Siemens Site
Yearly Performance Evaluation
Siemens Symphony 1.5T
21-Jul-08

Table of Contents

Coil and Other Hardware Inventory List

Site Name Siemens Site

ACR Magnet # _____ Nickname Symphony

Active	Coil Description	Manufacturer	Model	Rev.	Mfg. Date	SN	Channels
☐	Body - Integrated						1
☐	Body Array Flex	Siemens	07100048			3698	2
☐	Extremity CP	Siemens	03146466			3651	1
☐	Flex Large	Siemens	05512053			6584	1
☐	Flex Small	Siemens	05512038			6488	1
☐	Head	Siemens	03146037			4617	1
☐	Neck Array	Siemens	03146540			5280	2
☐	Shoulder Array - Large	Invivo	5516591			007093	4
☐	Shoulder Array - Small	Invivo	5516583			006738	4
☐	Spine Matrix	Siemens	03784498			4421	6
☐	Wrist Array	Invivo	101078		Mar, 2008	036538	4
☐							

MRI Equipment Evaluation Summary & Signature Page

Site Name: Siemens Site **MRAP #**

Address: **Survey Date:** 7/21/08

City, State, Zip **Report Date:** 7/28/08

MRI Mfg: Siemens **Model:** Symphony **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	☒	☐	☐

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 5 gauss line is containe within the scan room everywhere EXCEPT behind the magnet where it extends roughly 3 ft into the garden. Someone working out there could easily walk with 20 gauss. This should be blocked off in some way.
2. The RF Noise test show noticeable RF noise lines. Was the room adequately tested?
3. There are no MRI compatible fire extinguishers in the facility.
4. The ACR phantom (borrowed from Bettendorf) is exceptionally cloudy, there is a large quantity of particulate matter in the phantom. I have NEVER seen anything like this. The phantom should be sent back to the manufacturer for cleaning out and refilling.
5. The Neck Array produced noticeable artifacts and had lower SNR than the Bettendorf coil.
6. All other coils have comparable SNR to Bettendorf.
7. Magnet homogeneity is good.
8. All of the images exhibited higher than normal ghosting. Both the ACR T1 and Site T2 images are right on the edge of failing ACR accreditation. I recommend you have your service engineer look into it.
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: Siemens Site

Contact	Title	Phone	Fax	eMail

Equipment Information

MRI Manufacturer: Siemens Model: Symphony SN: MRC24191 Software: A30

Camera Manufacturer: Model: SN: Software:

PACS Manufacturer: Model: SN: Software:

ACR Phantom Number used: J2491

1. Table Positioning Reproducibility: **Pass**

Table motion out/in:	IsoCenter	Out/In	Out/In	Out/In
Measured Phantom Center	-4.9	-4.9	-4.9	-4.9

Comment: Reproducibility is excellent, but the calibration of the laser is off by about 5 mm.

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

Last Year CF: **N/A** This Year CF: **63,684,566** CF Change: **NA**

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

5 mm skip 4 mm, 256x128, 2nex

	15 cm	20 cm	25 cm
Axial:	**0.27**	**0.48**	**0.77**
Coronal:	**0.19**	**0.36**	**0.59**
Sagittal:	**0.17**	**0.34**	**0.57**

Comments: Magnet homogeneity is very good.

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	5.38	5	7.6%
SE (Site T1)	500	14	90	1	5.72	5	14.4%
SE (20/80)	2000	20	90	1	5.33	5	6.6%
SE (20/80)	2000	80	90	1	4.49	5	-10.2%
TSE(15)	5000	104	90	2	6.16	5	23.2%
TSE(3)	450	9.9	90	6	5.83	5	16.6%

Comments: The TSE sequences have excessive slice thickness. (This is typical of Siemens systems.)

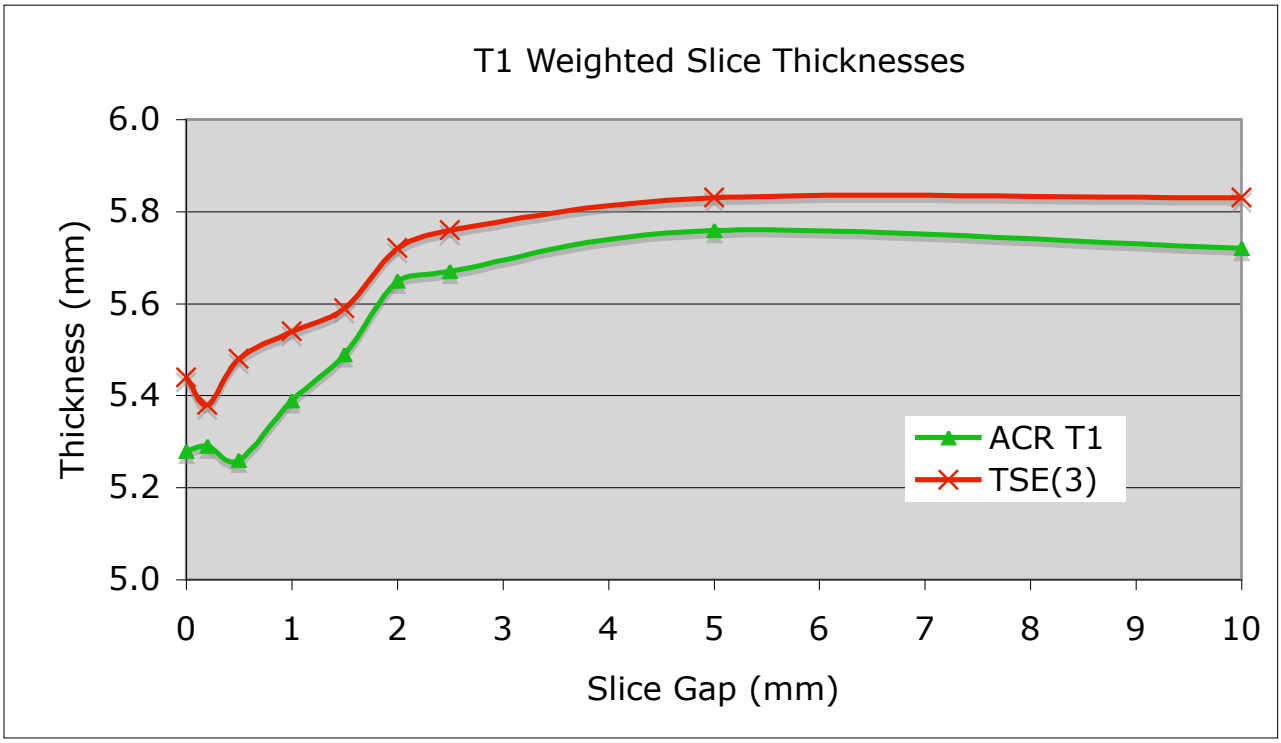
4. Slice Crosstalk (RF interference)

The following data were obtained using the ACR phantom slice thickness wedges to measure the slice profile of 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 50% of the slice thickness, the measured slice profiles begin to drop. I recommend that you always use at least a 20% gap.

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

Sequence Type	TR	TE	FOV (cm^2)	Matrix	NSA	Thickness	# of slices	Slice Measured
SE	450	10	25	256x256	2	5	11	6
TSE(3)	450	9.9	25	256x256	6	5	11	6

Skip	ACR T1	TSE(3)
0	5.28	5.44
0.2	5.29	5.38
0.5	5.26	5.48
1	5.39	5.54
1.5	5.49	5.59
2	5.65	5.72
2.5	5.67	5.76
5	5.76	5.83
10	5.72	5.83



5. Soft & Hard Copy Displays

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

Monitor Description: Siemens brand LCD

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	41	40.2	41.8	40.3	39

Uniformity		
MAX	MIN	Percent Delta
41.8	39	7%

SMPTE
OK?
Y

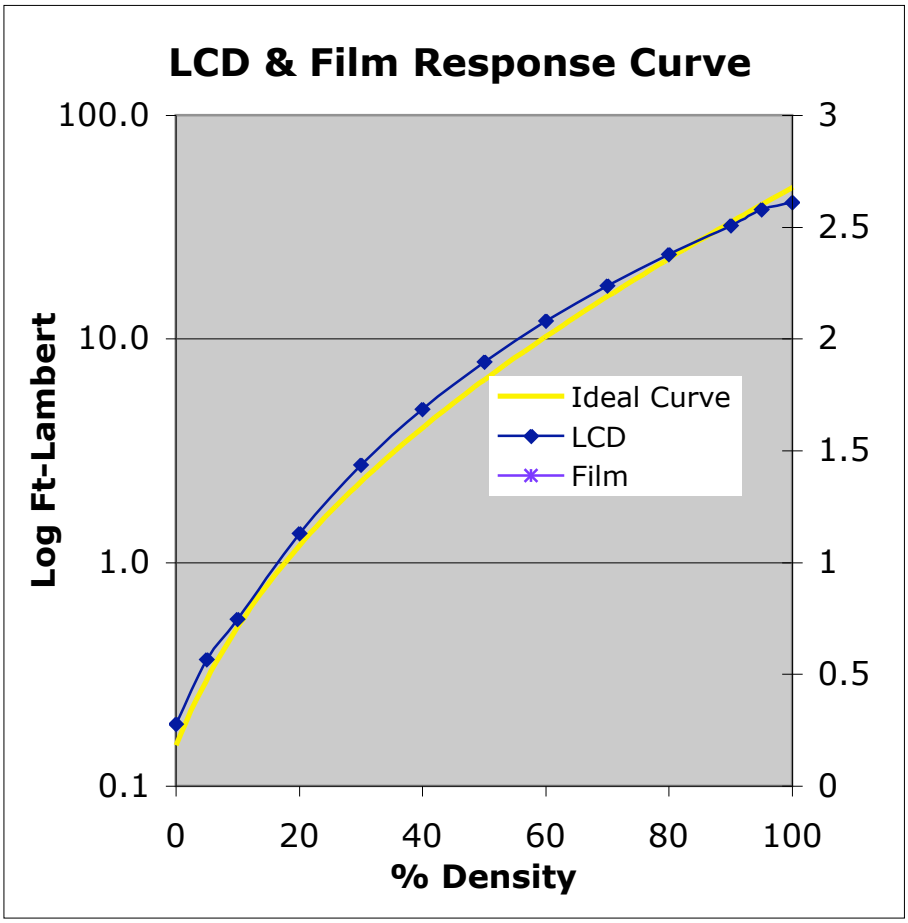
% delta =200% x (max-min)/(max+center) (>30% is action limit)

Minimum Brightness must be > 26.24 Ft. Lamberts

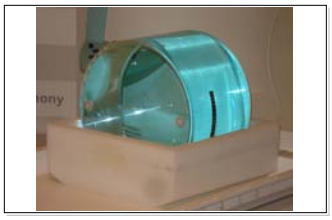
Display is excellent!

There is no camera to test.

Density	Ft-Lamber
0	0.19
5	0.37
10	0.56
20	1.35
30	2.74
40	4.85
50	7.89
60	12.02
70	17.3
80	23.9
90	32.1
95	38.0
100	40.9



RF Coil Performance Evaluation



Coil: Body - Integrated

Mfg.:

Mfg. Date: Coil ID: 1733

Phantom: 30 cm disk (from Picker system)

Test Date: 7/20/2008

Model:

Revision:

SN:

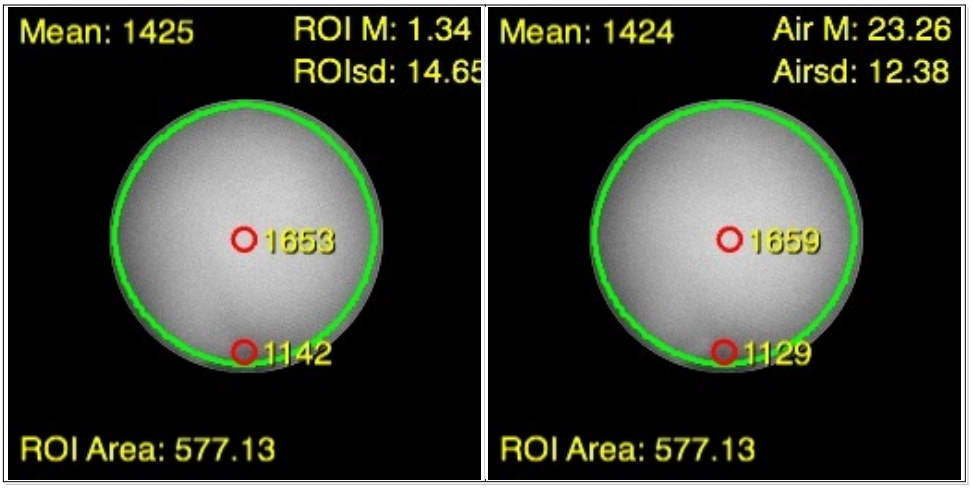
# of Channels 1

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	50	256	256	25.6	1	3	-

Coil Mode: Body

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	1,425	1,653	1,142	1.3	14.65	NEMA	68.8	31.7	79.8	81.7%
A	1,424	1,659	1,129	23.3	12.38	Air	75.4	34.8	87.8	81.0%



Test Images

RF Coil Performance Evaluation

Coil: Body Array Flex
Mfg.: Siemens
Mfg. Date: _____ Coil ID: 1731
Phantom: 2 Long Cylinders

Test Date: 7/20/2008
Model: 07100048
Revision: _____
SN: 3698
# of Channels 2

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	50	256	256	25.6	1	3	-

Coil Mode: B0 1,2

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Background	Noise SD	Noise Type
N	413	783	159	1.2	2.54	NEMA
N	400	772	156	-1.1	2.85	NEMA
A	411	781	156	4.7	2.05	Air
A	401	772	162	4.7	2.05	Air

Calculated Results

Mean SNR	Normalized	Max SNR	Uniformity
115.0	53.0	218.0	33.8%
99.3	45.8	191.6	33.6%
131.4	60.6	249.7	33.3%
128.2	59.1	246.8	34.7%

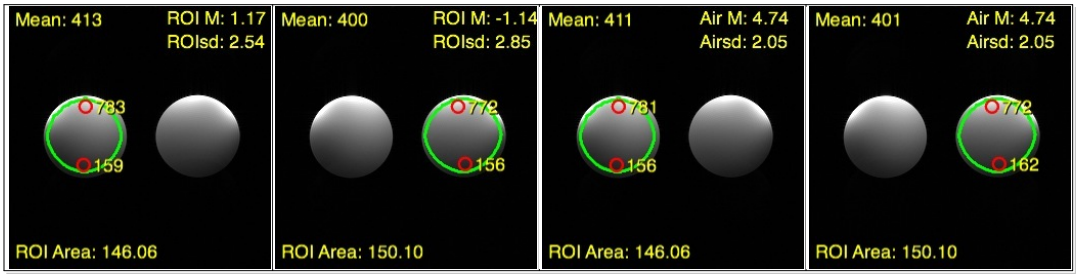
Analysis of Uncombined Images

Measured Data

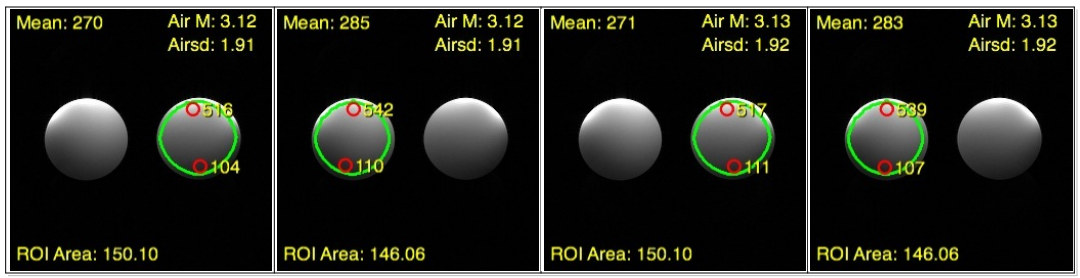
Ch	Mean	Max	Noise SD	Noise Type
1	270	516	1.91	Air
2	285	542	1.91	Air
3	271	517	1.92	Air
4	283	539	1.92	Air

Calculated Results

Mean SNR	% of Mean	Max SNR	% of Max
92.6	95%	177.0	95%
97.8	100%	186.0	100%
92.5	95%	176.5	95%
96.6	99%	184.0	99%



