Philips Site
Yearly Performance Evaluation
Philips - 3T
1-Jun-08

Table of Contents

MRI Equipment Evaluation Summary & Signature Page

Site Name: Philips Site **MRAP #** _____

Address: _____ **Survey Date:** 6/1/08

City, State, Zip _____ **Report Date:** 6/27/08

MRI Mfg: Philips **Model:** Achieva **Field:** 3T

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	☒	☐	☐
8. Hard Copy Display (film)	☒	☐	☐

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. LCD (soft copy display) looks good.
2. Two channels of CTL spine coil have noise levels 5-10 times higher than normal.
3. The slice thickness of the TSE(15) T2 sequence is surprisingly large, roughly 16% larger than expected.
4. Testing the shim is difficult on this magnet. The shim in the axial and coronal planes look OK. The sagittal results are not quite as good. Overall, it is much better (over a larger FOV) than the Gibbon 3T.
5. When using the T/R head coil, there was close to 5.8% ghosting. Additionally, the ACR T2 fails image uniformity.
6. The ACR phantom images passed when using the Head SENSE coil. The ACR T2 had 2.6% ghosting. This IS excessive but will squeak by the ACR requirements.
7. The RF Xtalk response is VERY strange. Normally, as slices get closer together the effective slice thickness gets smaller as the adjacent slices interfere. On this system, the measured thickness actually gets larger! I expect this is related to RF penetration issues. In any event, the crosstalk begins when the slice gap drops below 40%, which is typical of most systems.
8. The 5 gauss line is kept within the scan room (roughly 3 ft inside the door).
9.
10.
11.
12.
13.

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

MRI Equipment Performance Evaluation Data Form

Site Name: Philips Site

Contact	Title	Phone	eMail
	Chief Tech		

Equipment Information

MRI Manufacturer: Philips Model: Achieva SN: 17340 Software: 2.1.3.3

Camera Manufacturer: Model: SN: Software:

PACS Manufacturer: Model: SN: Software:

ACR Phantom Number used: J3486

1. Table Positioning Reproducibility: **Pass**

Table motion out/in:	IsoCenter	Out/In
Measured Phantom Center	-1.7	-1.2

Comment:

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

Last Year CF: **N/A** This Year CF: **127778003** CF Change: **NA**

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

5 mm skip 5 mm, BW: 18.3KHz, 256x128, 2nex

	15 cm	20 cm	25 cm
Axial:	0.3	0.4	0.6
Coronal:	0.5	0.8	1.1
Sagittal:	0.3	0.4	0.6

Comments: Testing the shim is difficult on this magnet. The shim in the axial plane looks OK. The homogeneity is definitely better and extends over a larger range than the Gibbon 3T.

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	5.39	5	7.8%
SE (Site T1)	450	10	90	1	5.36	5	7.2%
SE (20/80)	2000	20	90	1	5.38	5	7.6%
SE (20/80)	2000	80	90	1	5.30	5	6.0%
TSE(15)	3000	80	90	1	6.10	5	22.0%

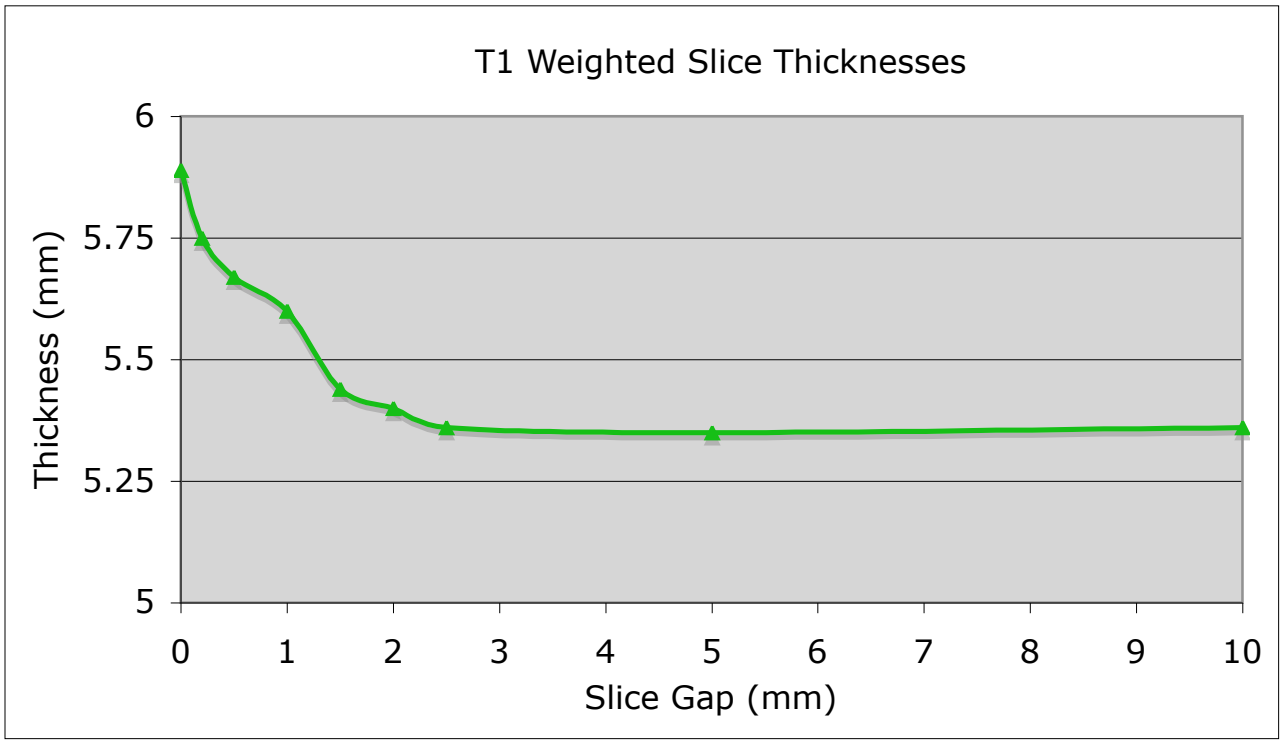
Comments: The large slice thickness for the TSE(15) is rather surprising. Typically this sequence is closer to 5.5 at 1.5T.

4. Slice Crosstalk (RF interference)

The following data were obtained using the ACR phantom slice thickness wedges to measure the slice profile of a common T1 weighted sequence 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 does NOT demonstrate this effect. Instead, once the slice gap reaches 40% of the slice thickness, the measured slice profile begins to RISE! There is no question that some sort of slice to slice interaction is going on but I have NEVER seen the slice thickness rise. Howeve, if you examine the slice profiles in appendix B, you see that the base becomes greatly broadened while the peak becomes more pointed. This unusual behaviour may be related to RF penetration issues and/or image normalization software.

Sequence Type	TR	TE	FOV (cm^2)	Matrix	NSA	Thickness	# of slices	Slice Measured
SE	500	10	25	256x256	1	5	11	6

Skip	SE
0	5.89
0.2	5.75
0.5	5.67
1	5.6
1.5	5.44
2	5.4
2.5	5.36
5	5.35
10	5.36



5. Soft & Hard Copy Displays

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

Monitor Description: Philips 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	70.7	58.6	65	70.8	67.8

Uniformity		
MAX	MIN	Percent Delta
70.8	58.6	19%

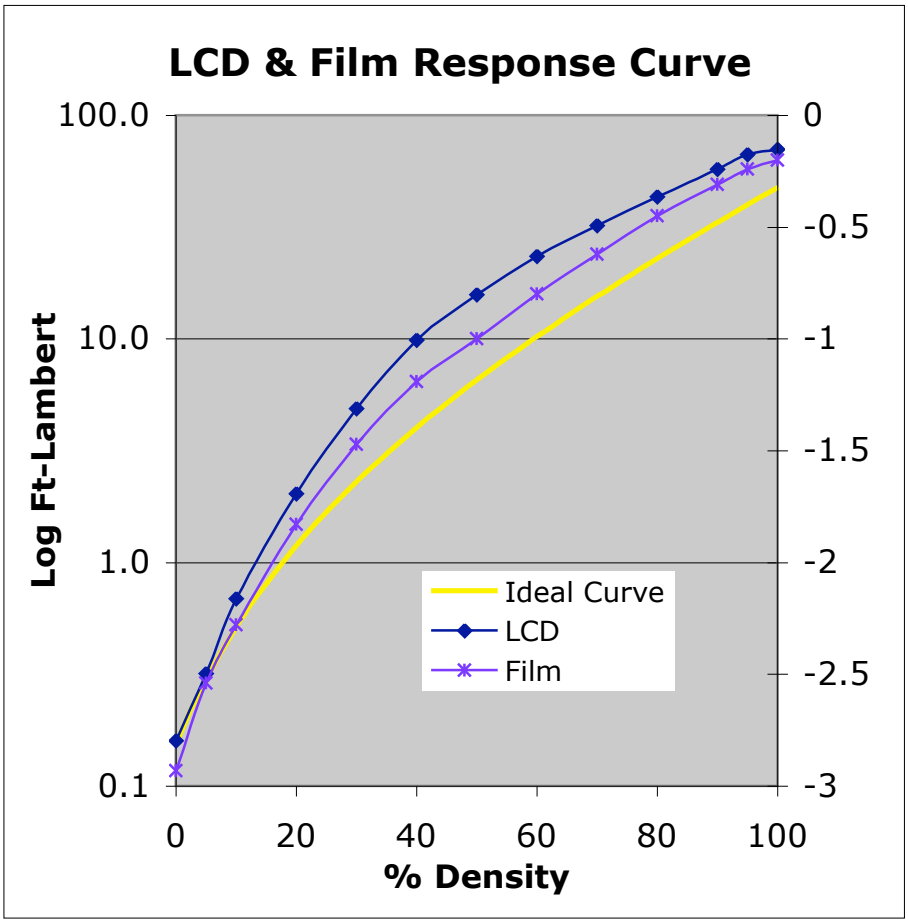
SMPTE
OK?
Y

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

Minimum Brightness must be > 26.24 Ft. Lamberts

Good agreement between monitor and film!

Density	Ft-Lamber	Film Density
0	0.16	-2.93
5	0.32	-2.54
10	0.69	-2.28
20	2.03	-1.83
30	4.88	-1.47
40	9.89	-1.19
50	15.84	-1
60	23.40	-0.8
70	32.1	-0.62
80	43.4	-0.45
90	57.5	-0.31
95	66.9	-0.24
100	70.6	-0.2



Coil and Other Hardware Inventory List

Site Name Philips Site

ACR Magnet # _____ Nickname JHN 3T

Active	Coil Description	Manufacturer	Model	Rev.	Mfg. Date	SN	Channels
☐	Body Integrated	Philips					1
☐	Breast Array	Invivo	103219	1	Aug, 2006	U29285	4
☐	CTL Spine	USAI	4535 670 14331	1	Mar, 2007	699	5
☐	Flex SENSE - Large	Philips	4522 132 19164		Dec, 2006	300155809	2
☐	Flex SENSE - Medium	Philips	4522 132 19264		May, 2006	300153765	2
☐	Head SENSE	Invivo	4535 670 61672		Nov, 2006	00303	8
☐	Head T/R	Philips	4522 132 19833		May, 2006	300124033	1
☐	Knee	Invivo	4535 670 61682		Dec, 2006	000232	8
☐	Neurovascular Array	Invivo	4522 132 31721		Dec, 2006	0000231	16
☐	Torso SENSE	USAI	100372	1		634	6
☐							

RF Coil Performance Evaluation

Coil: Body Integrated

Mfg.: Philips

Mfg. Date: _____ Coil ID: 1712

Phantom: 32 cm Sphere

Test Date: 6/1/2008

Model: _____

Revision: _____

SN: _____

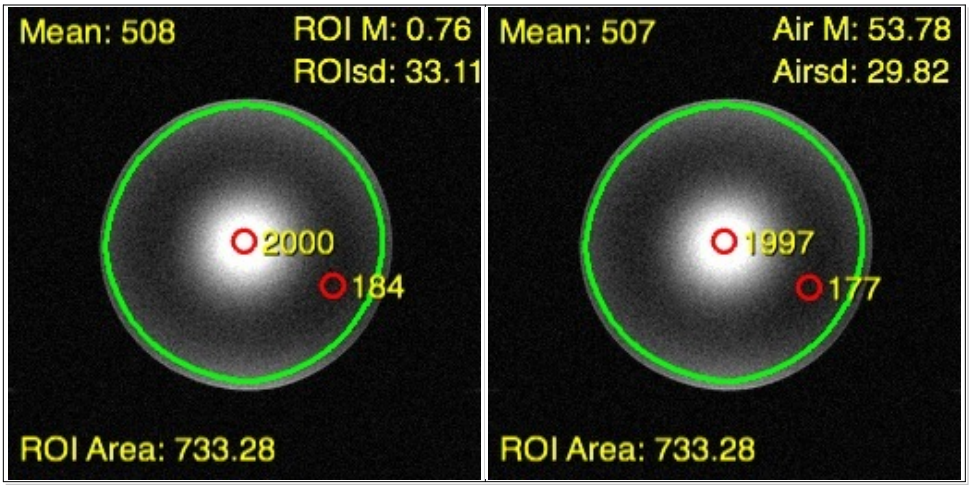
# of Channels 1

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	53	256	256	28.04	1	3	-

Coil Mode: Q-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	508	2,000	184	0.8	33.11	NEMA	10.9	4.7	42.7	16.8%
A	507	1,997	177	53.8	29.82	Air	11.1	4.8	43.9	16.3%



Test Images

RF Coil Performance Evaluation

Coil: Breast Array
Mfg.: Invivo
Mfg. Date: 8/1/2006 Coil ID: 1715
Phantom: Two bottles

Test Date: 3/23/2008
Model: 103219
Revision: 1
SN: U29285
# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	53	256	256	28.04	1	3	-

Coil Mode: SENSE-Breast-4

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Back ground	Noise SD	Noise Type
NL	1,236	1,973	463	-0.9	4.43	NEMA
NR	1,274	1,804	429	1.7	6.62	NEMA
AL	1,237	1,977	466	2.3	1.87	Air
AR	1,272	1,807	419	2.3	1.86	Air

Calculated Results

Mean SNR	Normal-ized	Max SNR	Uni-formity
197.3	84.8	315.0	38.0%
136.1	58.5	192.7	38.4%
433.5	186.2	692.8	38.1%
448.1	192.5	636.6	37.6%

Analysis of Uncombined Images

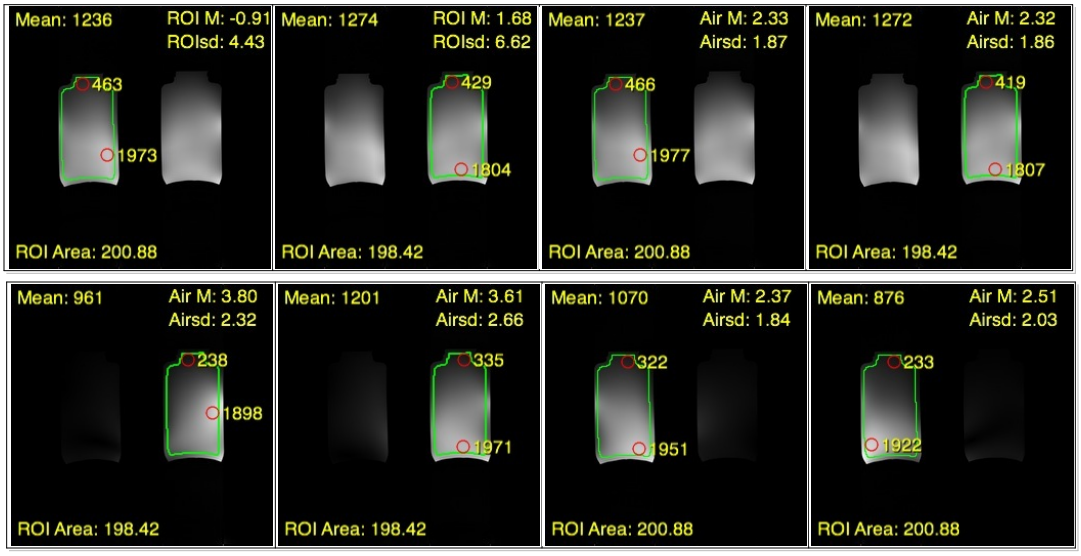
Measured Data

Ch	Mean	Max	Noise SD	Noise Type
L1	961	1,898	2.32	Air
L2	1,201	1,971	2.66	Air
R3	1,070	1,951	1.84	Air
R4	876	1,922	2.03	Air

Calculated Results

Mean SNR	% of Mean	Max SNR	% of Max
271.4	71%	536.1	77%
295.9	78%	485.6	70%
381.1	100%	694.8	100%
282.8	74%	620.4	89%

Substantial ghosting made using the NEMA method difficult.



RF Coil Performance Evaluation

Coil: Breast Array
Mfg.: Invivo
Mfg. Date: 8/1/2006 Coil ID: 1715
Phantom: Two bottles

Test Date: 3/23/2008
Model: 103219
Revision: 1
SN: U29285
# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	C	40	256	256	28.04	1	3	-

Coil Mode: SENSE-Breast-4

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Background	Noise SD	Noise Type
NR	1,709	2,007	1,508	-0.4	4.94	NEMA
NL	1,671	1,949	1,423	-0.2	3.54	NEMA
AR	1,709	2,013	1,512	4.9	3.66	Air
AL	1,671	1,949	1,422	4.9	3.66	Air

Calculated Results

Mean SNR	Normal-ized	Max SNR	Uni-formity
244.7	184.5	287.3	85.8%
333.8	251.8	389.4	84.4%
306.0	230.8	360.4	85.8%
299.2	225.6	349.0	84.4%

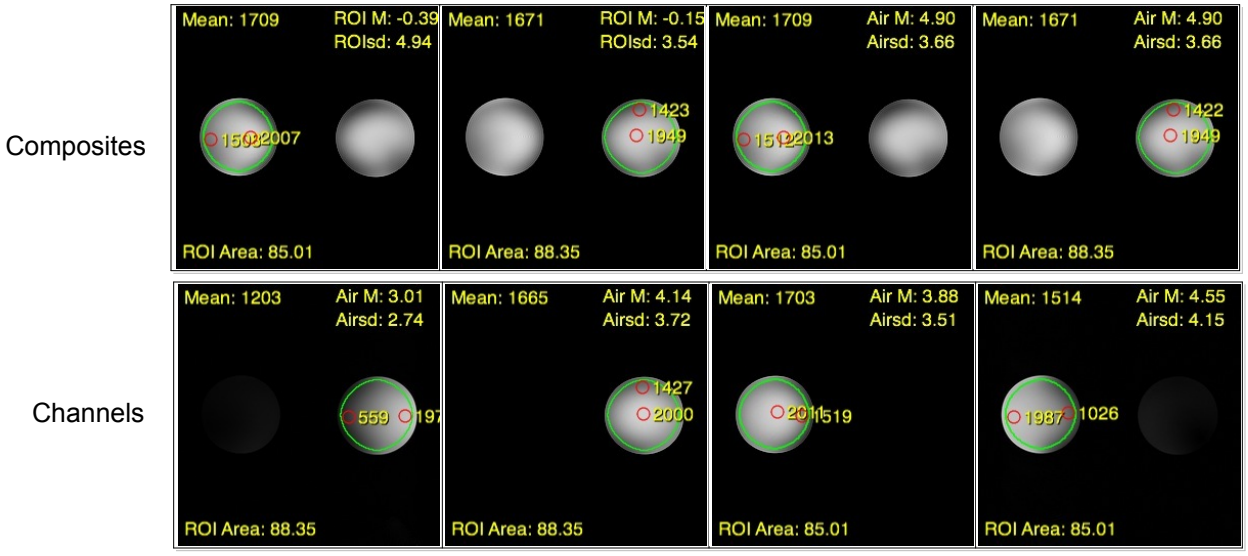
Analysis of Uncombined Images

Measured Data

Ch	Mean	Max	Noise SD	Noise Type
L1	1,203	1,977	2.74	Air
L2	1,665	2,000	3.72	Air
R3	1,703	2,011	3.51	Air
R4	1,514	1,987	4.15	Air

Calculated Results

Mean SNR	% of Mean	Max SNR	% of Max
287.7	90%	472.8	100%
293.3	92%	352.3	75%
317.9	100%	375.4	79%
239.1	75%	313.8	66%



RF Coil Performance Evaluation

Coil: Breast Array
Mfg.: Invivo
Mfg. Date: 8/1/2006 Coil ID: 1715
Phantom: Two bottles

Test Date: 3/23/2008
Model: 103219
Revision: 1
SN: U29285
# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	53	256	256	28.04	1	3	-

