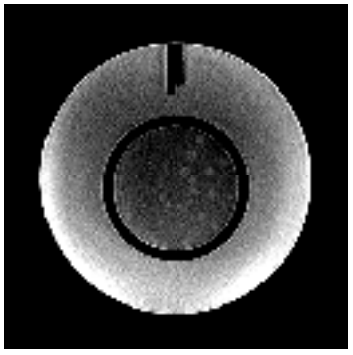
Low Contrast - #9



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.