Philips Site
Yearly Performance Evaluation
Philips Openview
16-Jan-08

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MRI Equipment Evaluation Summary & Signature Page

Site Name: Philips Site - Openview **MRAP #**

Address: **Survey Date:** 1/16/08

City, State, Zip **Report Date:** 1/22/08

MRI Mfg: Philips **Model:** Openview **Field:** 0.23

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

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

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

*See comments page for description of any failures.

Specific Comments and Recommendations

1. Magnet homogeneity looks good.

   Note: With the following comments, I shall be comparing the measured SNR values of all of your coils to similar coils at a second Picker Outlook facility.

2. The Body&Spine XL coil has VERY poor SNR… I don't have any previous results to compare it to.
3. The Body&Spine L coil also has VERY poor SNR, only 1/8th the SNR of the other site.
4. The Body&Spine M has comparable SNR.
5. The Body&Spine S coil looks fine.
6. The Extremity coil is 50% better than the other site.
7. The head coil is 30% lower than the other site. - See appendix C for full head coil & ACR phantom analysis.
8. The Multi-Purpose Large coil is 30% lower than the other site.
9. The Multi-Purpose Medium coil is 20% lower than the other site.
10. The Multi-Purpose Small coil is almost identical to the Medium coil… it should have been noticeably better.
11. The Multi-Purpose Extra small coil looks OK - nothing to compare it to.
12. The Neck coil looks adequate - nothing to compare it to.
13. The Shoulder coil looks adequate - nothing to compare it to.
14. There is a severe problem with image ghosting - particularly with the ACR T2 sequence. See appendix C.
15. The positioning laser is miscalibrated by 8 mm.
16. Please begin daily QA and weekly film QA as per our discussion.

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

MRI Equipment Performance Evaluation Data Form

Site Name: Philips Site - Openview

Contact	Title	Phone	eMail
	Owner		
	Chief Tech.		

Equipment Information

MRI Manufacturer: Philips Model: Openvieww SN: 4022 Software: Via 2.1.4

Camera Manufacturer: Agfa Model: SN: Software:

PACS Manufacturer: Model: SN: Software:

ACR Phantom Number used: 5065

1. Table Positioning Reproducibility: **Pass**

Table motion out/in:	IsoCenter	Out/In	Out/In	Out/In
Measured Phantom Center	-8			

Comment: Table reproducibility is not applicable with this magnet. However, the laser calibration is off by roughly 8 mm.

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

Last Year CF: **N/A** This Year CF: **9200000** CF Change: **NA**

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

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

	15 cm	20 cm	25 cm
Axial:	3.6	5.1	8.6
Coronal:	2.2	3.3	5.1
Sagittal:	3.3	5.1	9.2

Comments: This homogeneity is adequate for a low field open magnet.

3. Slice Thickness Accuracy

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

Sequence	TR	TE	Flip	NSA	Calc	Target	% Error
SE (ACR)	500	20	90	1	5.01	5	0.2%
SE (20/80)	2000	20	90	1	5.62	5	12.4%
SE (20/80)	2000	80	90	1	5.15	5	3.0%
SE (Site T1)	500	2	90	2	4.88	5	-2.4%
FSE(8)	3000	80	90	8	5.27	5	5.4%

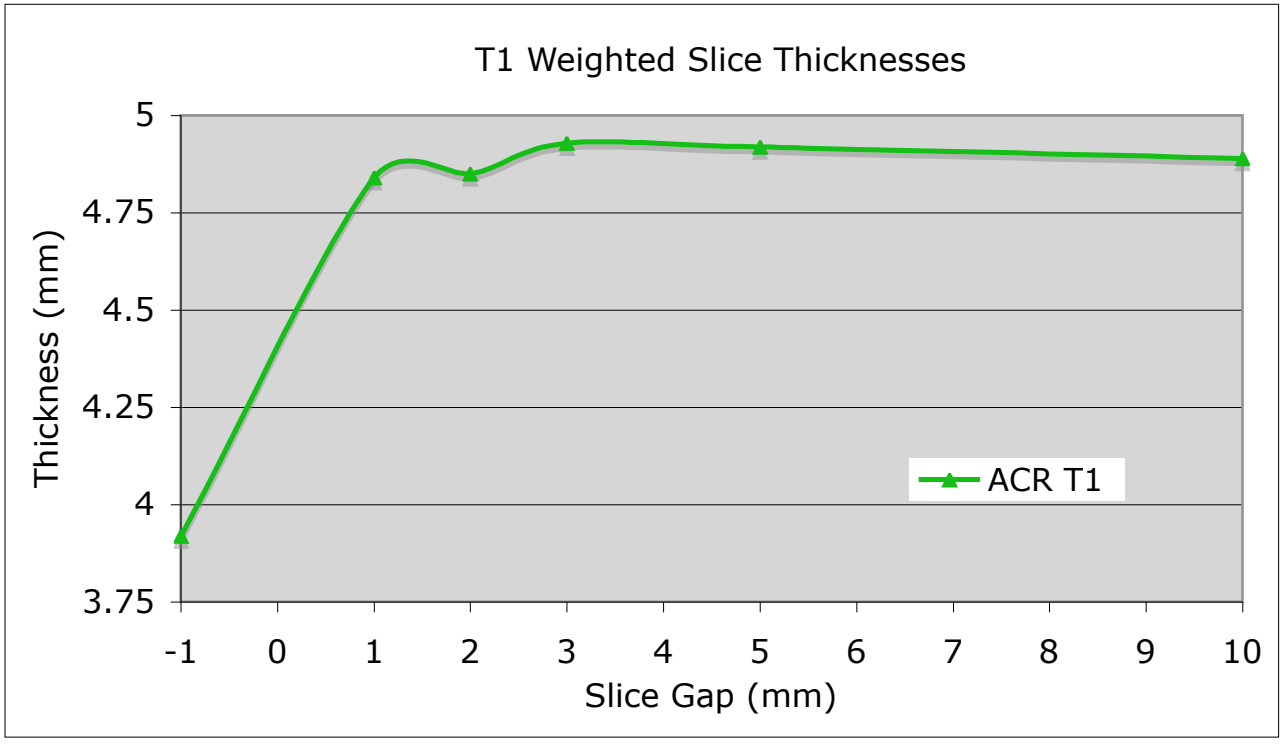
Comments:

4. Slice Crosstalk (RF interference)

The following data were obtained using the ACR phantom slice thickness wedges to measure the slice profile of a T1 weighted sequences when the slice gap varies from 200% down to -20% (overlapping) 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 shows little interaction down to a 20% gap. I acquired an image with 0% gap (contiguous) but it became corrupted. The overlapping slice shows dramatic degredation of the slice profile (as expected.)
All of the slice profiles can be seen in Appendix B.

Sequence Type	TR	TE	FOV (cm^2)	Matrix	NSA	Thickness	# of slices	Slice Measured
SE	500	20	25	256x256	2	5	11	6

Skip	ACR T1
-1	3.92
1	4.84
2	4.85
3	4.93
5	4.92
10	4.89



5. Soft & Hard Copy Displays

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

Monitor Description: Efilm workstation

Luminance Measured: Ft. lamberts

Measured Data					
Which Monitor	Center of Image Display	Top Left Corner	Top Right Corner	Bottom Left Corner	Bottom Right Corner
Console					

Uniformity		
MAX	MIN	Percent Delta

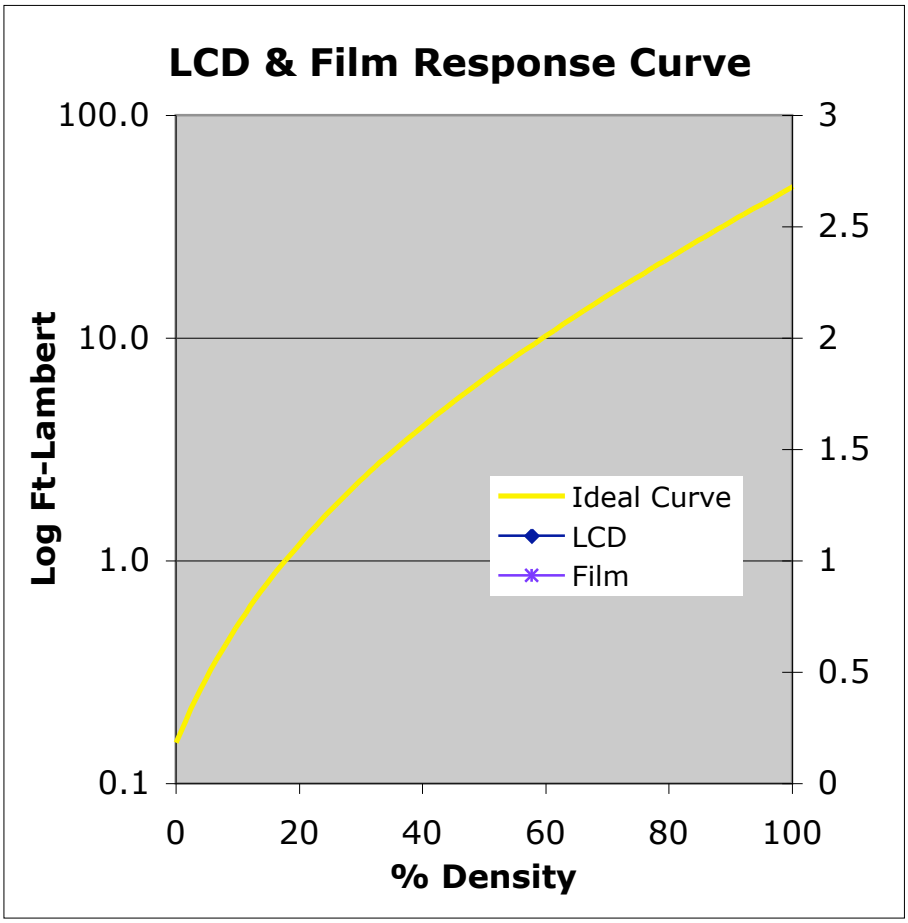
SMPTE
OK?
Y

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

Minimum Brightness must be > 26.24 Ft. Lamberts

There is no SMPTE pattern available on this scanner. I was unable to measure the film densities for the lack of a film densitometer. I have kept a copy of the film SMPTE pattern and will measure it when I next get access to a densitometer.

Density	Ft-Lamber	Film Density
0		
5		
10		
20		
30		
40		
50		
60		
70		
80		
90		
95		
100		



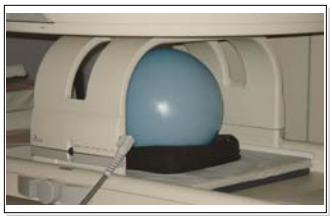
Coil and Other Hardware Inventory List

Site Name Philips Site

ACR Magnet # _____ Nickname Openview

Active	Coil Description	Manufacturer	Model	Rev.	Mfg. Date	SN	Channels
☒	Body & Spine - Extra Lge.	Marconi	955971	D	Aug, 2000	76	1
☒	Body & Spine - Large	Marconi	955969	E	Jun, 2006	340	1
☒	Body & Spine - Medium	Marconi	955968	B	May, 2002	285	1
☒	Body & Spine - Small	Marconi	955982	B	Dec, 2000	31	1
☒	Extremity	Marconi	95966	B	Jan, 2002	195	1
☒	Head	Marconi	955965	B	Nov, 1999	119	1
☒	Multi Purpose - Extra Small	Marconi	953541	D	Dec, 2000	51	1
☒	Multi Purpose - Large	Marconi	953544	D	Jan, 2001	132	1
☒	Multi Purpose - Medium	Marconi	953543	D	Dec, 2000	145	1
☒	Multi Purpose - Small	Marconi	953542	D	Dec, 2000	111	1
☒	Neck - Large	MRI Tech.	100202	A	Nov, 2003	377	1
☒	Shoulder	USA	10019	B	Sep, 2001	378	1
☐							

RF Coil Performance Evaluation



Coil: Body & Spine - Extra Lge.