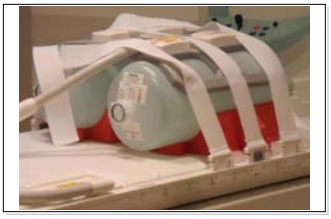
Composites



Channels

Channel 1 Channel 2 Channel 3 Channel 4

RF Coil Performance Evaluation



Coil: Body Array Flex
Mfg.: Siemens
Mfg. Date: _____ Coil ID: 1731
Phantom: 2 Long Cylinders

Test Date: 7/20/2008
Model: 07100048
Revision: _____
SN: 3698
# of Channels: 2

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	50	256	256	25.6	2	3	-

Coil Mode: BO 1,2

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Background	Noise SD	Noise Type
N	270	422	49	-0.1	1.55	NEMA
N	250	374	50	-0.1	1.49	NEMA
A	270	421	50	3.4	1.54	Air
A	250	374	50	3.4	1.54	Air

Calculated Results

Mean SNR	Normalized	Max SNR	Uniformity
123.2	40.2	192.5	20.8%
118.7	38.7	177.5	23.6%
114.9	37.5	179.1	21.2%
106.4	34.7	159.1	23.6%

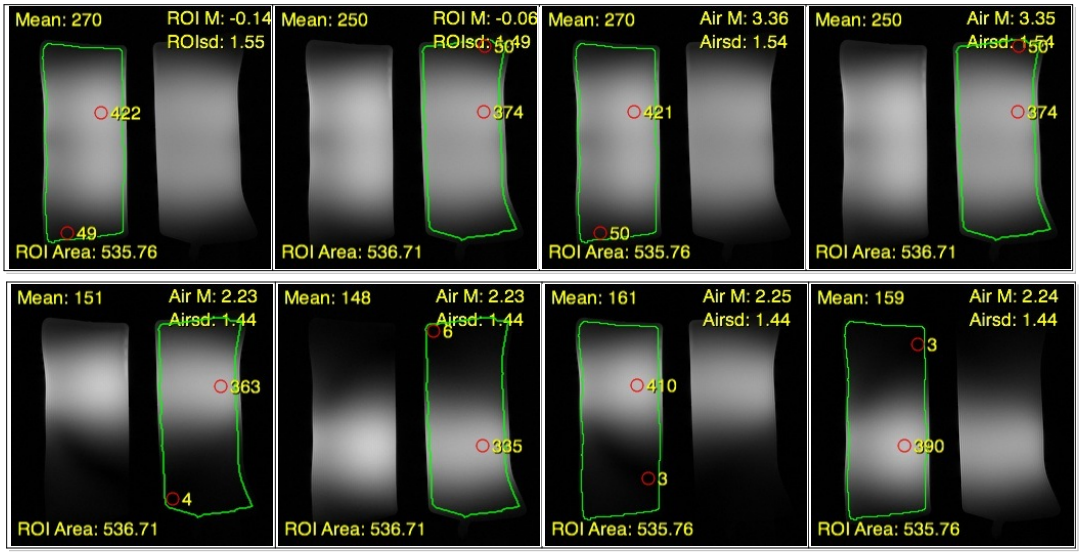
Analysis of Uncombined Images

Measured Data

Ch	Mean	Max	Noise SD	Noise Type
1	151	363	1.44	Air
2	148	335	1.44	Air
3	161	410	1.44	Air
4	159	390	1.44	Air

Calculated Results

Mean SNR	% of Mean	Max SNR	% of Max
68.7	94%	165.2	89%
67.4	92%	152.5	82%
73.3	100%	186.6	100%
72.4	99%	177.5	95%



RF Coil Performance Evaluation

Coil: Extremity CP

Mfg.: Siemens

Mfg. Date: _____ Coil ID: 1728

Phantom: Long Cylinder

Test Date: 7/20/2008

Model: 03146466

Revision: _____

SN: 3651

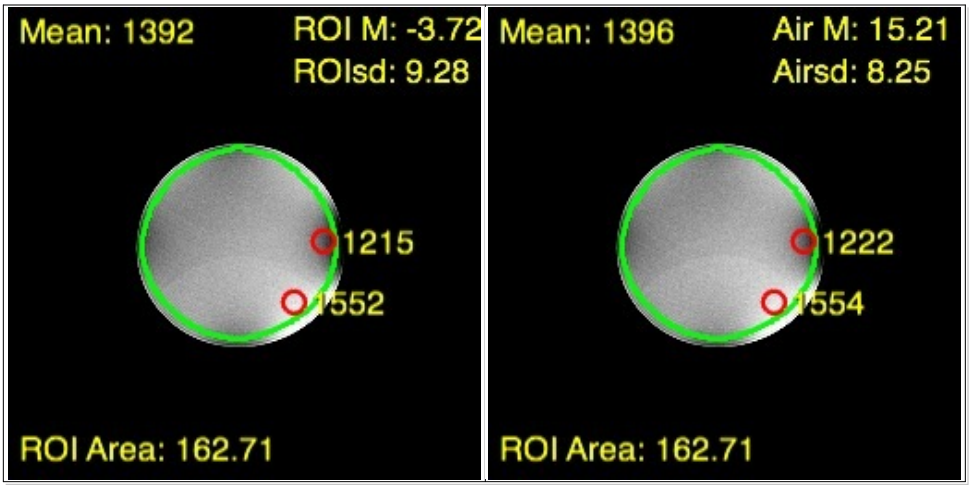
# of Channels 1

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	36	256	256	25.6	1	3	-

Coil Mode: EX

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	1,392	1,552	1,215	-3.7	9.28	NEMA	106.1	94.4	118.3	87.8%
A	1,396	1,554	1,222	15.2	8.25	Air	110.9	98.6	123.4	88.0%



Test Images

RF Coil Performance Evaluation

Coil: Flex Large
Mfg.: Siemens
Mfg. Date: _____ Coil ID: 1732
Phantom: Long Cylinder

Test Date: 7/20/2008
Model: 05512053
Revision: _____
SN: 6584
# of Channels 1

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	36	256	256	25.6	1	3	-

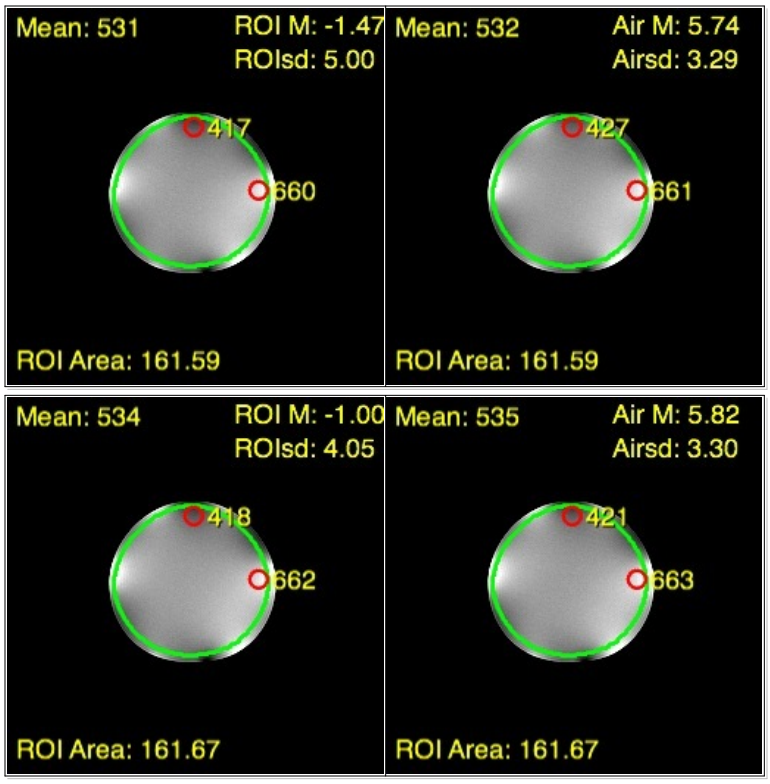
Coil Mode: FL Ports 1 and 4

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
N1	531	660	417	-1.5	5.00	NEMA	75.1	66.8	93.4	77.4%
A1	532	661	427	5.7	3.29	Air	106.0	94.3	131.7	78.5%
N4	534	662	418	-1.0	4.05	NEMA	93.2	83.0	115.6	77.4%
A4	535	663	421	5.8	3.30	Air	106.2	94.5	131.7	77.7%

Port 1 are first (upper) two. Port 4 are lower 2

Test Images



RF Coil Performance Evaluation

Coil: Flex Small

Mfg.: Siemens

Mfg. Date: _____ Coil ID: 1723

Phantom: Small Bottle

Test Date: 7/20/2008

Model: 05512038

Revision: _____

SN: 6488

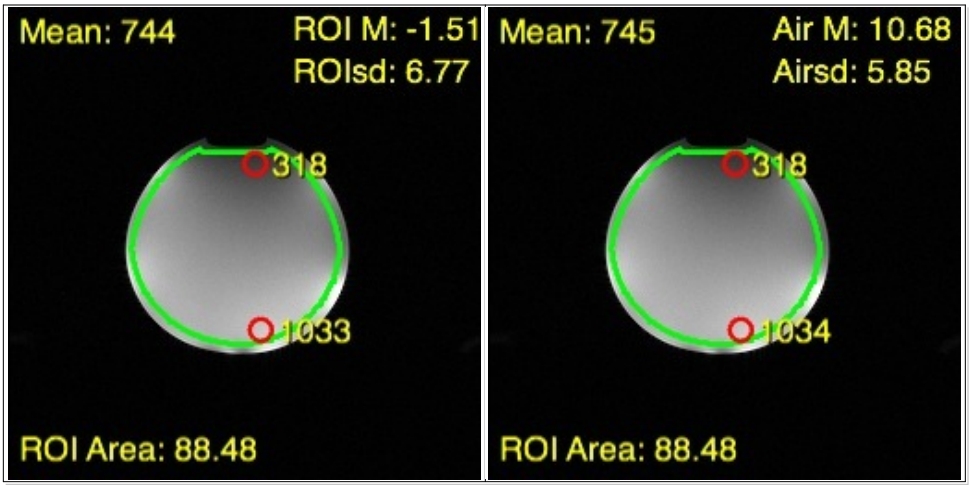
# of Channels 1

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	25	256	256	25.6	1	3	-

Coil Mode: FS

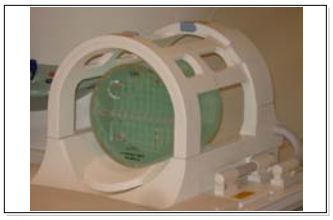
Analysis of Test Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	744	1,033	318	-1.5	6.77	NEMA	77.7	143.4	107.9	47.1%
A	745	1,034	318	10.7	5.85	Air	83.5	153.9	115.8	47.0%



Test Images

RF Coil Performance Evaluation



Coil: Head
Mfg.: Siemens
Mfg. Date: _____ Coil ID: 1727
Phantom: ACR Phantom

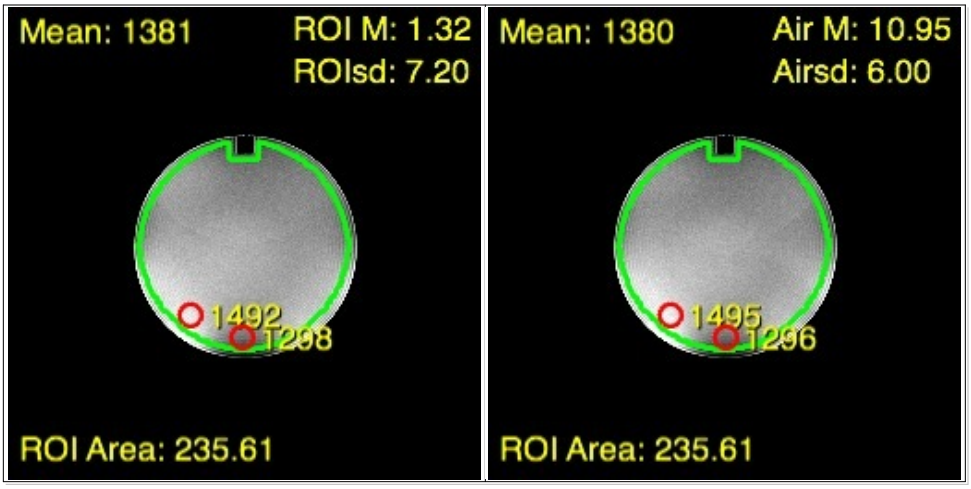
Test Date: 7/20/2008
Model: 03146037
Revision: _____
SN: 4617
# of Channels 1

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	40	256	256	25.6	1	3	-

Coil Mode: Head

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	1,381	1,492	1,298	1.3	7.20	NEMA	135.6	97.7	146.6	93.0%
A	1,380	1,495	1,296	11.0	6.00	Air	150.7	108.6	163.3	92.9%



Test Images

RF Coil Performance Evaluation

Coil: Neck Array
Mfg.: Siemens
Mfg. Date: _____ Coil ID: 1730
Phantom: Long Cylinder

Test Date: 7/20/2008
Model: 03146540
Revision: _____
SN: 5280
# of Channels 2

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	S	50	256	256	25.6	1	3	-

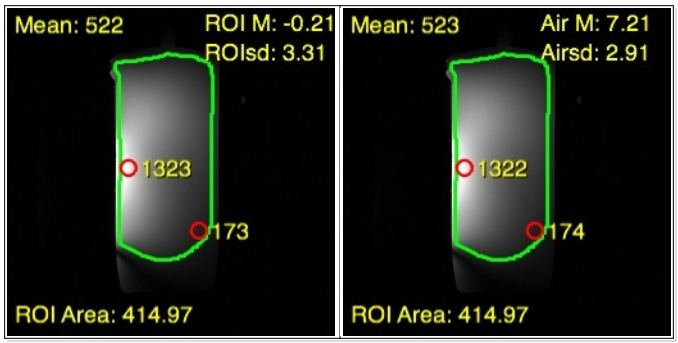
Coil Mode: NE 1,2

Analysis of Composite Image

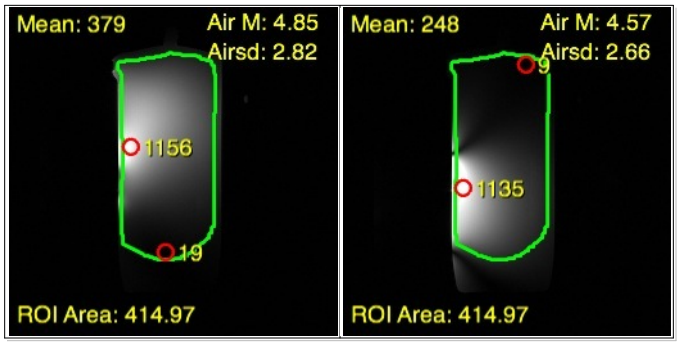
Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	522	1,323	173	-0.2	3.31	NEMA	111.5	51.4	282.7	23.1%
A	523	1,322	174	7.2	2.91	Air	117.8	54.3	297.7	23.3%

Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	379	1,156	2.82	Air	88.1	100%	268.6	96%
2	248	1,135	2.66	Air	61.1	69%	279.6	100%



Composites



Channel 1 Channel 2

RF Coil Performance Evaluation

Coil: Neck Array
Mfg.: Siemens
Mfg. Date: _____ Coil ID: 1730
Phantom: Long Cylinder

Test Date: 7/20/2008
Model: 03146540
Revision: _____
SN: 5280
# of Channels 2

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	36	256	256	25.6	1	3	-

Coil Mode: Neck 2 slices

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Back ground	Noise SD	Noise Type
N1	735	1,208	317	-0.1	6.05	NEMA
A1	735	1,207	317	16.4	6.23	Air
N2	494	1,148	201	-1.1	7.34	NEMA
A2	495	1,152	201	19.2	7.07	Air

Calculated Results

Mean SNR	Normal-ized	Max SNR	Uni-formity
85.9	76.4	141.2	41.6%
77.3	68.8	127.0	41.6%
47.6	42.3	110.6	29.8%
45.9	40.8	106.8	29.7%