Coil Mode: SENSE-Breast-4 Left

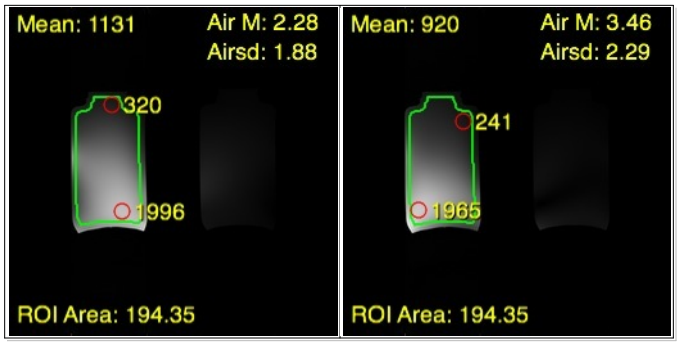
Analysis of Composite Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	1,156	1,997	317	2.1	3.94	NEMA	207.5	89.1	358.5	27.4%
A	1,154	1,999	318	1.4	1.10	Air	687.5	295.3	1190.9	27.4%

Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	1,131	1,996	1.88	Air	394.2	100%	695.7	100%
2	920	1,965	2.29	Air	263.3	67%	562.3	81%

Composites



Channel 1 Channel 2

RF Coil Performance Evaluation

Coil: Breast Array
Mfg.: Invivo
Mfg. Date: 8/1/2006 Coil ID: 1715
Phantom: Two bottles

Test Date: 3/23/2008
Model: 103219
Revision: 1
SN: U29285
# of Channels 4

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	53	256	256	28.04	1	3	-

Coil Mode: SENSE-Breast-4 Right

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	1,245	1,931	332	-1.3	1.90	NEMA	463.4	199.1	718.8	29.3%
A	1,246	1,933	336	3.3	1.10	Air	742.3	318.9	1151.6	29.6%

Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	996	1,942	2.10	Air	310.8	100%	606.0	100%
2						0%		0%

Channel 2 not reconstructed

Composites

Channel 1 Channel 2

RF Coil Performance Evaluation

Coil: CTL Spine
Mfg.: USAI
Mfg. Date: 3/1/2007 Coil ID: 1711
Phantom: 5 Liter Bottle

Test Date: 6/1/2008
Model: 4535 670 14331
Revision: 1
SN: 699
# of Channels 5

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	S	53	256	256	28.04	1	3	-

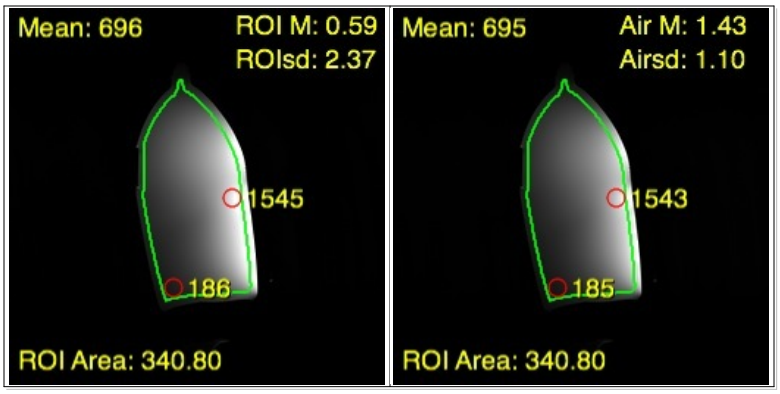
Coil Mode: SENSE - Spine AB

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	696	1,545	186	0.6	2.37	NEMA	207.7	89.2	461.0	21.5%
A	695	1,543	185	1.4	1.10	Air	414.0	177.9	919.2	21.4%

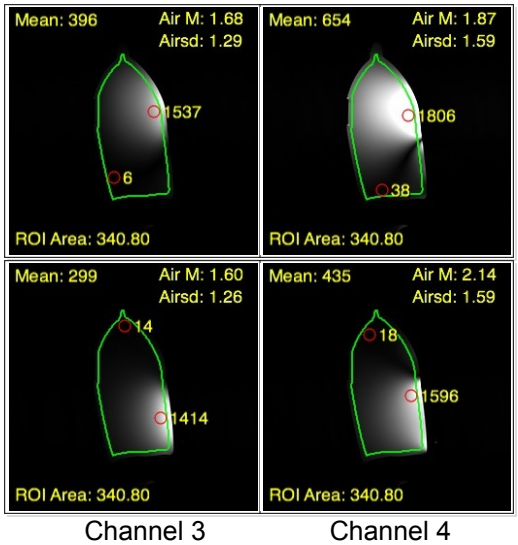
Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	396	1,537	1.29	Air	201.2	75%	780.8	100%
2	654	1,806	1.59	Air	269.5	100%	744.3	95%
3	299	1,414	1.26	Air	155.5	58%	735.4	94%
4	435	1,596	1.59	Air	179.3	67%	657.8	84%



Composites

Channel 1 Channel 2



Channel 3 Channel 4

RF Coil Performance Evaluation

Coil: CTL Spine
Mfg.: USAI
Mfg. Date: 3/1/2007 Coil ID: 1711
Phantom: Large Body Disk

Test Date: 6/1/2008
Model: 4535 670 14331
Revision: 1
SN: 699
# of Channels 5

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	S	53	256	256	28.04	1	3	-

Coil Mode: SENSE - Spine CD

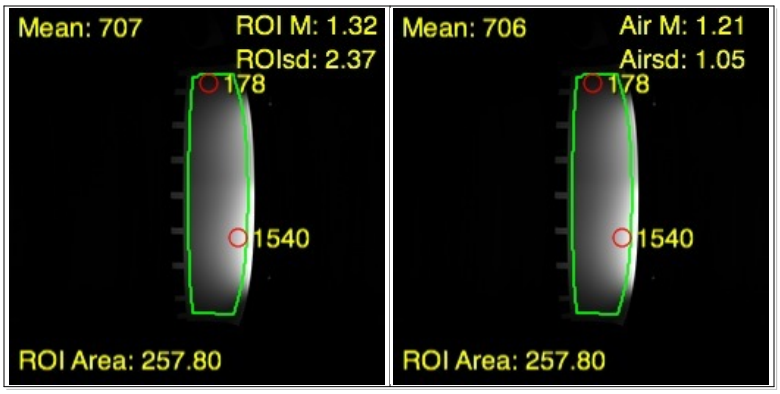
Analysis of Composite Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	707	1,540	178	1.3	2.37	NEMA	211.0	90.6	459.5	20.7%
A	706	1,540	178	1.2	1.05	Air	440.6	189.3	961.1	20.7%

Analysis of Uncombined Images

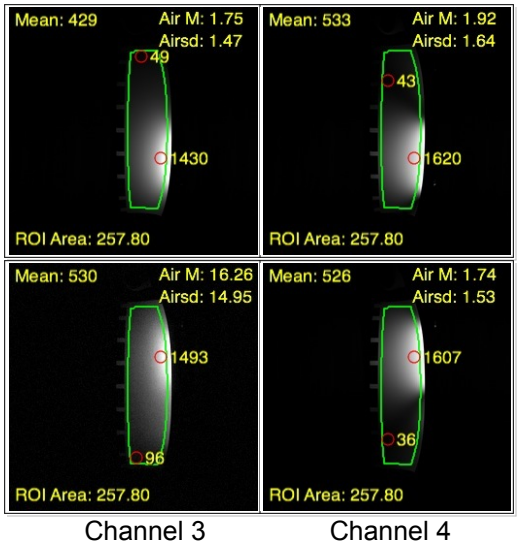
Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	429	1,430	1.47	Air	191.2	85%	637.5	93%
2	533	1,620	1.64	Air	213.0	95%	647.3	94%
5	530	1,493	14.95	Air	23.2	10%	65.4	10%
6	526	1,607	1.53	Air	225.3	100%	688.3	100%

Synergy channel 5 is effectively dead



Composites

Channel 1 Channel 2



Channel 3 Channel 4

RF Coil Performance Evaluation

Coil: CTL Spine
Mfg.: USAI
Mfg. Date: 3/1/2007 Coil ID: 1711
Phantom: Large Body Disk

Test Date: 6/1/2008
Model: 4535 670 14331
Revision: 1
SN: 699
# of Channels 5

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	S	53	256	256	28.04	1	3	-

Coil Mode: SENSE - Spine EF

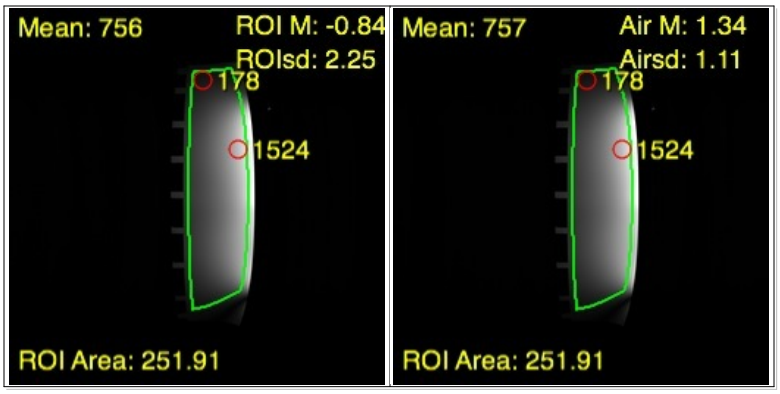
Analysis of Composite Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	756	1,524	178	-0.8	2.25	NEMA	237.6	102.1	479.0	20.9%
A	757	1,524	178	1.3	1.11	Air	446.9	192.0	899.7	20.9%

Analysis of Uncombined Images

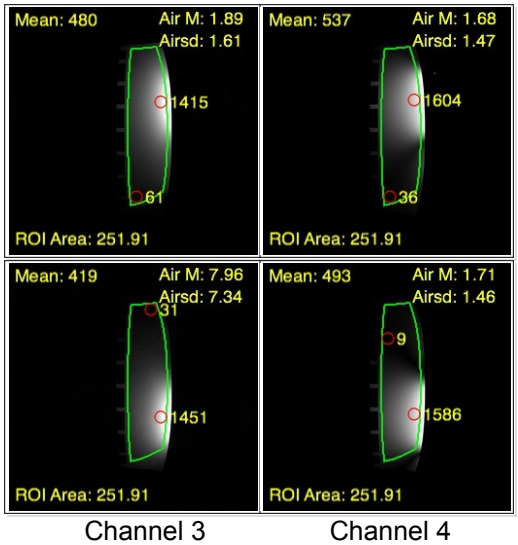
Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
3	480	1,415	1.61	Air	195.4	82%	575.9	81%
4	537	1,604	1.47	Air	239.4	100%	715.0	100%
5	419	1,451	7.34	Air	37.4	16%	129.5	18%
6	493	1,586	1.46	Air	221.3	92%	711.9	100%

Synergy channel 5 is effectively dead



Composites

Channel 1 Channel 2



Channel 3 Channel 4

RF Coil Performance Evaluation

Coil: Flex SENSE - Large
Mfg.: Philips
Mfg. Date: 12/1/2006 Coil ID: 1714
Phantom: 5 liter bottle

Test Date: 6/1/2008
Model: 4522 132 19164
Revision:
SN: 300155809
# of Channels 2

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	36	256	256	28.01	1	3	-

Coil Mode: SENSE-Flex-L

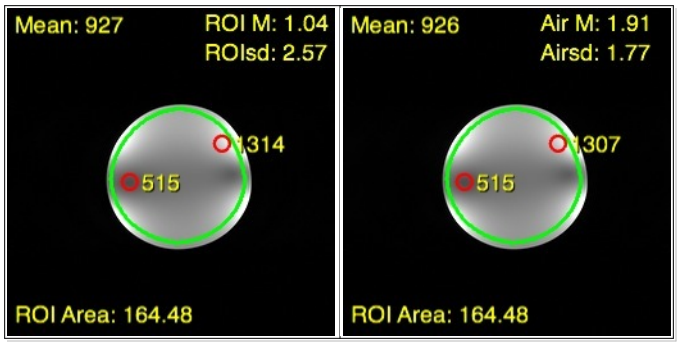
Analysis of Composite Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	927	1,314	515	1.0	2.57	NEMA	255.1	237.4	361.6	56.3%
A	926	1,307	515	1.9	1.77	Air	342.8	319.0	483.9	56.5%

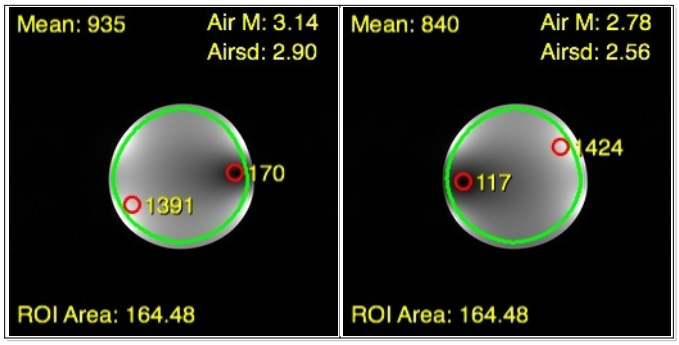
Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	935	1,391	2.90	Air	211.3	98%	314.3	86%
2	840	1,424	2.56	Air	215.0	100%	364.5	100%

This is roughly 10-15% lower than Gibbon 3T



Composites



Channel 1 Channel 2

RF Coil Performance Evaluation

Coil: Flex SENSE - Medium

Mfg.: Philips

Mfg. Date: 5/1/2006 Coil ID: 1708

Phantom: 5 liter bottle

Test Date: 6/1/2008

Model: 4522 132 19264

Revision:

SN: 300153765

# of Channels 2

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	36	256	256	28.04	1	3	-

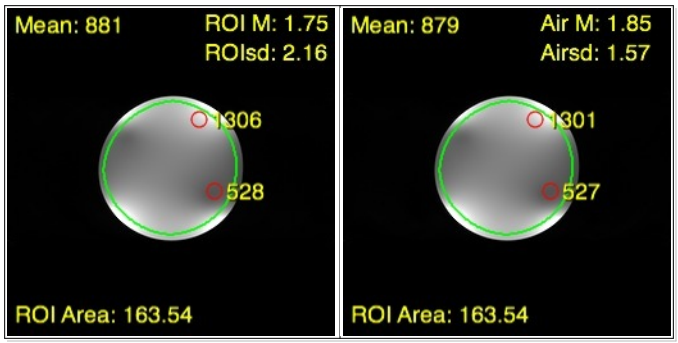
Coil Mode: SENSE-Flex-M

Analysis of Composite Image

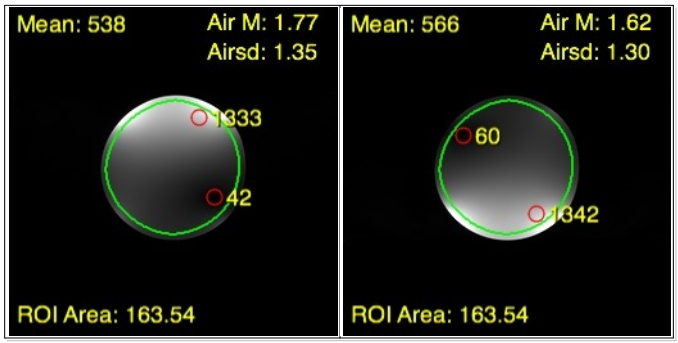
Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	881	1,306	528	1.8	2.16	NEMA	288.5	268.6	427.6	57.6%
A	879	1,301	527	1.9	1.57	Air	366.9	341.6	543.0	57.7%

Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	538	1,333	1.35	Air	261.2	92%	647.1	96%
2	566	1,342	1.30	Air	285.3	100%	676.5	100%



Composites



Channel 1 Channel 2

RF Coil Performance Evaluation

Coil: Head SENSE
Mfg.: Invivo
Mfg. Date: 11/1/2006 Coil ID: 1716
Phantom: ACR Phantom

Test Date: 6/1/2008
Model: 4535 670 61672
Revision:
SN: 00303
# of Channels 8

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	40	256	256	28.01	1	3	-

Coil Mode: SENSE-Head-8

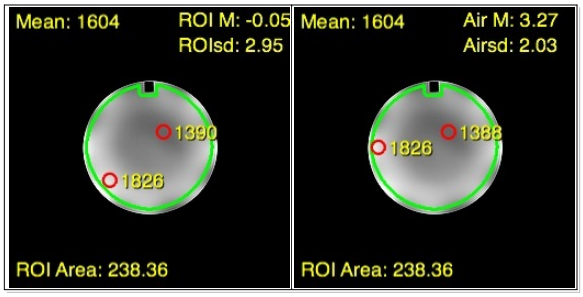
Analysis of Composite Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	1,604	1,826	1,390	-0.1	2.95	NEMA	384.5	289.8	437.8	86.4%
A	1,604	1,826	1,388	3.3	2.03	Air	517.8	390.3	589.5	86.4%

Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max

The individual channel data was not reconstructed. The composite data is nearly identical to Gibbon 3T



Composites

Channel 1	Channel 2	Channel 3	Channel 4
Channel 5	Channel 6	Channel 7	Channel 8

RF Coil Performance Evaluation

Coil: Head T/R

Mfg.: Philips

Mfg. Date: 5/1/2006 Coil ID: 1709

Phantom: ACR Phantom

Test Date: 6/1/2008

Model: 4522 132 19833

Revision:

SN: 300124033

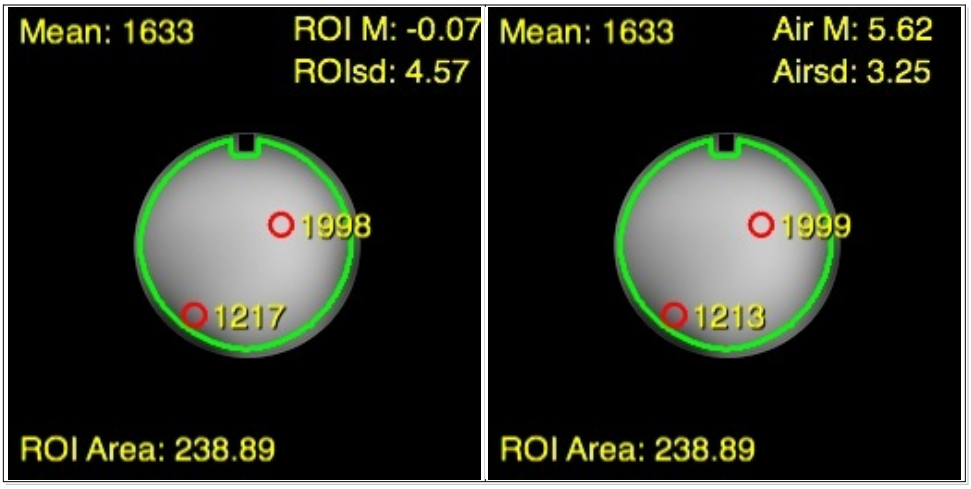
# of Channels 1

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	40	256	256	28.04	1	3	-

Coil Mode: T/R-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	1,633	1,998	1,217	-0.1	4.57	NEMA	252.7	190.6	309.2	75.7%
A	1,633	1,999	1,213	5.6	3.25	Air	329.3	248.3	403.1	75.5%



Test Images

RF Coil Performance Evaluation

Coil: Knee
Mfg.: Invivo
Mfg. Date: 12/1/2006 Coil ID: 1707
Phantom: Knee Bottle

Test Date: 6/1/2008
Model: 4535 670 61682
Revision:
SN: 000232
# of Channels 8

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	25	256	256	28.04	1	3	-

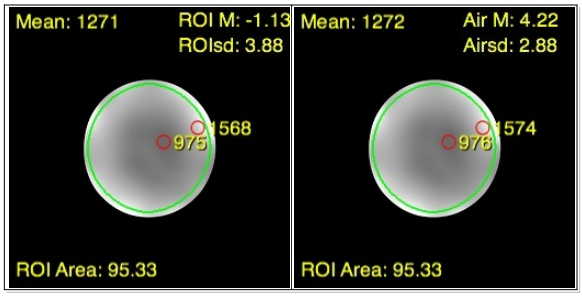
Coil Mode: SENSE-Knee-8

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	1,271	1,568	975	-1.1	3.88	NEMA	231.7	447.3	285.8	76.7%
A	1,272	1,574	976	4.2	2.88	Air	289.4	558.8	358.1	76.5%