Mfg.: Marconi

Mfg. Date: 8/1/2000 Coil ID: 1451

Phantom: 32 cm sphere

Test Date: 1/16/2008

Model: 955971

Revision: D

SN: 76

# of Channels 1

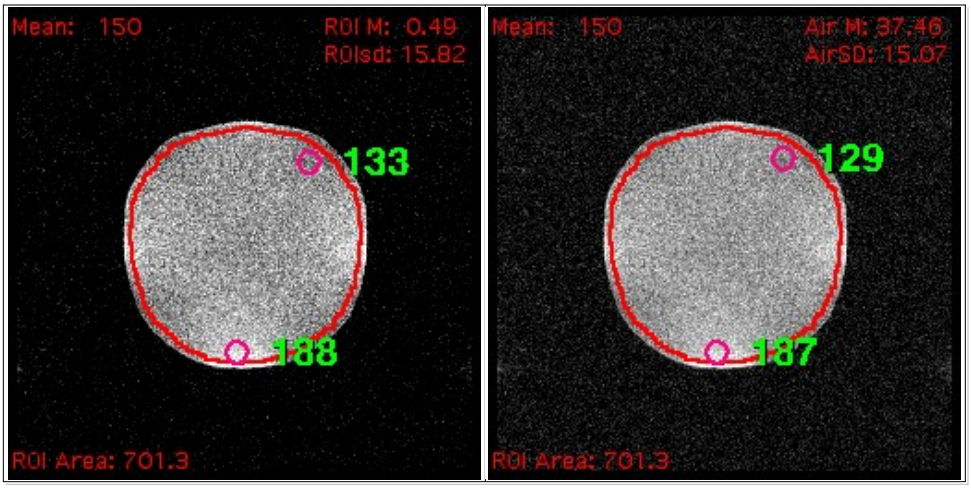
Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	60	256	256	10.7	1	5	-

Coil Mode: Body&Spine_XL

Analysis of Test Image

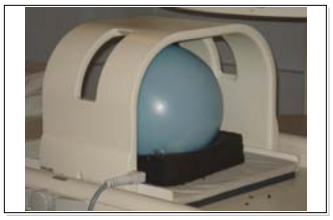
Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	150	188	133	0.5	15.82	NEMA	6.7	0.8	8.4	82.9%
A	150	187	129	37.5	15.07	Air	6.5	0.8	8.1	81.6%

The SNR of this coil is VERY poor. I don't have any basis for comparison with any other site



Test Images

RF Coil Performance Evaluation



Coil: Body & Spine - Large

Mfg.: Marconi

Mfg. Date: 6/1/2006 Coil ID: 1449

Phantom: 32 cm sphere

Test Date: 1/16/2008

Model: 955969

Revision: E

SN: 340

# of Channels 1

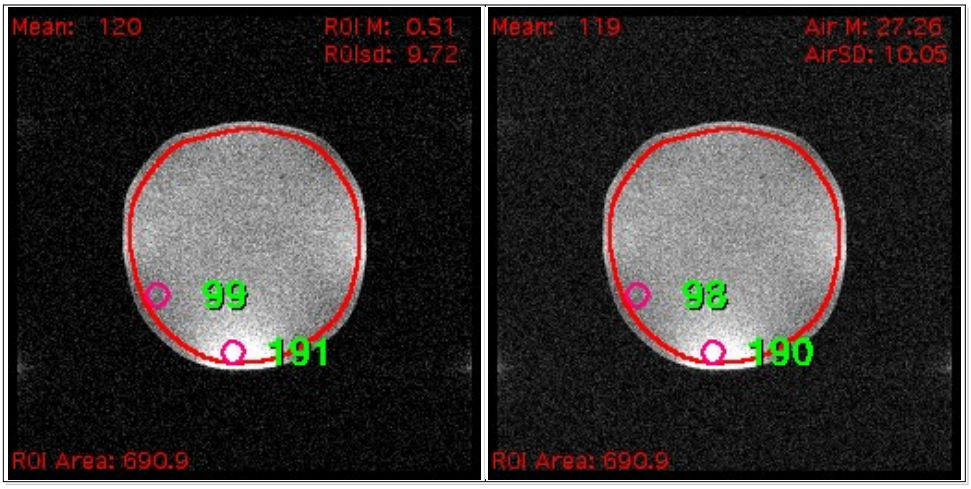
Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	60	256	256	10.7	1	5	-

Coil Mode: Body&Spine_L

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	120	191	99	0.5	9.72	NEMA	8.7	1.1	13.9	68.3%
A	119	190	98	27.3	10.05	Air	7.8	1.0	12.4	68.1%

The SNR of this coil is VERY poor. It is much worse than a similar that had the Large Flex coil - That site had a normalize SNR of 8.0



Test Images

RF Coil Performance Evaluation

Coil: Body & Spine - Medium

Mfg.: Marconi

Mfg. Date: 5/1/2002 Coil ID: 1448

Phantom: 27 cm sphere

Test Date: 1/16/2008

Model: 955968

Revision: B

SN: 285

# of Channels 1

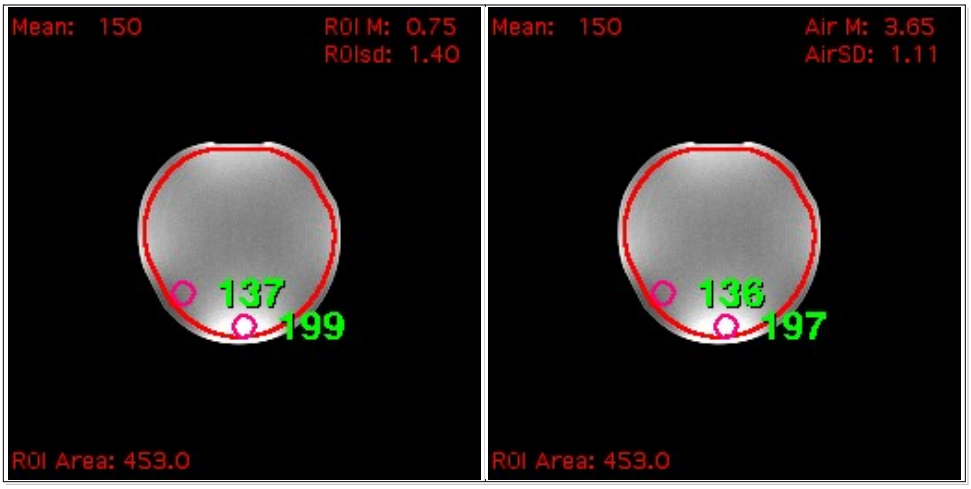
Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	60	256	256	10.7	1	5	-

Coil Mode: Body&Spine_M

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	150	199	137	0.8	1.40	NEMA	75.8	9.4	100.5	81.5%
A	150	197	136	3.7	1.11	Air	88.6	11.0	116.3	81.7%

The SNR of this coil is comparable to a similar site.



Test Images

RF Coil Performance Evaluation

Coil: Body & Spine - Small

Mfg.: Marconi

Mfg. Date: 12/1/2000 Coil ID: 1447

Phantom: F11 phantom

Test Date: 1/16/2008

Model: 955982

Revision: B

SN: 31

# of Channels 1

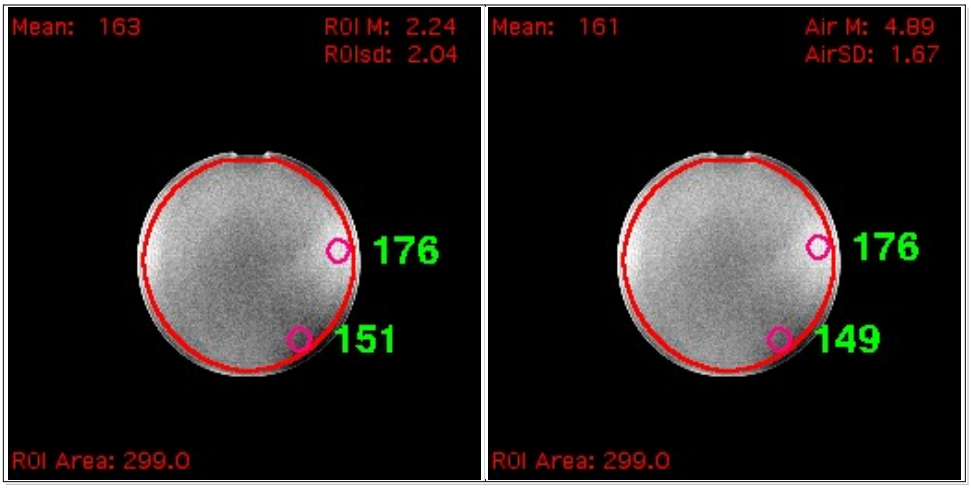
Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	44	256	256	10.7	1	5	-

Coil Mode: Body&Spine_S

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	163	176	151	2.2	2.04	NEMA	56.5	13.1	61.0	92.4%
A	161	176	149	4.9	1.67	Air	63.2	14.6	69.1	91.7%

Looks 'OK'



Test Images

RF Coil Performance Evaluation

Coil: Extremity
Mfg.: Marconi
Mfg. Date: 1/1/2002 Coil ID: 1442
Phantom: F2 phantom

Test Date: 1/16/2008
Model: 95966
Revision: B
SN: 195
# of Channels 1

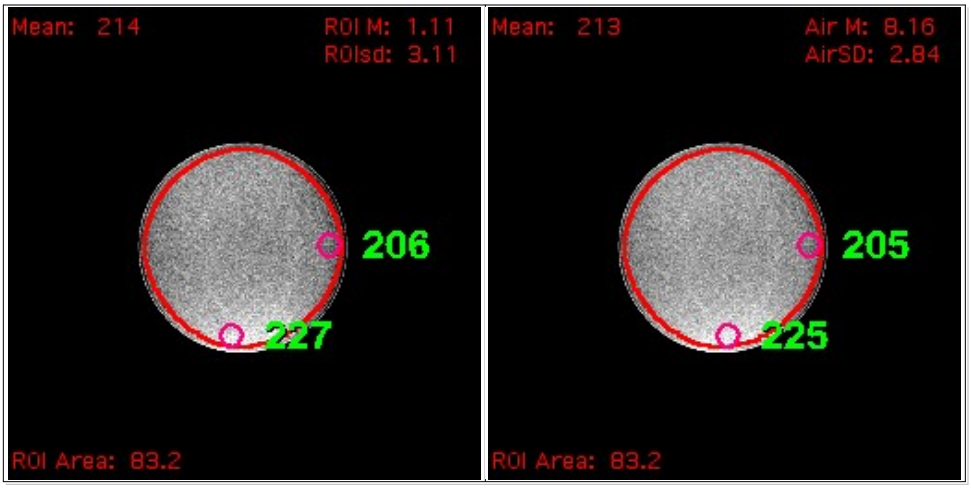
Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	25	256	256	10.7	1	5	-

Coil Mode: Extremity

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	214	227	206	1.1	3.11	NEMA	48.7	34.8	51.6	95.2%
A	213	225	205	8.2	2.84	Air	49.1	35.2	51.9	95.3%

SNR is good. (50% better than comparable site.)



Test Images

RF Coil Performance Evaluation

Coil: Head
Mfg.: Marconi
Mfg. Date: 11/1/1999 Coil ID: 1439
Phantom: ACR Phantom

Test Date: 1/16/2008
Model: 955965
Revision: B
SN: 119
# of Channels 1

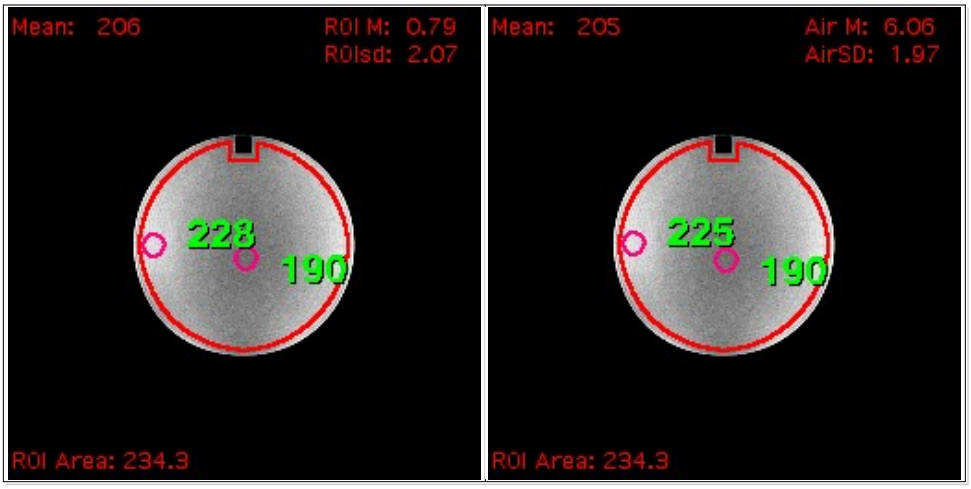
Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	40	256	256	10.7	1	5	-

Coil Mode: Head

Analysis of Test Image

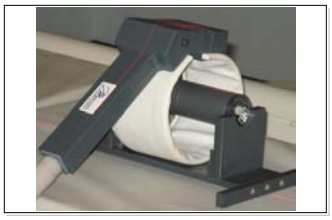
Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	205	228	190	0.8	2.07	NEMA	70.0	19.6	77.9	90.9%
A	205	225	190	6.1	1.97	Air	68.2	19.1	74.8	91.6%

Please look at Appendix C for complete ACR Phantom analysis.
SNR of this coil is 30% lower than a similar site.



Test Images

RF Coil Performance Evaluation



Coil: Multi Purpose - Extra Small

Mfg.: Marconi

Mfg. Date: 12/1/2000 Coil ID: 1443

Phantom: F3

Test Date: 1/16/2008

Model: 953541

Revision: D

SN: 51

# of Channels 1

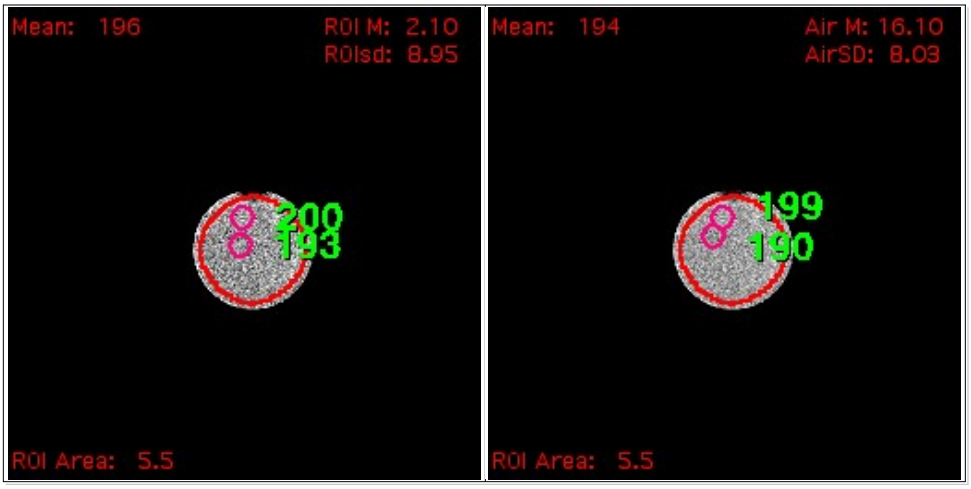
Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	12	256	256	11.1	1	5	-

Coil Mode: MPXS

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	196	200	193	2.1	8.95	NEMA	15.5	49.0	15.8	98.2%
A	194	200	193	16.1	8.03	Air	15.8	50.1	16.3	98.2%

Looks 'OK' - nothing to compare it to



Test Images

RF Coil Performance Evaluation

Coil: Multi Purpose - Large
Mfg.: Marconi
Mfg. Date: 1/1/2001 Coil ID: 1446
Phantom: F2