Analysis of Uncombined Images

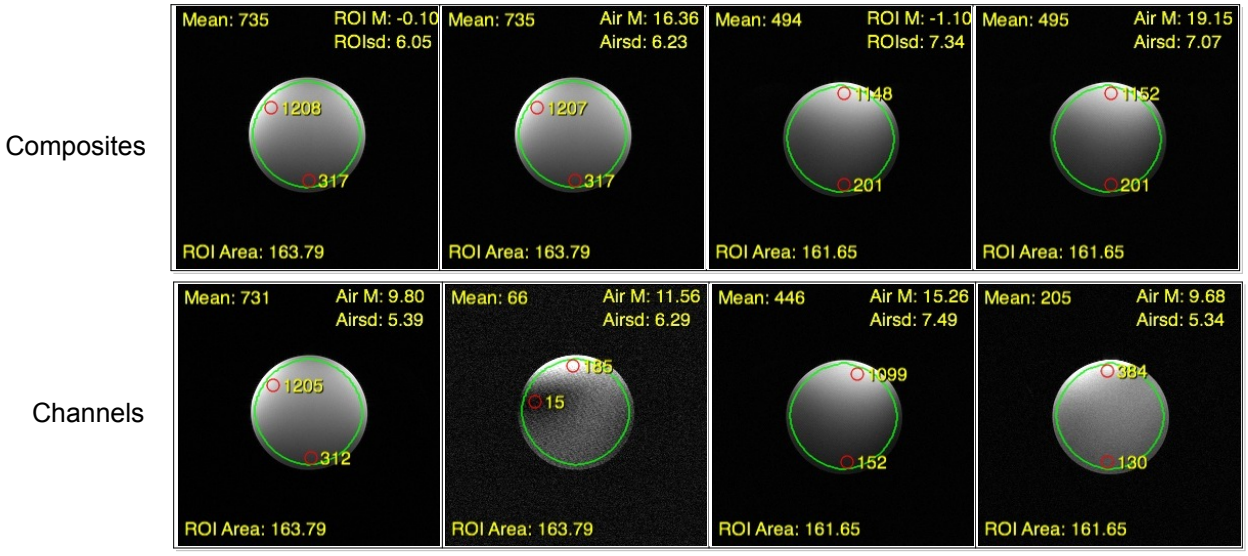
Measured Data

Ch	Mean	Max	Noise SD	Noise Type
1a	731	1,205	5.39	Air
2a	66	185	6.29	Air
1b	446	1,099	7.49	Air
2b	205	384	5.34	Air

Calculated Results

Mean SNR	% of Mean	Max SNR	% of Max
88.9	100%	146.5	100%
6.9	8%	19.3	13%
39.0	44%	96.2	66%
25.2	28%	47.1	32%

The low signal in 2a is normal.
Some of the images had obvious artifacts and the overall SNR of this coil is significantly lower than Bettendorf's coil.



RF Coil Performance Evaluation

Coil: Shoulder Array - Large
Mfg.: Invivo
Mfg. Date: _____ Coil ID: 1725
Phantom: Small Bottle

Test Date: 7/20/2008
Model: 5516591
Revision: _____
SN: 007093
# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	30	256	256	25.6	1	3	-

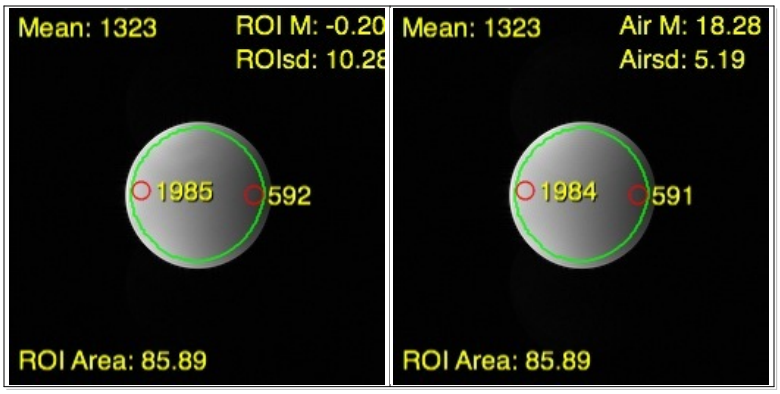
Coil Mode: SH 1,2,3,4

Analysis of Composite Image

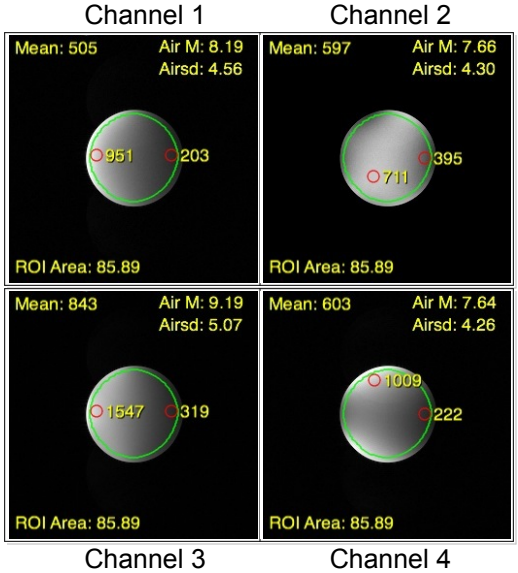
Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	1,323	1,985	592	-0.2	10.28	NEMA	91.0	116.6	136.6	45.9%
A	1,323	1,984	591	18.3	5.19	Air	167.0	214.0	250.5	45.9%

Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	505	951	4.56	Air	72.6	67%	136.7	68%
2	597	711	4.30	Air	91.0	83%	108.4	54%
3	843	1,547	5.07	Air	109.0	100%	200.0	100%
4	603	1,009	4.26	Air	92.8	85%	155.2	78%



Composites



RF Coil Performance Evaluation

Coil: Shoulder Array - Large
Mfg.: Invivo
Mfg. Date: _____ Coil ID: 1725
Phantom: Small Bottle

Test Date: 7/20/2008
Model: 5516591
Revision: _____
SN: 007093
# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	C	36	256	256	25.6	1	3	-

Coil Mode: SH 1,2,3,4

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	908	1,929	371	-8.2	11.56	NEMA	55.5	49.4	118.0	32.3%
A	916	1,932	384	12.4	3.61	Air	166.3	147.9	350.7	33.2%

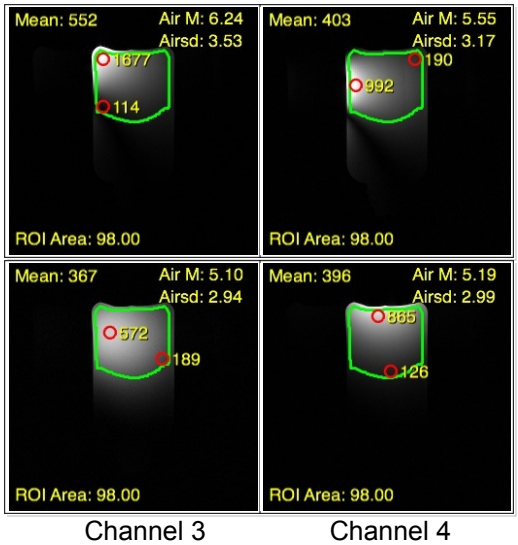
Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	552	1,677	3.53	Air	102.5	100%	311.3	100%
2	403	992	3.17	Air	83.3	81%	205.1	66%
3	367	572	2.94	Air	81.8	80%	127.5	41%
4	396	865	2.99	Air	86.8	85%	189.6	61%

The poor NEMA value is caused by variations in the ghosting levels.

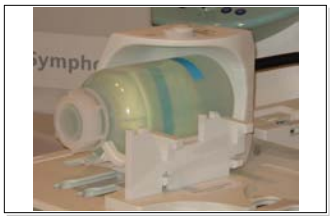
Composites

Channel 1 Channel 2



Channel 3 Channel 4

RF Coil Performance Evaluation



Coil: Shoulder Array - Small
Mfg.: Invivo
Mfg. Date: _____ Coil ID: 1724
Phantom: Small Bottle

Test Date: 7/20/2008
Model: 5516583
Revision: _____
SN: 006738
# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	30	256	256	25.6	1	3	-

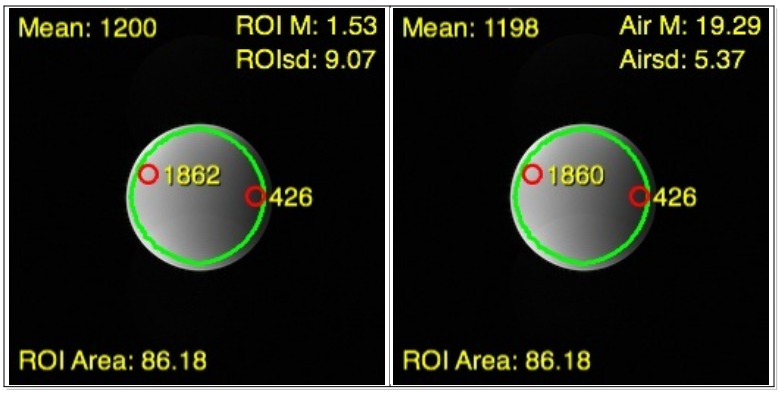
Coil Mode: SH 1,2,3,4

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	1,200	1,862	426	1.5	9.07	NEMA	93.6	119.9	145.2	37.2%
A	1,198	1,860	426	19.3	5.37	Air	146.2	187.3	227.0	37.3%

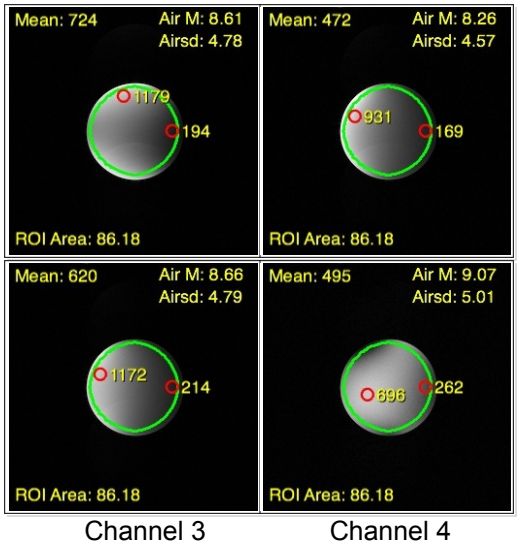
Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	724	1,179	4.78	Air	99.3	100%	161.6	100%
2	472	931	4.57	Air	67.7	68%	133.5	83%
3	620	1,172	4.79	Air	84.8	85%	160.3	99%
4	495	696	5.01	Air	64.7	65%	91.0	56%



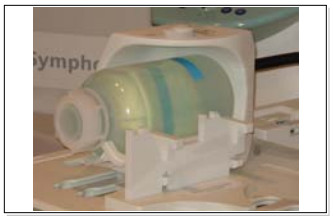
Composites

Channel 1 Channel 2



Channel 3 Channel 4

RF Coil Performance Evaluation



Coil: Shoulder Array - Small
Mfg.: Invivo
Mfg. Date: _____ Coil ID: 1724
Phantom: Small Bottle

Test Date: 7/20/2008
Model: 5516583
Revision:
SN: 006738
# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	C	36	256	256	25.6	1	3	-

Coil Mode: SH 1,2,3,4

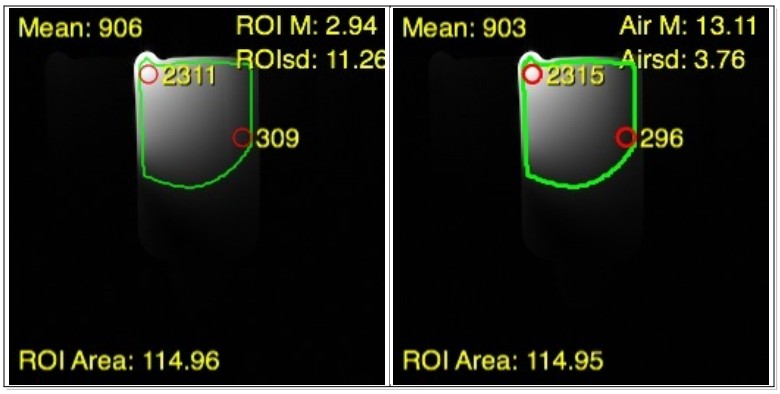
Analysis of Composite Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	906	2,311	309	2.9	11.26	NEMA	56.9	50.6	145.1	23.6%
A	903	2,315	296	13.1	3.76	Air	157.4	140.0	403.5	22.7%

Analysis of Uncombined Images

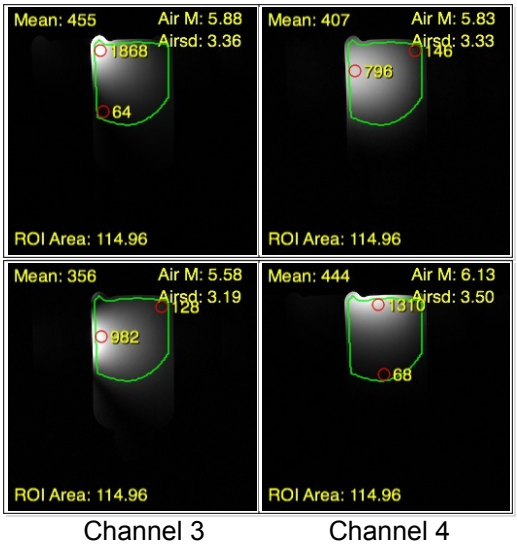
Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	455	1,868	3.36	Air	88.7	100%	364.3	100%
2	407	796	3.33	Air	80.1	90%	156.6	43%
3	356	982	3.19	Air	73.1	82%	201.7	55%
4	444	1,310	3.50	Air	83.1	94%	245.3	67%

The poor NEMA value is caused by variations in the ghosting levels.



Composites

Channel 1 Channel 2



Channel 3 Channel 4

RF Coil Performance Evaluation

Coil: Spine Matrix
Mfg.: Siemens
Mfg. Date: _____ Coil ID: 1734
Phantom: Long Cylinder

Test Date: 7/20/2008
Model: 03784498
Revision: _____
SN: 4421
# of Channels 6

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	S	50	256	256	25.6	1	3	-

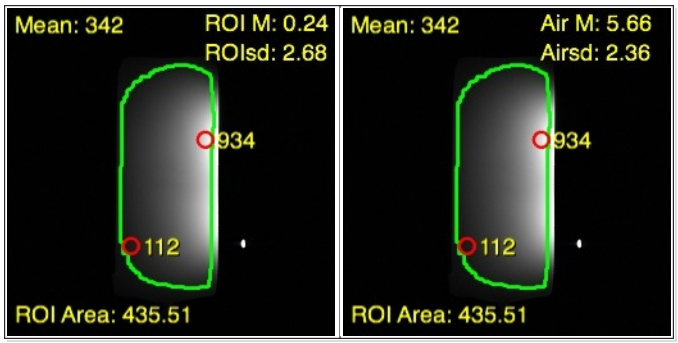
Coil Mode: SP 12

Analysis of Composite Image

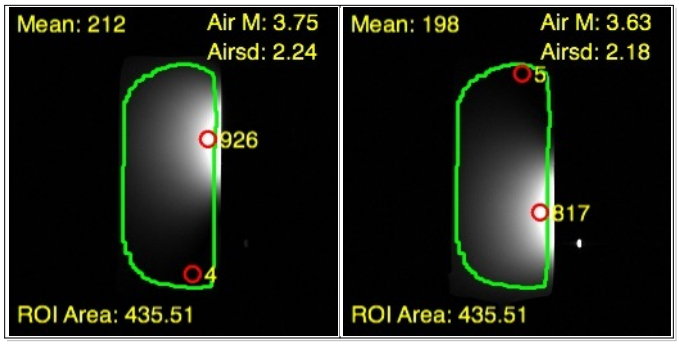
Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	342	934	112	0.2	2.68	NEMA	90.2	41.6	246.5	21.4%
A	342	934	112	5.7	2.36	Air	95.0	43.8	259.3	21.4%

Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	212	926	2.24	Air	62.0	100%	270.9	100%
2	198	817	2.18	Air	59.5	96%	245.6	91%



Composites



Channel 1 Channel 2

RF Coil Performance Evaluation

Coil: Spine Matrix
Mfg.: Siemens
Mfg. Date: _____ Coil ID: 1734
Phantom: Long Cylinder

