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

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Coil and Other Hardware Inventory List

Site Name Siemens Site

ACR Magnet # _____ Nickname Symphony

Activ	e Coil Description	Manufacturer	Model	Rev.	Mfg. Date	SN	Channels
	Body - Integrated						1
	Body Array Flex	Siemens	07100048			3698	2
	Extremity CP	Siemens	03146466			3651	1
	Flex Large	Siemens	05512053			6584	1
	Flex Small	Siemens	05512038			6488	1
	Head	Siemens	03146037			4617	1
	Neck Array	Siemens	03146540			5280	2
	Shoulder Array - Large	Invivo	5516591			007093	4
	Shoulder Array - Small	Invivo	5516583			006738	4
	Spine Matrix	Siemens	03784498			4421	6
	Wrist Array	Invivo	101078		Mar, 2008	036538	4
							7 -

Site Name:	Siemens Site			MRAP #	
Address:				Survey Date:	7/21/08
City, State, Zip				Report Date:	7/28/08
MRI Mfg:	Siemens	Model:	Symphony	Field:	1.5T
MRI Scientist:	Moriel NessAiver, Ph.D.	Signature:	Moriel 1	Ventiver, P	h.O.
	Equipment Evalua	ation Tests		Pass Fail * N/A	
1.	Magnetic field homogeneity				
	Slice position accuracy:				
	Table positioning reproduci	bility:			
	Slice thickness accuracy:	5			
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				
				Pass Fail * N/A	
	Evaluation of Site's Technol	8	gram	Pas Fail N/A	
	Set up and positioning accur	racy: (daily)			
	Center frequency: (daily)				
	Transmitter attenuation or g				
	Geometric accuracy measur				
	Spatial resolution measurem				
	Low contrast detectability: ((daily)			
	Head Coil SNR (daily)				
	Body Coil SNR (weekly)	1 1 1	(1.1)		
	Fast Spin Echo (FSE/TSE)		: (daily)		
	Film quality control: (weekl	(y)			
11.	Visual checklist: (weekly)				

Specific Comments and Recommendations

1.	The 5 gauss line is containe within the scan room everywhere EXCEPT behind the magnet where it extends
	roughly 3 ft into the garden. Someone working out there could easily walk with 20 gauss. This should be
	blocked off in some way.

2.	The RF Noise test show noticeable RF noise lines.	Was the room adequately tested?
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3.]	There a	are no	MRI	compatible	fire	extinguishers	in	the	facility	•
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- 4. <u>The ACR phantom (borrowed from Bettendorf) is exceptionally cloudy, there is a large quantity of particulate matter</u> in the phantom. I have NEVER seen anything like this. The phantom should be sent back to the manufacturer for cleaning out and refilling.
- 5. The Neck Array produced noticeable artifacts and had lower SNR than the Bettendorf coil.
- 6. <u>All other coils have comparable SNR to Bettendorf.</u>
- 7. Magnet homogeneity is good.
- 8. All of the images exhibited higher than normal ghosting. Both the ACR T1 and Site T2 images are right on the

edge of failing ACR accreditation. I recommend you have your service engineer look into it.