Test Date: 1/16/2008
Model: 953544
Revision: D
SN: 132
# of Channels 1

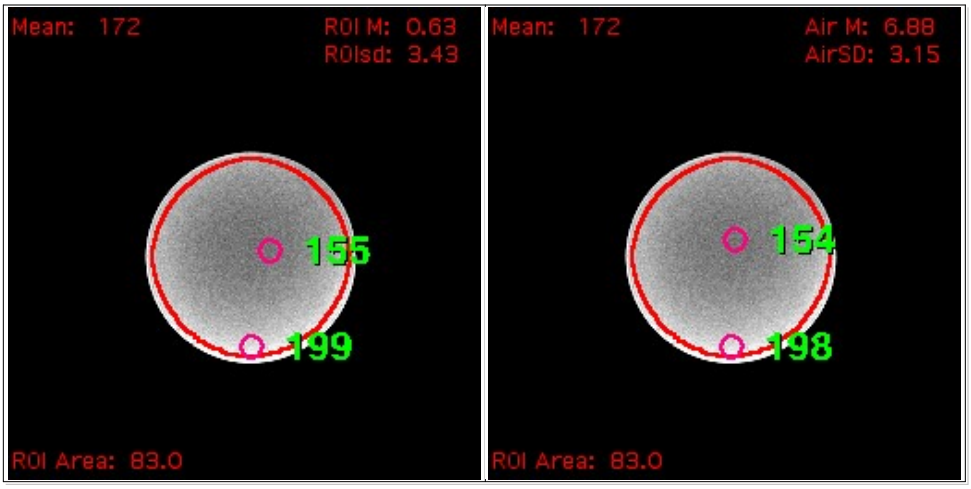
Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	25	256	256	10.7	1	5	-

Coil Mode: MPL

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	172	199	155	0.6	3.43	NEMA	35.5	25.4	41.0	87.6%
A	172	198	154	6.9	3.15	Air	35.8	25.6	41.2	87.5%

SNR of this coil is 30% lower than a similar site



Test Images

RF Coil Performance Evaluation

Coil: Multi Purpose - Medium
Mfg.: Marconi
Mfg. Date: 12/1/2000 Coil ID: 1445
Phantom: F2

Test Date: 1/16/2008
Model: 953543
Revision: D
SN: 145
# of Channels 1

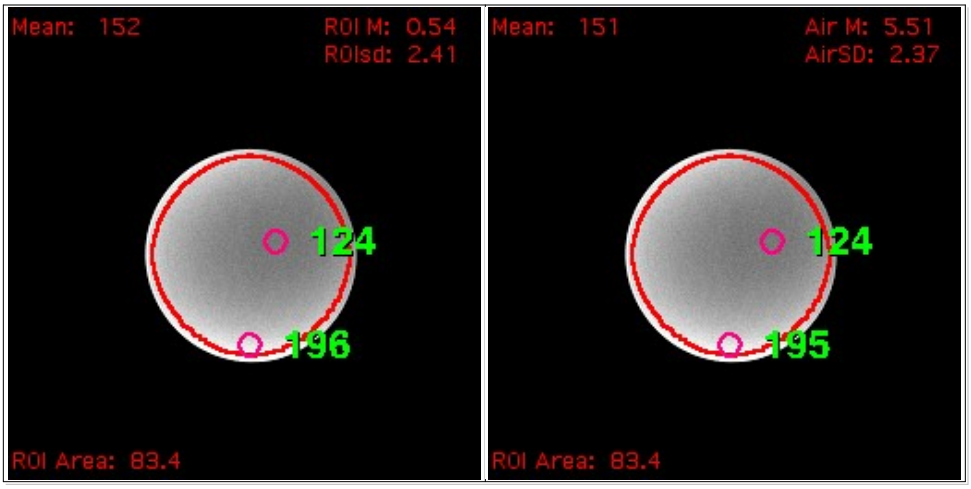
Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	25	256	256	10.7	1	5	-

Coil Mode: MPM

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	152	196	124	0.5	2.41	NEMA	44.6	31.9	57.5	77.5%
A	151	195	124	5.5	2.37	Air	41.8	29.9	53.9	77.7%

SNR of this coil is 20% lower than a similar site



Test Images

RF Coil Performance Evaluation

Coil: Multi Purpose - Small

Mfg.: Marconi

Mfg. Date: 12/1/2000 Coil ID: 1444

Phantom: F2

Test Date: 1/16/2008

Model: 953542

Revision: D

SN: 111

# of Channels 1

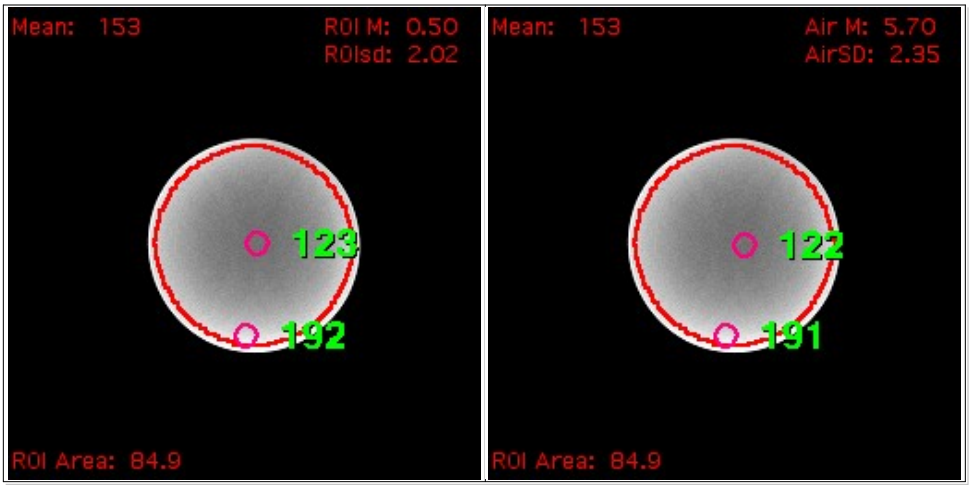
Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	25	256	256	10.7	1	5	-

Coil Mode: MPS

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	153	192	123	0.5	2.02	NEMA	53.6	38.3	67.2	78.1%
A	153	191	122	5.7	2.35	Air	42.7	30.5	53.3	78.0%

There is almost no difference between this coil's NSR and the Multi-purpose Medium... it should have had better SNR



Test Images

RF Coil Performance Evaluation

Coil: Neck - Large

Mfg.: MRI Tech.

Mfg. Date: 11/25/2003 Coil ID: 1440

Phantom: F2 Phantom

Test Date: 1/16/2008

Model: 100202

Revision: A

SN: 377

# of Channels 1

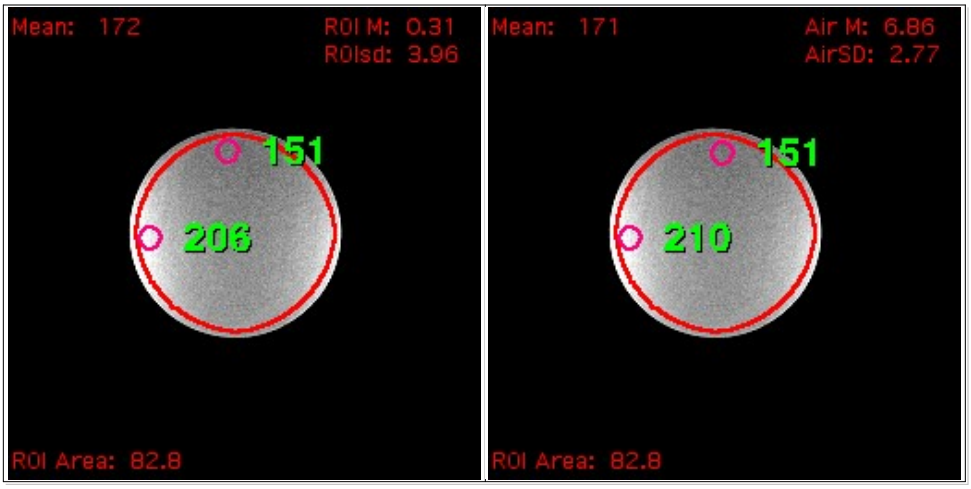
Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	T	25	256	256	10.7	1	5	-

Coil Mode: Neck-L

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	172	206	151	0.3	3.96	NEMA	30.7	22.0	36.8	84.6%
A	171	210	151	6.9	2.77	Air	40.5	28.9	49.7	83.7%

Adequate - no comparison available



Test Images

RF Coil Performance Evaluation

Coil: Neck - Large

Mfg.: MRI Tech.

Mfg. Date: 11/25/2003 Coil ID: 1440

Phantom: F2 Phantom

Test Date: 1/16/2008

Model: 100202

Revision: A

SN: 377

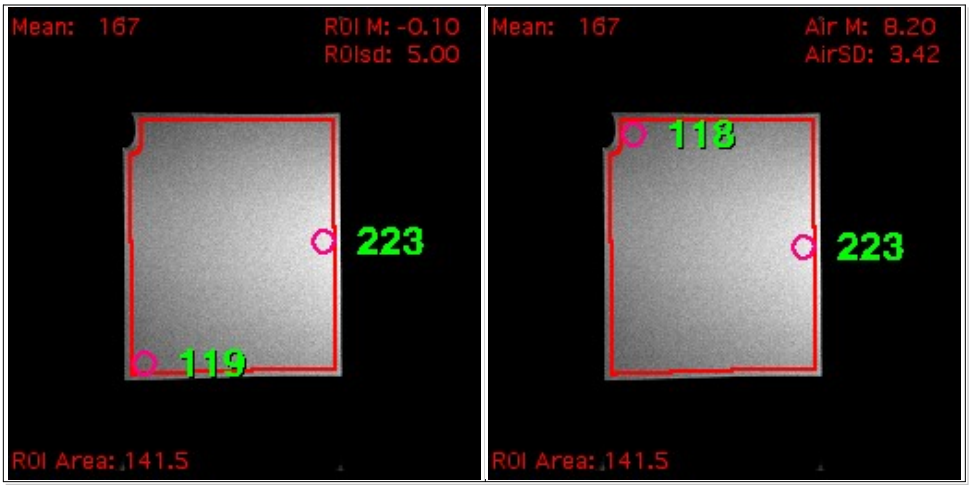
# of Channels 1

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	S	25	256	256	10.7	1	5	-

Coil Mode: Neck-L

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	167	223	119	-0.1	5.00	NEMA	23.6	16.9	31.5	69.6%
A	167	223	118	8.2	3.42	Air	32.0	22.9	42.7	69.2%



Test Images

RF Coil Performance Evaluation

Coil: Shoulder
Mfg.: USA
Mfg. Date: 9/13/2001 Coil ID: 1441
Phantom: F2 Phantom

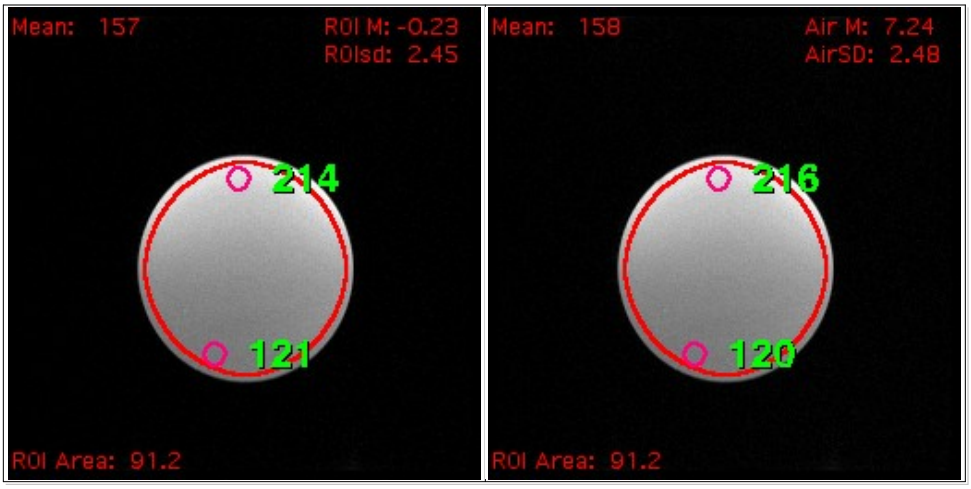
Test Date: 1/16/2008
Model: 10019
Revision: B
SN: 378
# of Channels 1

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	S	25	256	256	10.7	1	5	-

Coil Mode: Shoulder

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	157	214	121	-0.2	2.45	NEMA	45.3	32.4	61.8	72.2%
A	158	216	120	7.2	2.48	Air	41.7	29.9	57.1	71.4%



Test Images

RF Coil Performance Evaluation

Coil: Shoulder
Mfg.: USA
Mfg. Date: 9/13/2001 Coil ID: 1441
Phantom: F2 Phantom

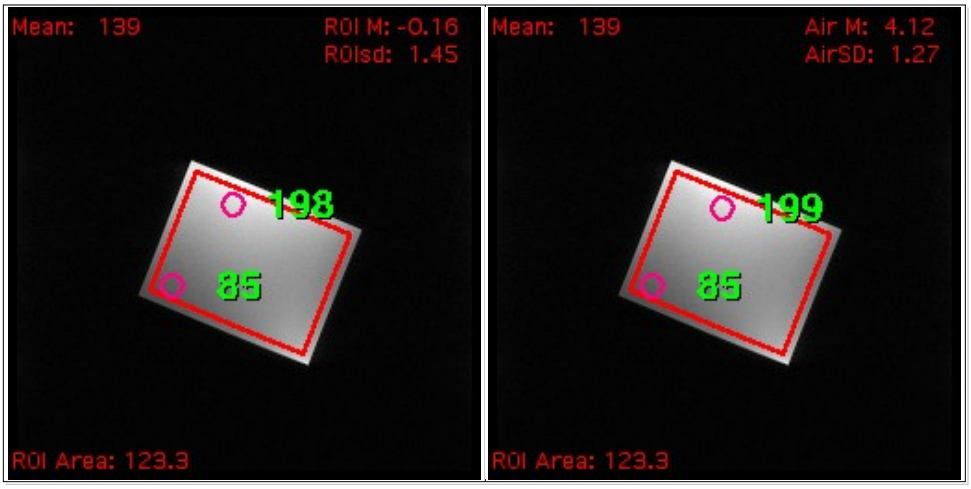
Test Date: 1/16/2008
Model: 10019
Revision: B
SN: 378
# of Channels 1