Test Date: 7/20/2008
Model: 03784498
Revision: _____
SN: 4421
# of Channels 6

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	S	50	256	256	25.6	1	3	-

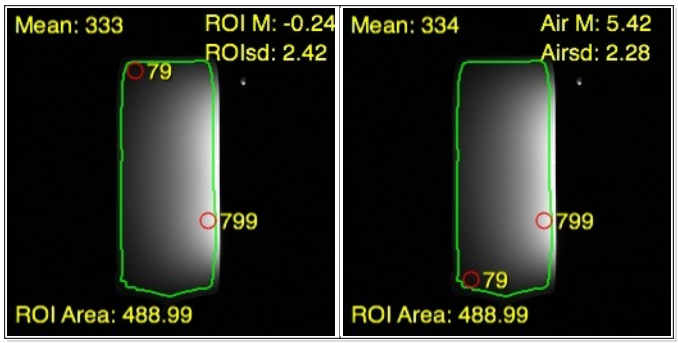
Coil Mode: SP 34

Analysis of Composite Image

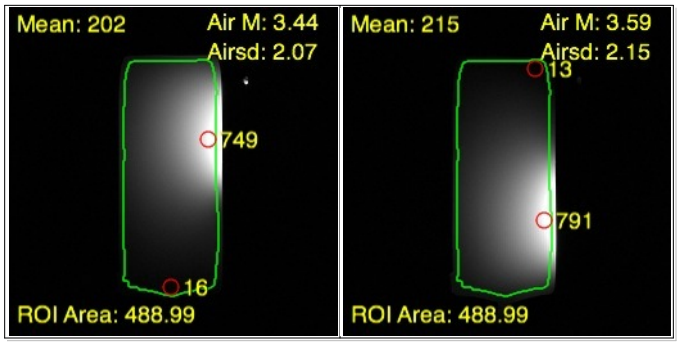
Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	333	799	79	-0.2	2.42	NEMA	97.3	44.9	233.5	18.0%
A	334	799	79	5.4	2.28	Air	96.0	44.3	229.6	18.0%

Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	202	749	2.07	Air	63.9	98%	237.1	98%
2	215	791	2.15	Air	65.5	100%	241.1	100%



Composites



Channel 1 Channel 2

RF Coil Performance Evaluation

Coil: Spine Matrix
Mfg.: Siemens
Mfg. Date: _____ Coil ID: 1734
Phantom: Long Cylinder

Test Date: 7/20/2008
Model: 03784498
Revision: _____
SN: 4421
# of Channels 6

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	S	50	256	256	25.6	1	3	-

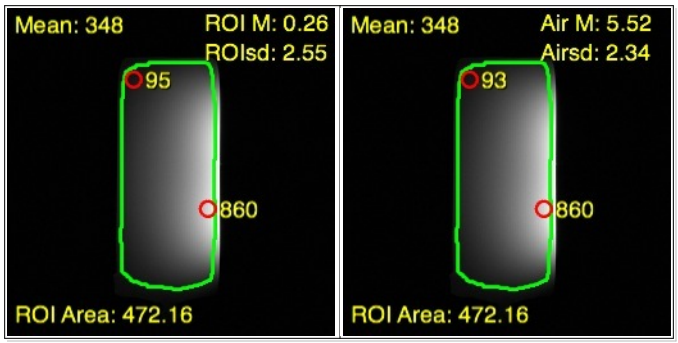
Coil Mode: SP 56

Analysis of Composite Image

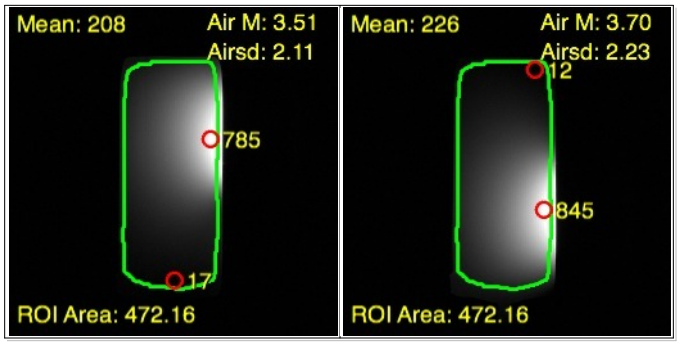
Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	348	860	95	0.3	2.55	NEMA	96.5	44.5	238.5	19.9%
A	348	860	93	5.5	2.34	Air	97.5	44.9	240.8	19.5%

Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
5	208	785	2.11	Air	64.6	97%	243.8	98%
6	226	845	2.23	Air	66.4	100%	248.3	100%



Composites



Channel 1 Channel 2

RF Coil Performance Evaluation

Coil: Wrist Array
Mfg.: Invivo
Mfg. Date: 3/8/2008 Coil ID: 1726
Phantom: Wrist Phatnom

Test Date: 7/21/2008
Model: 101078
Revision:
SN: 036538
# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	S	20	256	256	25.6	1	3	-

Coil Mode: WR

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Back ground	Noise SD	Noise Type
N	1,309	2,168	160	0.1	4.98	NEMA
A	1,309	2,173	160	14.9	4.21	Air

Calculated Results

Mean SNR	Normal-ized	Max SNR	Uni-formity
185.9	535.8	307.9	13.7%
203.8	587.3	338.2	13.7%

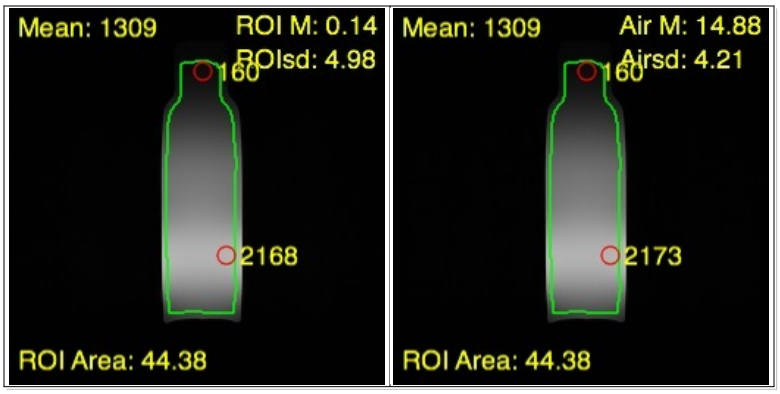
Analysis of Uncombined Images

Measured Data

Ch	Mean	Max	Noise SD	Noise Type
1	644	1,570	4.03	Air
2	582	1,429	4.12	Air
3	506	940	3.24	Air
4	516	977	3.29	Air

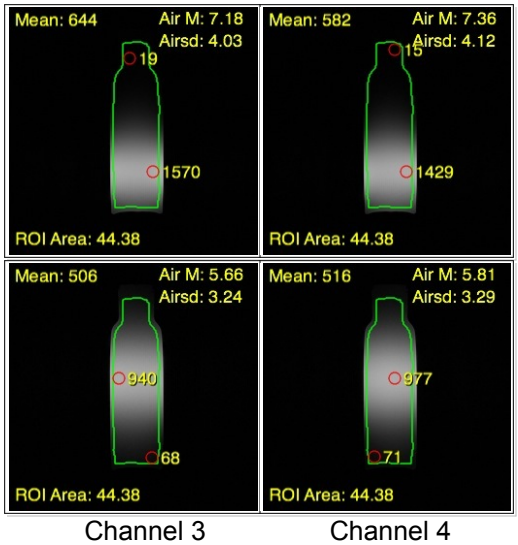
Calculated Results

Mean SNR	% of Mean	Max SNR	% of Max
104.7	100%	255.3	100%
92.6	88%	227.3	89%
102.3	98%	190.1	74%
102.8	98%	194.6	76%



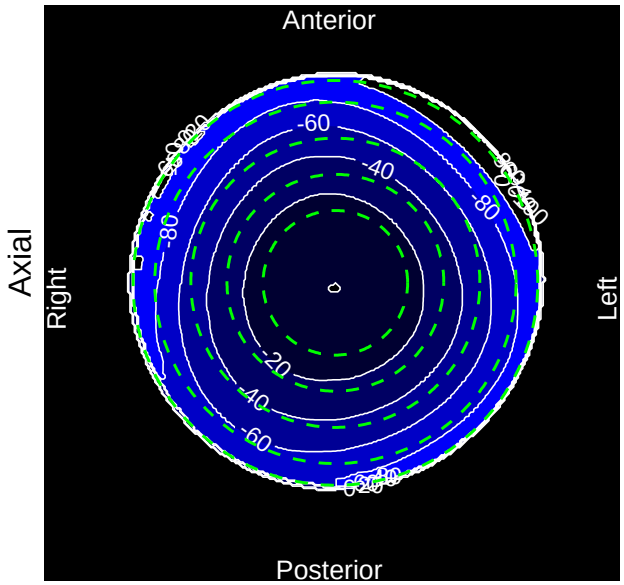
Composites

Channel 1 Channel 2



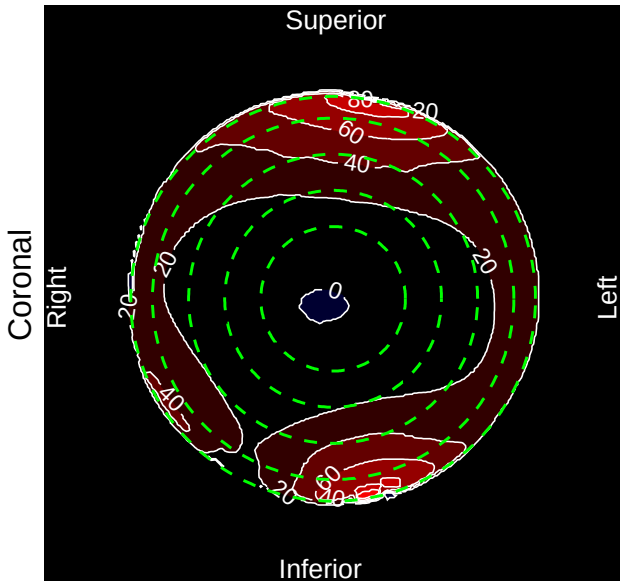
Channel 3 Channel 4

Appendix A: Magnet Homogeneity Field Maps Siemens Site
Siemens Symphony 1.5T - 3 central planes
Measured July 20, 2008



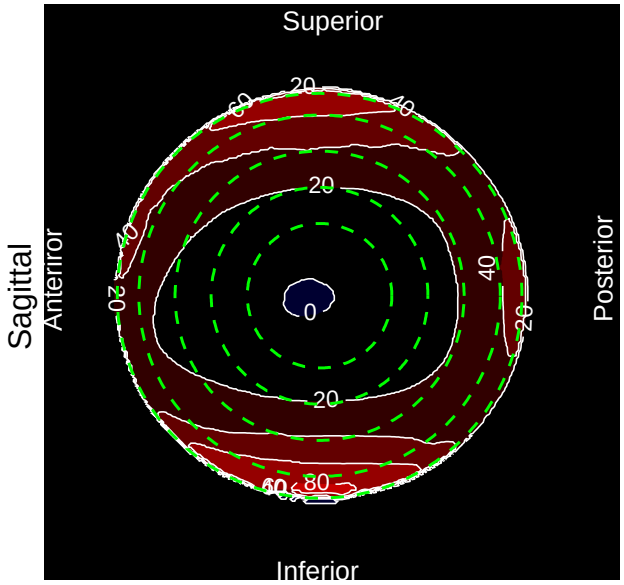
Axial

DIAMETER	MIN	MAX	RANGE	PPM	MEAN	STDEV
10	-15.2	0.0	15.2	0.12	-6.22	3.7
15	-34.0	0.0	34.0	0.27	-14.11	8.4
20	-61.0	0.0	61.0	0.48	-25.29	15.0
25	-97.7	0.0	97.7	0.77	-39.55	23.4
28	-115.9	0.0	115.9	0.91	-49.23	28.8



Coronal

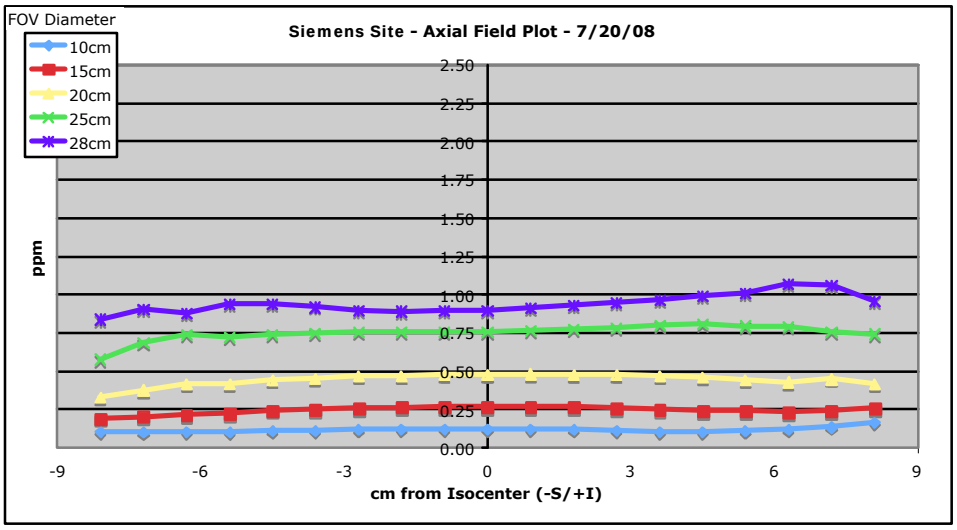
DIAMETER	MIN	MAX	RANGE	PPM	MEAN	STDEV
10	-0.5	10.3	10.7	0.08	2.78	2.3
15	-0.5	23.7	24.2	0.19	6.69	5.0
20	-0.5	45.6	46.0	0.36	12.38	9.3
25	-0.5	74.4	74.9	0.59	19.58	14.7
28	-4.2	109.0	113.2	0.89	24.31	18.4

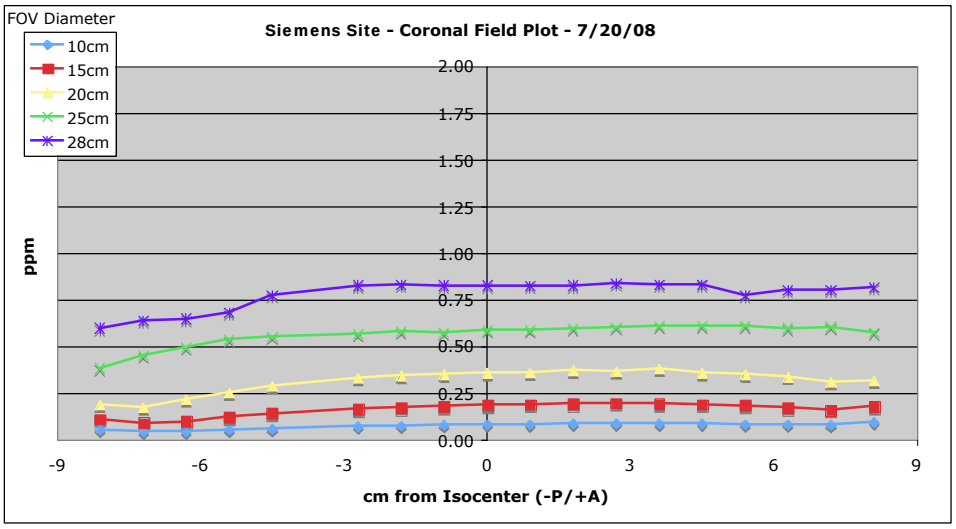


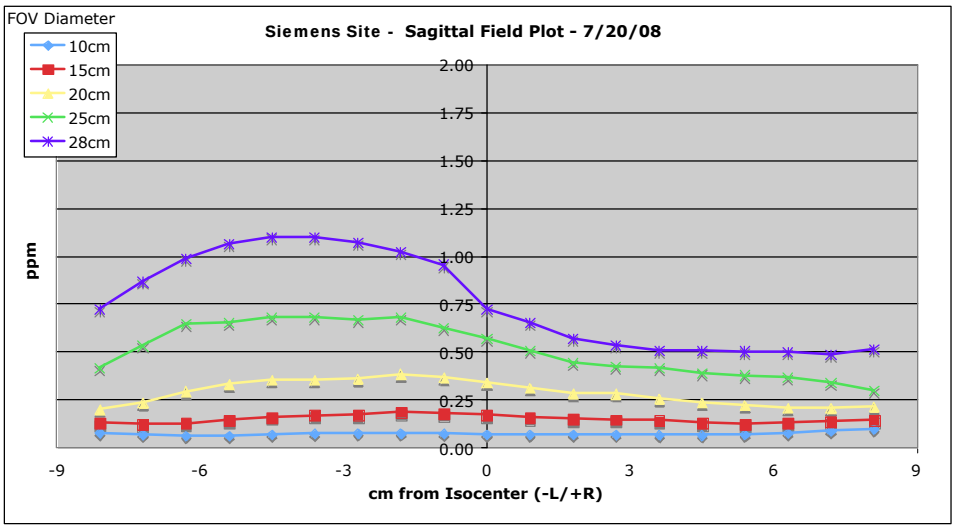
Sagittal

DIAMETER	MIN	MAX	RANGE	PPM	MEAN	STDEV
10	-0.5	8.3	8.8	0.07	2.82	2.2
15	-0.5	20.9	21.5	0.17	7.03	5.0
20	-0.5	42.9	43.4	0.34	13.23	9.3
25	-0.5	72.0	72.6	0.57	21.18	14.8
28	-6.3	85.8	92.2	0.72	26.75	18.7