9.	
10.	
11.	
-	
-	

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

C	ontact		Title	·	Phon	le	-	F	ax		eMail
MRI Mai mera Mai	nufacturer:	Sier	nens	Model:	Sympho			SN:		Software: Software: Software:	
		ACR P	hantom Nu	mber used:	J2491	-					
. Table]		g Reprod		0.47	0/T		/T				Pass
		ion out/in	IsoCenter	Out/In	Out/In	Out/					
			4.0	10	10	1	\cap				
Comr	ured Phanto nent: <u>Repr</u> 	om Center	-4.9 is excellent	See append		eld plot	er is o				PASS
Comr . Magne	ured Phanto ment: <u>Repr</u> etic Field Last Yea 15 cm	om Center oducibility Homogen r CF: 20 cm	-4.9 is excellent, eity N/A 25 cm	, but the cal See append Thi GRE 5 mm	ibration of lix A for fig s Year CF: TR: 500, T skip 4 mm	eld plot <u>63,0</u> E: 10 & , 256x12	er is o s. 684,56 15 Fl 28, 2n	56 lip Angl ex	CF Ch e: 45, F(ange: <u>N</u>	
Comr . Magne Axial:	ured Phanto nent: <u>Repr</u> etic Field Last Yea 15 cm 0.27	om Center oducibility Homogen r CF: 20 cm 0.48	-4.9 is excellent eity N/A 25 cm 0.77	, but the cal See append Thi GRE 5 mm	ibration of lix A for fi s Year CF: TR: 500, T	eld plot <u>63,0</u> E: 10 & , 256x12	er is o s. 684,56 15 Fl 28, 2n	56 lip Angl ex	CF Ch e: 45, F(ange: <u>N</u>	
Comr . Magne	etic Field Last Yea 0.27 0.19	om Center oducibility Homogen r CF: 20 cm	-4.9 is excellent, eity N/A 25 cm	, but the cal See append Thi GRE 5 mm	ibration of lix A for fig s Year CF: TR: 500, T skip 4 mm	eld plot <u>63,0</u> E: 10 & , 256x12	er is o s. 684,56 15 Fl 28, 2n	56 lip Angl ex	CF Ch e: 45, F(ange: <u>N</u>	
Comr . Magne Axial: Coronal: Sagittal: . Slice T	ured Phanto ment: <u>Repr</u> etic Field Last Yea <u>15 cm</u> 0.27 0.19 0.17 Chickness FOV: <u>250n</u>	Momogener Homogener r CF: 20 cm 0.48 0.36 0.34 Accuracy	-4.9 is excellent eity N/A 25 cm 0.77 0.59	, but the cal See append Thi GRE 5 mm Comn	ibration of lix A for fit s Year CF: TR: 500, T skip 4 mm nents: <u>Mag</u> i	eld plot <u>63,0</u> E: 10 & , 256x12 het homo	er is o s. 684,56 215 Fl 28, 2nd ogeneit	56 lip Angl ex ty is ver	CF Ch e: 45, Fo	ange: <u>N</u>	J <u>A</u>
Comr . Magne Axial: Coronal: Sagittal: . Slice T	ured Phanto nent: <u>Repr</u> etic Field Last Yea <u>15 cm</u> 0.27 0.19 0.17 Thickness FOV: 250n Sequ	m Center oducibility Homogen r CF: 20 cm 0.48 0.36 0.34 Accuracy m M	-4.9 is excellent eity N/A 25 cm 0.77 0.59 0.57 atrix: 256x	but the cal See append Thi GRE 5 mm Comn	ibration of lix A for fi s Year CF: TR: 500, T skip 4 mm nents: <u>Mag</u> i (Slic	e #1 frc	er is o s. 584,56 584,56 57 28, 2nd ogeneit	56 lip Angl ex ty is ver	CF Ch e: 45, F0 y good.	ange: <u>N</u> OV: 40	J <u>A</u>
Comr . Magne Axial: Coronal: Sagittal: . Slice T	ured Phanto ment: <u>Repr</u> etic Field Last Yea 15 cm 0.27 0.19 0.17 Chickness FOV: 250n Sequ SI	m Center oducibility Homogen r CF: 20 cm 0.48 0.36 0.36 0.34 Accuracy m M ience	-4.9 is excellent, eity N/A 25 cm 0.77 0.59 0.57 atrix: 256x TR	but the cal See append Thi GRE 5 mm Comn 256 TE	ibration of lix A for fit s Year CF: TR: 500, T skip 4 mm nents: <u>Mag</u> r (Slic Flip	e #1 fro	er is o er is o 584,56 28,2nd ogeneit	56 lip Angl ex ty is ver	CF Ch e: 45, Fo y good. ntom) A Farget	ange: <u>N</u> OV: 40	J <u>A</u>
Comr . Magne Axial: Coronal: Sagittal: . Slice T	ured Phanton nent: <u>Repr</u> etic Field Last Yea 15 cm 0.27 0.19 0.17 Thickness FOV: 250n Sequ SI SE	m Center oducibility Homogen r CF: 20 cm 0.48 0.36 0.34 Accuracy m M ence E (ACR)	-4.9 is excellent, eity N/A 25 cm 0.77 0.59 0.57 atrix: 256x: TR 500	but the cal See append Thi GRE 5 mm Comn 256 <u>TE</u> 20	ibration of lix A for fi s Year CF: TR: 500, T skip 4 mm nents: <u>Magn</u> (Slice Flip 90	e #1 fro	er is o s. 584,56 28, 2nd ogeneit om AC Cal 5.3	56 lip Angl ex ty is ver	CF Ch e: 45, F(y good. ntom) A Farget 5	ange: <u>N</u> OV: 40	J <u>A</u>
Comr . Magne Axial: Coronal: Sagittal: . Slice T	ured Phantoment: <u>Repr</u> etic Field End End End End End End End End End En	m Center oducibility Homogen r CF: 20 cm 0.48 0.36 0.34 Accuracy m M ence E (ACR) (Site T1)	-4.9 is excellent, eity N/A 25 cm 0.77 0.59 0.57 atrix: 256x TR 500 500	but the cal See append Thi GRE 5 mm Comm 	ibration of lix A for fit s Year CF: TR: 500, T skip 4 mm nents: <u>Magn</u> (Slic Flip 90 90	e #1 from NSA	er is o s. 684,56 28, 2n6 28, 2n6 28, 2n6 0 28, 2n6 0 5.3 5.7	56 lip Angl ex ty is ver	CF Ch e: 45, F (y good. <u>ntom) A</u> <u>Farget</u> <u>5</u> 5	ange: <u>N</u> OV: 40	J <u>A</u>
Comr . Magne Axial: Coronal: Sagittal: . Slice T	ured Phantoment: <u>Repr</u> etic Field I Last Yea 15 cm 0.27 0.19 0.17 Chickness FOV: 250n Sequ SE SE SE SE SE	om Center oducibility Homogen r CF: 20 cm 0.48 0.36 0.34	-4.9 is excellent. eity N/A 25 cm 0.77 0.59 0.57 atrix: 256x: TR 500 500 2000	but the cal See append Thi GRE 5 mm Comn 256 TE 20 14 20	ibration of lix A for fid s Year CF: TR: 500, T skip 4 mm nents: <u>Magn</u> (Slice Flip 90 90 90	e #1 from 1 et homo e #1 from NSA 1 1 1	er is o s. 584,56 215 Fl 28, 2nd ogeneit om AC Cal 5.33 5.77 5.33	56	CF Ch e: 45, F0 y good. ntom) A Farget 5 5 5	ange: <u>N</u> OV: 40	J <u>A</u>