Sequence	TR	TE	Plane	FOV	Nx	Ny	BW	NSA	Thickness	Gap
SE	300	20	C	36	256	256	10.7	1	5	-

Coil Mode: Shoulder

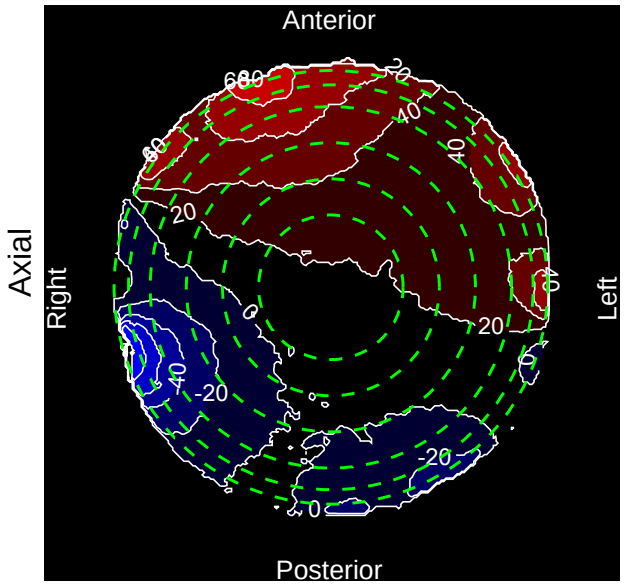
Analysis of Test Image

Measured Data							Calculated Results			
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal-ized	Max SNR	Uni-formity
N	139	198	85	-0.2	1.45	NEMA	67.8	23.4	96.6	60.1%
A	139	199	85	4.1	1.27	Air	71.7	24.7	102.7	59.9%



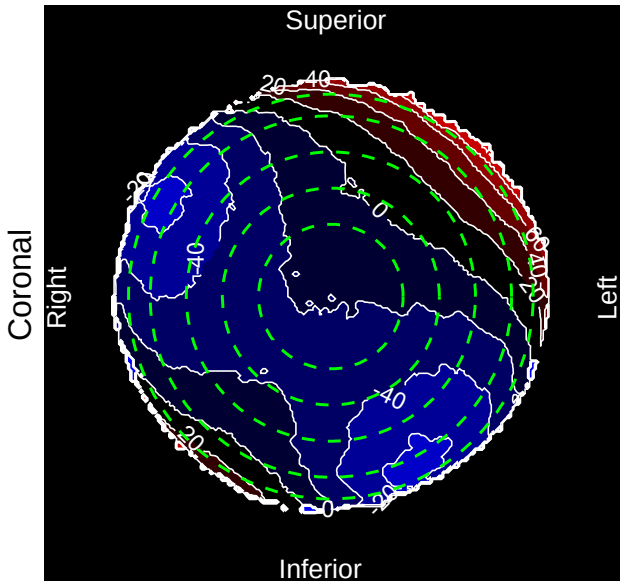
Test Images

Appendix A: Magnet Homogeneity Field Maps
Marconi Outlook Openview - 3 central planes
Measured January 16, 2008



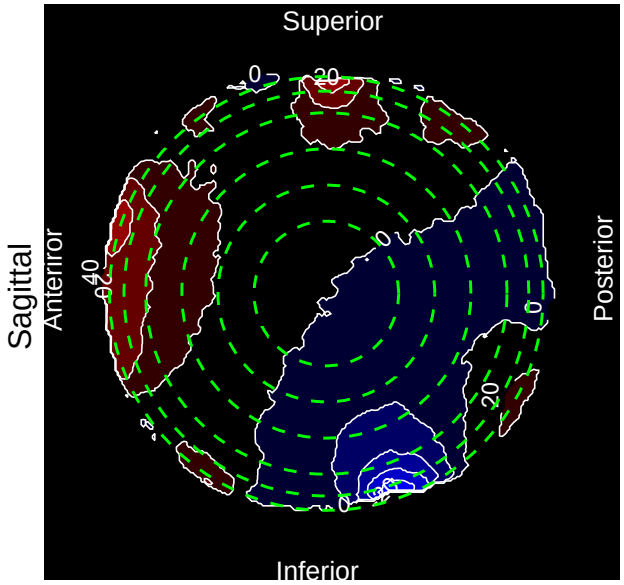
Axial

DIAMETER	MIN	MAX	RANGE	PPM	MEAN	STDEV
10	-1	29	31	3.2	15.4	6.3
15	-9	40	50	5.1	15.7	10.2
20	-27	54	81	8.3	15.9	14.9
25	-59	71	130	13.3	16.0	20.6
28	-87	86	174	17.8	16.1	24.7



Coronal

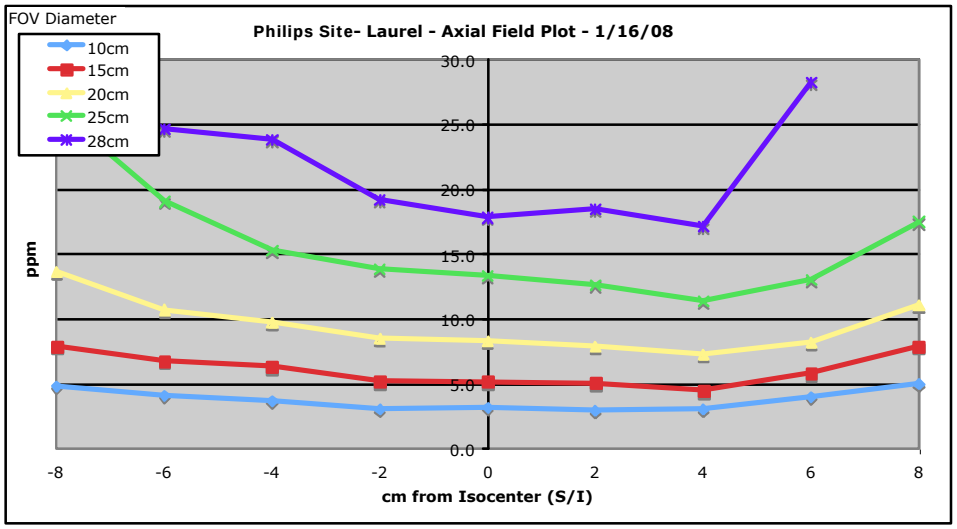
DIAMETER	MIN	MAX	RANGE	PPM	MEAN	STDEV
10	-34	-4	30	3.1	-19.4	5.4
15	-40	4	44	4.5	-20.0	8.9
20	-53	17	71	7.3	-20.4	13.6
25	-63	44	107	11.0	-19.6	20.3
28	-65	80	146	14.9	-17.3	25.5

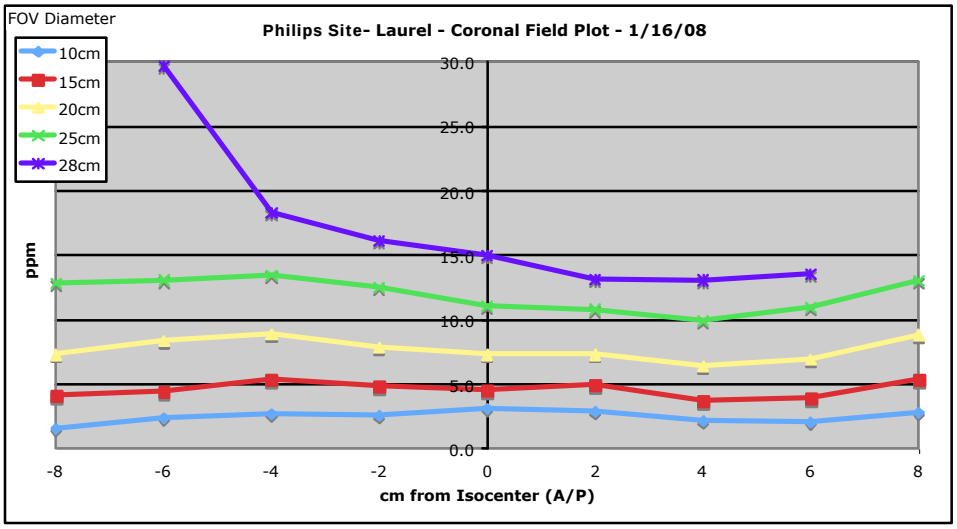


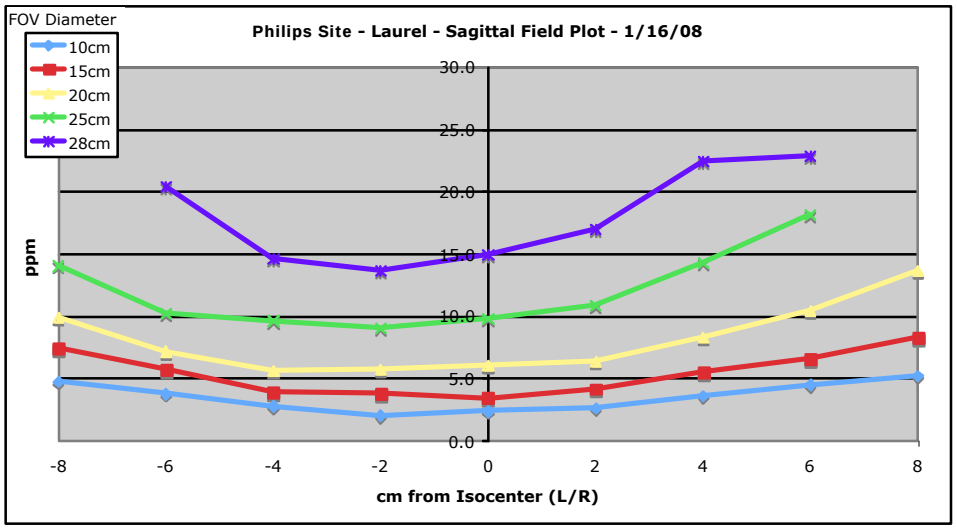
Sagittal

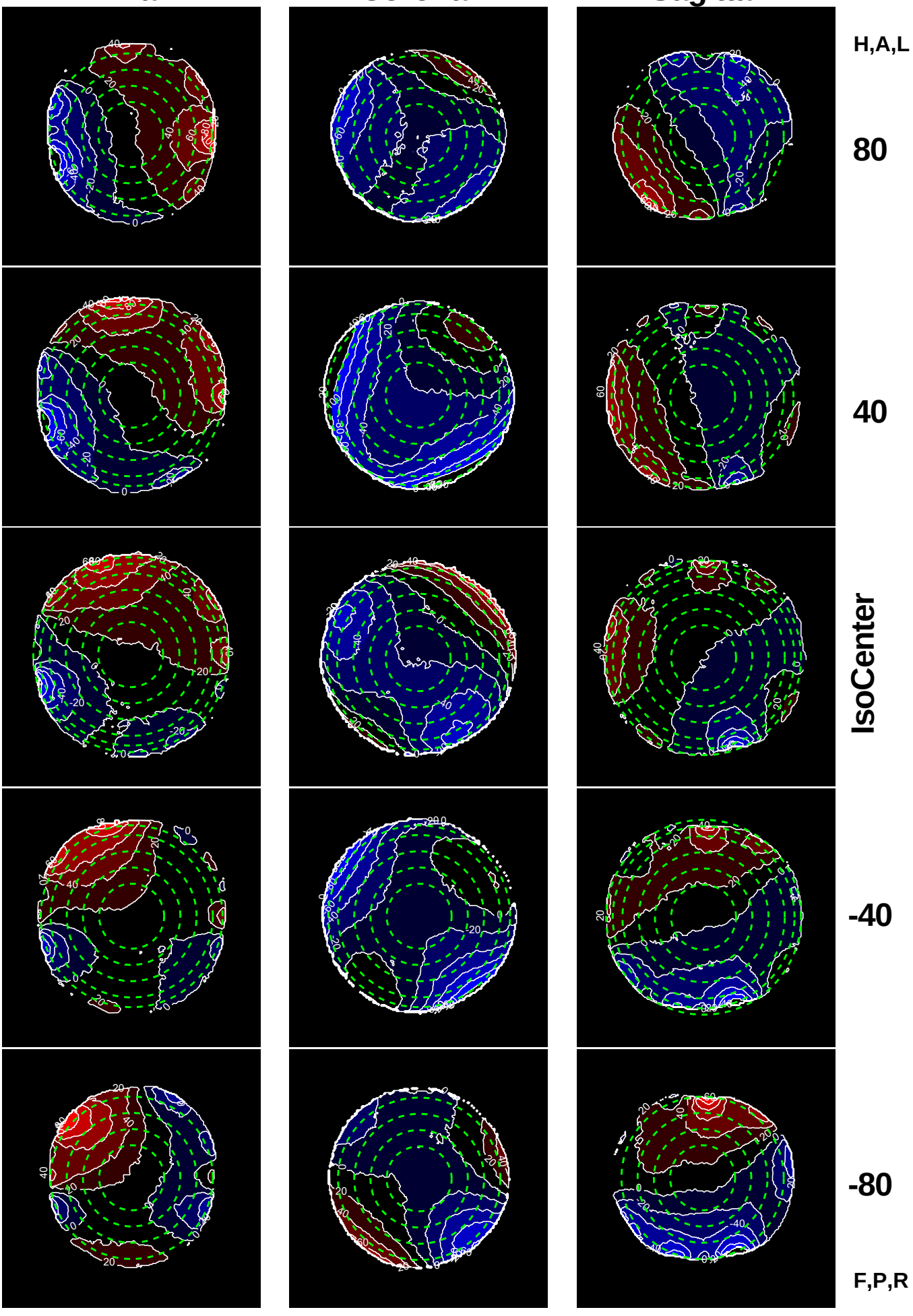
DIAMETER	MIN	MAX	RANGE	PPM	MEAN	STDEV
10	-36	-18	18	1.9	-26.0	4.2
15	-43	-13	29	3.0	-26.4	6.6
20	-53	-5	47	4.8	-27.1	9.4
25	-65	6	72	7.4	-27.8	12.7
28	-74	18	93	9.6	-28.2	15.2
30	-84	27	111	11.4	-28.5	17.5