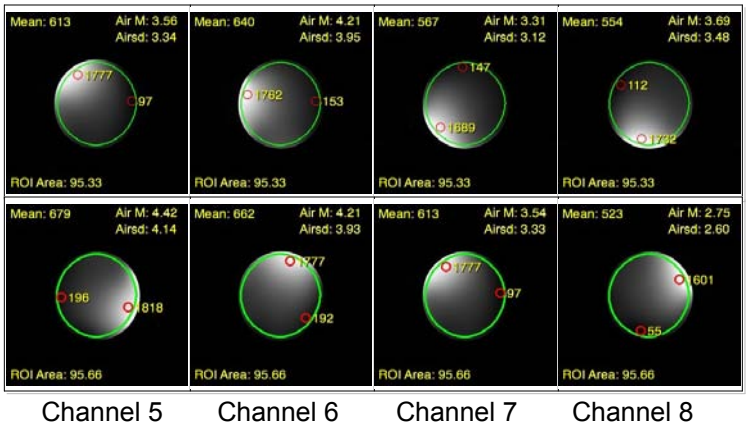
Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	613	1,777	3.34	Air	120.3	91%	348.6	86%
2	640	1,762	3.95	Air	106.2	81%	292.3	72%
3	567	1,689	3.12	Air	119.1	90%	354.7	88%
4	554	1,732	3.48	Air	104.3	79%	326.1	81%
5	553	1,661	4.14	Air	87.5	66%	262.9	65%
6	662	1,777	3.93	Air	110.4	84%	296.3	73%
7	613	1,777	3.33	Air	120.6	92%	349.7	87%
8	523	1,601	2.60	Air	131.8	100%	403.5	100%



Composites

Channel 1 Channel 2 Channel 3 Channel 4



Channel 5 Channel 6 Channel 7 Channel 8

RF Coil Performance Evaluation

Coil: Neurovascular Array
Mfg.: Invivo
Mfg. Date: 12/1/2006 Coil ID: 1706
Phantom: Invivo NVA Phantom

Test Date: 6/1/2008
Model: 4522 132 31721
Revision:
SN: 0000231
# of Channels 16

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	36	256	256	28.04	1	3	-

Coil Mode: a SENSE-NV-16 Head 1,2,3,4,5,6

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Background	Noise SD	Noise Type
N	1,599	2,000	1,286	-0.9	3.12	NEMA
A	1,600	2,002	1,284	3.0	1.92	Air

Calculated Results

Mean SNR	Normal-ized	Max SNR	Uni-formity
362.4	337.4	453.3	78.3%
546.1	508.4	683.3	78.1%

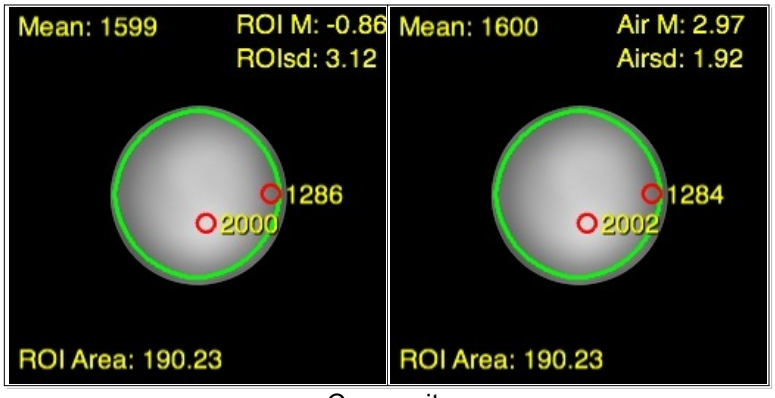
Analysis of Uncombined Images

Measured Data

Ch	Mean	Max	Noise SD	Noise Type
1	864	1,982	3.74	Air
2	834	1,969	3.26	Air
3	785	1,979	3.44	Air
4	1,043	1,997	2.99	Air
5	904	1,943	3.87	Air
6	1,028	1,997	3.12	Air

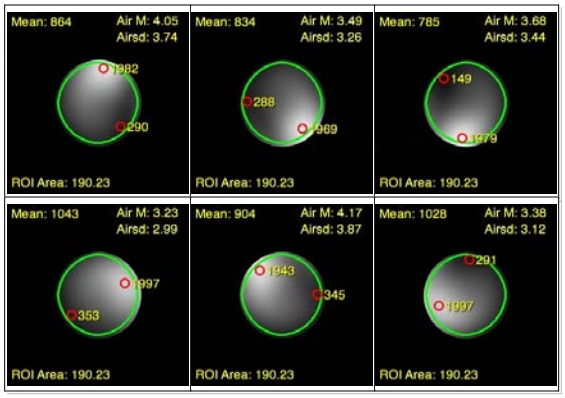
Calculated Results

Mean SNR	% of Mean	Max SNR	% of Max
151.4	66%	347.3	79%
167.6	73%	395.8	90%
149.5	65%	377.0	86%
228.6	100%	437.7	100%
153.1	67%	329.0	75%
215.9	94%	419.4	96%



Composites

Channel 1 Channel 2 Channel 3



Channel 4 Channel 5 Channel 6

RF Coil Performance Evaluation

Coil: Neurovascular Array
Mfg.: Invivo
Mfg. Date: 12/1/2006 Coil ID: 1706
Phantom: Invivo NVA Phantom

Test Date: 6/1/2008
Model: 4522 132 31721
Revision:
SN: 0000231
# of Channels 16

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	S	53	256	256	28.04	1	3	-

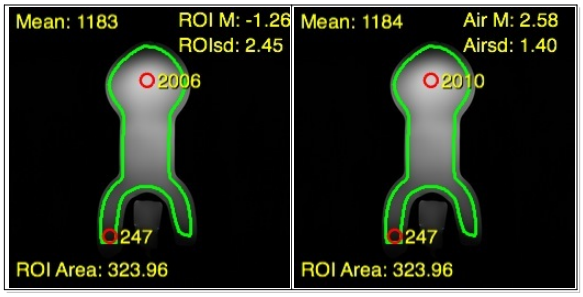
Coil Mode: b SENSE-NV-16 All Channels 1-8

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	1,183	2,006	247	-1.3	2.45	NEMA	341.5	146.7	579.0	21.9%
A	1,184	2,010	247	2.6	1.40	Air	554.2	238.1	940.8	21.9%

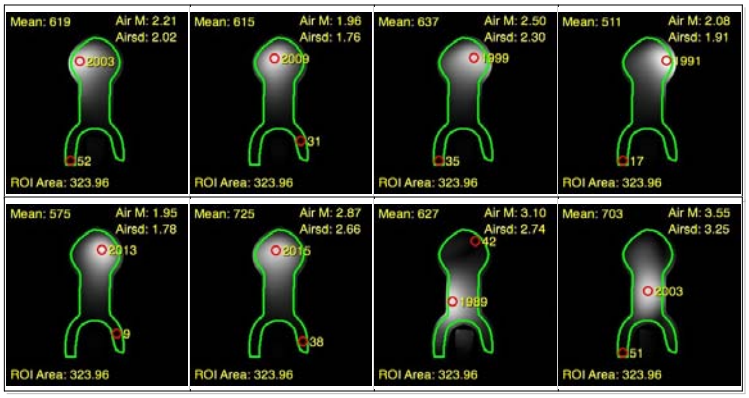
Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	619	2,003	2.02	Air	200.8	88%	649.8	87%
2	615	2,009	1.76	Air	229.0	100%	748.0	100%
3	637	1,999	2.30	Air	181.5	79%	569.5	76%
4	511	1,991	1.91	Air	175.3	77%	683.1	91%
5	575	2,013	1.78	Air	211.7	92%	741.1	99%
6	725	2,015	2.66	Air	178.6	78%	496.4	66%
7	627	1,989	2.74	Air	150.0	65%	475.7	64%
8	703	2,003	3.25	Air	141.7	62%	403.9	54%



Composites

Channel 1 Channel 2 Channel 3 Channel 4



Channel 5 Channel 6 Channel 7 Channel 8

RF Coil Performance Evaluation

Coil: Neurovascular Array
Mfg.: Invivo
Mfg. Date: 12/1/2006 Coil ID: 1706
Phantom: Invivo NVA Phantom

Test Date: 6/1/2008
Model: 4522 132 31721
Revision:
SN: 0000231
# of Channels 16

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	S	53	256	256	28.04	1	3	-

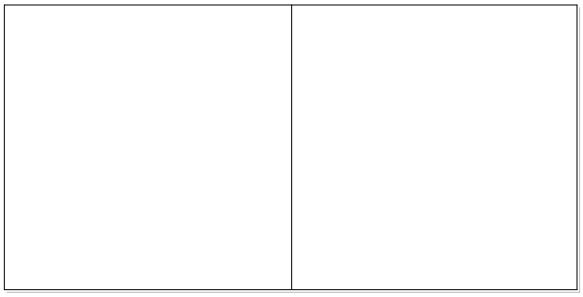
Coil Mode: c SENSE-NV-16 All Channels 9-16

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
								0.0		
								0.0		

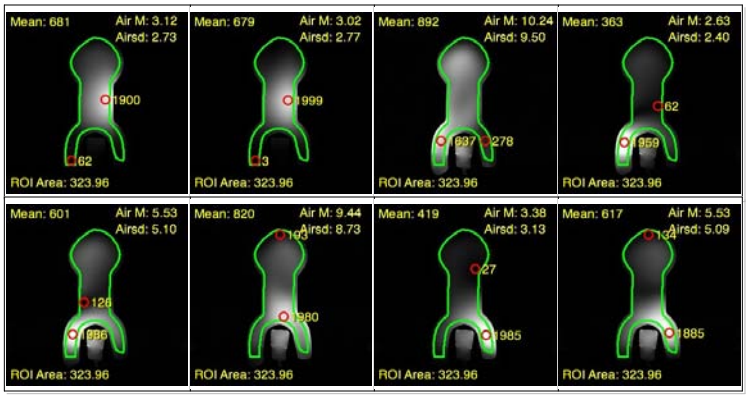
Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
9	681	1,900	2.73	Air	163.5	100%	456.1	85%
10	679	1,999	2.77	Air	160.6	98%	472.9	88%
11	892	1,637	9.50	Air	61.5	38%	112.9	21%
12	363	1,959	2.40	Air	99.1	61%	534.9	100%
13	601	1,986	5.10	Air	77.2	47%	255.2	48%
14	820	1,980	8.73	Air	61.6	38%	148.6	28%
15	419	1,985	3.13	Air	87.7	54%	415.6	78%
16	617	1,885	5.09	Air	79.4	49%	242.7	45%



Composites

Channel 1 Channel 2 Channel 3 Channel 4



Channel 5 Channel 6 Channel 7 Channel 8

RF Coil Performance Evaluation

Coil: Neurovascular Array
Mfg.: Invivo
Mfg. Date: 12/1/2006 Coil ID: 1706
Phantom: Invivo NVA Phantom

Test Date: 6/1/2008
Model: 4522 132 31721
Revision:
SN: 0000231
# of Channels 16

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	C	53	256	256	28.01	1	3	-

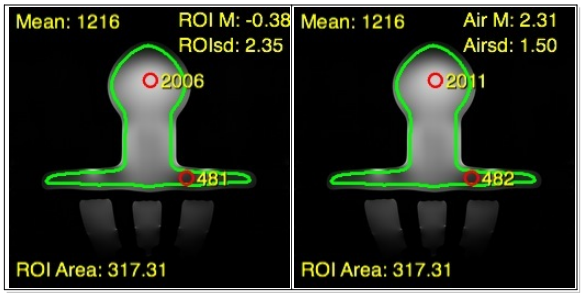
Coil Mode: d SENSE-NV-16 All Channels 1-8

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	1,216	2,006	481	-0.4	2.35	NEMA	365.9	157.1	603.7	38.7%
A	1,216	2,011	482	2.3	1.50	Air	531.2	228.1	878.5	38.7%

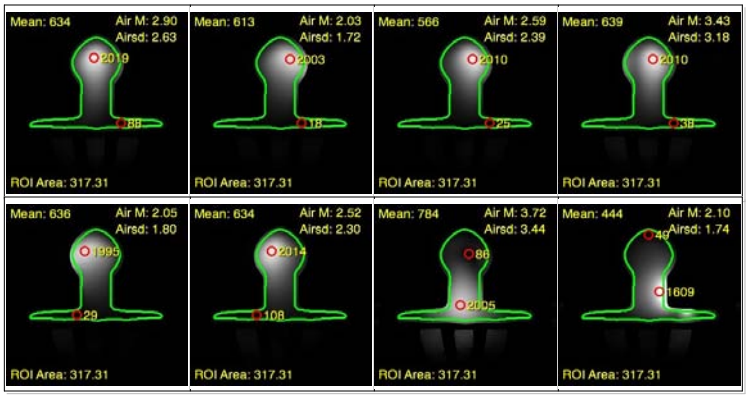
Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	634	2,019	2.63	Air	158.0	68%	503.1	66%
2	613	2,003	1.72	Air	233.5	100%	763.1	100%
3	566	2,010	2.39	Air	155.2	66%	551.1	72%
4	639	2,010	3.18	Air	131.7	56%	414.2	54%
5	636	1,995	1.80	Air	231.5	99%	726.3	95%
6	634	2,014	2.30	Air	180.6	77%	573.8	75%
7	784	2,005	3.44	Air	149.3	64%	381.9	50%
8	444	1,609	1.74	Air	167.2	72%	606.0	79%



Composites

Channel 1 Channel 2 Channel 3 Channel 4



Channel 5 Channel 6 Channel 7 Channel 8

RF Coil Performance Evaluation

Coil: Neurovascular Array
Mfg.: Invivo
Mfg. Date: 12/1/2006 Coil ID: 1706
Phantom: Invivo NVA Phantom

Test Date: 6/1/2008
Model: 4522 132 31721
Revision:
SN: 0000231
# of Channels 16

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	C	53	256	256	28.01	1	3	-

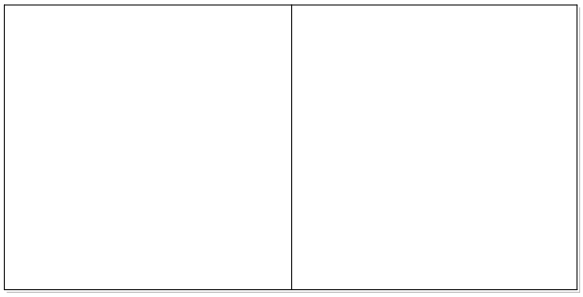
Coil Mode: e SENSE-NV-16 All Channels 9-16

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
								0.0		
								0.0		

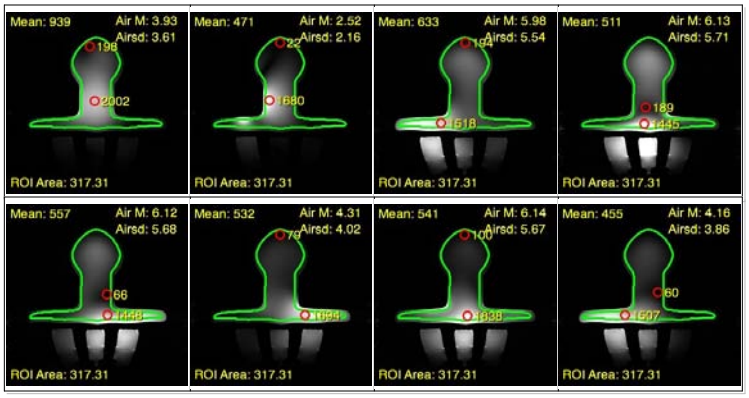
Analysis of Uncombined Images

Measured Data					Calculated Results			
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max
1	939	2,002	3.61	Air	170.5	100%	363.4	71%
2	471	1,680	2.16	Air	142.9	84%	509.7	100%
3	633	1,518	5.54	Air	74.9	44%	179.6	35%
4	511	1,445	5.71	Air	58.6	34%	165.8	33%
5	557	1,448	5.68	Air	64.3	38%	167.1	33%
6	532	1,694	4.02	Air	86.7	51%	276.1	54%
7	541	1,838	5.67	Air	62.5	37%	212.4	42%
8	455	1,507	3.86	Air	77.2	45%	255.8	50%



Composites

Channel 1 Channel 2 Channel 3 Channel 4



Channel 5 Channel 6 Channel 7 Channel 8

RF Coil Performance Evaluation

Coil: Torso SENSE
Mfg.: USAI
Mfg. Date: _____ Coil ID: 1710
Phantom: Large Body Disk

Test Date: 6/1/2008
Model: 100372
Revision: 1
SN: 634
# of Channels 6

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	53	256	256	28.04	1	3	-

Coil Mode: SENSE-Torso (Phase A/P)

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Background	Noise SD	Noise Type
N	1,501	1,767	1,196	1.4	3.62	NEMA
A	1,500	1,767	1,195	4.4	3.00	Air

Calculated Results

Mean SNR	Normalized	Max SNR	Uniformity
293.2	126.0	345.2	80.7%
327.7	140.7	386.0	80.7%

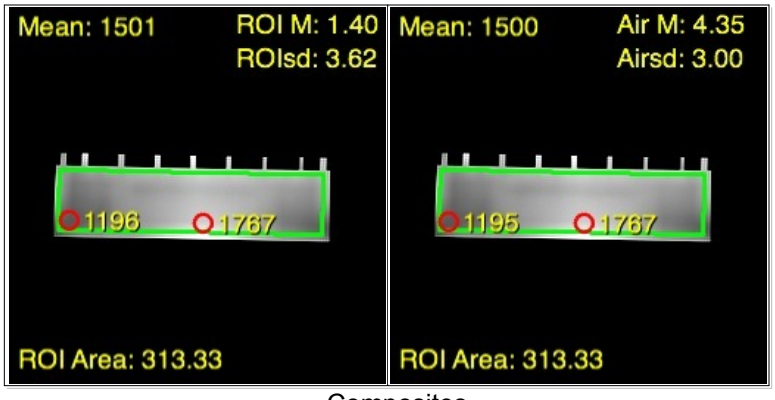
Analysis of Uncombined Images

Measured Data

Ch	Mean	Max	Noise SD	Noise Type
1	288	1,574	1.80	Air
2	770	1,498	4.64	Air
3	749	1,617	4.18	Air
4	338	1,593	1.86	Air
5	714	1,595	3.18	Air
6	781	1,533	3.28	Air

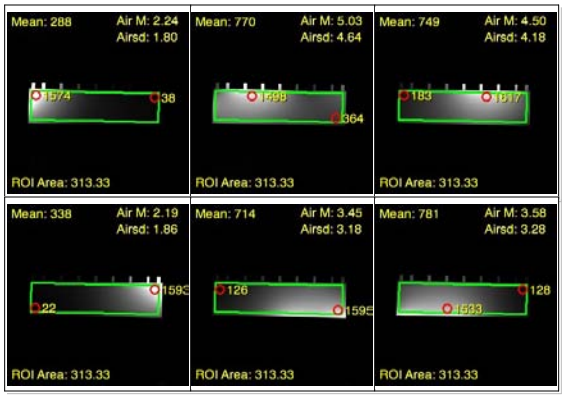
Calculated Results

Mean SNR	% of Mean	Max SNR	% of Max
104.8	67%	573.0	100%
108.7	70%	211.6	37%
117.4	75%	253.5	44%
119.1	76%	561.2	98%
147.1	94%	328.7	57%
156.0	100%	306.3	53%



Composites

Channel 1 Channel 2 Channel 3



Channel 4 Channel 5 Channel 6

RF Coil Performance Evaluation

Coil: Torso SENSE

Mfg.: USAI

Mfg. Date: _____ Coil ID: 1710

Phantom: Large Body Disk

Test Date: 6/1/2008

Model: 100372

Revision: 1

SN: 634

# of Channels 6

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	53	256	256	28.04	2	3	-

Coil Mode: SENSE-Torso (phase L/R & NPW)

Analysis of Composite Image

Measured Data

Label	Mean	Max	Min	Background	Noise SD	Noise Type
N	1,556	1,836	1,241	-1.3	2.69	NEMA
A	1,558	1,839	1,242	2.8	1.69	Air

Calculated Results

Mean SNR	Normal-ized	Max SNR	Uni-formity
409.1	124.3	482.7	80.7%
604.1	183.5	713.1	80.6%

Analysis of Uncombined Images

Measured Data

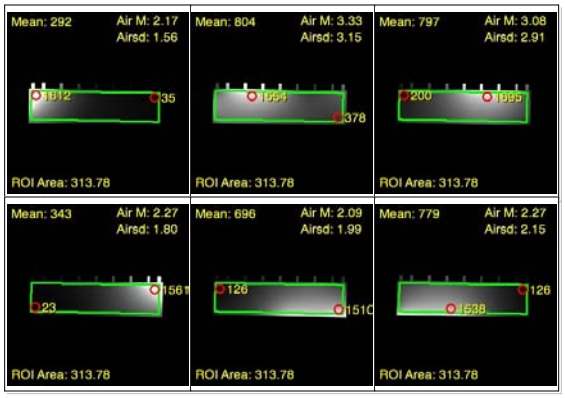
Ch	Mean	Max	Noise SD	Noise Type
1	292	1,612	1.56	Air
2	804	1,554	3.15	Air
3	797	1,695	2.91	Air
4	343	1,561	1.80	Air
5	696	1,510	1.99	Air
6	779	1,538	2.15	Air