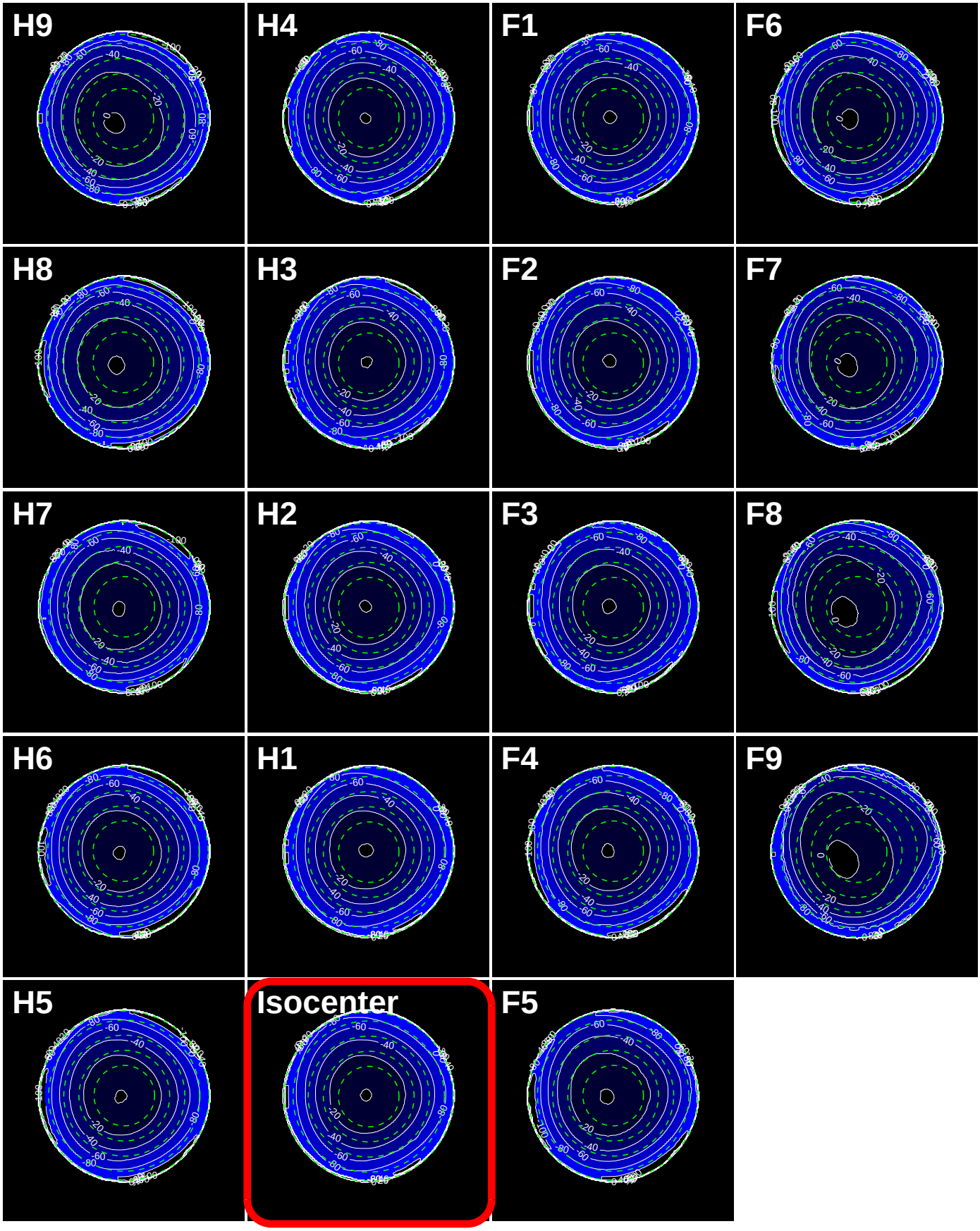
Appendix A: Magnet Homogeneity Field Maps Siemens Site
Siemens Symphony 1.5T
Measured July 20, 2008



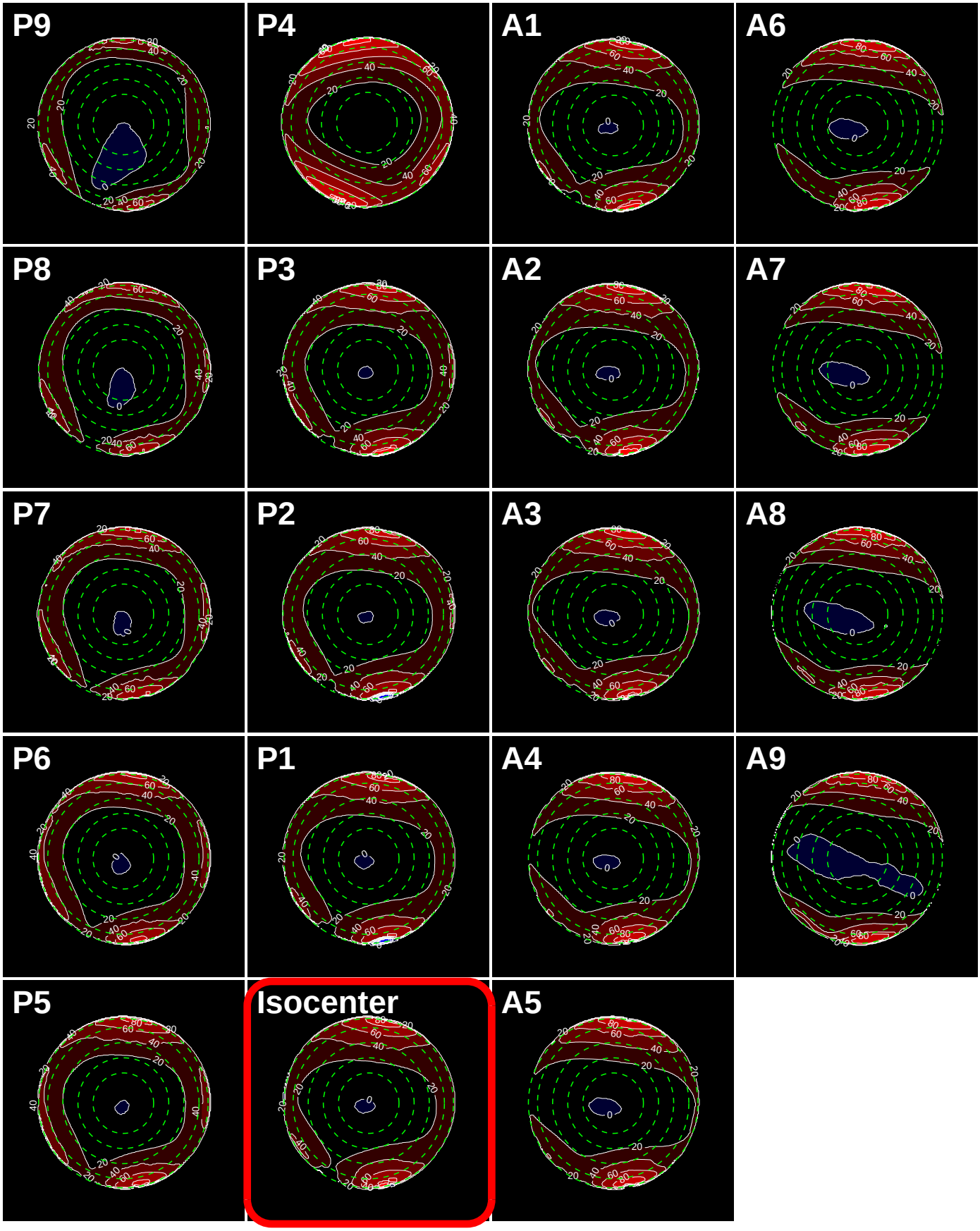




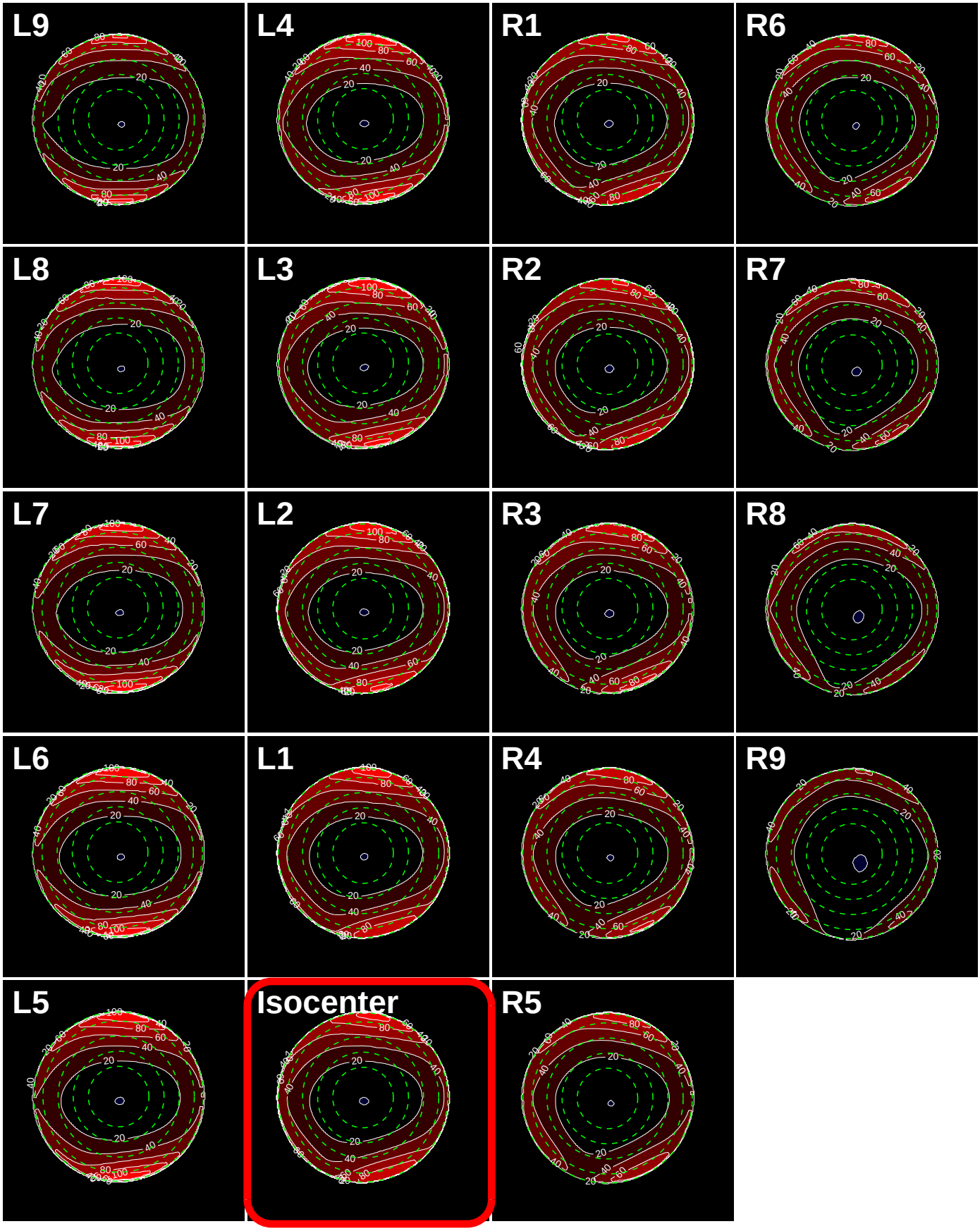
Axial Field Plots



Coronal Field Plots

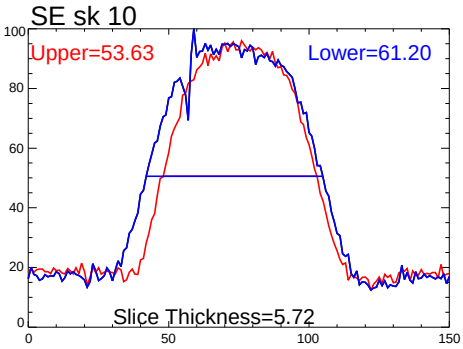


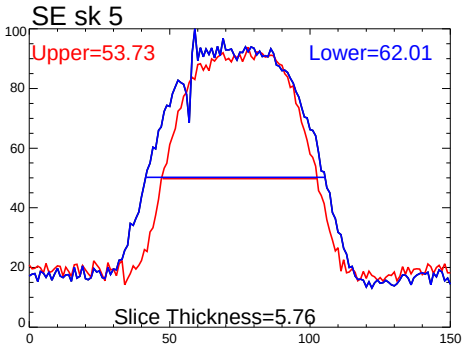
Sagittal Field Plots

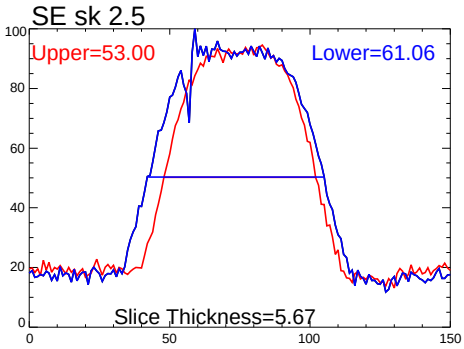


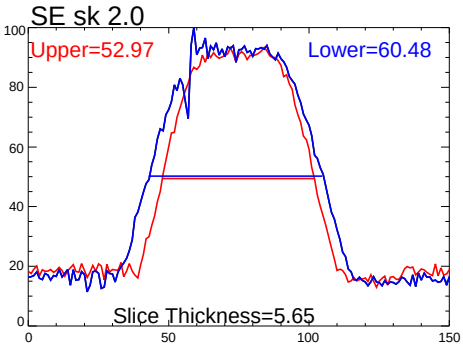
Appendix B: RF Crosstalk and Slice Profiles

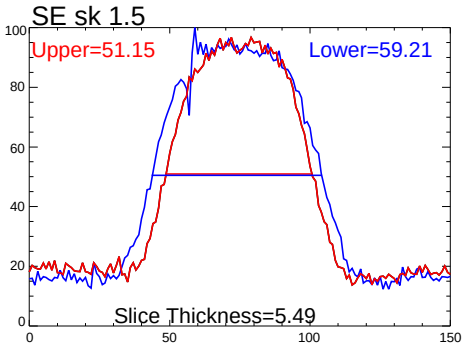
Turbo Spin Echo
ETL = 3
TR/TE = 450/9.9
BW = 21.76 KHz
nex = 6
Scan time: 3:51