Appendix A: Magnet Homogeneity Field Maps
Marconi Outlook Openview
Measured January 16, 2008



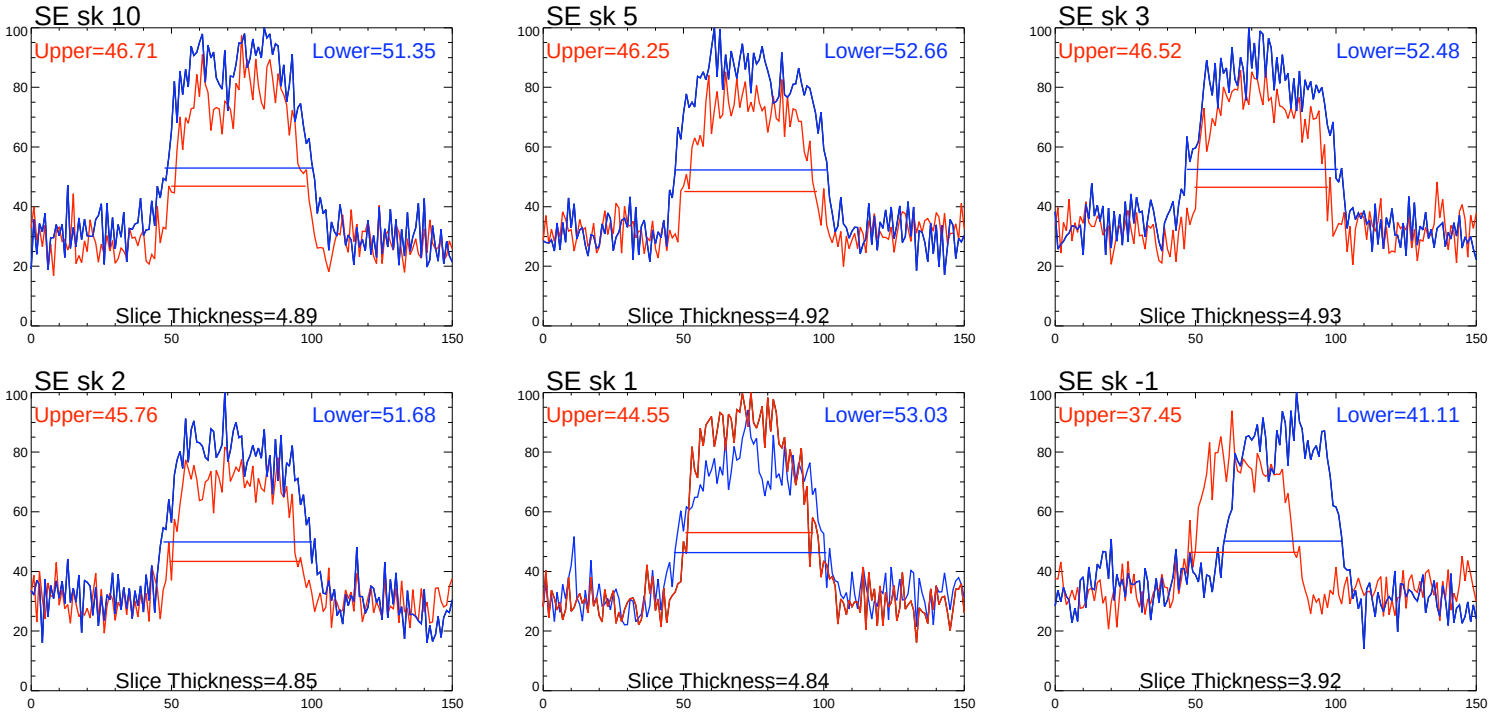


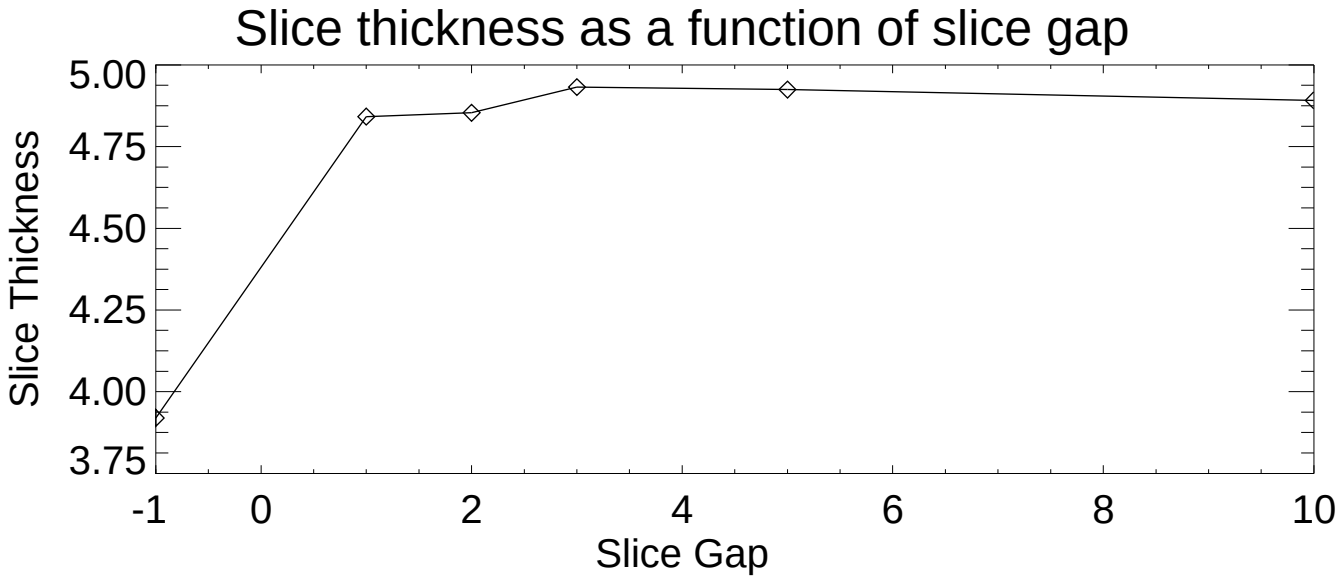



Axial
Coronal
Sagittal
H,A,L
80
40
IsoCenter
-40
-80
F,P,R

Appendix B: RF Slice Profiles and Crosstalk

Spin Echo - ACR T1
TR/TE = 500/20
BW = 11.1 KHz
nex = 1.5
Scan time: 3:18





The data point at gap = 0 was invalid due to poor SNR.

Philips Site **Openview**

Coil Used: **Head** Test Date: **1/16/2008**

	Sagittal Locator		
1	Length of phantom, end to end (mn 148± 2)	146.5	= 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)	0.9	0.9	0.9	0.9	0.9
3		0.9	0.9	0.9	0.9	0.9
4	Slice Thickness (fwhm in mm) Top	52.2	56.5	53.0	50.5	54.2
5	Bottom	48.2	55.9	50.2	47.2	51.3
6	Calculated value 5.0±0.7	5.01	5.62	5.15	4.88	5.27
7	Wedge (mm) = + = -	0.5	0.6	0.4	0.8	0.8
8	Diameter (mm) (190±2) ⊕	191.7	190.0	189.2	191.3	191.9
9	⊖	188.0	188.5	188.8	189.4	188.5
	Slice Location #5					
10	Diameter (mm) (190±2) ⊕	191.0	189.7	188.4	190.9	191.6
11	⊖	188.4	188.8	189.2	188.9	188.6
12	⊘	190.7	189.4	188.3	190.2	191.1
13	⊘	190.8	189.5	188.4	191.2	191.4
	Slice Location #7					
14	Signal (mean only) Big ROI	133	142	137	143	134
15	High	154	165	160	161	154
16	Low	121	126	127	125	120
17	Uniformity (>87.5%)	88.0%	86.6%	88.5%	87.4%	87.6%
18	Background Noise (mean ±std dev) Top	8.7 ± 2.94	6.6 ± 2.05	7.8 ± 2.48	6.3 ± 2.02	6.3 ± 1.97
19	Bottom	8.6 ± 2.72	6.5 ± 2.06	7.9 ± 2.56	6.6 ± 2.08	6.4 ± 2.01
20	Left	10.3 ± 3.67	8.4 ± 2.71	11.5 ± 3.07	6.4 ± 1.96	8.4 ± 2.74
21	Right	9.7 ± 3.41	11.7 ± 3.97	12.6 ± 3.14	6.4 ± 2.12	8.5 ± 2.6
22	Ghosting Ratio (<2.5%)	1.0%	2.5%	3.1%	0.0%	1.6%
23	SNR (no spec)	47	69	54	70	67
	Low Con Detectability					
24	Slice Location #8 1.4%	0	0	0	0	0
25	Slice Location #9 2.5%	0	0	0	0	4
26	Slice Location #10 3.6%	4	0	4	4	4
27	Slice Location #11 5.1%	5	3	8	8	7
28	Total # of Spokes (>=9)	9	3	12	12	15
	Slice Location #11					
29	Wedge (mm) = + = -	1.1	0.8	0.2	1.2	0.6
30	Slice Position Error	0.6	0.2	-0.2	0.4	-0.3

There is excessive ghosting in many images, particularly the ACR PD/T2 images.

Philips Site **Openview**

Sequence parameters Test Date: **1/16/2008**

Coil Used:**Head** **Test ID** **243**

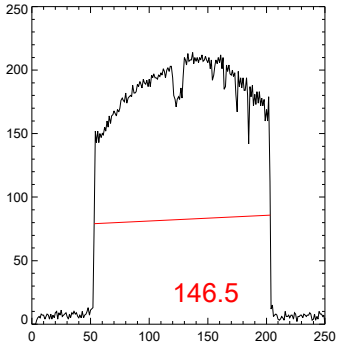
Study Description	Pulse Sequence (ETL)	TR (ms)	TE (ms)	FOV (cm)	Phase Sample Ratio	Number of Slices	Thick-ness (mm)	Slice Gap	NSA (Nex)	Freq Matrix	Phase Matrix	Band Width (kHz)	Scan Time (min:sec)
ACR T1	SE	500	20	25	1	11	5	5	1	256	256	10.7	2:09
ACR PD	Dual Echo SE	2000	20	25	1	11	5	5	1	256	256	9.3	8:32
ACR T2	Dual Echo SE	2000	80	25	1	11	5	5	1	256	256	4.6	8:32
Site T1	SE	500	20	24	2	11	5	5	2	256	256	10.7	6:24
Site T2	FSE(8)	2000	80	24	2	11	5	5	4	256	256	20.8	8:32

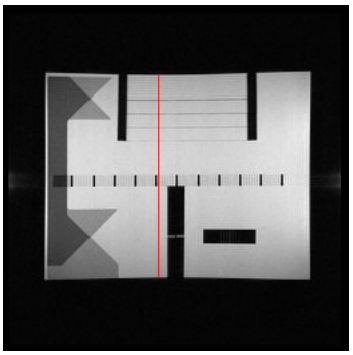
Magnet ID: **188** **Coil ID:** **1439** **TestID:** **243**