Calculated Results

Mean SNR	% of Mean	Max SNR	% of Max
122.7	52%	677.2	100%
167.3	70%	323.3	48%
179.5	76%	381.7	56%
124.9	53%	568.3	84%
229.2	97%	497.2	73%
237.4	100%	468.8	69%

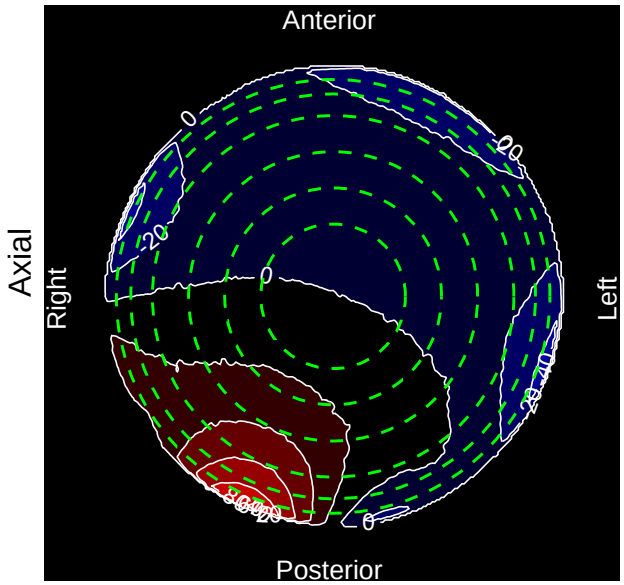
Composites

Channel 1 Channel 2 Channel 3



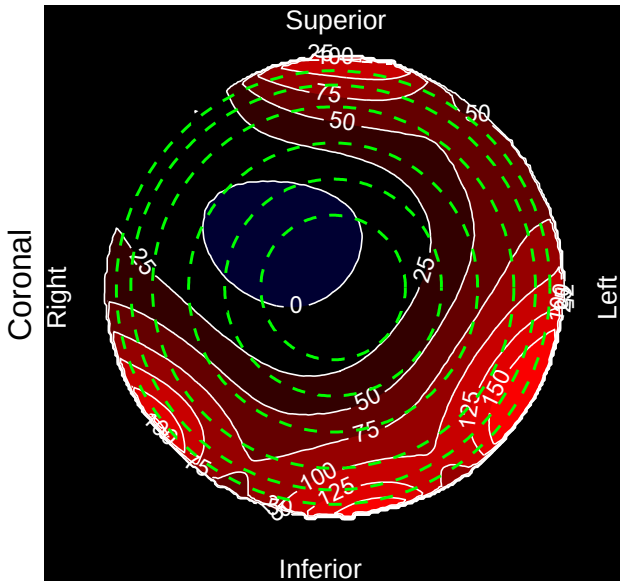
Channel 4 Channel 5 Channel 6

Appendix A: Magnet Homogeneity Field Maps
Philips Achieva - 3 central planes
Measured June 2nd, 2008



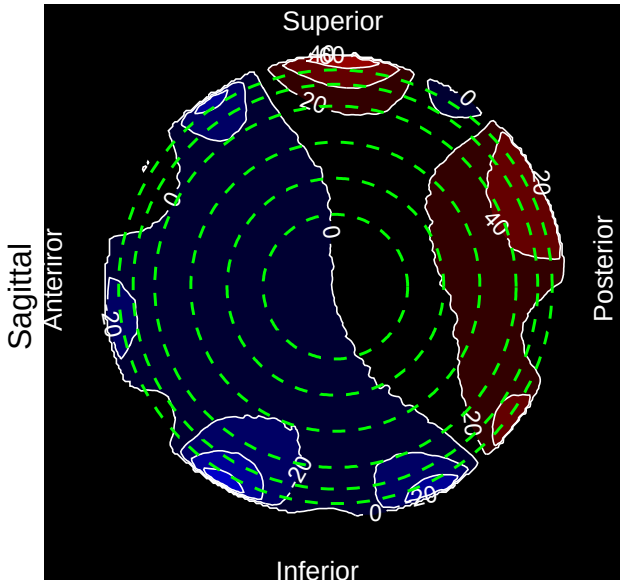
Axial

DIAMETER	MIN	MAX	RANGE	PPM	MEAN	STDEV
10	-6	15	22	0.2	1.2	5.3
15	-9	25	34	0.3	1.8	8.1
20	-11	38	50	0.4	2.2	11.0
25	-21	58	79	0.6	2.2	14.5
28	-32	75	107	0.8	1.6	17.2
30	-43	88	132	1.0	1.0	19.4



Coronal

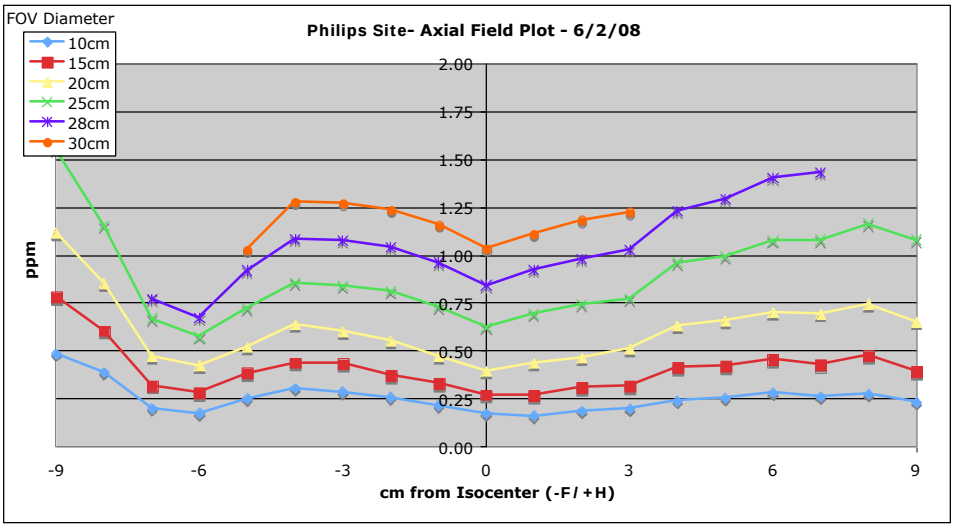
DIAMETER	MIN	MAX	RANGE	PPM	MEAN	STDEV
10	-11	24	35	0.3	3.1	8.8
15	-11	47	59	0.5	9.1	14.3
20	-11	84	95	0.8	19.4	22.0
25	-11	130	142	1.1	32.6	31.0
28	-11	165	177	1.4	41.1	36.5
30	-11	192	203	1.6	46.6	40.5

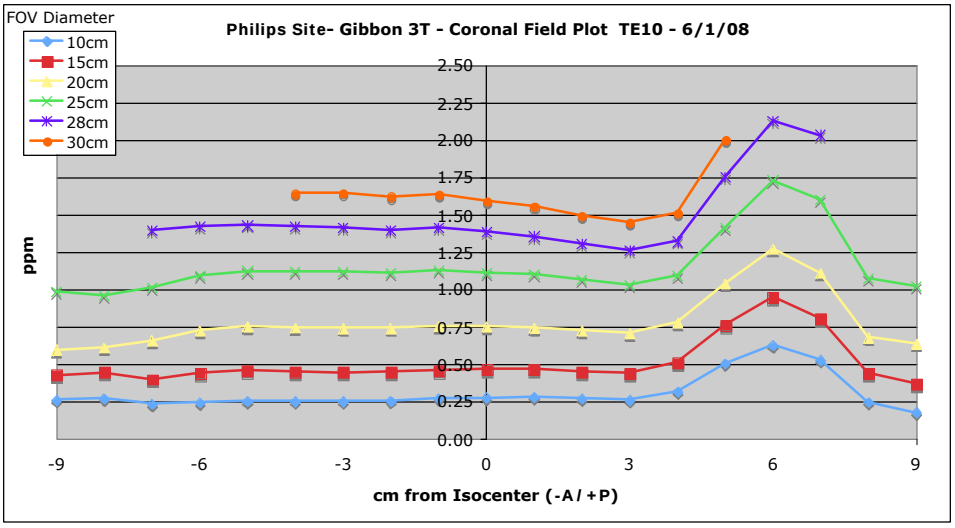


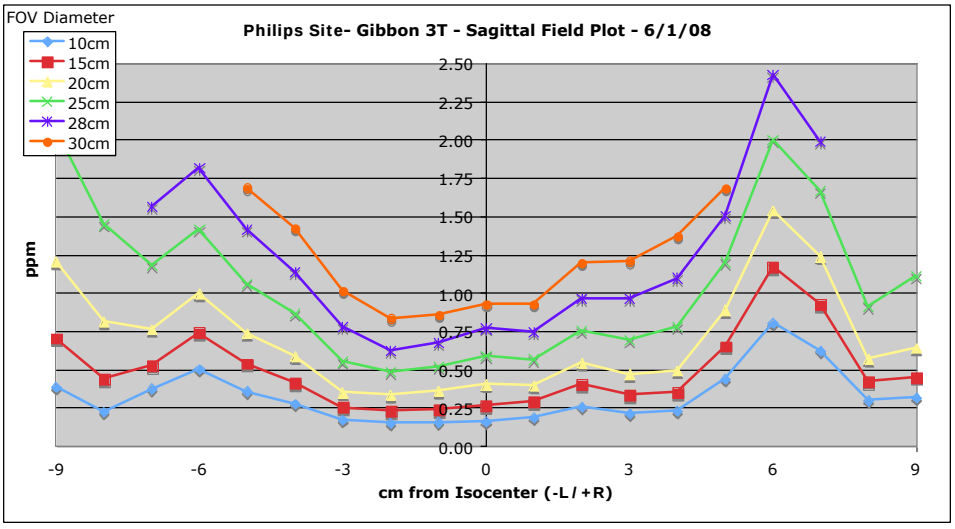
Sagittal

DIAMETER	MIN	MAX	RANGE	PPM	MEAN	STDEV
10	-7	13	20	0.2	0.7	5.3
15	-11	21	33	0.3	1.0	8.0
20	-19	31	51	0.4	1.4	10.9
25	-32	43	75	0.6	1.9	14.2
28	-47	50	97	0.8	2.2	16.6
30	-62	56	118	0.9	2.4	18.7

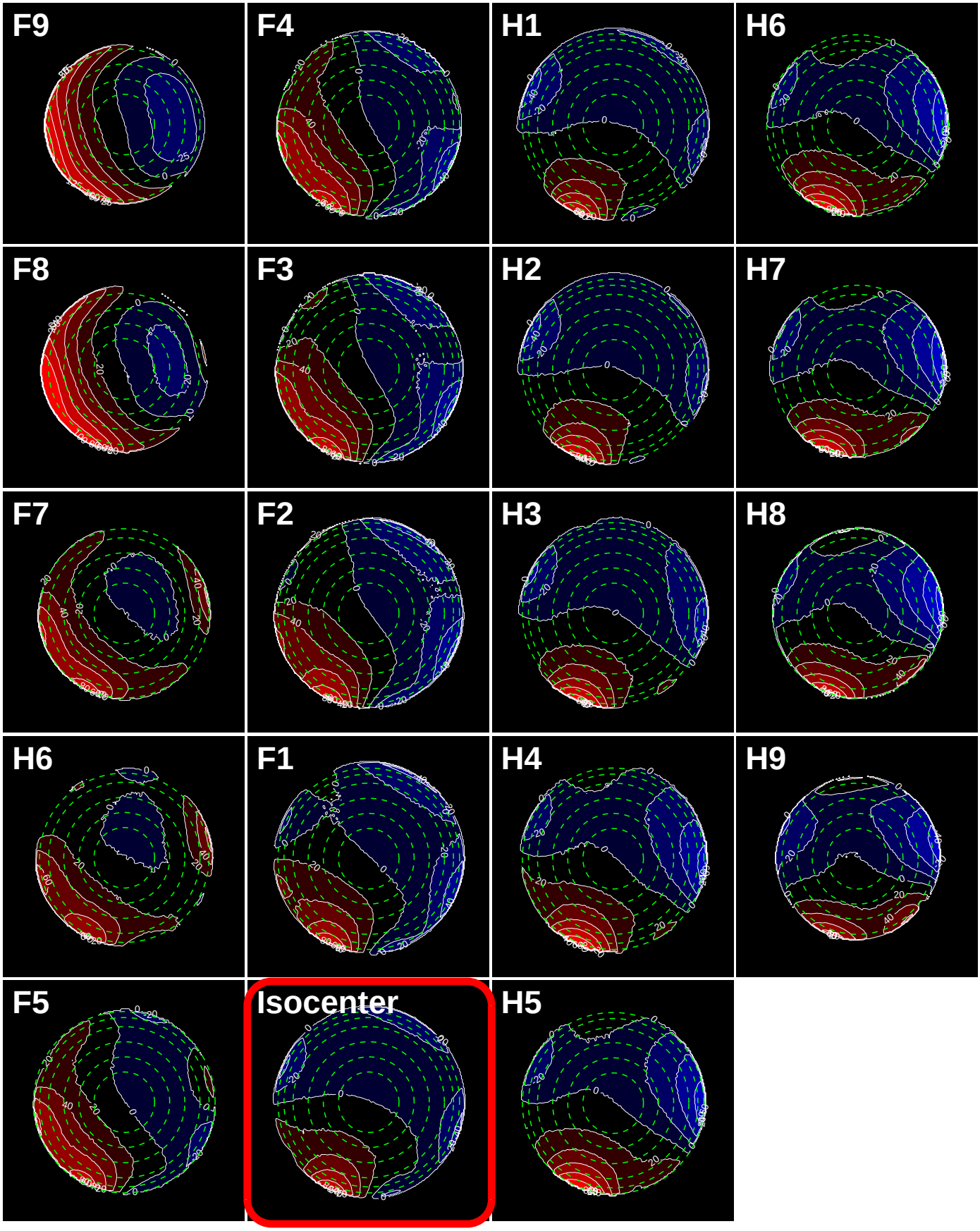
Appendix A: Magnet Homogeneity Field Maps
Philips Achieva
Measured June 2nd, 2008