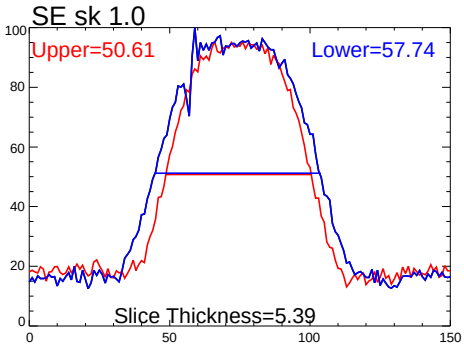


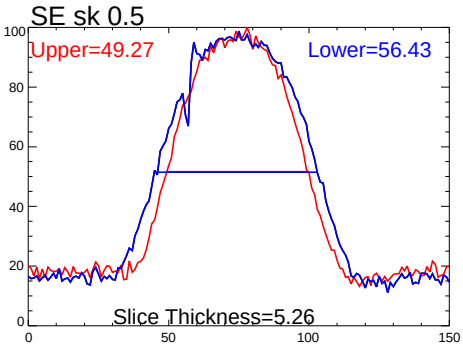


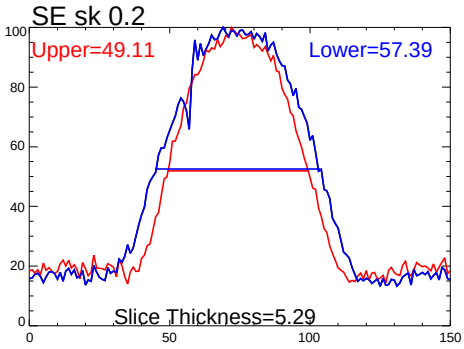


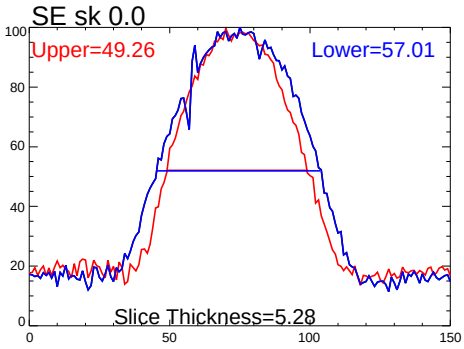


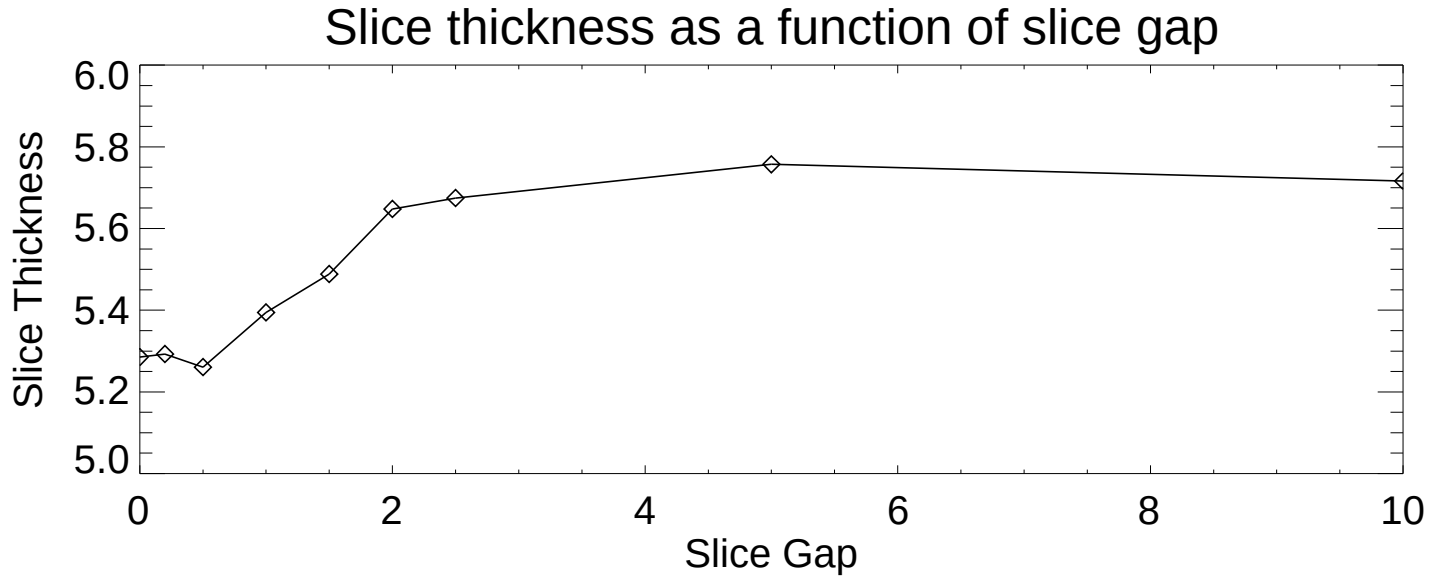






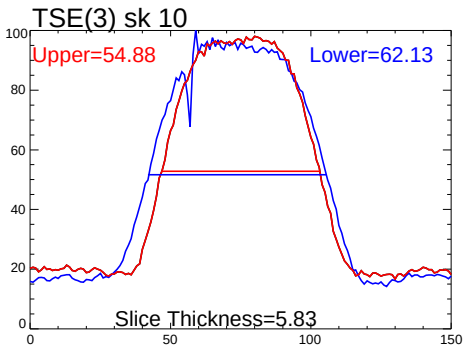


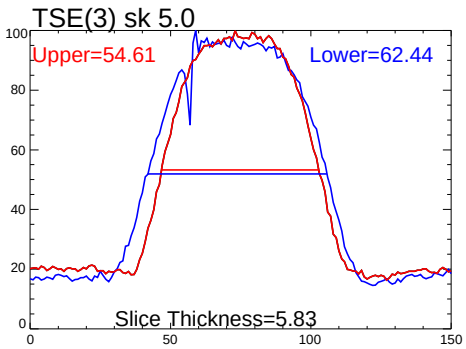


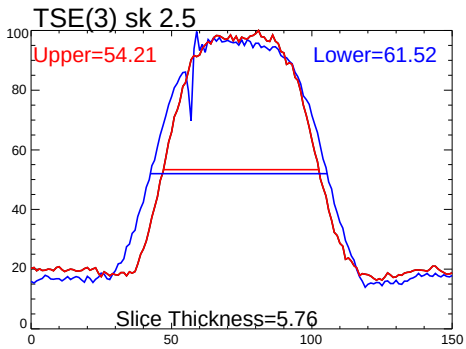


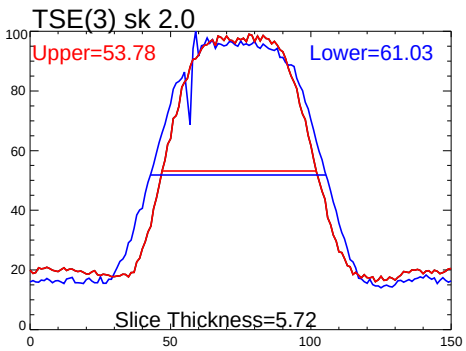
Appendix B: RF Crosstalk and Slice Profiles

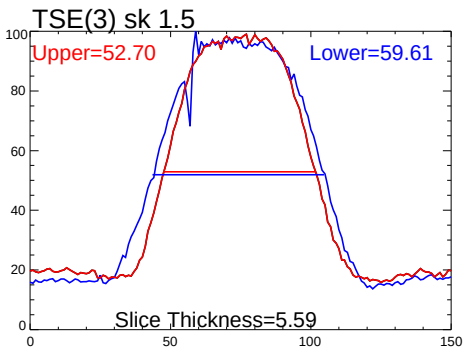
Turbo Spin Echo
ETL = 3
TR/TE = 450/9.9
BW = 21.76 KHz
nex = 6
Scan time: 3:51

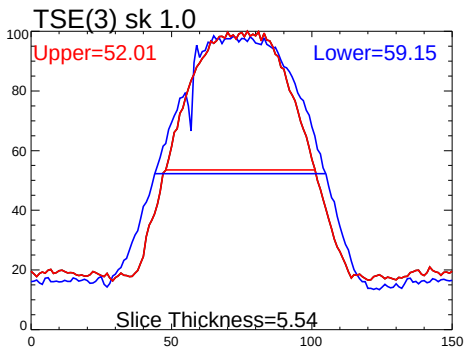


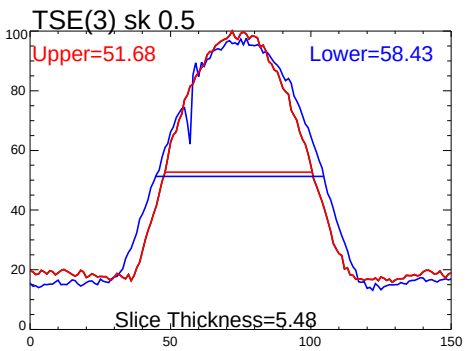


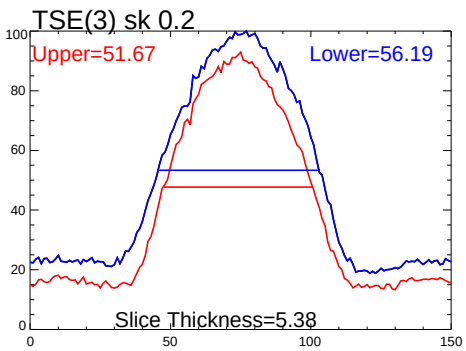


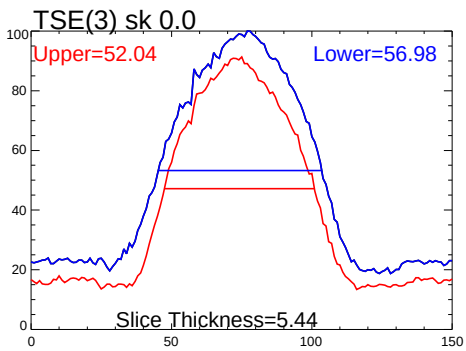


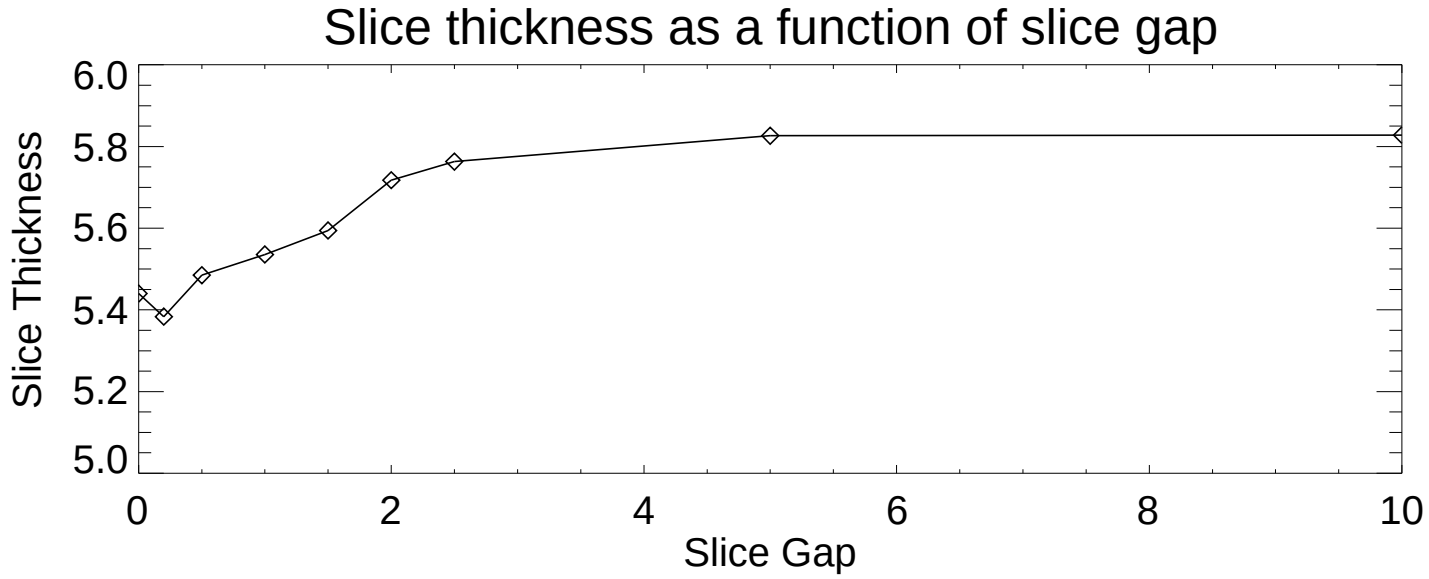












Siemens Site **Symphony**

Coil Used: **Head** Test Date: **7/20/2008**

	Sagittal Locator	
1	Length of phantom, end to end (mn 148± 2)	147.2

= 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	0.9	0.9	0.9	0.9	0.9
3	(1.10, 1.00, 0.90 mm)	0.9	0.9	0.9	0.9	0.9
4	Slice Thickness Top	58.0	57.3	47.9	62.0	66.2
5	(fwhm in mm) Bottom	50.1	49.8	42.3	53.1	57.6
6	Calculated value 5.0±0.7	5.38	5.33	4.49	5.72	6.16
7	Wedge (mm) = + = -	0.7	0.7	0.6	0.8	0.8
8	Diameter (mm) (190±2) ⊕	191.6	191.6	191.6	191.5	191.3
9	⊖	190.4	190.4	190.4	190.5	190.4
	Slice Location #5					
10	Diameter (mm) (190±2) ⊕	191.3	191.3	191.3	191.3	190.8
11	⊖	190.3	190.3	190.3	190.3	190.0
12	⊘	190.8	190.7	190.8	190.8	190.6
13	⊘	190.4	190.4	190.4	190.5	190.4
	Slice Location #7					
14	Signal Big ROI	1682	1749	941	1691	1102
15	(mean only) High	1785	1850	999	1757	1124
16	Low	1629	1707	916	1603	1062
17	Uniformity (>87.5%)	95.4%	96.0%	95.7%	95.4%	97.2%
18	Background Noise Top	22.8 ± 10.6	22.2 ± 10.2	14.0 ± 7.6	22.2 ± 10.5	28.3 ± 14.4
19	Bottom	21.3 ± 10.7	22.7 ± 10.8	13.8 ± 7.5	23.0 ± 11.4	27.8 ± 15.1
20	(mean ±std dev) Left	64.5 ± 10.3	40.6 ± 13.8	15.8 ± 8.6	38.1 ± 10.1	47.0 ± 20.0
21	Right	55.8 ± 10.5	31.5 ± 12.4	12.9 ± 7.2	39.0 ± 9.5	67.1 ± 27.2
22	Ghosting Ratio (<2.5%)	2.3%	0.8%	0.0%	0.9%	2.6%
23	SNR (no spec)	162	167	125	173	75
	Low Con Detectability					
24	Slice Location #8 1.4%	5	8	5	5	0
25	Slice Location #9 2.5%	10	10	7	10	0
26	Slice Location #10 3.6%	10	10	10	10	6
27	Slice Location #11 5.1%	10	10	10	10	10
28	Total # of Spokes (>=9)	35	38	32	35	16
	Slice Location #11					
29	Wedge (mm) = + = -	0.2	0.2	0.1	0.4	1.0
30	Slice Position Error	-0.5	-0.5	-0.5	-0.5	0.2

Most of the images had excessive ghosting, the ACR T1 and Site T2 have exceptionally large ghosting

Siemens Site

Symphony

Sequence parameters

Test Date: **7/20/2008**

Coil Used:**Head**

Test ID **314**

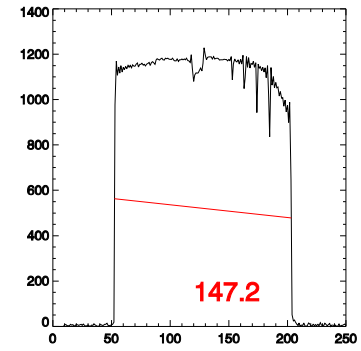
Study Description	Pulse Sequence (ETL)	TR (ms)	TE (ms)	FOV (cm)	Phase Sample Ratio	Number of Slices	Thick-ness (mm)	Slice Gap	NSA (Nex)	Freq Matrix	Phase Matrix	Band Width (kHz)	Scan Time (min:sec)
ACR T1	SE	500	20	25	1	11	5	5	1	256	256	15.6	2:09:00
ACR PD	Dual Echo SE	2000	20	25	1	11	5	5	1	256	256	15.6	8:32
ACR T2	Dual Echo SE	2000	80	25	1	11	5	5	1	256	256	15.6	8:32
Site T1	SE	400	10	24	1	11	5	5	2	256	256	16.64	3:25
Site T2	TSE(15)	5000	104	24	1	11	5	5	2	256	512	33.28	3:42