Appendix C: ACR Phantom Analysis

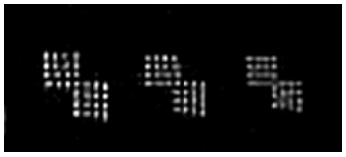
ACR T1

Sagital Length

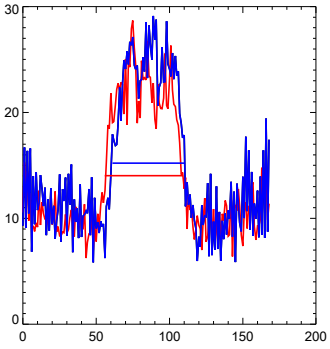




High Contrast Resolution



Slice Thickness

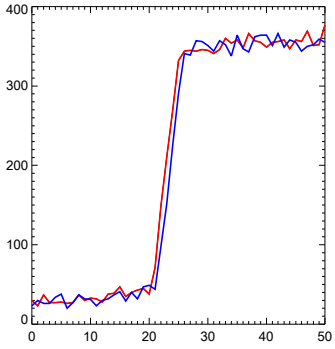


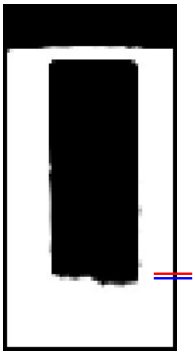
Upper=52.20

Lower=48.21

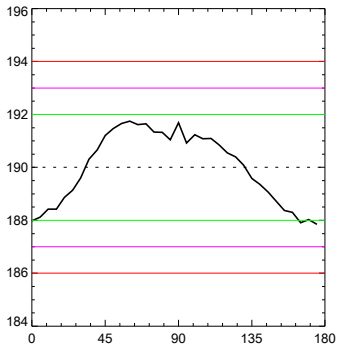
Slice Thickness=5.01

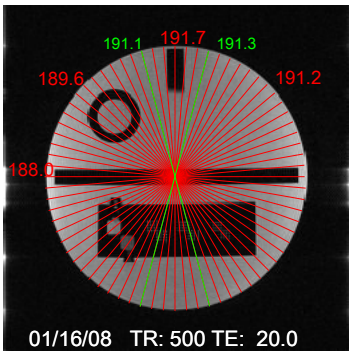
Slice Position - Inferior



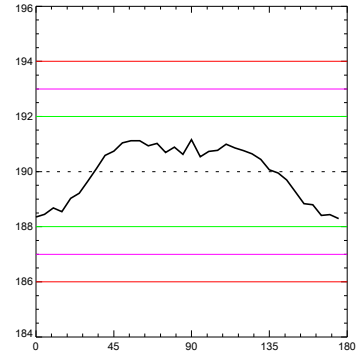


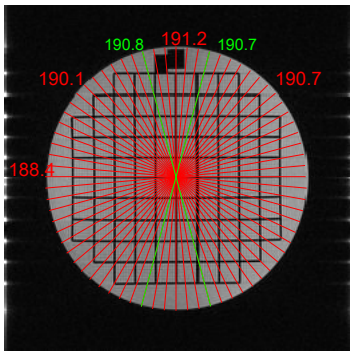
Axial Diameters - #1



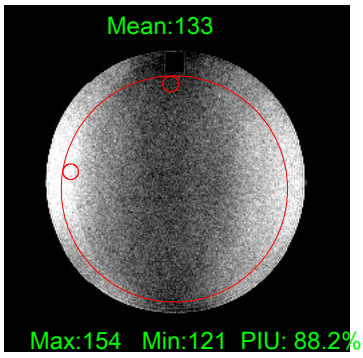


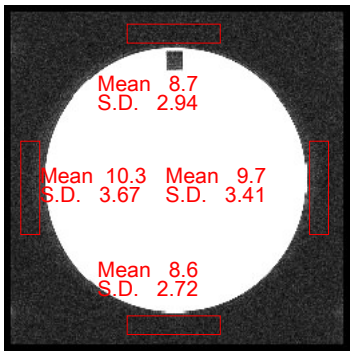
Axial Diameters - #5



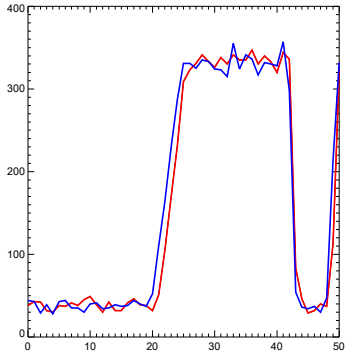


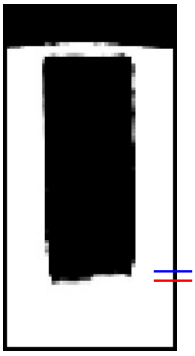
Uniformity & Ghosting - #7



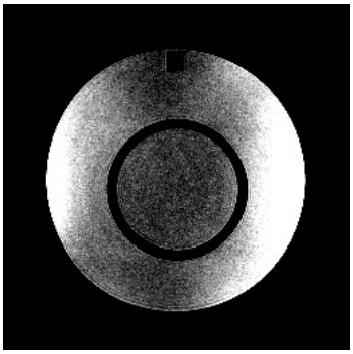


Slice Position - Superior

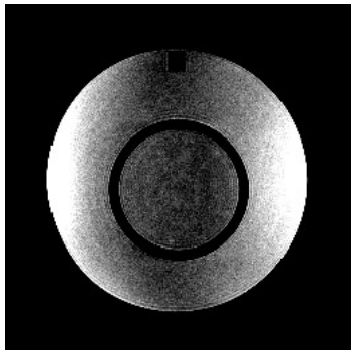




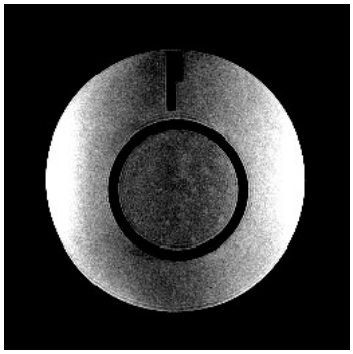
Low Contrast - #8



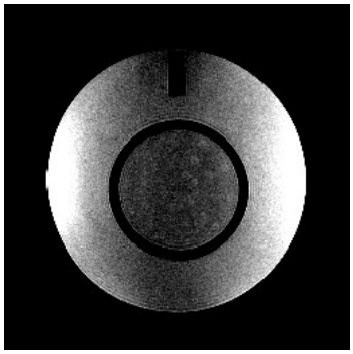
Low Contrast - #9



Low Contrast - #10



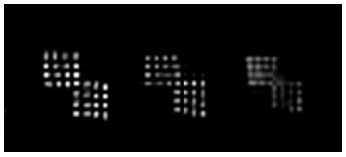
Low Contrast - #11



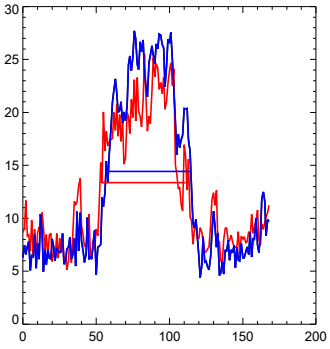
Appendix C: ACR Phantom Analysis

ACR PD

High Contrast Resolution



Slice Thickness

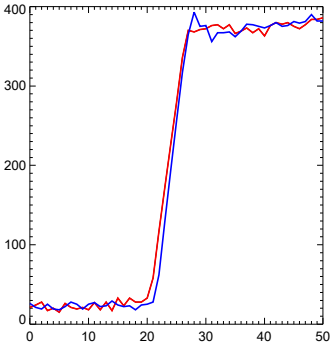


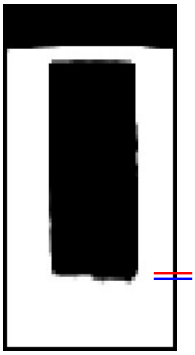
Upper=56.47

Lower=55.88

Slice Thickness=5.62

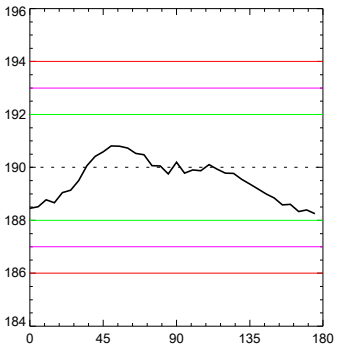
Slice Position - Inferior

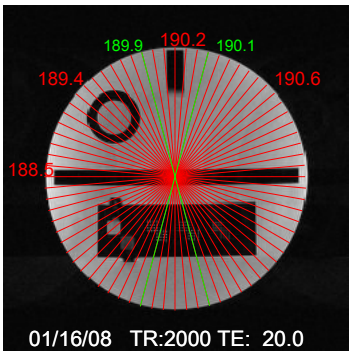




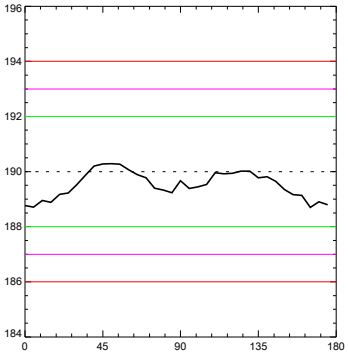
Diff.= 0.62

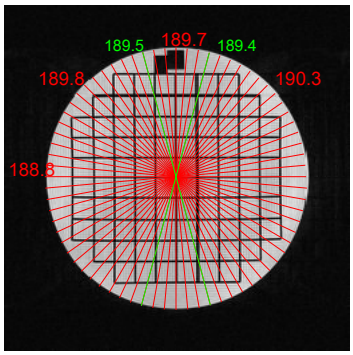
Axial Diameters - #1



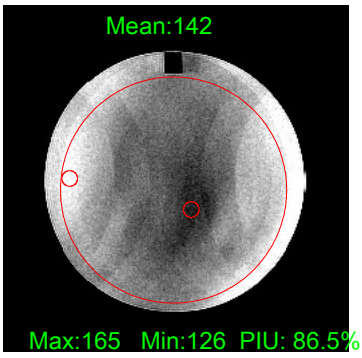


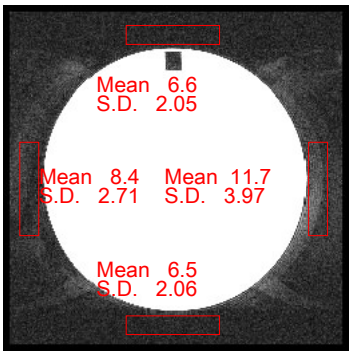
Axial Diameters - #5



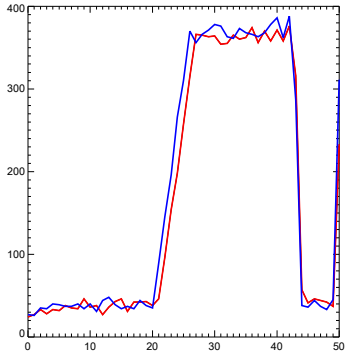


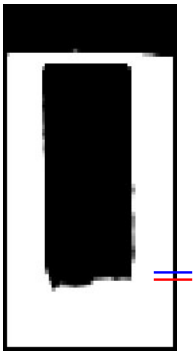
Uniformity & Ghosting - #7





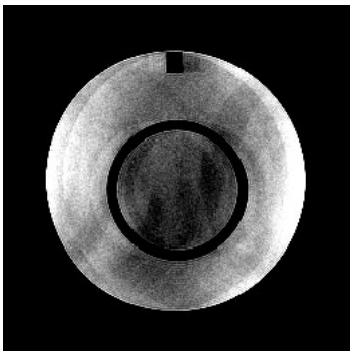
Slice Position - Superior



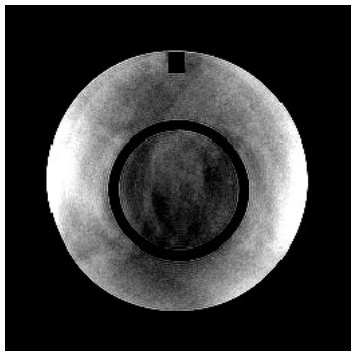


Diff.= -0.82

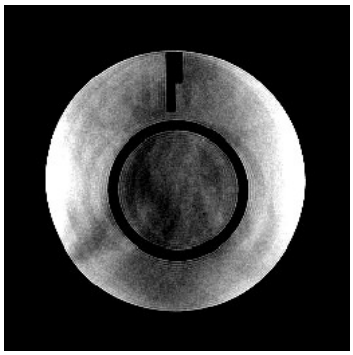
Low Contrast - #8



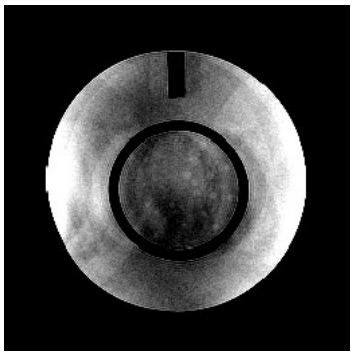
Low Contrast - #9



Low Contrast - #10



Low Contrast - #11

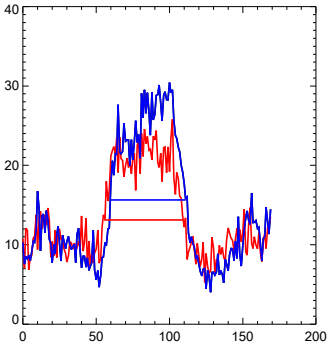


Appendix C: ACR Phantom Analysis

ACR T2

High Contrast Resolution

Slice Thickness

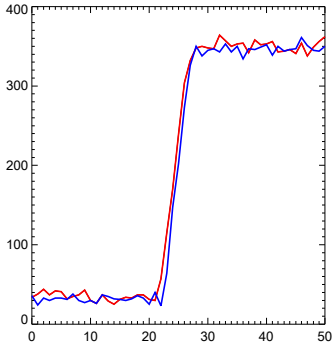


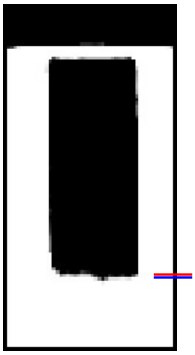
Upper=52.97

Lower=50.18

Slice Thickness=5.15

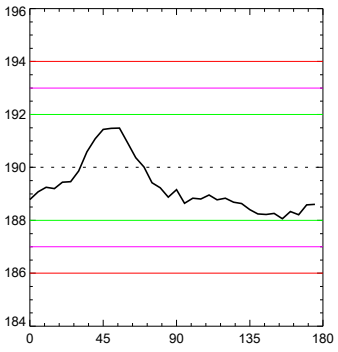