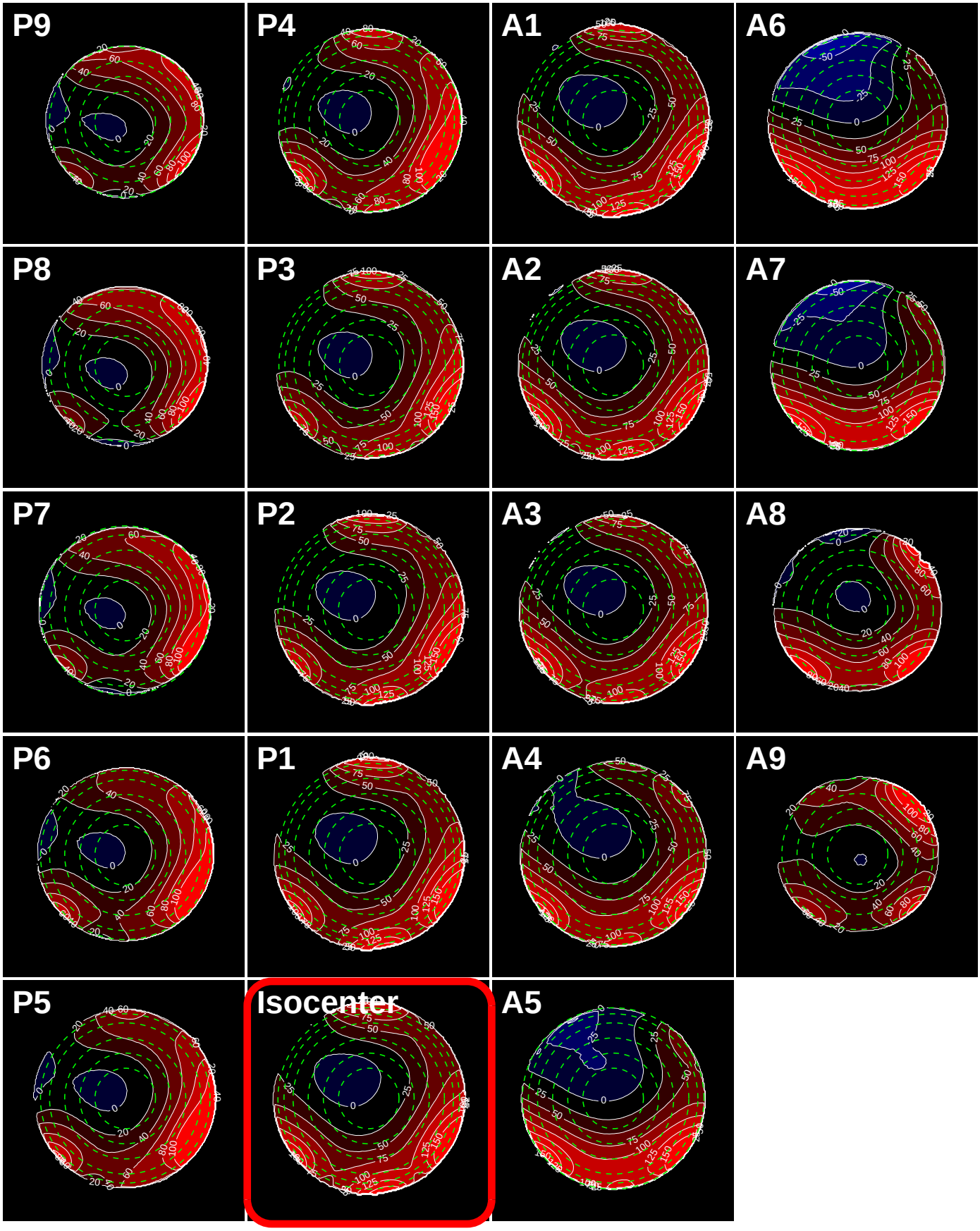




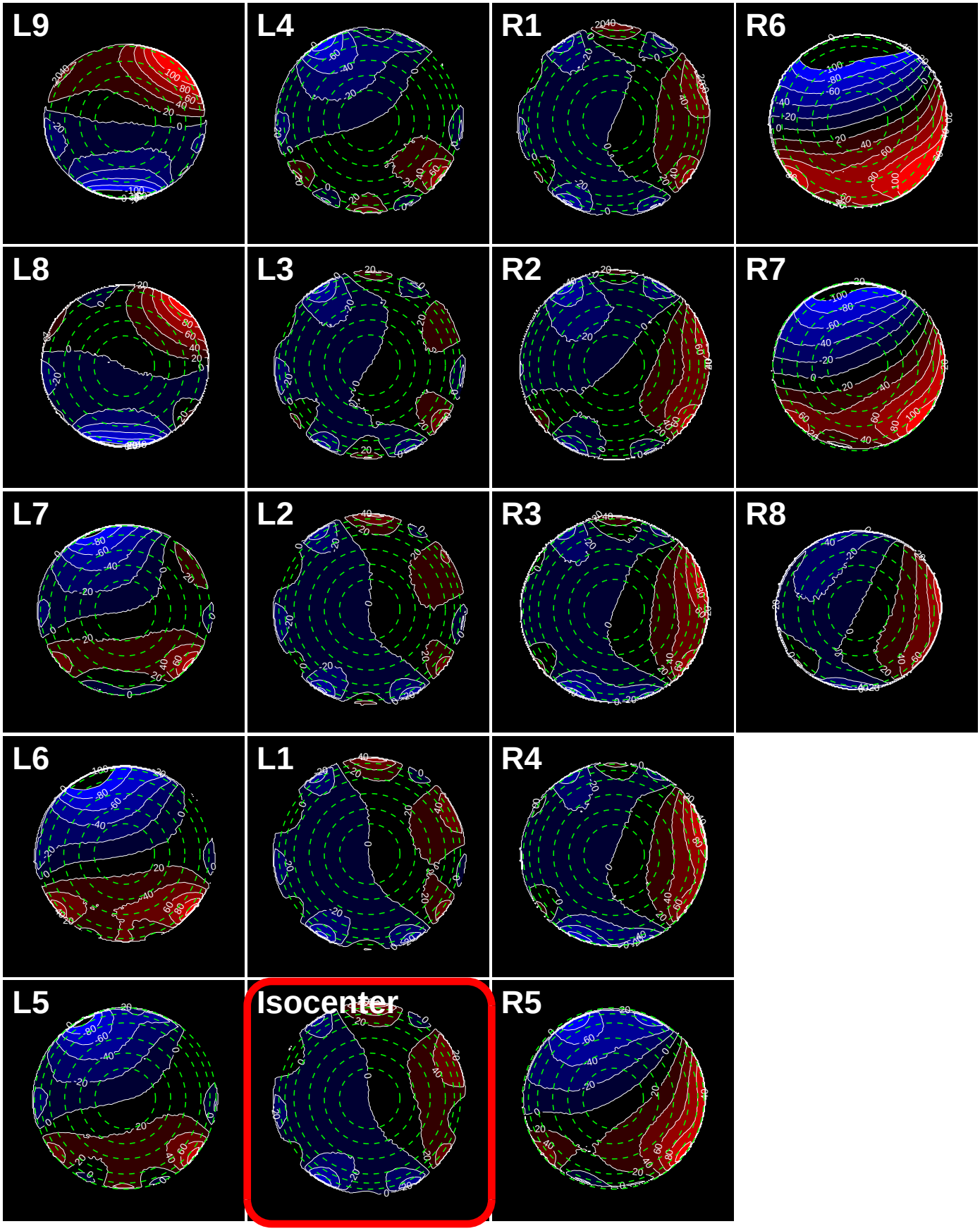
Axial Field Plots



Coronal Field Plots

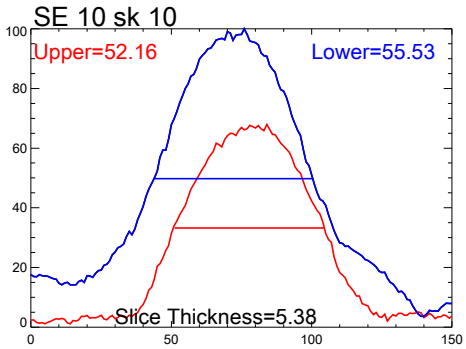


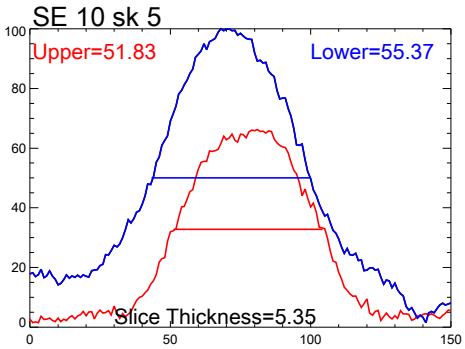
Sagittal Field Plots

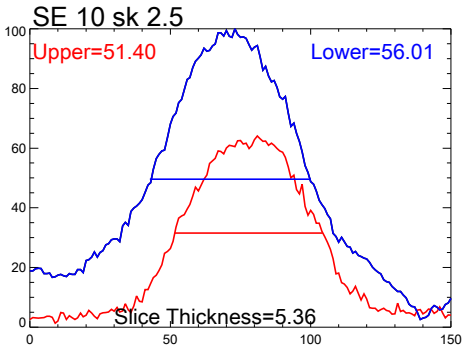


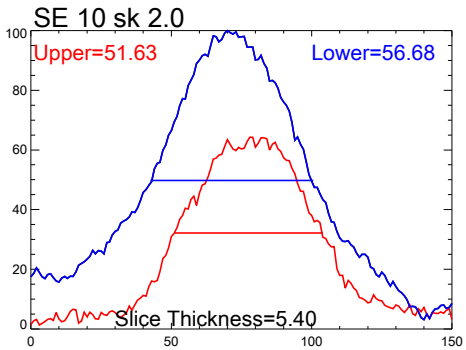
Appendix B: RF Slice Profiles and Crosstalk

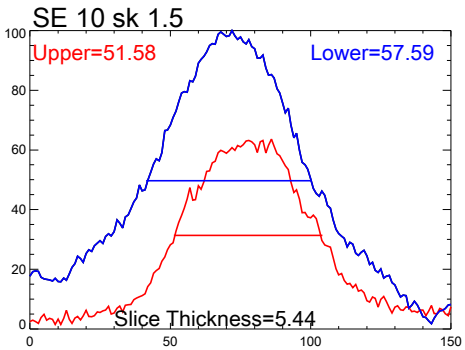
Spin Echo
TR/TE: 450/10
Flip Angle: 90°
BW = 20.93 KHz
nex = 1
Scan time: 1:56

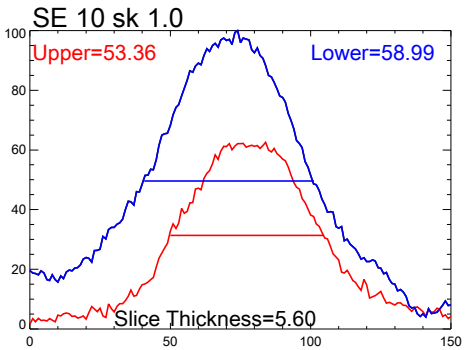


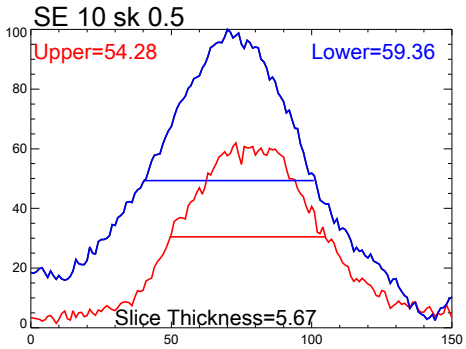


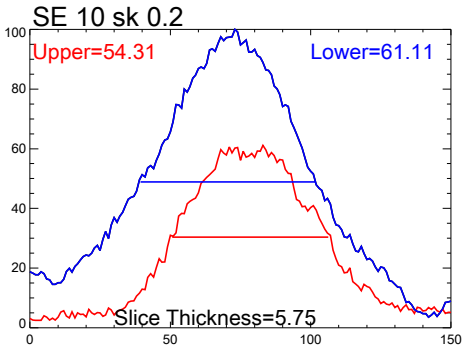


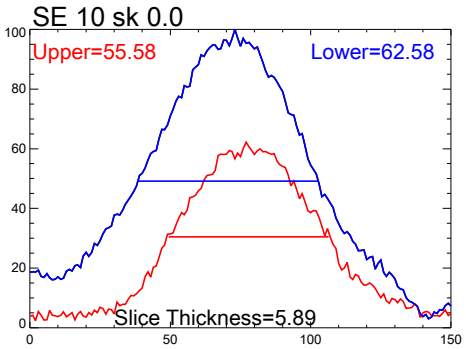


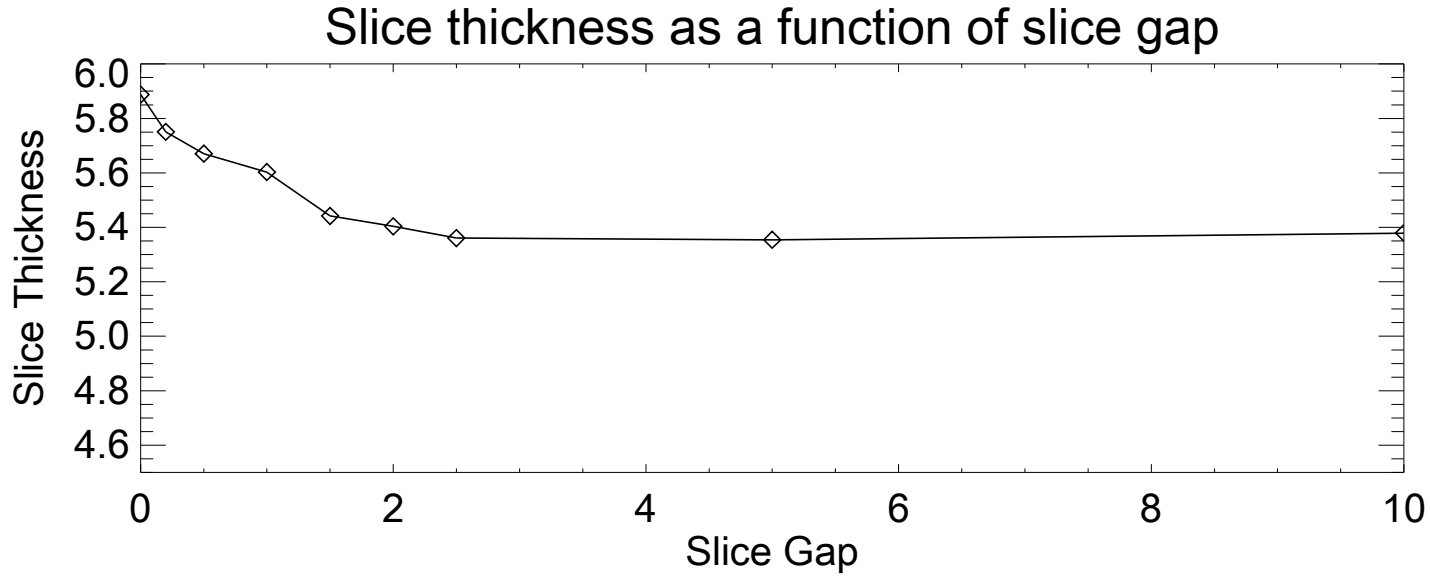












Philips Site **JHN 3T**

Coil Used: **Head T/R** Test Date: **6/2/2008**

	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 (1.10, 1.00, 0.90 mm)	1.0	1.0	1.0	1.0	1.0
3		1.0	1.0	1.0	1.0	1.0
4	Slice Thickness (fwhm in mm) Top	54.5	54.1	53.3	51.1	60.0
5	Bottom	53.4	53.6	52.7	50.4	56.2
6	Calculated value 5.0±0.7	5.39	5.38	5.30	5.07	5.80
7	Wedge (mm) = + = -	1.2	1.1	0.8	1.2	1.2
8	Diameter (mm) (190±2) ⊕	190.7	190.6	190.6	190.7	190.7
9	⊖	190.4	190.4	190.2	190.3	190.4
	Slice Location #5					
10	Diameter (mm) (190±2) ⊕	190.5	190.5	190.5	190.6	190.7
11	⊖	190.3	190.4	190.3	190.2	190.2
12	⊘	190.5	190.5	190.4	190.5	190.6
13	⊘	189.9	190.0	190.0	190.0	190.1
	Slice Location #7					
14	Signal (mean only) Big ROI	1792	1479	1507	1252	1317
15	High	1926	1730	1721	1340	1409
16	Low	1407	1199	1188	1023	1074
17	Uniformity (>87.5%)	84.4%	81.9%	81.7%	86.6%	86.5%
18	Background Noise (mean ±std dev) Top	8.3 ± 4.70	7.2 ± 4.23	6.1 ± 6.05	9.7 ± 3.65	11.3 ± 4.41
19	Bottom	7.9 ± 4.36	7.1 ± 3.94	6.1 ± 6.16	9.5 ± 3.38	12.2 ± 4.50
20	Left	9.8 ± 5.32	11.6 ± 5.65	78.8 ± 17.1	17.8 ± 7.68	17.7 ± 6.86
21	Right	8.8 ± 4.85	46.4 ± 14.5	109.5 ± 28.7	12.1 ± 4.48	18.1 ± 8.09
22	Ghosting Ratio (<2.5%)	0.1%	1.5%	5.8%	0.4%	0.5%
23	SNR (no spec)	396	362	247	356	296
	Low Con Detectability					
24	Slice Location #8 1.4%	10	10	9	9	9
25	Slice Location #9 2.5%	10	10	10	10	10
26	Slice Location #10 3.6%	10	10	10	10	10
27	Slice Location #11 5.1%	10	10	10	10	10
28	Total # of Spokes (>=9)	40	40	39	39	39
	Slice Location #11					
29	Wedge (mm) = + = -	-1.2	-1.4	-1.3	-1.2	-1.3
30	Slice Position Error	-2.4	-2.5	-2.1	-2.4	-2.5

The ACR PD/T2 sequence fails minimum image uniformity specs. Additionally, the ACR T2 has such excessive ghosting that it would be an automatic failure.

Philips Site

JHN 3T

Sequence parameters

Test Date: **6/2/2008**

Coil Used:**Head T/R**

Test ID **289**

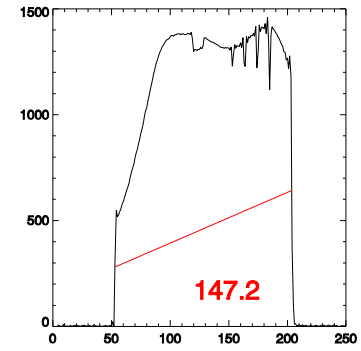
Study Description	Pulse Sequence (ETL)	TR (ms)	TE (ms)	FOV (cm)	Phase Sample Ratio	Number of Slices	Thick-ness (mm)	Slice Gap	NSA (Nex)	Freq Matrix	Phase Matrix	Band Width (kHz)	Scan Time (min:sec)
ACR T1	SE	500	20	25	1	11	5	5	1	256	256	18.53	2:09
ACR PD	Dual Echo SE	2000	20	25	1	11	5	5	1	256	256	18.53	8:32
ACR T2	Dual Echo SE	2000	80	25	1	11	5	5	1	256	256	18.53	8:32
Site T1	SE	450	10	24	1	11	5	5	1	256	255	20.93	1:55
Site T2	TSE(15	3000	80	24	1	11	5	5	2	256	255	21.7	1:42

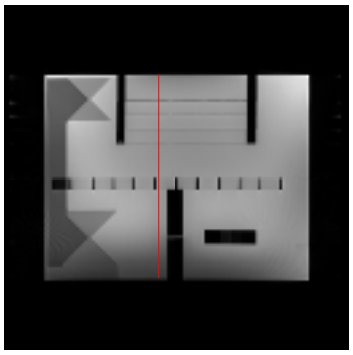
Magnet ID: **216** **Coil ID:** **1709** **TestID:** **289**

Appendix C: ACR Phantom Analysis

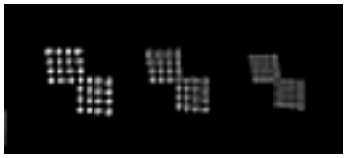
ACR T1

Sagital Length

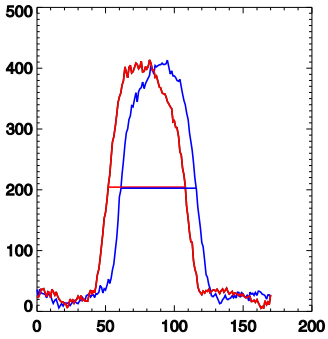




High Contrast Resolution



Slice Thickness

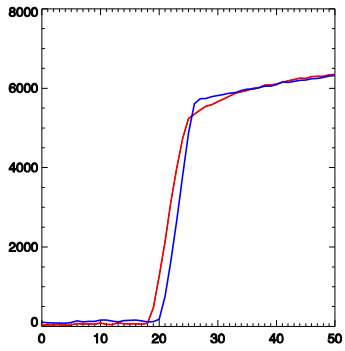


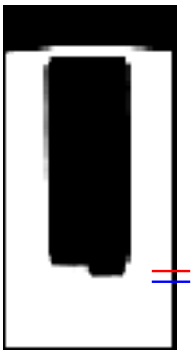
Upper=54.52

Lower=53.43

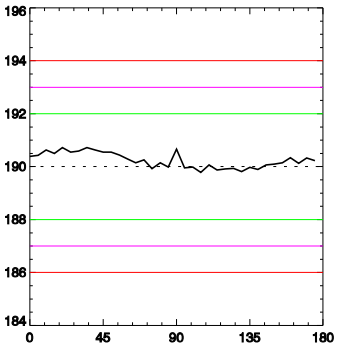
Slice Thickness=5.40

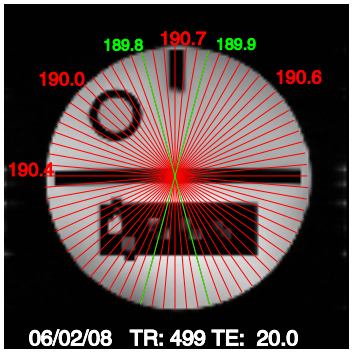
Slice Position - Inferior



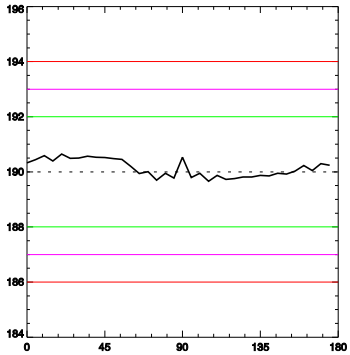


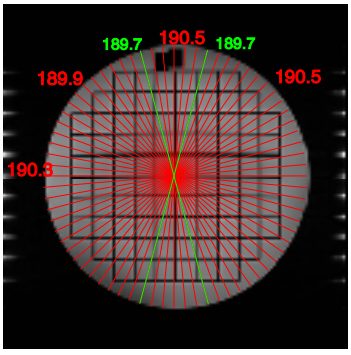
Axial Diameters - #1



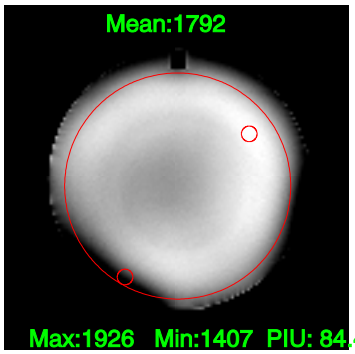


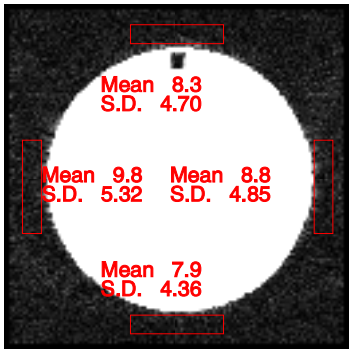
Axial Diameters - #5



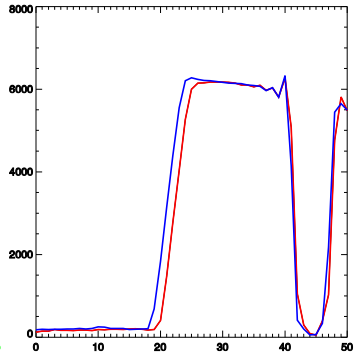


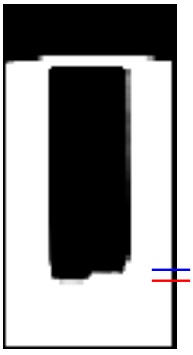
Uniformity & Ghosting - #7



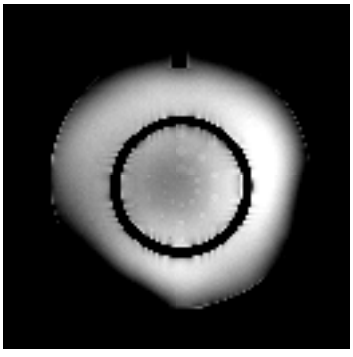


Slice Position - Superior

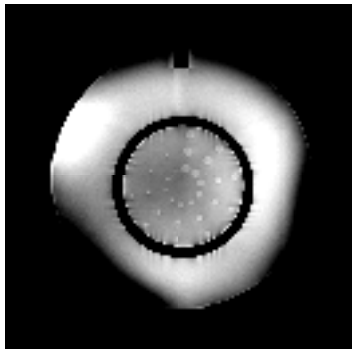




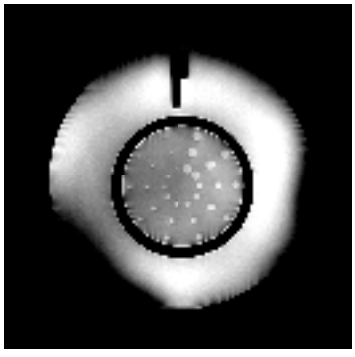
Low Contrast - #8



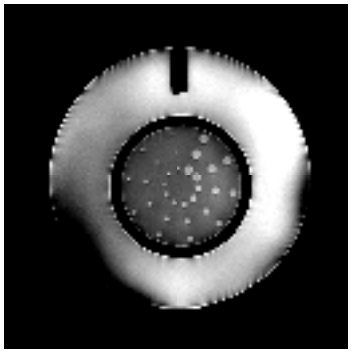
Low Contrast - #9



Low Contrast - #10



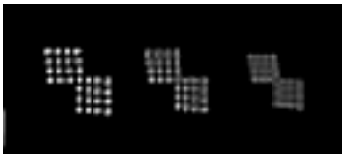
Low Contrast - #11



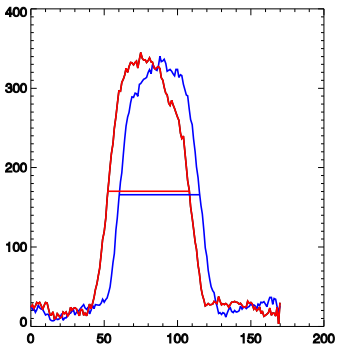
Appendix C: ACR Phantom Analysis

ACR PD

High Contrast Resolution

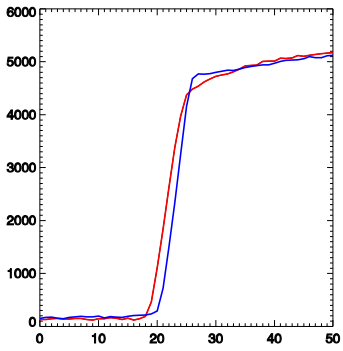


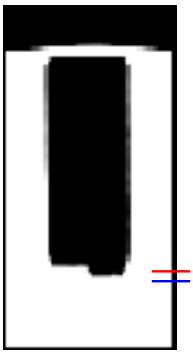
Slice Thickness



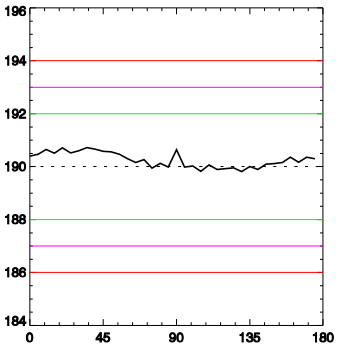
Upper=54.12
Lower=53.56
Slice Thickness=5.38