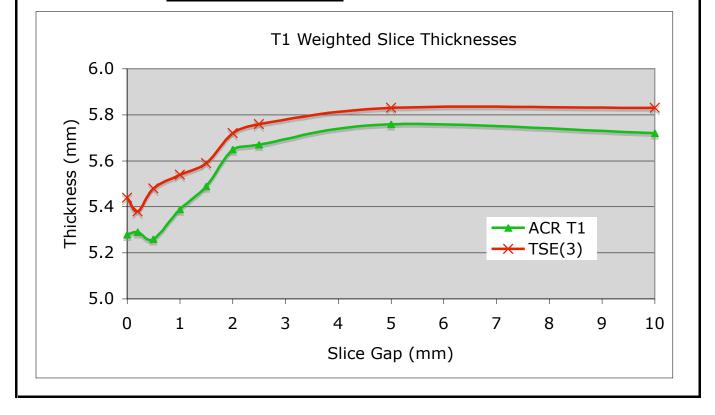
4. Slice Crosstalk (RF interference)

The following data were obtained using the ACR phantom slice thickness wedges to measure the slice profile of two common T1 weighted sequences when the slice gap varies from 200% down to 0% (contiguous) As the slices get closer together it is expected that the edges of the slices will overlap causing a deterioration of the slice profile. The data shown below clearly demonstrates this effect. Once the slice gap reaches 50% of the slice thickness, the measured slice profiles begin to drop. I recommend that you always use at least a 20% gap.