Slice Position - Inferior

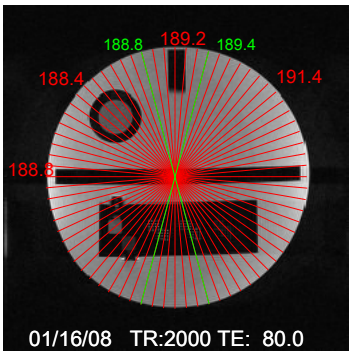




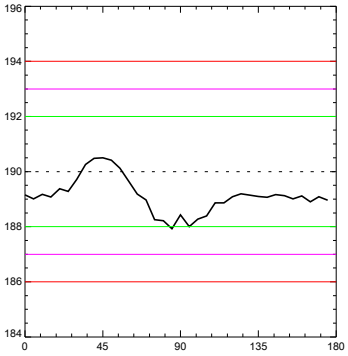
Diff.= 0.35

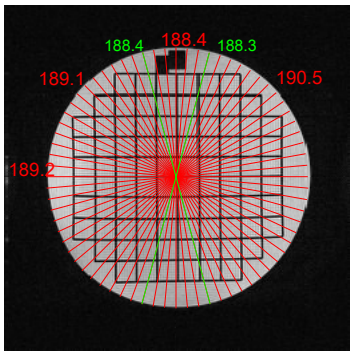
Axial Diameters - #1



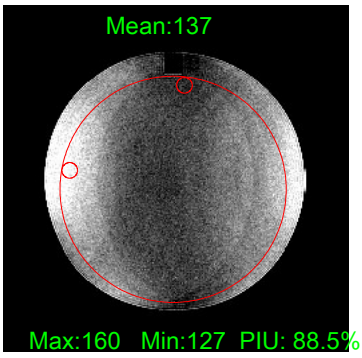


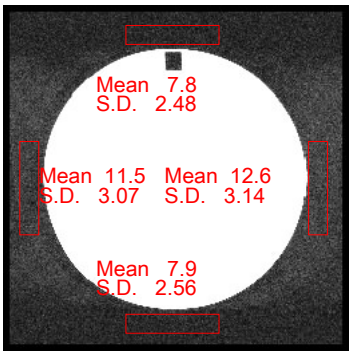
Axial Diameters - #5



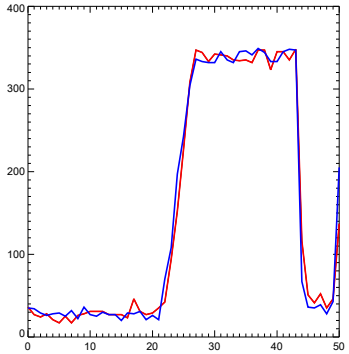


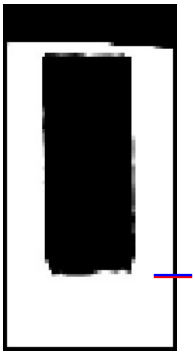
Uniformity & Ghosting - #7





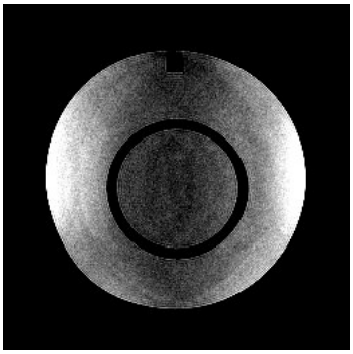
Slice Position - Superior



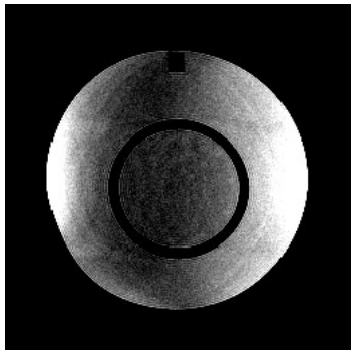


Diff.= -0.19

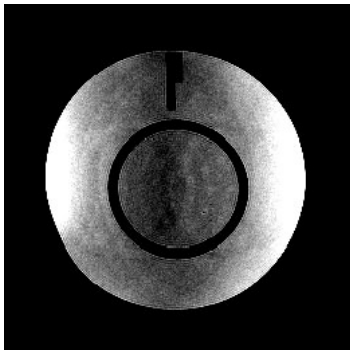
Low Contrast - #8



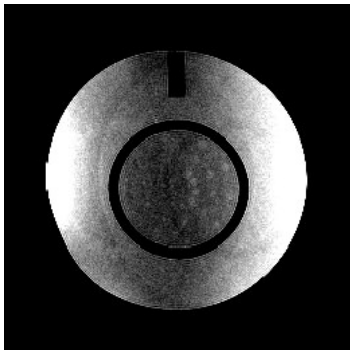
Low Contrast - #9



Low Contrast - #10



Low Contrast - #11



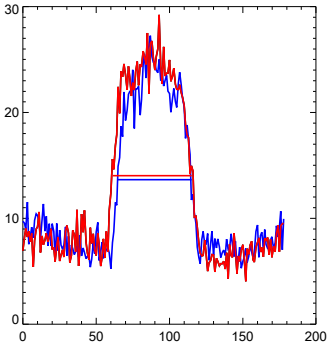
Appendix C: ACR Phantom Analysis

AP/PE

Site T1

High Contrast Resolution

Slice Thickness

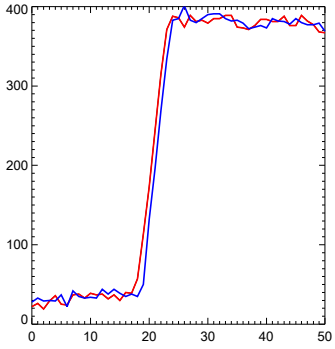


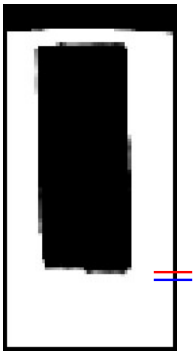
Upper=50.53

Lower=47.20

Slice Thickness=4.88

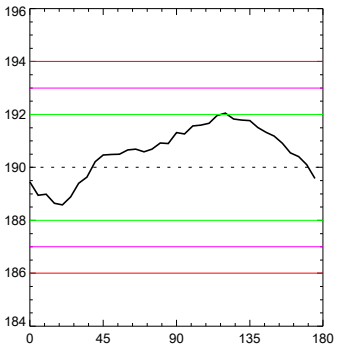
Slice Position - Inferior

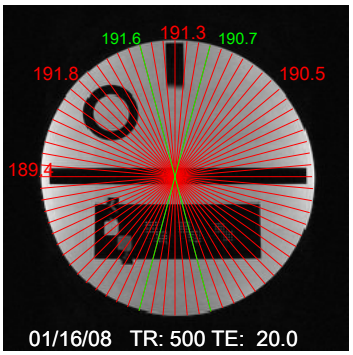




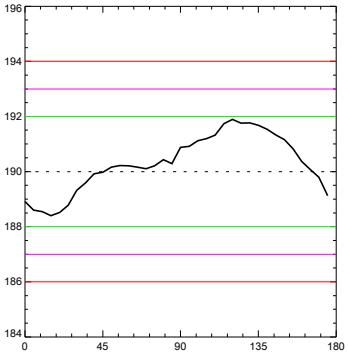
Diff.= 0.83

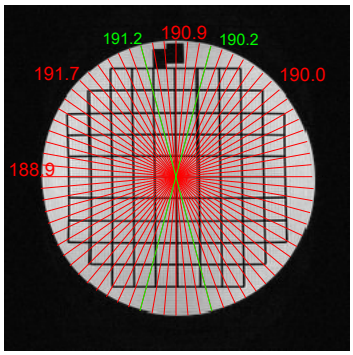
Axial Diameters - #1



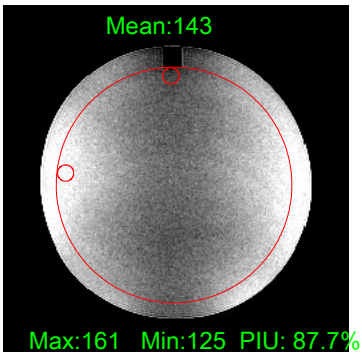


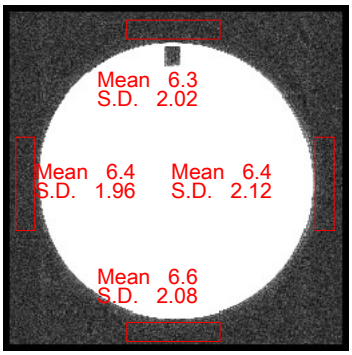
Axial Diameters - #5



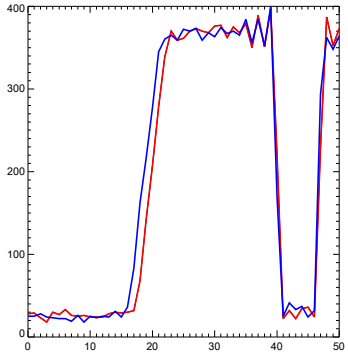


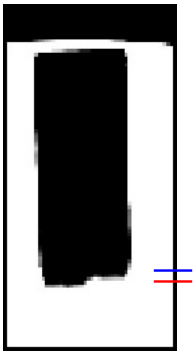
Uniformity & Ghosting - #7





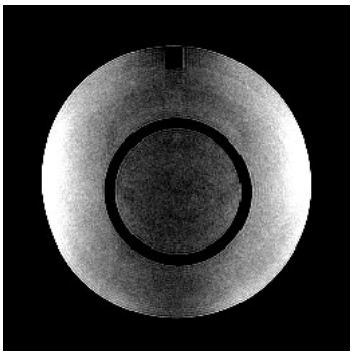
Slice Position - Superior



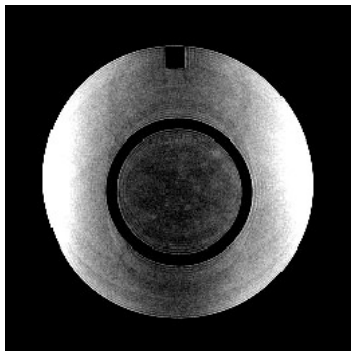


Diff.= -1.20

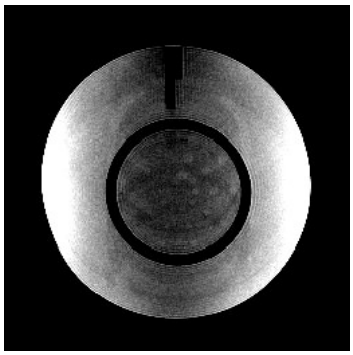
Low Contrast - #8



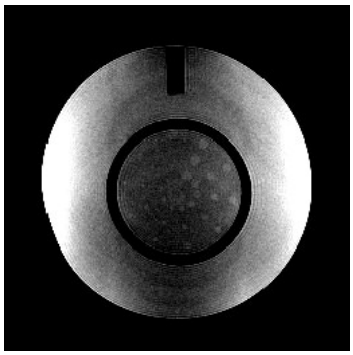
Low Contrast - #9



Low Contrast - #10



Low Contrast - #11

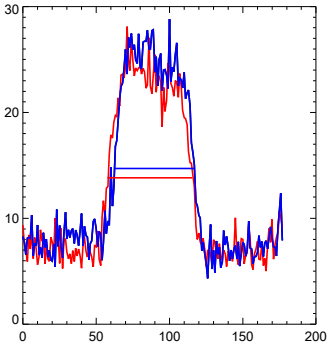


Appendix C: ACR Phantom Analysis

LR/PE Site T2

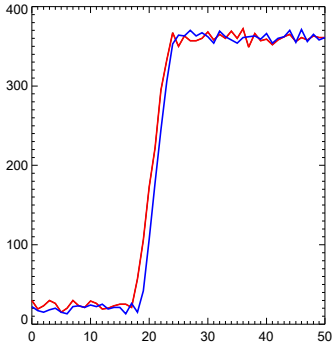
High Contrast Resolution

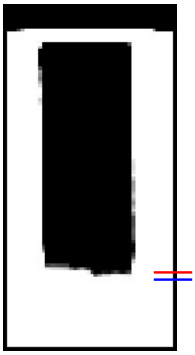
Slice Thickness



Upper=54.15
Lower=51.32
Slice Thickness=5.27

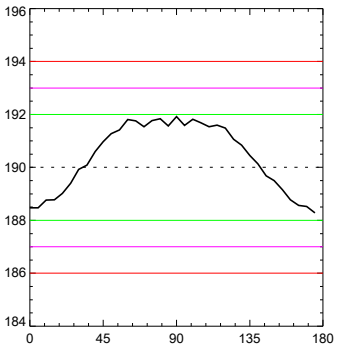
Slice Position - Inferior

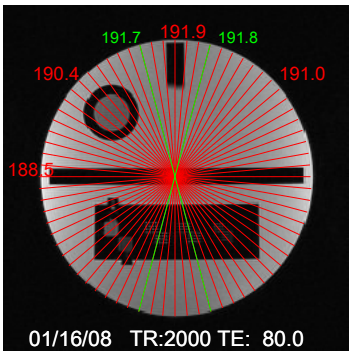




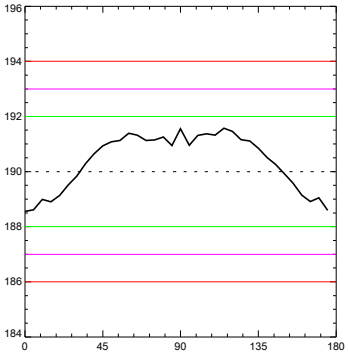
Diff.= 0.80

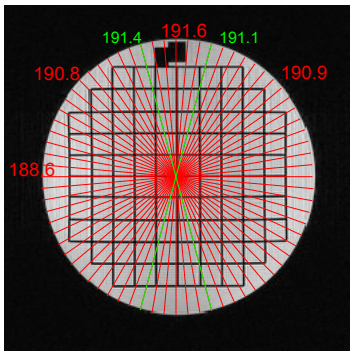
Axial Diameters - #1



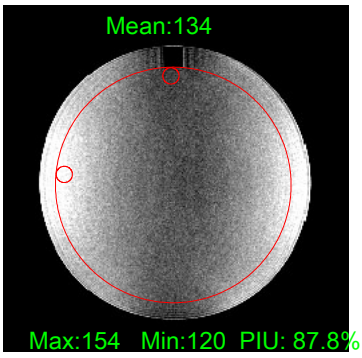


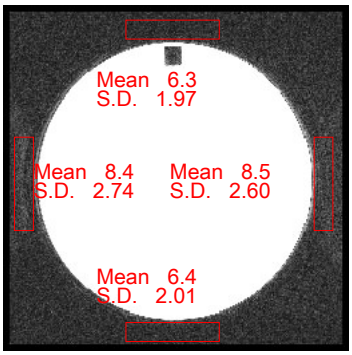
Axial Diameters - #5



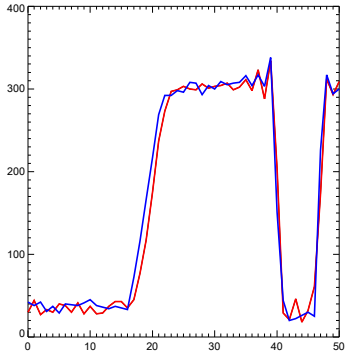