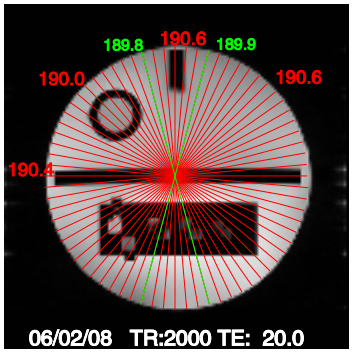
Slice Position - Inferior



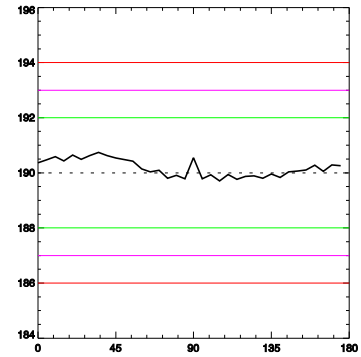


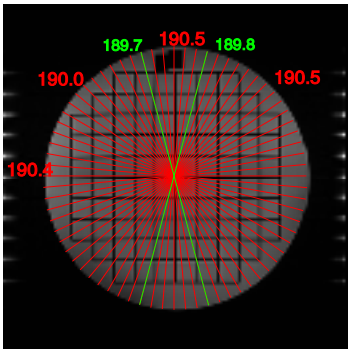
Axial Diameters - #1



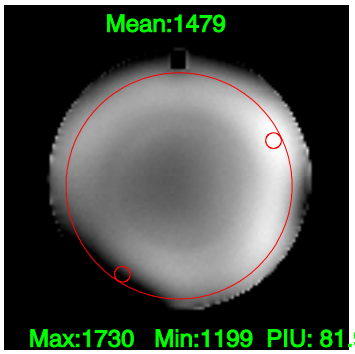


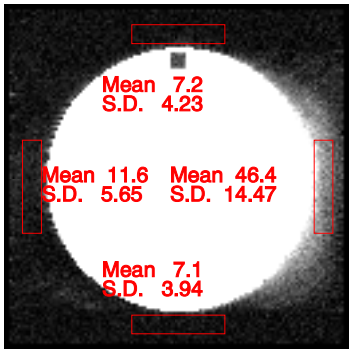
Axial Diameters - #5



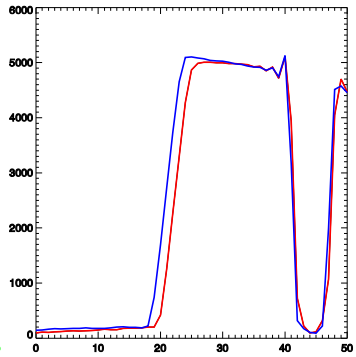


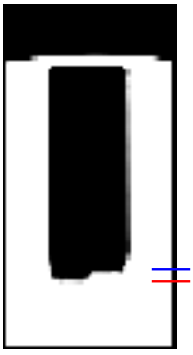
Uniformity & Ghosting - #7



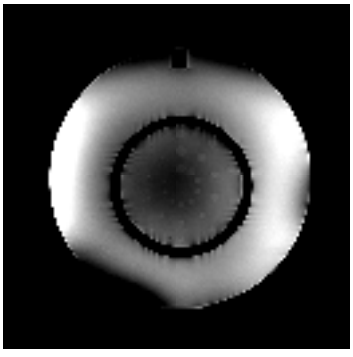


Slice Position - Superior

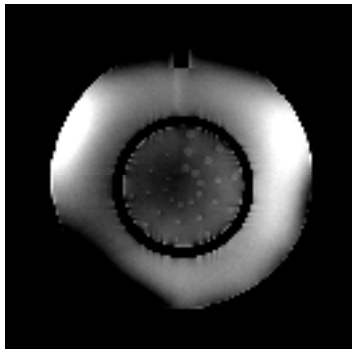




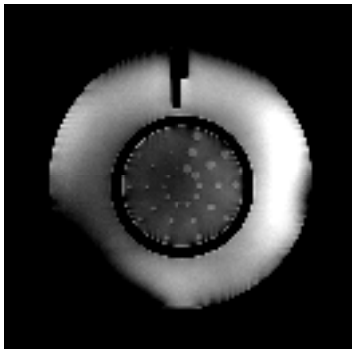
Low Contrast - #8



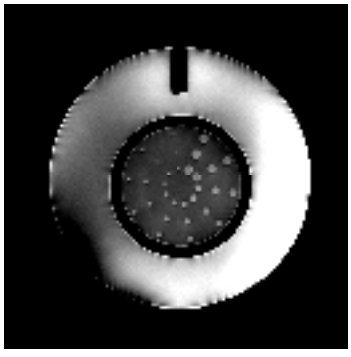
Low Contrast - #9



Low Contrast - #10



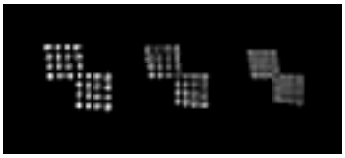
Low Contrast - #11



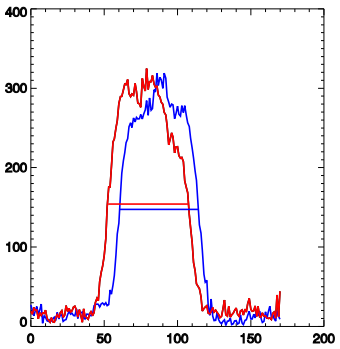
Appendix C: ACR Phantom Analysis

ACR T2

High Contrast Resolution



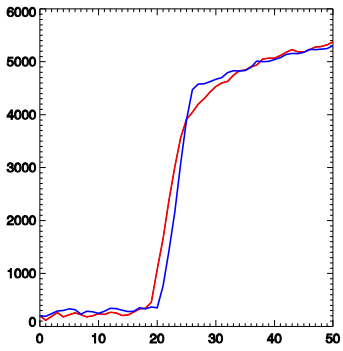
Slice Thickness

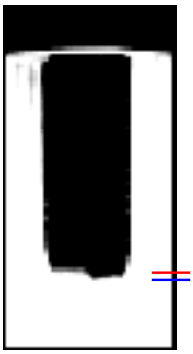


Upper=53.26
Lower=52.70
Slice Thickness=5.30

-

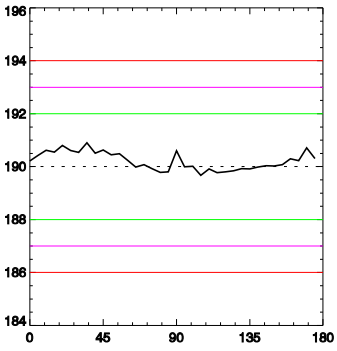
Slice Position - Inferior

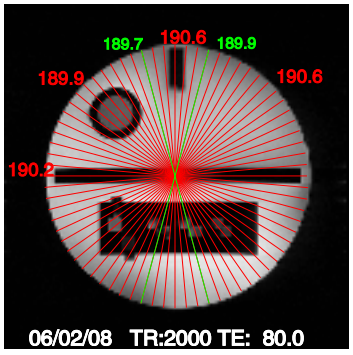




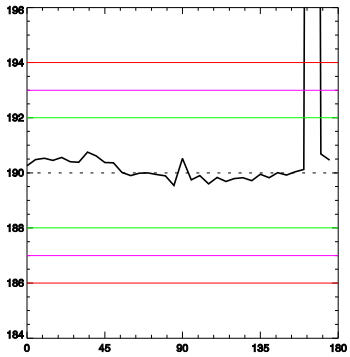
Diff.= 0.83

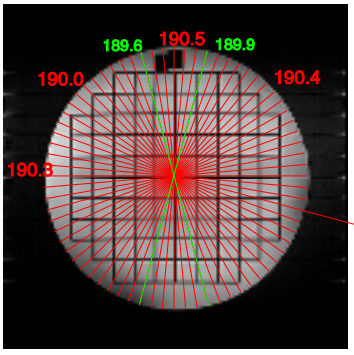
Axial Diameters - #1



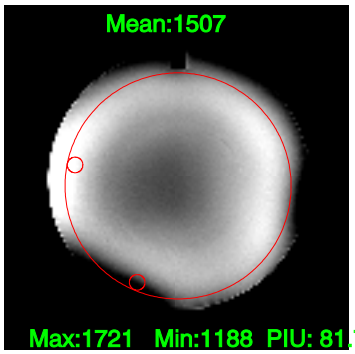


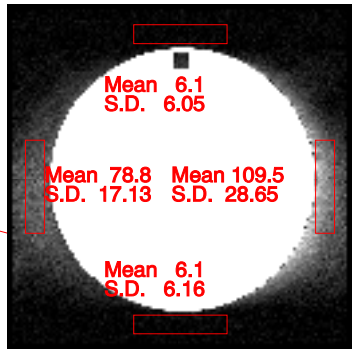
Axial Diameters - #5



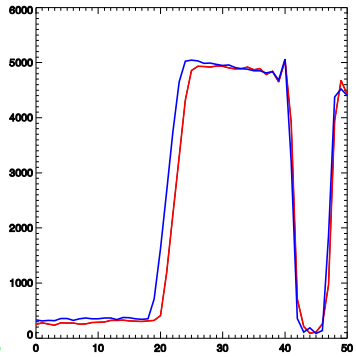


Uniformity & Ghosting - #7



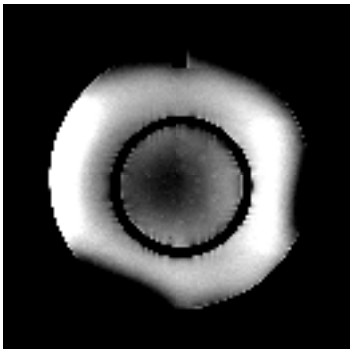


Slice Position - Superior

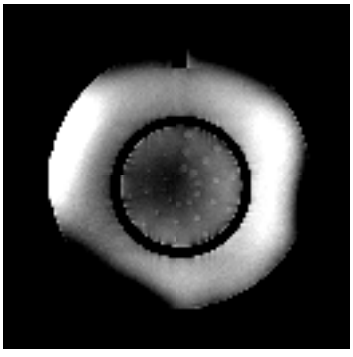


Diff.= -1.33

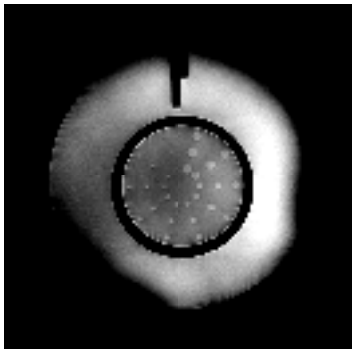
Low Contrast - #8



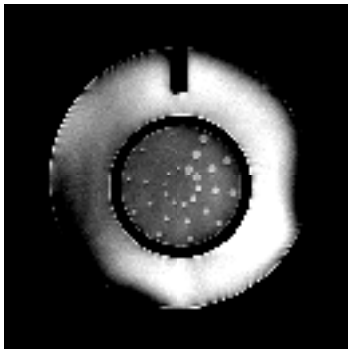
Low Contrast - #9



Low Contrast - #10



Low Contrast - #11

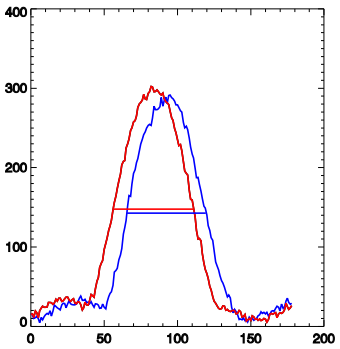


Appendix C: ACR Phantom Analysis

Site T1

High Contrast Resolution

Slice Thickness

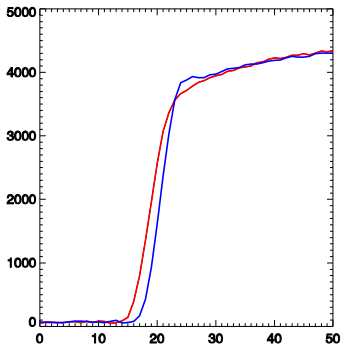


Upper=51.08

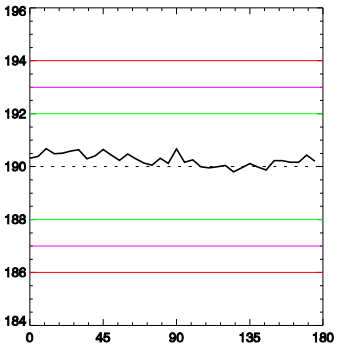
Lower=50.40

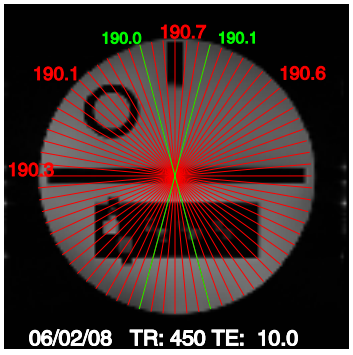
Slice Thickness=5.07

Slice Position - Inferior

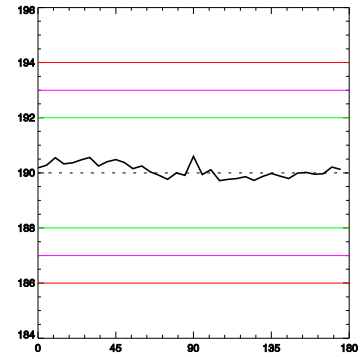


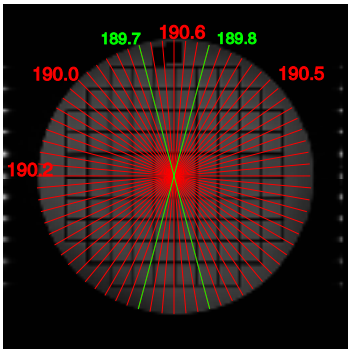
Axial Diameters - #1



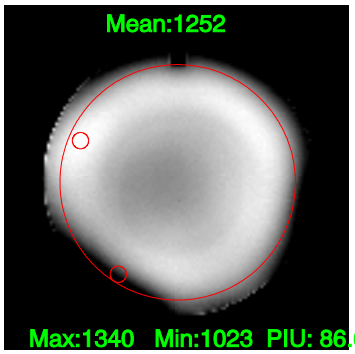


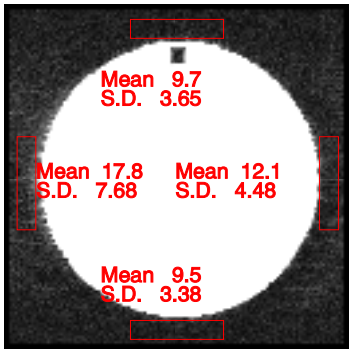
Axial Diameters - #5



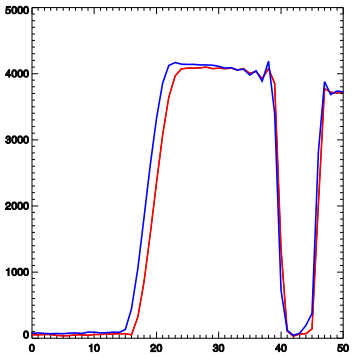


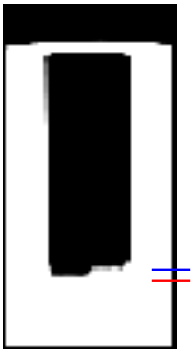
Uniformity & Ghosting - #7



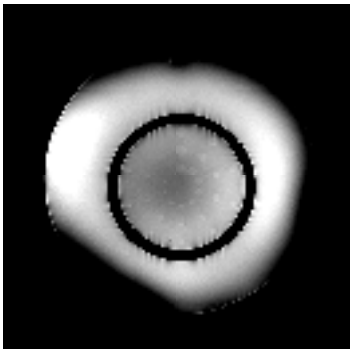


Slice Position - Superior

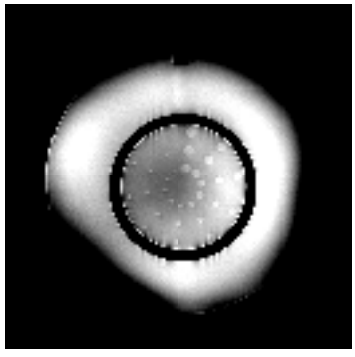




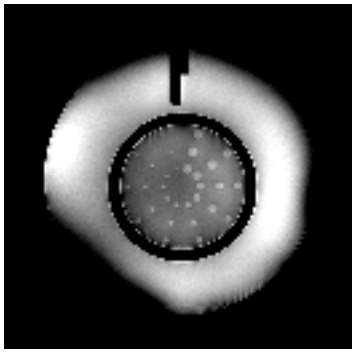
Low Contrast - #8



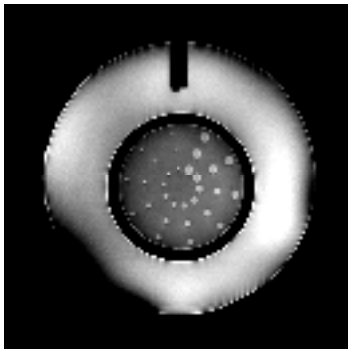
Low Contrast - #9



Low Contrast - #10



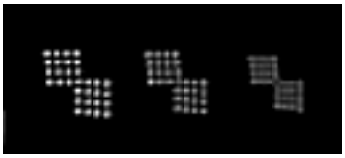
Low Contrast - #11



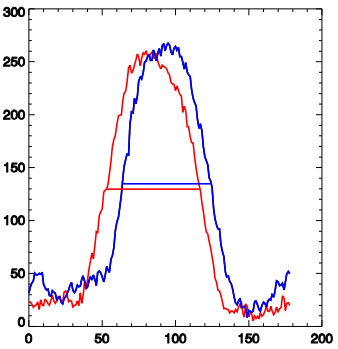
Appendix C: ACR Phantom Analysis

Site T2

High Contrast Resolution



Slice Thickness

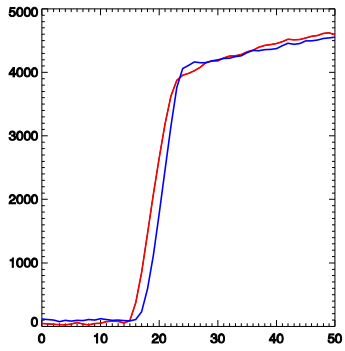


Upper=60.00

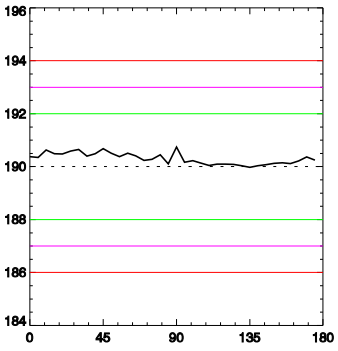
Lower=56.16

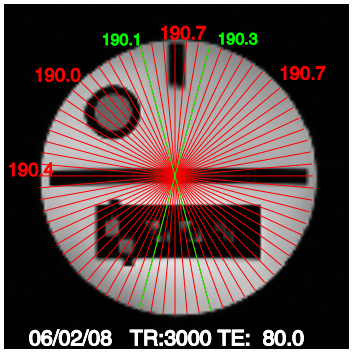
Slice Thickness=5.80

Slice Position - Inferior

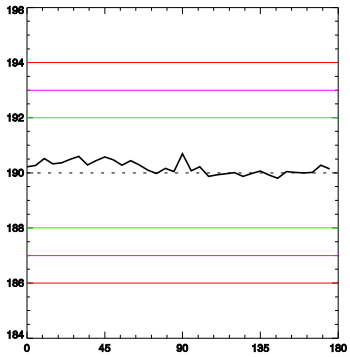


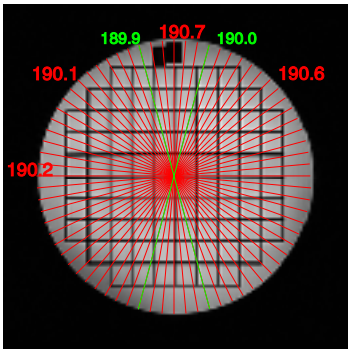
Axial Diameters - #1



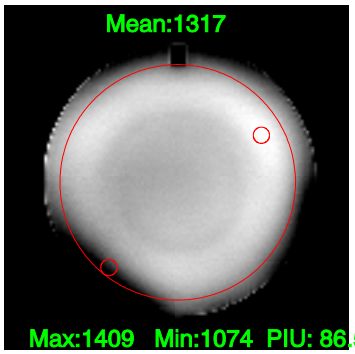


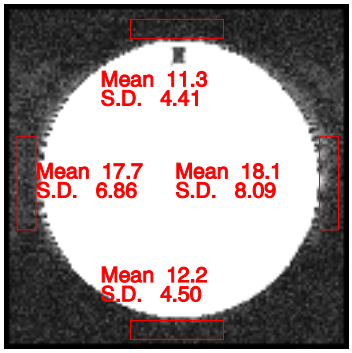
Axial Diameters - #5



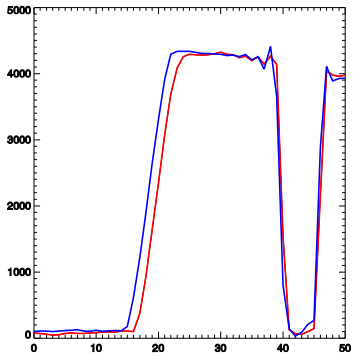


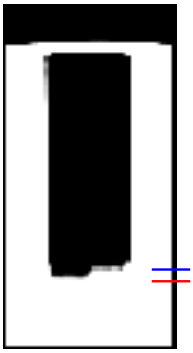
Uniformity & Ghosting - #7



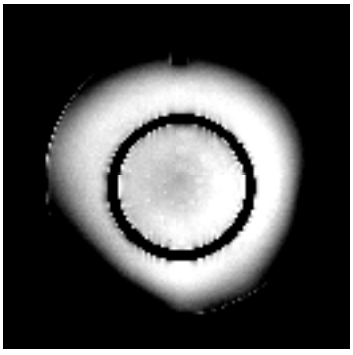


Slice Position - Superior

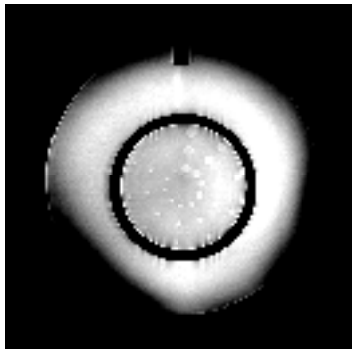




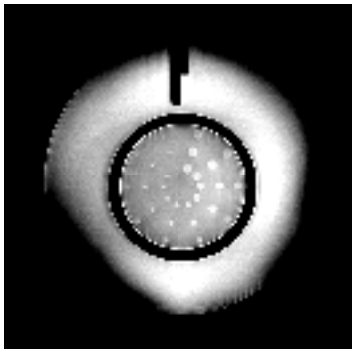
Low Contrast - #8



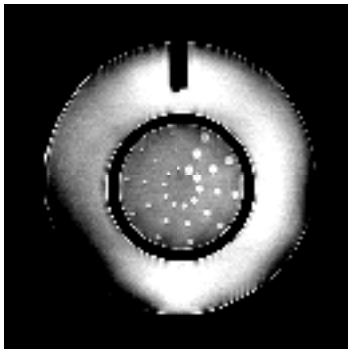
Low Contrast - #9



Low Contrast - #10



Low Contrast - #11



Philips Site **JHN 3T**

Coil Used: **Head SENSE** Test Date: **6/2/2008**

	Sagittal Locator	
1	Length of phantom, end to end (mn 148± 2)	146.4

= calculated field

		(SE 500/20)	(SE 2000/20)	(SE 2000/80)	(Site T1)	(Site T2)