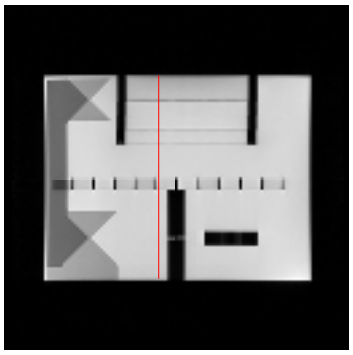
Magnet ID: **219** **Coil ID:** **1727** **TestID:** **314**

Appendix C: ACR Phantom Analysis

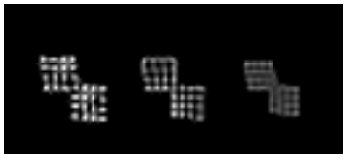
ACR T1

Sagital Length

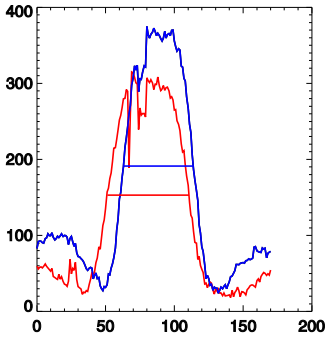




High Contrast Resolution

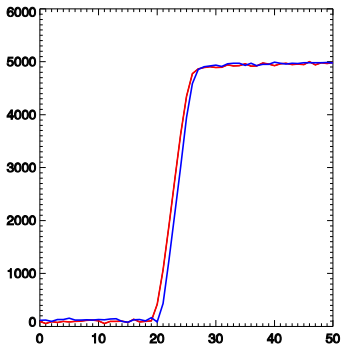


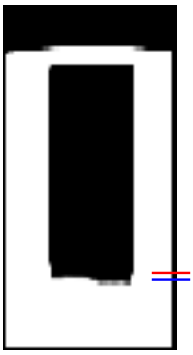
Slice Thickness



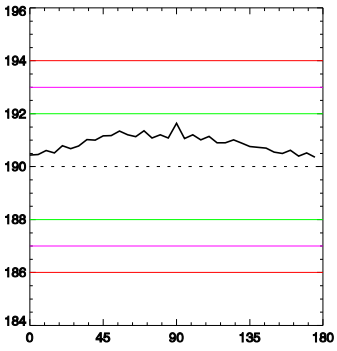
Upper=57.97
Lower=50.07
Slice Thickness=5.37