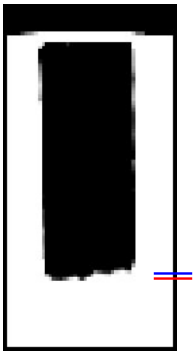
Uniformity & Ghosting - #7





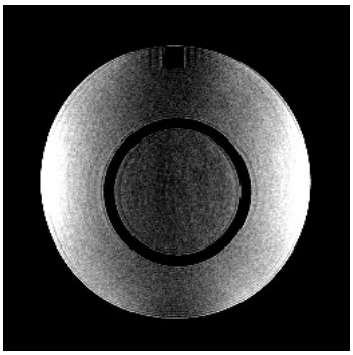
Slice Position - Superior



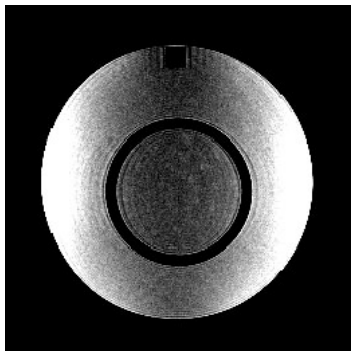


Diff.= -0.55

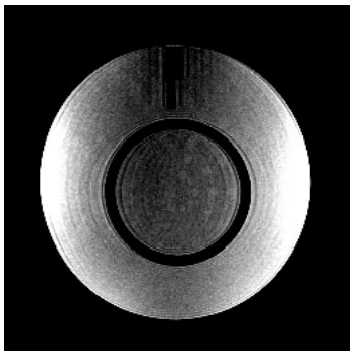
Low Contrast - #8



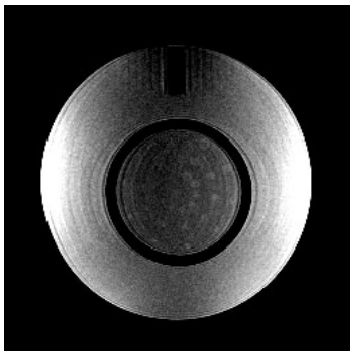
Low Contrast - #9



Low Contrast - #10



Low Contrast - #11

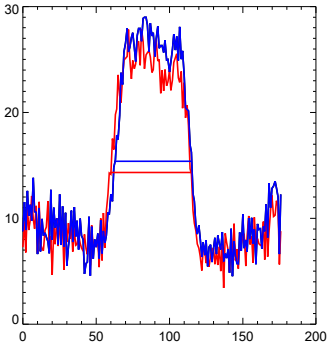


Appendix C: ACR Phantom Analysis

Site T1 LR/PE

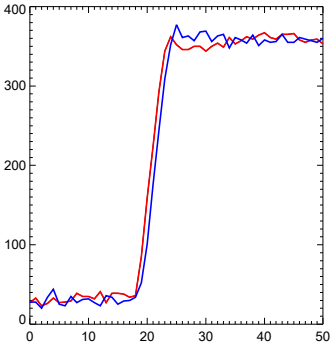
High Contrast Resolution

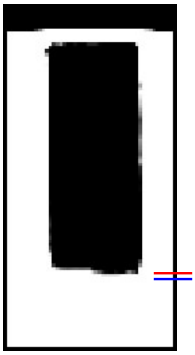
Slice Thickness



Upper=51.65
Lower=48.81
Slice Thickness=5.02

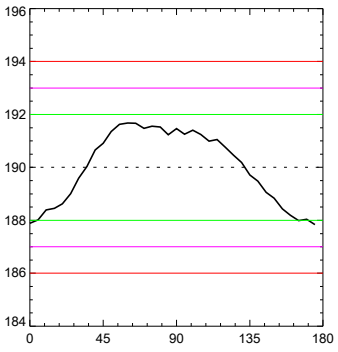
Slice Position - Inferior

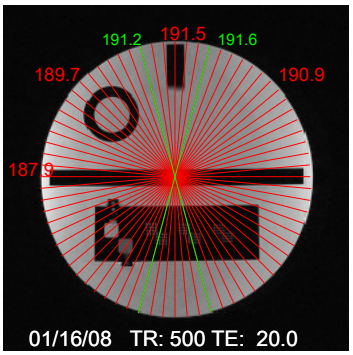




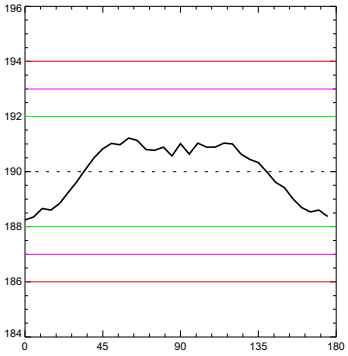
Diff.= 0.64

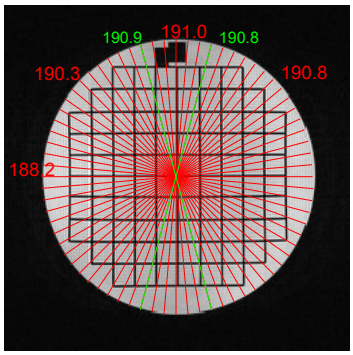
Axial Diameters - #1



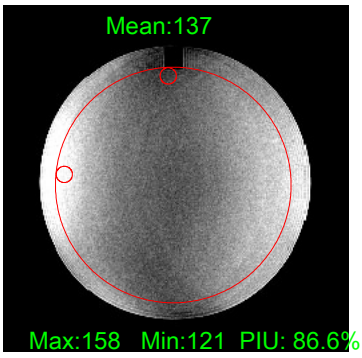


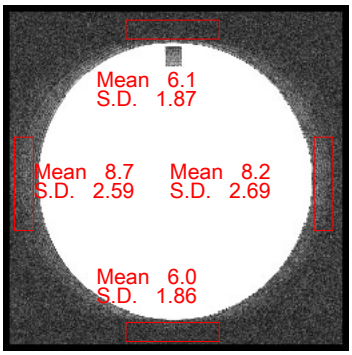
Axial Diameters - #5



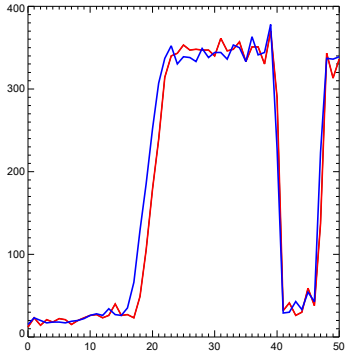


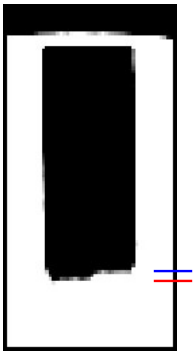
Uniformity & Ghosting - #7





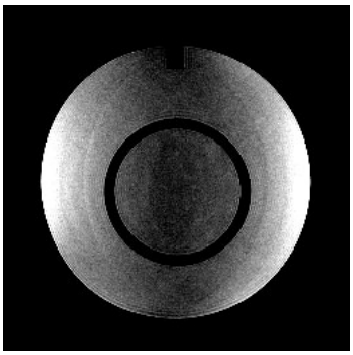
Slice Position - Superior



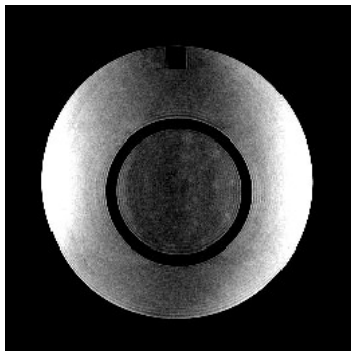


Diff.= -1.07

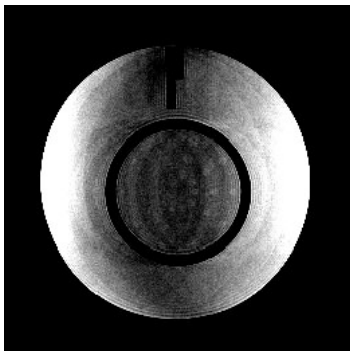
Low Contrast - #8



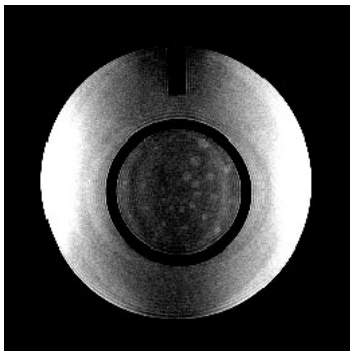
Low Contrast - #9



Low Contrast - #10



Low Contrast - #11

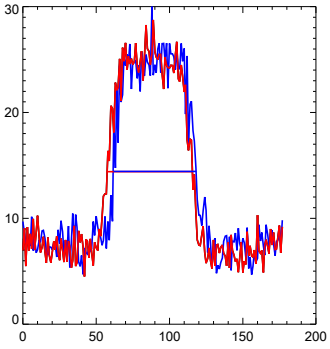


Appendix C: ACR Phantom Analysis

Site T2 - AP/PE

High Contrast Resolution

Slice Thickness

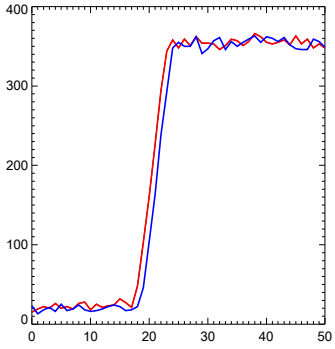


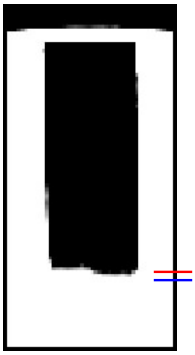
Upper=54.68

Lower=52.95

Slice Thickness=5.38

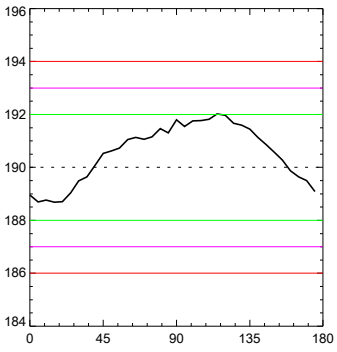
Slice Position - Inferior

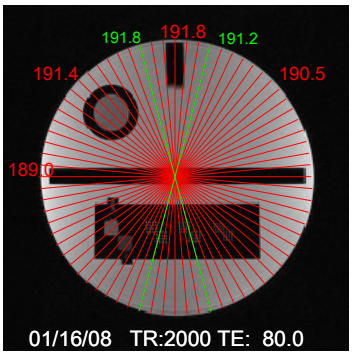




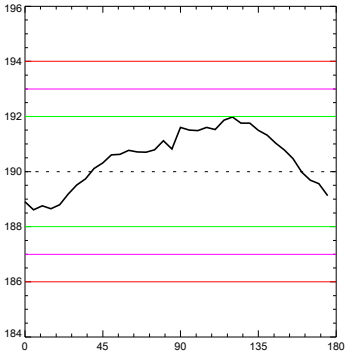
Diff.= 0.89

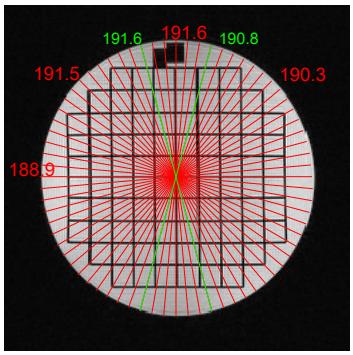
Axial Diameters - #1



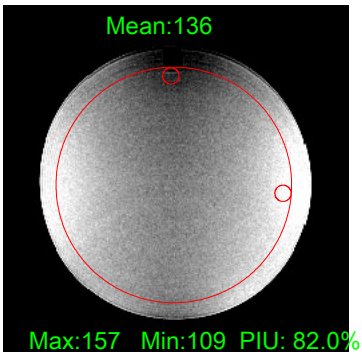


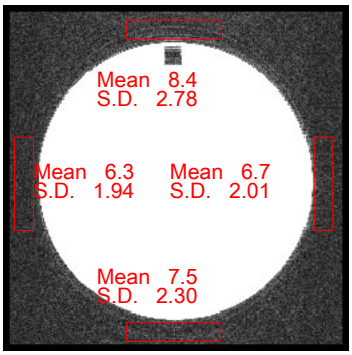
Axial Diameters - #5



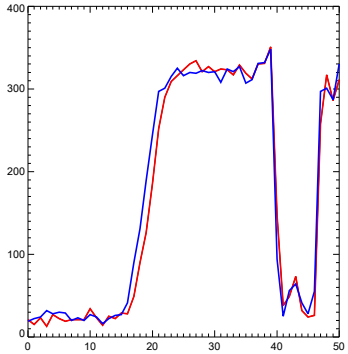


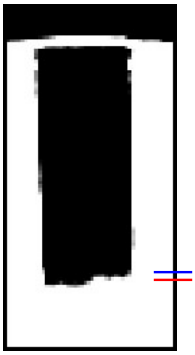
Uniformity & Ghosting - #7





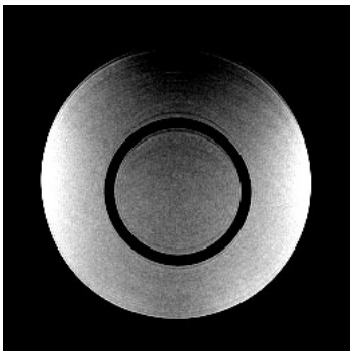
Slice Position - Superior



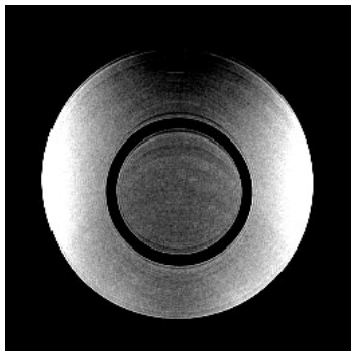


Diff.= -0.83

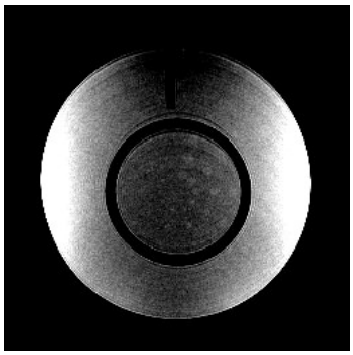
Low Contrast - #8



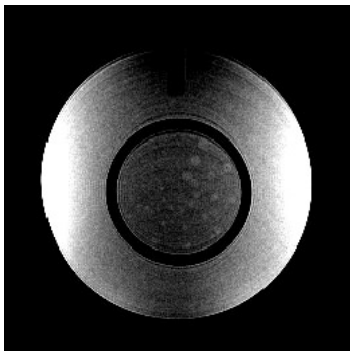
Low Contrast - #9



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.