	Slice Location #1	ACR T1	ACR PD	ACR T2	Site T1	Site T2
2	Resolution	1.0	1.0	1.0	1.0	1.0
3	(1.10, 1.00, 0.90 mm)	1.0	1.0	1.0	1.0	1.0
4	Slice Thickness Top	55.0	56.8	57.1	55.0	62.9
5	(fwhm in mm) Bottom	56.1	53.2	52.3	53.9	63.8
6	Calculated value 5.0±0.7	5.55	5.49	5.46	5.44	6.33
7	Wedge (mm) = + = -	2.2	2.1	1.9	2.1	2.2
8	Diameter (mm) (190±2)	190.6	190.6	190.6	190.7	190.7
9		190.6	190.6	190.6	190.4	190.5
	Slice Location #5					
10	Diameter (mm) (190±2)	190.4	190.4	190.4	190.5	190.6
11		190.5	190.5	190.5	1990.4	190.4
12		1990.6	190.6	190.7	190.7	190.8
13		189.8	189.8	189.8	189.9	189.9
	Slice Location #7					
14	Signal Big ROI	1473	1480	783	1794	1688
15	(mean only) High	1783	1793	927	2141	2016
16	Low	1282	1287	687	1577	1483
17	Uniformity (>87.5%)	83.7%	83.6%	85.1%	84.8%	84.8%
18	Background Noise Top	1.5 ± 1.56	1.6 ± 1.72	1.7 ± 1.65	2.4 ± 2.42	2.9 ± 2.54
19	Bottom	1.4 ± 1.62	1.3 ± 1.59	1.5 ± 1.56	2.5 ± 2.42	2.4 ± 2.46
20	(mean ±std dev) Left	11.1 ± 4.42	8.3 ± 3.54	8.8 ± 3.48	24.6 ± 11.3	16.2 ± 14.3
21	Right	17.6 ± 11.5	25.7 ± 14.8	34.8 ± 14.8	6.9 ± 4.01	6.6 ± 4.16
22	Ghosting Ratio (<2.5%)	0.9%	1.1%	2.6%	0.7%	0.5%
23	SNR (no spec)	926	894	488	741	675
	Low Con Detectability					
24	Slice Location #8 1.4%	10	10	10	9	9
25	Slice Location #9 2.5%	10	10	10	10	10
26	Slice Location #10 3.6%	10	10	10	10	10
27	Slice Location #11 5.1%	10	10	10	10	10
28	Total # of Spokes (>=9)	40	40	40	39	39
	Slice Location #11					
29	Wedge (mm) = + = -	-1.2	-1.3	-1.3	-1.2	-1.3
30	Slice Position Error	-3.4	-3.4	-3.2	-3.3	-3.5

When using this Head SENSE coil, all of the images pass the image uniformity requirement. The ACR T2 image DOES have excessive ghosting, not quite enough to fail the ACR requirements but way more than expected.

Philips Site

JHN 3T

Sequence parameters

Test Date: **6/2/2008**

Coil Used:**Head SENSE**

Test ID **290**

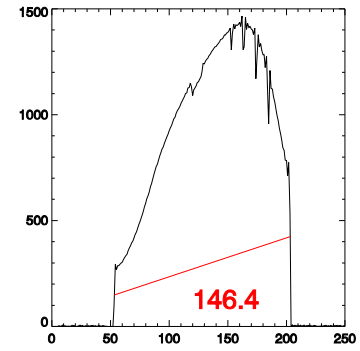
Study Description	Pulse Sequence (ETL)	TR (ms)	TE (ms)	FOV (cm)	Phase Sample Ratio	Number of Slices	Thick-ness (mm)	Slice Gap	NSA (Nex)	Freq Matrix	Phase Matrix	Band Width (kHz)	Scan Time (min:sec)
ACR T1	SE	500	20	25	1	11	5	5	1	256	256	18.53	2:09
ACR PD	Dual Echo SE	2000	20	25	1	11	5	5	1	256	256	18.53	8:32
ACR T2	Dual Echo SE	2000	80	25	1	11	5	5	1	256	256	18.53	8:32
Site T1	SE	450	14	24	1	11	5	5	1	256	256	26.5	1:55
Site T2	TSE(15)	3000	80	24	1	11	5	5	2	256	256	24.51	1:42

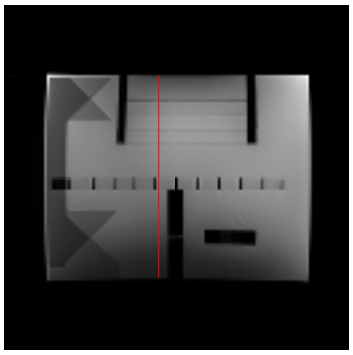
Magnet ID: **216** **Coil ID:** **1716** **TestID:** **290**

Appendix C: ACR Phantom Analysis

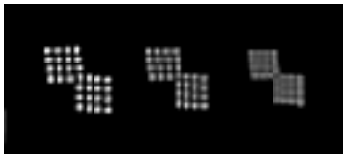
ACR T1

Sagital Length

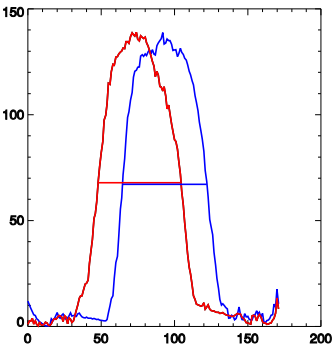




High Contrast Resolution

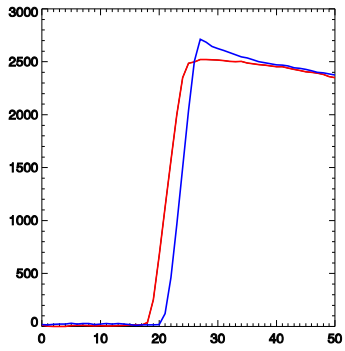


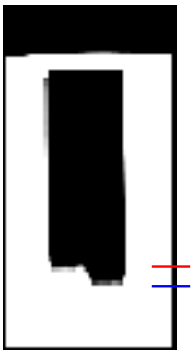
Slice Thickness



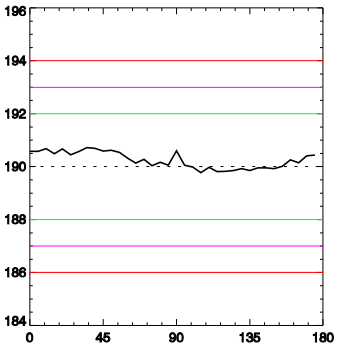
Upper=55.04
Lower=56.12
Slice Thickness=5.56

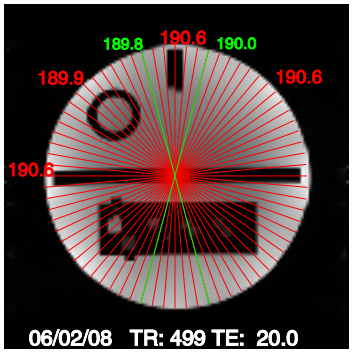
Slice Position - Inferior



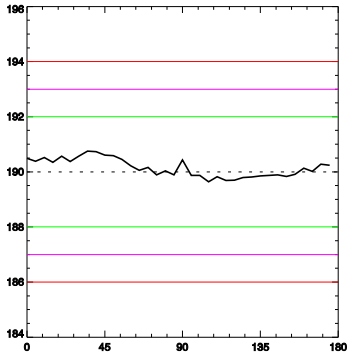


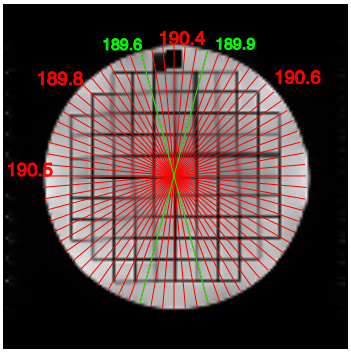
Axial Diameters - #1



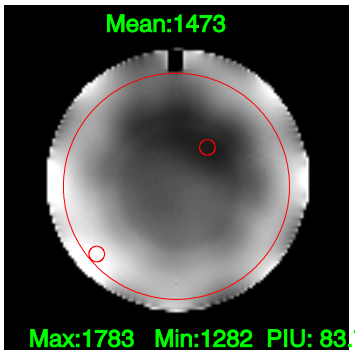


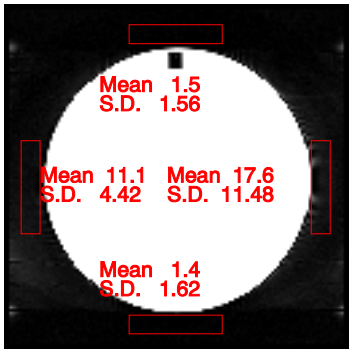
Axial Diameters - #5



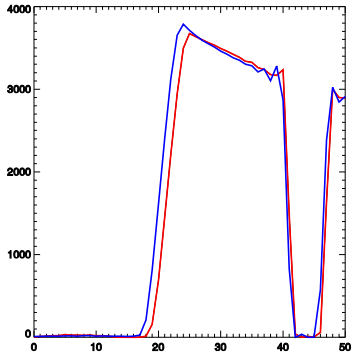


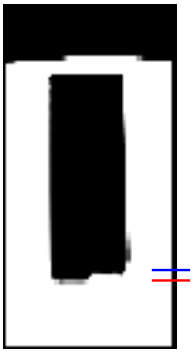
Uniformity & Ghosting - #7



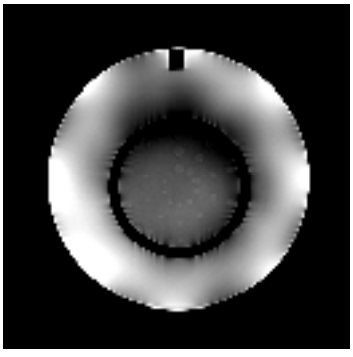


Slice Position - Superior

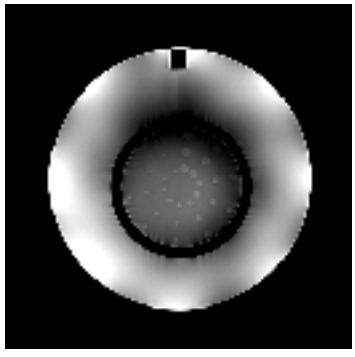




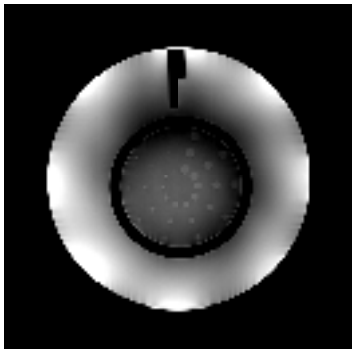
Low Contrast - #8



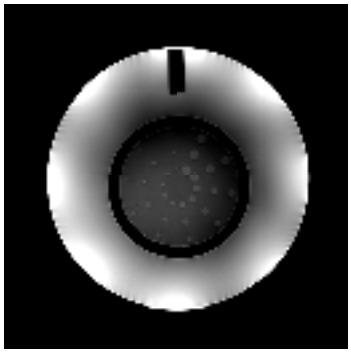
Low Contrast - #9



Low Contrast - #10



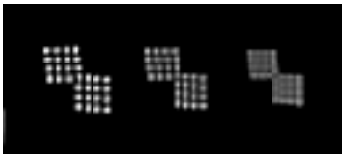
Low Contrast - #11



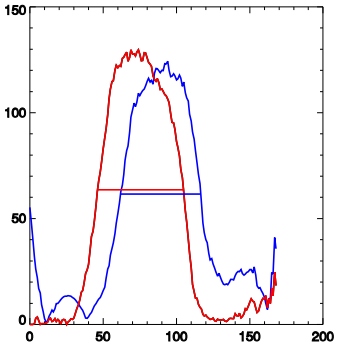
Appendix C: ACR Phantom Analysis

ACR PD

High Contrast Resolution

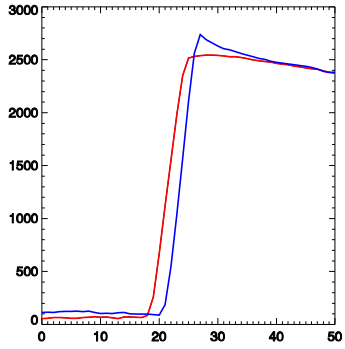


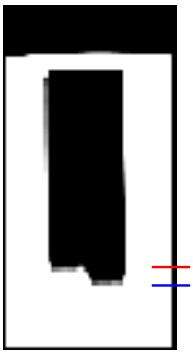
Slice Thickness



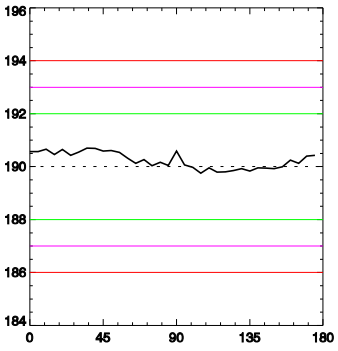
Upper=56.80
Lower=53.18
Slice Thickness=5.49