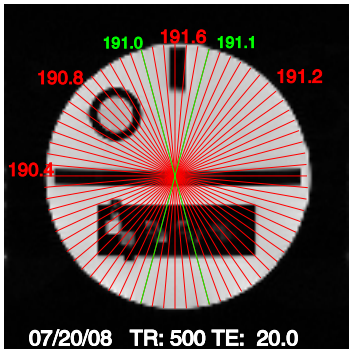
Slice Position - Inferior



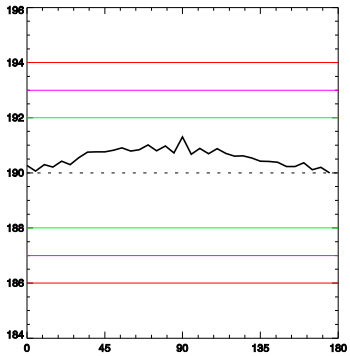


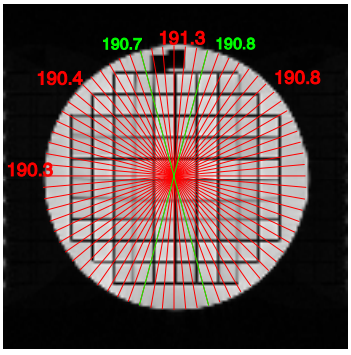
Axial Diameters - #1



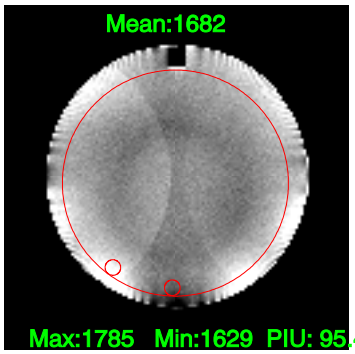


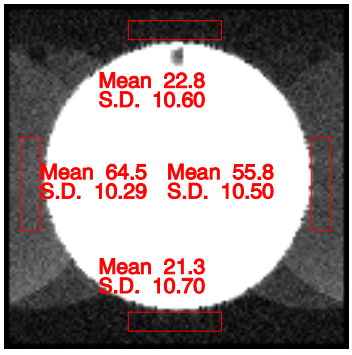
Axial Diameters - #5



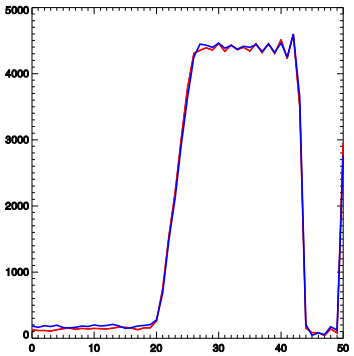


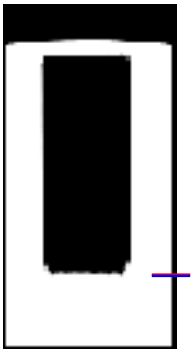
Uniformity & Ghosting - #7



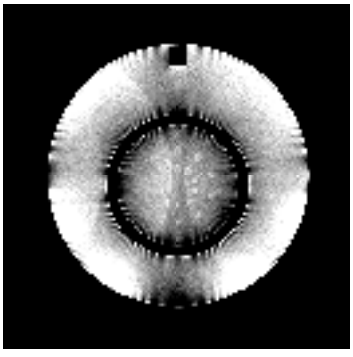


Slice Position - Superior

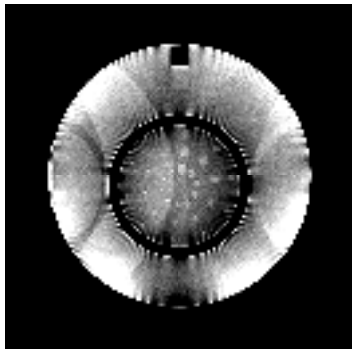




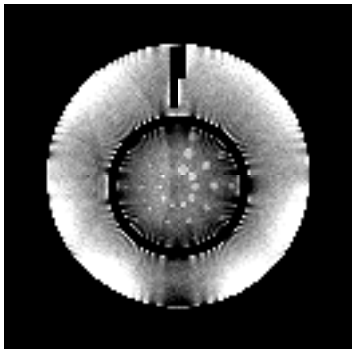
Low Contrast - #8



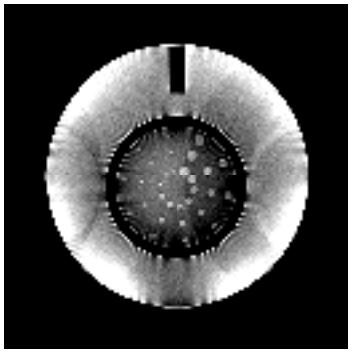
Low Contrast - #9



Low Contrast - #10



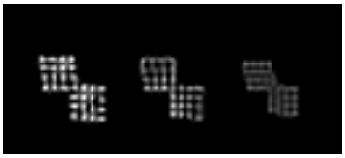
Low Contrast - #11



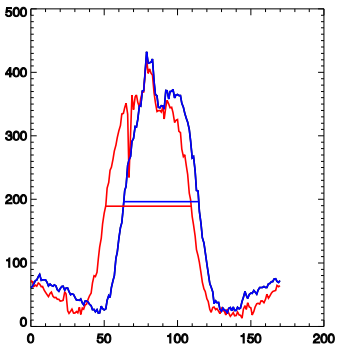
Appendix C: ACR Phantom Analysis

ACR PD

High Contrast Resolution



Slice Thickness

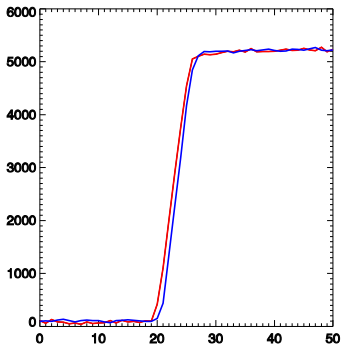


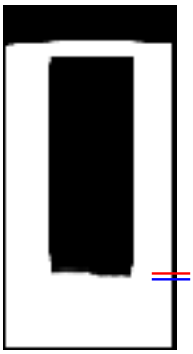
Upper=57.30

Lower=49.83

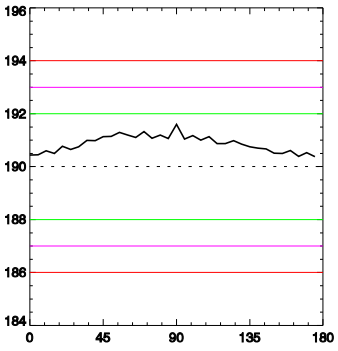
Slice Thickness=5.33

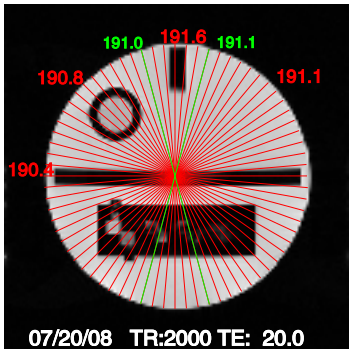
Slice Position - Inferior



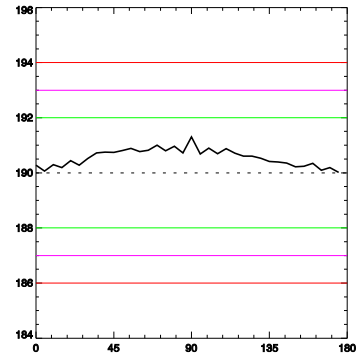


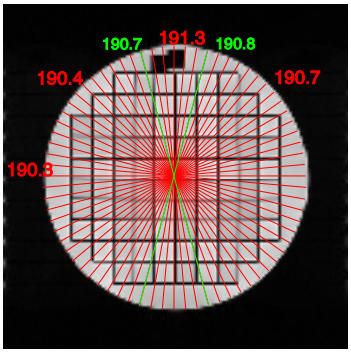
Axial Diameters - #1



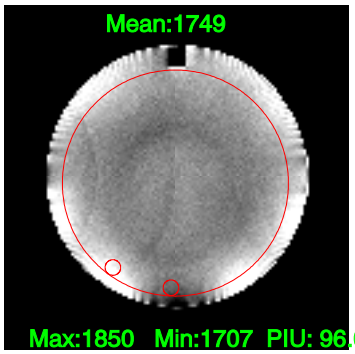


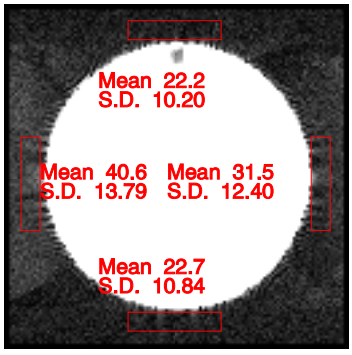
Axial Diameters - #5



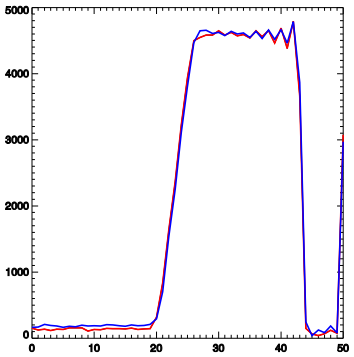


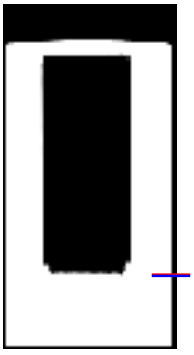
Uniformity & Ghosting - #7



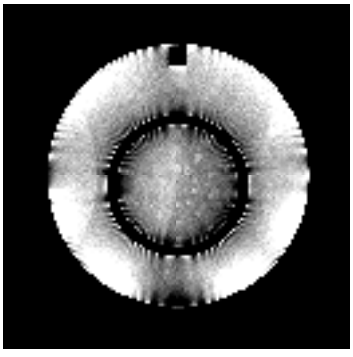


Slice Position - Superior

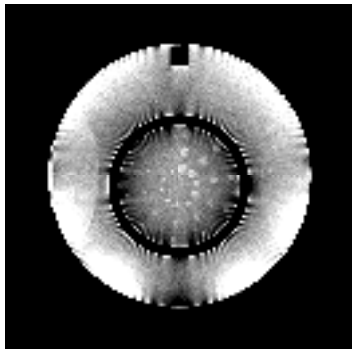




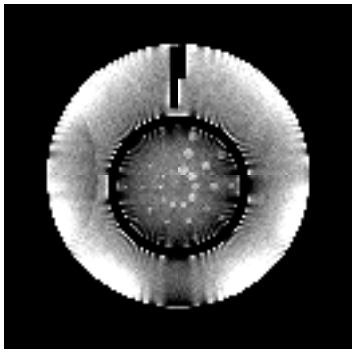
Low Contrast - #8



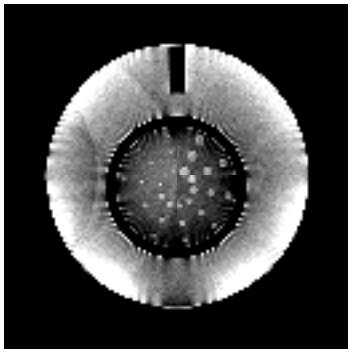
Low Contrast - #9



Low Contrast - #10



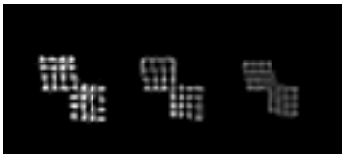
Low Contrast - #11



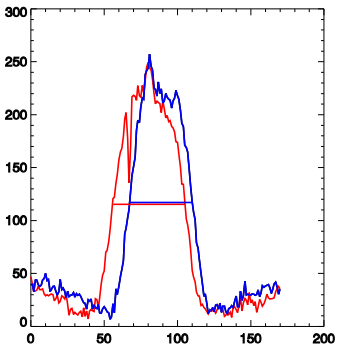
Appendix C: ACR Phantom Analysis

ACR T2

High Contrast Resolution



Slice Thickness

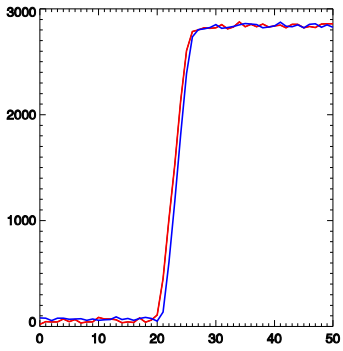


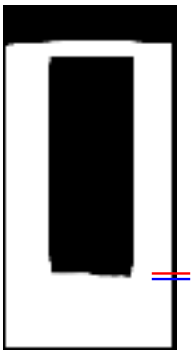
Upper=47.90

Lower=42.26

Slice Thickness=4.49

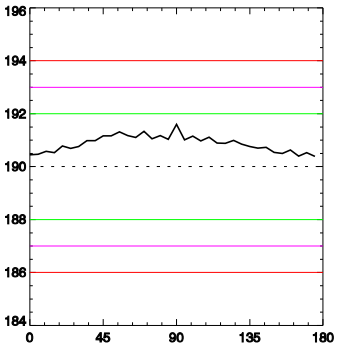
Slice Position - Inferior

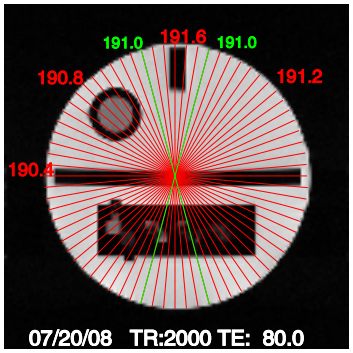




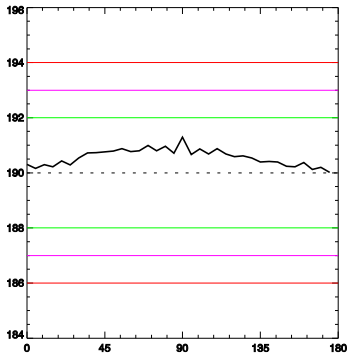
Diff.= 0.64

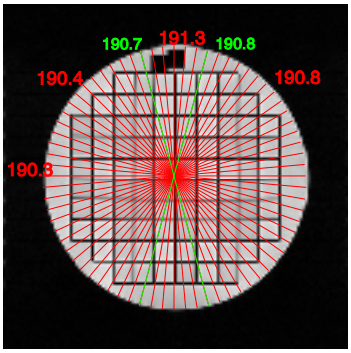
Axial Diameters - #1



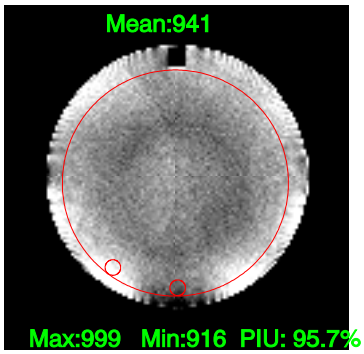


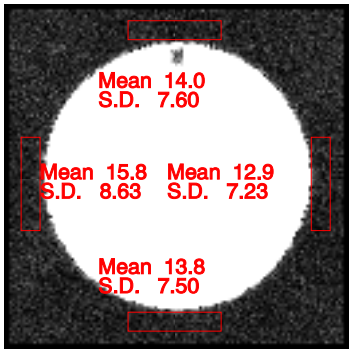
Axial Diameters - #5



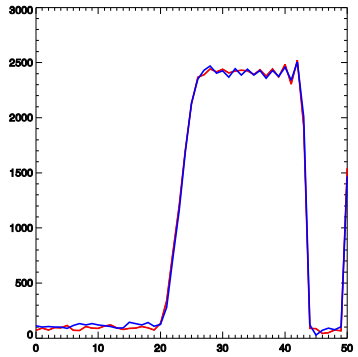


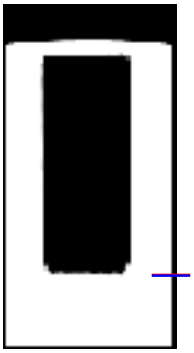
Uniformity & Ghosting - #7





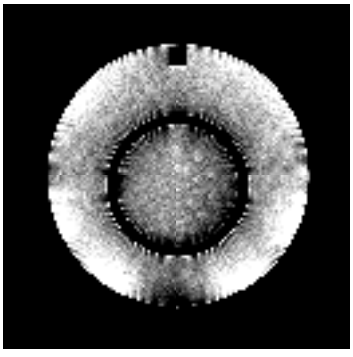
Slice Position - Superior



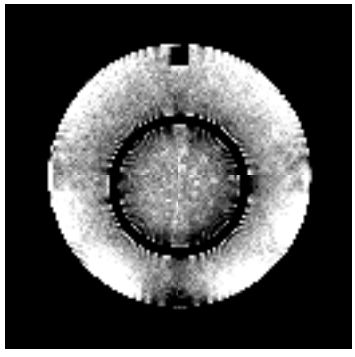


Diff.= 0.09

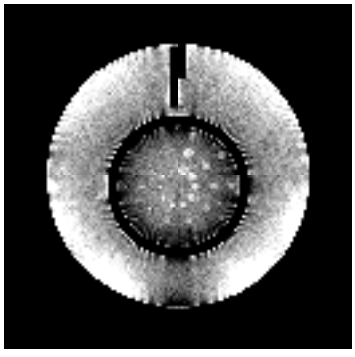
Low Contrast - #8



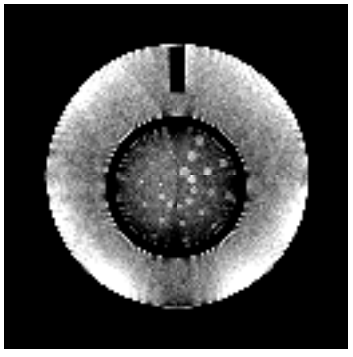
Low Contrast - #9



Low Contrast - #10



Low Contrast - #11

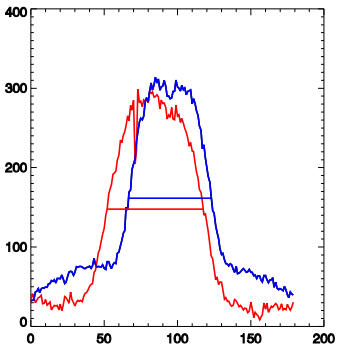


Appendix C: ACR Phantom Analysis

Site T1

High Contrast Resolution

Slice Thickness

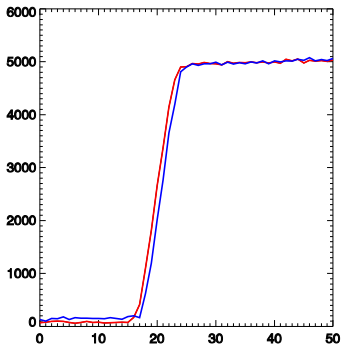


Upper=61.99

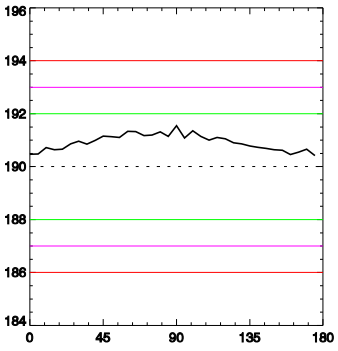
Lower=53.06

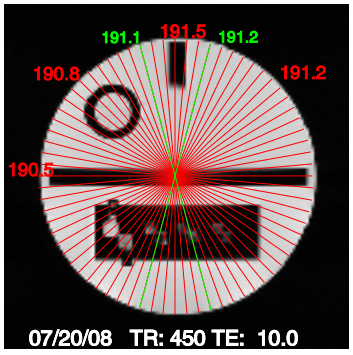
Slice Thickness=5.72

Slice Position - Inferior

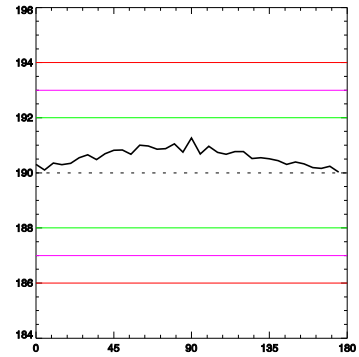


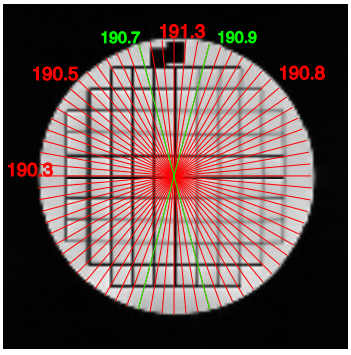
Axial Diameters - #1



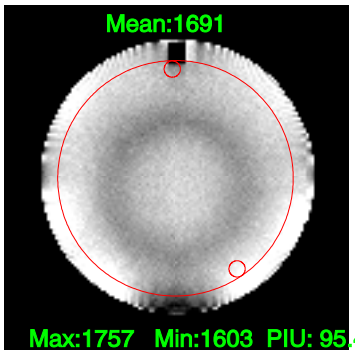


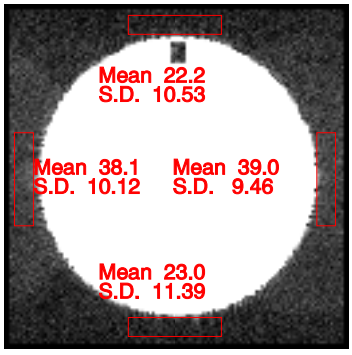
Axial Diameters - #5



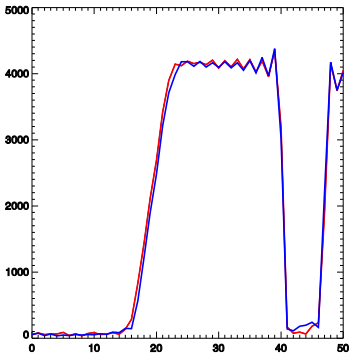


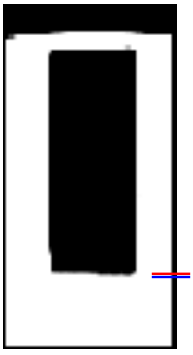
Uniformity & Ghosting - #7



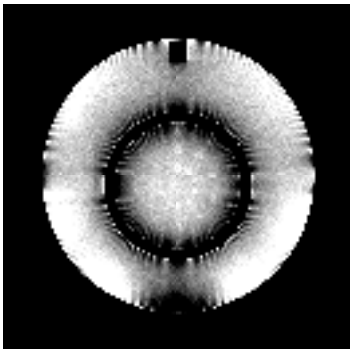


Slice Position - Superior

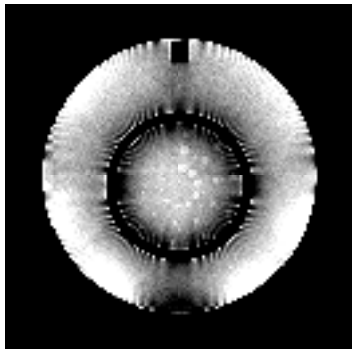




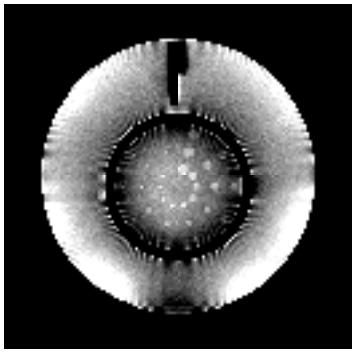
Low Contrast - #8



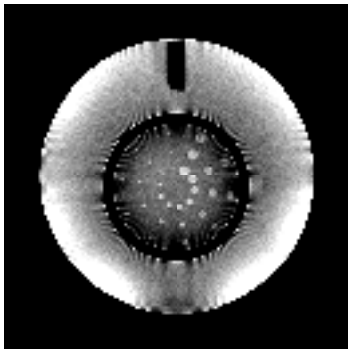
Low Contrast - #9



Low Contrast - #10



Low Contrast - #11

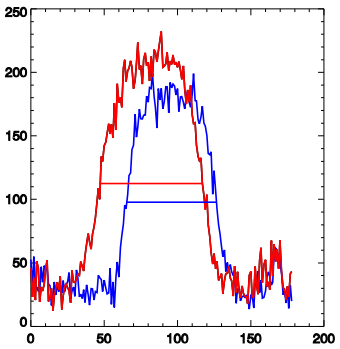


Appendix C: ACR Phantom Analysis

Site T2

High Contrast Resolution

Slice Thickness

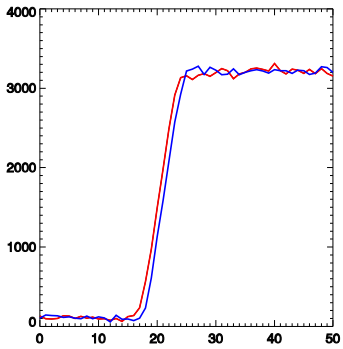


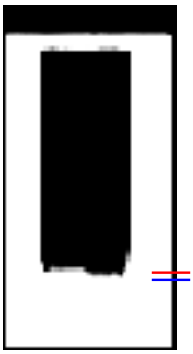
Upper=66.16

Lower=57.58

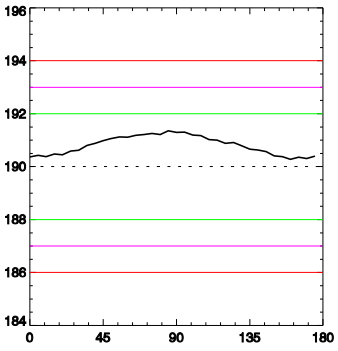
Slice Thickness=6.16

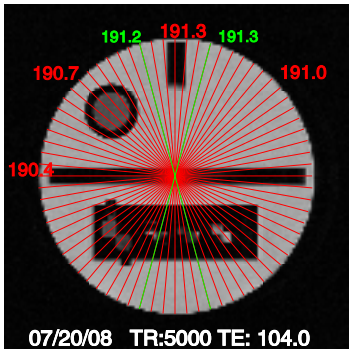
Slice Position - Inferior



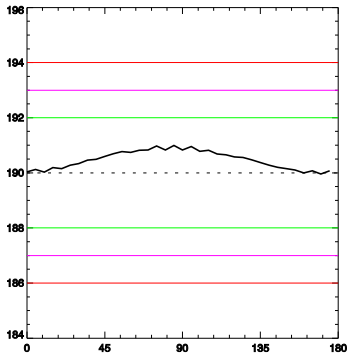


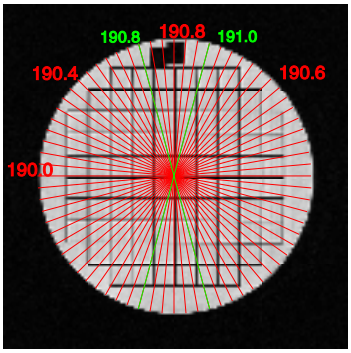
Axial Diameters - #1



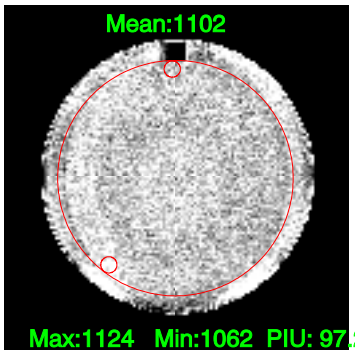


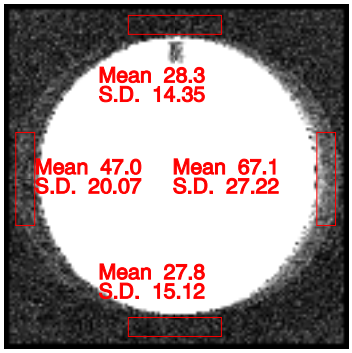
Axial Diameters - #5



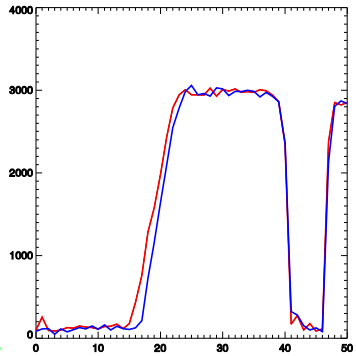


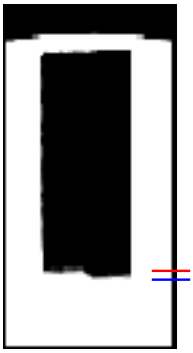
Uniformity & Ghosting - #7



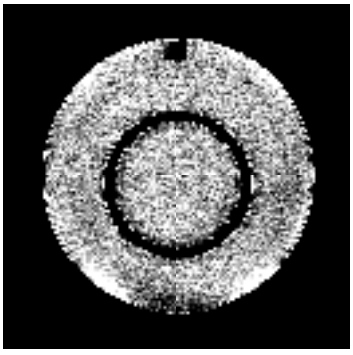


Slice Position - Superior

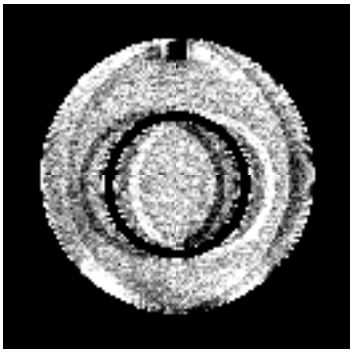




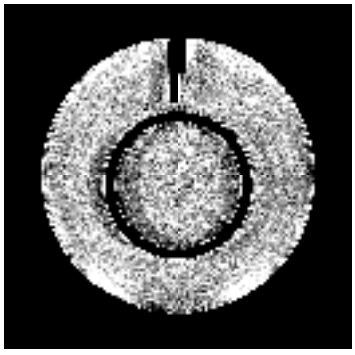
Low Contrast - #8



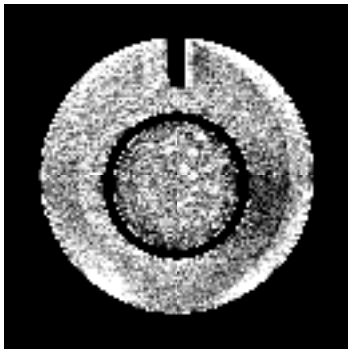
Low Contrast - #9



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 25.73KHz (200 Hz/pixel). 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 pre or post Normalization).

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.