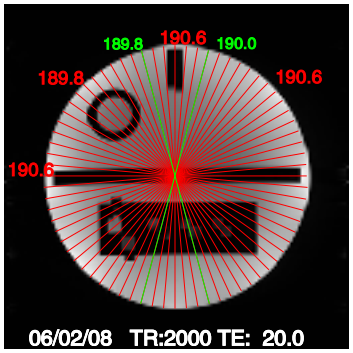
Slice Position - Inferior



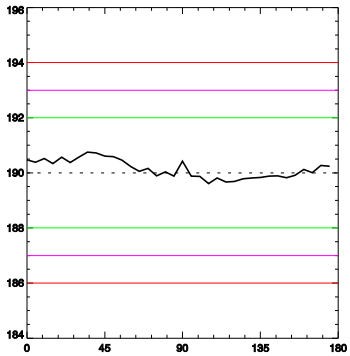


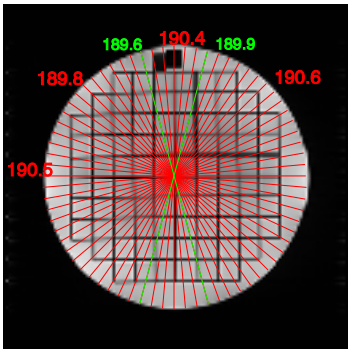
Axial Diameters - #1



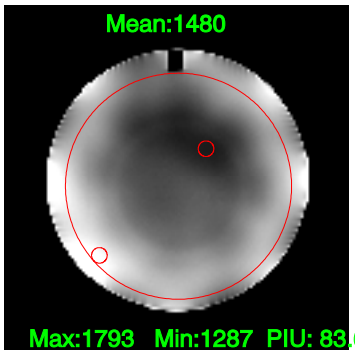


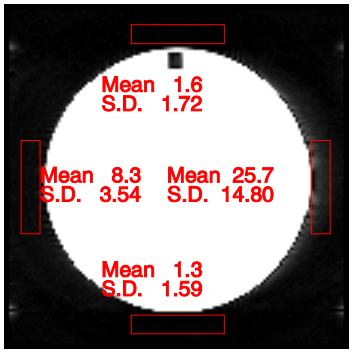
Axial Diameters - #5



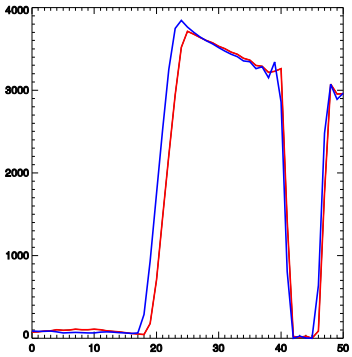


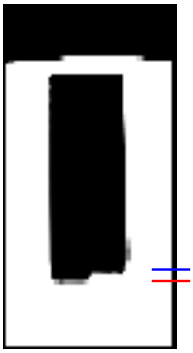
Uniformity & Ghosting - #7



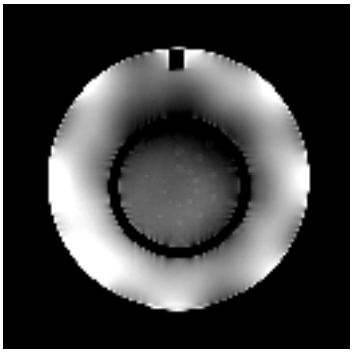


Slice Position - Superior

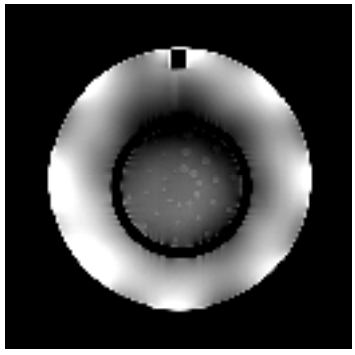




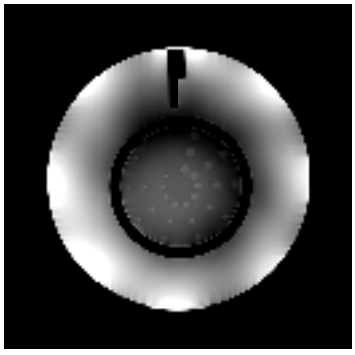
Low Contrast - #8



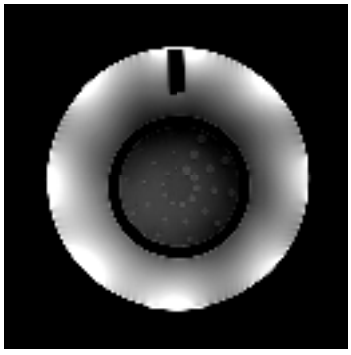
Low Contrast - #9



Low Contrast - #10



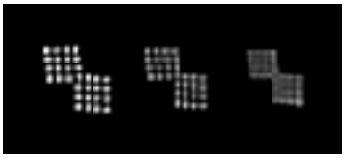
Low Contrast - #11



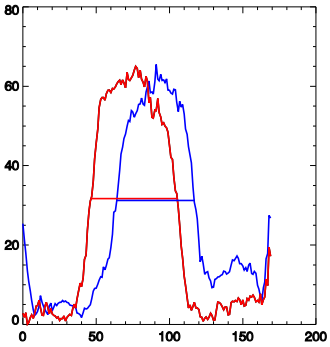
Appendix C: ACR Phantom Analysis

ACR T2

High Contrast Resolution



Slice Thickness

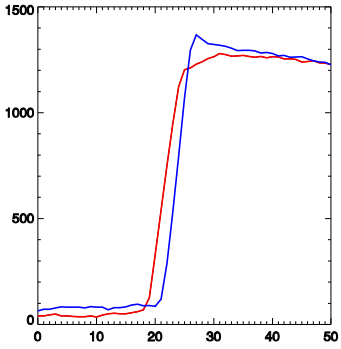


Upper=57.12

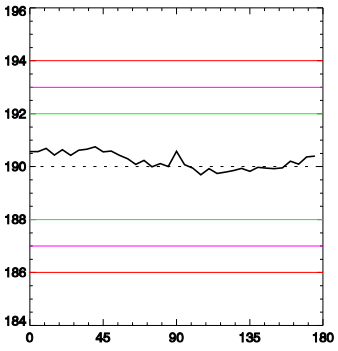
Lower=52.33

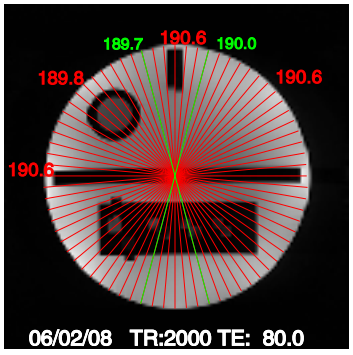
Slice Thickness=5.46

Slice Position - Inferior

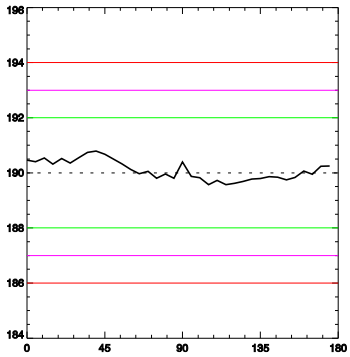


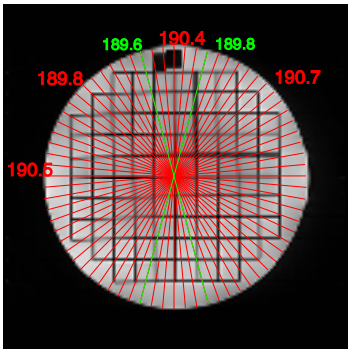
Axial Diameters - #1



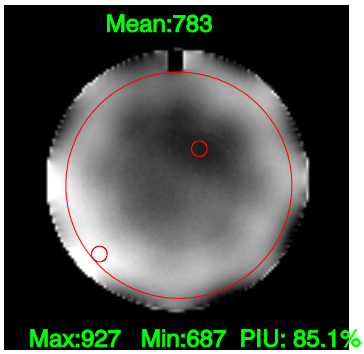


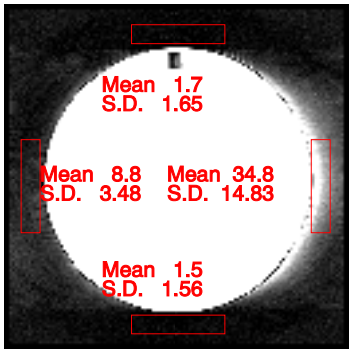
Axial Diameters - #5



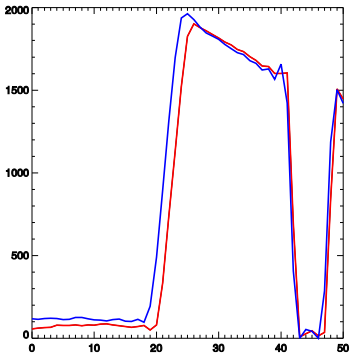


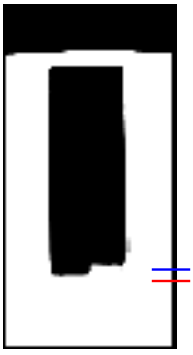
Uniformity & Ghosting - #7



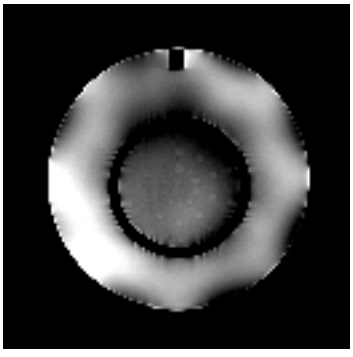


Slice Position - Superior

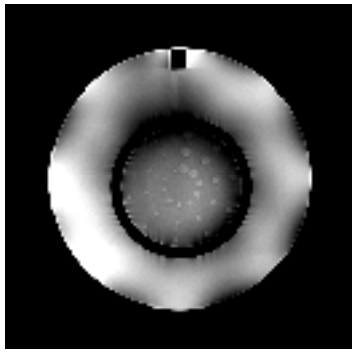




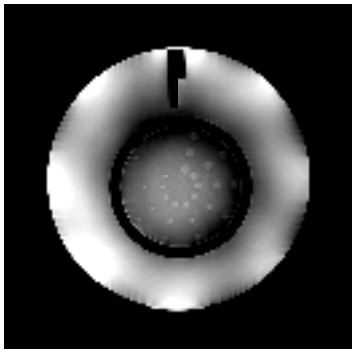
Low Contrast - #8



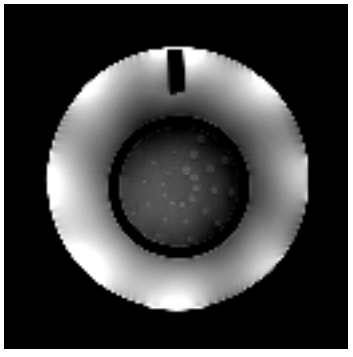
Low Contrast - #9



Low Contrast - #10



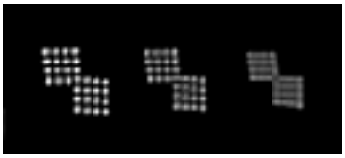
Low Contrast - #11



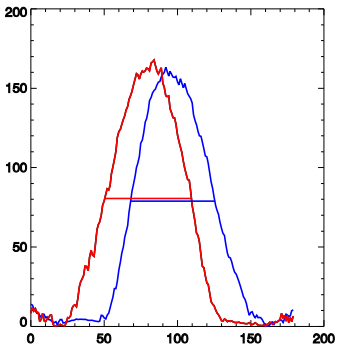
Appendix C: ACR Phantom Analysis

Site T1

High Contrast Resolution



Slice Thickness

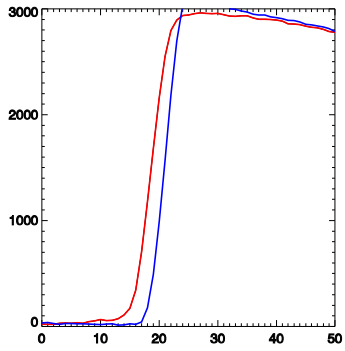


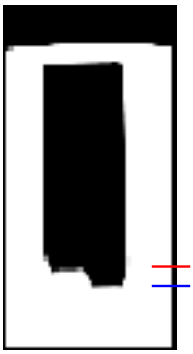
Upper=54.97

Lower=53.93

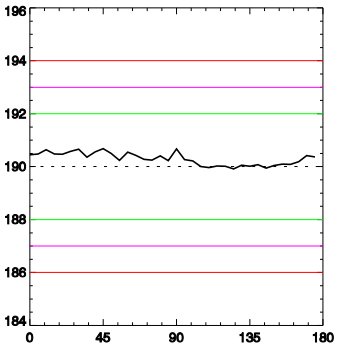
Slice Thickness=5.44

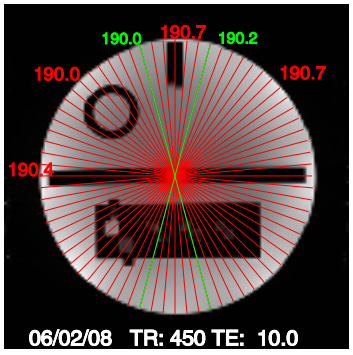
Slice Position - Inferior





Axial Diameters - #1





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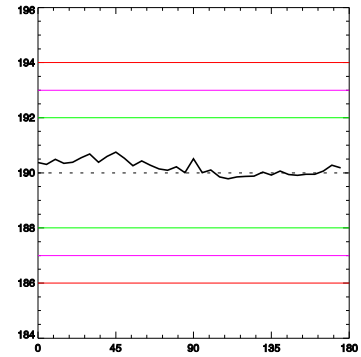
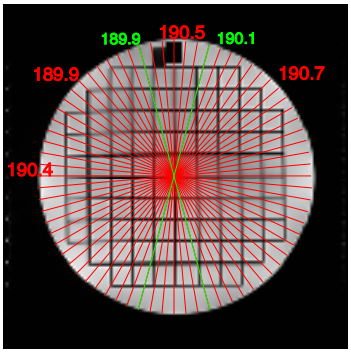
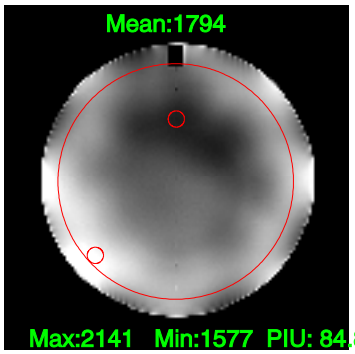
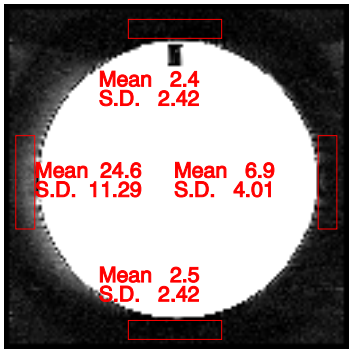


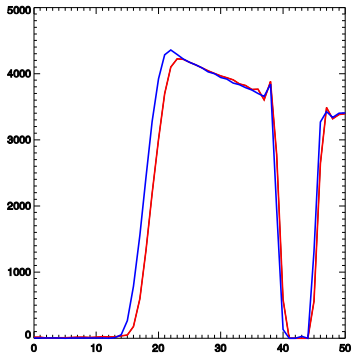


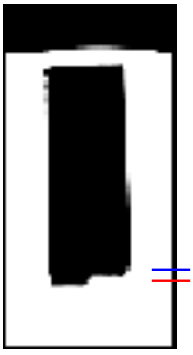
Uniformity & Ghosting - #7



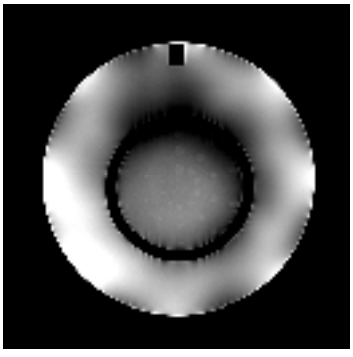


Slice Position - Superior





Low Contrast - #8



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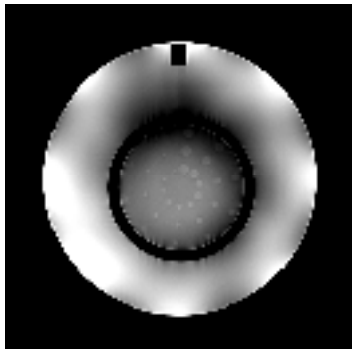
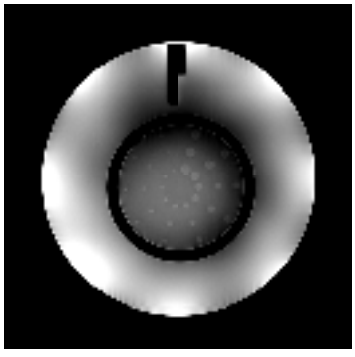
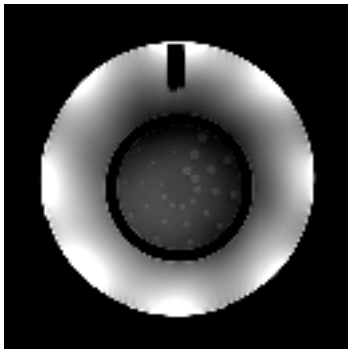


Low Contrast - #10



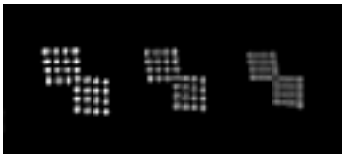
Low Contrast - #11



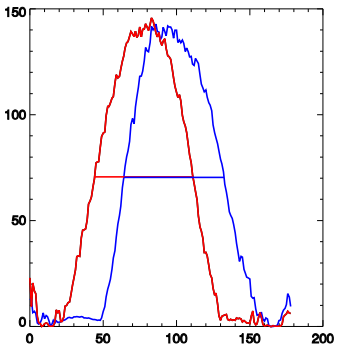
Appendix C: ACR Phantom Analysis

Site T2

High Contrast Resolution



Slice Thickness

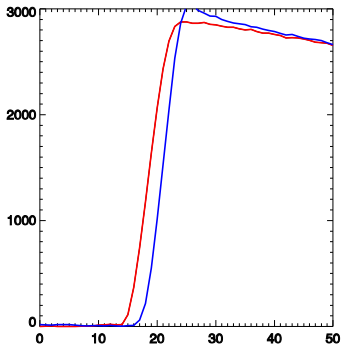


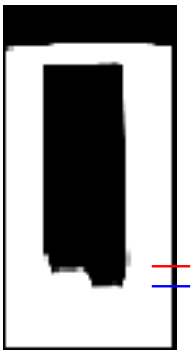
Upper=62.93

Lower=63.82

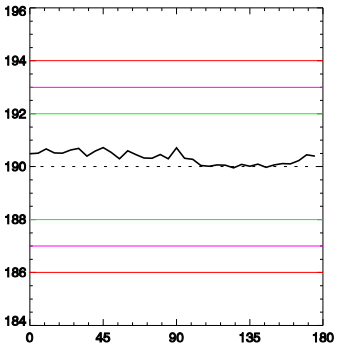
Slice Thickness=6.34

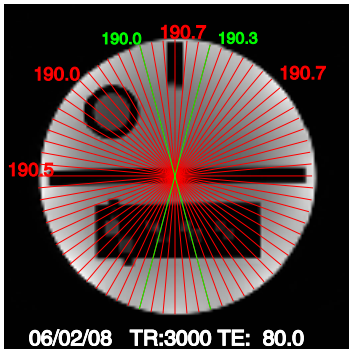
Slice Position - Inferior



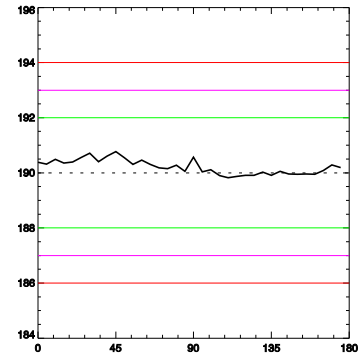


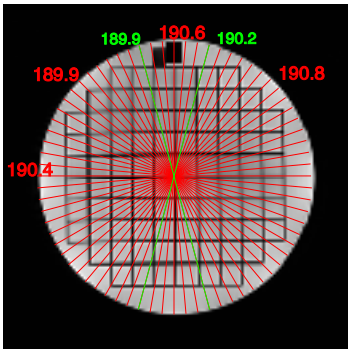
Axial Diameters - #1



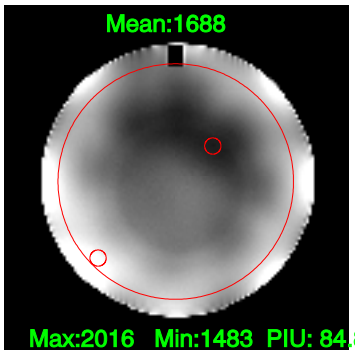


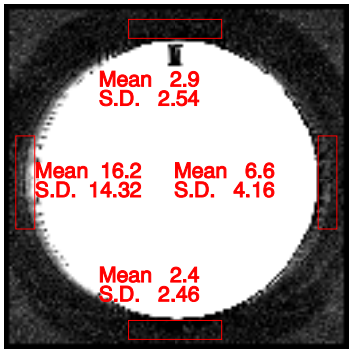
Axial Diameters - #5



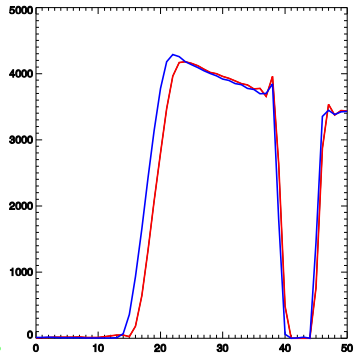


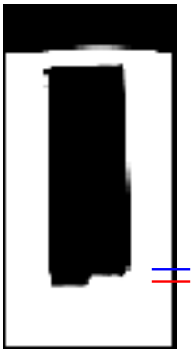
Uniformity & Ghosting - #7



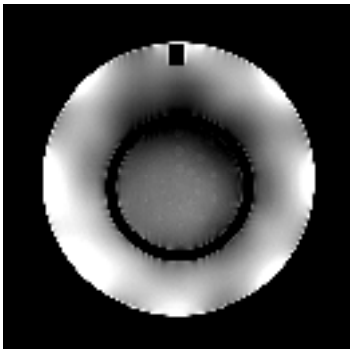


Slice Position - Superior

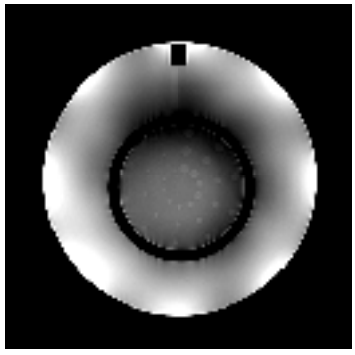




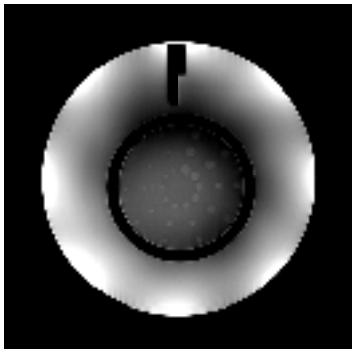
Low Contrast - #8



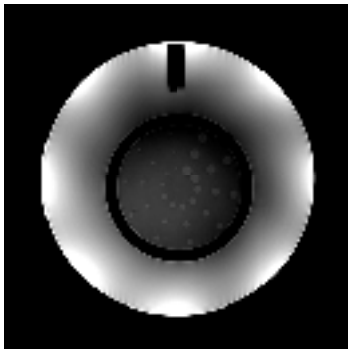
Low Contrast - #9



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 28.1 KHz (a 1 pixel fat/water chemical shift). 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.