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

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

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



5. Soft & Hard Copy Displays Luminance Meter Make/Model: Tektronix J16 Digital Photometer Cal Expires: 4/6/06 Monitor Description: Siemens brand LCD Luminance Measured: Ft. lamberts **Measured Data** Uniformity SMPTE Bottom Bottom Тор Center of Top Left Which Percent MAX Image Right Left Right MIN OK? Monitor Delta Corner Display Corner Corner Corner 40.3 39 41.8 7% Console 41 40.2 41.8 39 Y % delta =200% x (max-min)/(max+center) (>30% is action limit) Minimum Brightness must be > 26.24 Ft. Lamberts Display is excellent! There is no camera to test. Ft-Density **LCD & Film Response Curve** Lamber 100.0 3 0 0.19 5 0.37 2.5 10 0.56 20 1.35 2.74 Log Ft-Lambert 30 10.0 2 40 4.85 Ideal Curve 50 7.89 - LCD 1.5 - Film 60 12.02 70 17.3 1.0 1 80 23.9 90 32.1 + 0.5 38.0 95 40.9 100 0 0.1 0 20 40 60 80 100 % Density

RF Coil Performance Evaluation Coil: Body - Integrated Mfg.:	Test Date: 7/20/2008 Model:						
Coil Mode: Body							
Analysis of Test Image Measured Data	Calculated Results						
Back Noise Noise Mean Label Mean Max Min ground SD Type SNR	Normal- Max Uni- ized SNR formity						
N 1,425 1,653 1,142 1.3 14.65 NEMA 68.8	<u>31.7</u> 79.8 81.7%						
A 1,424 1,659 1,129 23.3 12.38 Air 75.4	34.8 87.8 81.0%						
Mean: 1425 ROI M: 1.34 ROIsd: 14.65 0 11653 0 11629 ROI Area: 577.13 Mean: 1424 Air M: 23.26 Airsd: 12.38 0 1659 0 11659 ROI Area: 577.13							

RF Coil Per	formance Evalı	uation		Test Date:7/20/2008
Coil: Body A	Array Flex		BREFE	Model: 07100048
Mfg.: Siemens	•			Revision:
Mfg. Date:	Coil ID:	1731		SN: 3698
Phantom: 2 Long (Cylinders			# of Channels 2
	RTEPlane0020T	FOV Nx 50 256	Ny BW 256 25.6	NSA Thickness Gap
		200	200 200	
Coil Mode: <u>B0 1</u> ,				
		Analysis of Com		
	Measured			Calculated Results
Label Mean	Max Min	Back Noise ground SD	Noise Mean Type SNR	Normal- Max Uni- ized SNR formity
N 413	783 159	1.2 2.54	NEMA 115.0	53.0 218.0 33.8%
N 400	772 156	-1.1 2.85	NEMA 99.3	45.8 191.6 33.6%
A 411	781 156	4.7 2.05	Air 131.4	60.6 249.7 33.3%
A 401	772 162	4.7 2.05	Air 128.2	59.1 246.8 34.7%
	Ar	nalysis of Uncor	nbined Images	
N	leasured Data		Ca	Iculated Results
Ch Maan	Noise Max SD	Noise		% of Max % of
Ch Mean 1 270	Max SD	Type Air		Mean SNR Max 95% 177.0 95%
2 285	542 1.91	Air		100% 186.0 100%
3 271	517 1.92	Air	92.5	95% 176.5 95%
4 283	539 1.92	Air	96.6	99% 184.0 99%
	Mean: 413 ROI M: 1.17 ROIsd: 2.54	Mean: 400 ROI M: - ROIsd: 2		
Composites	07/93 01/59 ROI Area: 146.06	ROI Area: 150.10	BOI Area: 146.06	BOI Area: 150.10
	Mean: 270 Air M: 3.12 Airsd: 1.91	Mean: 285 Air M: 3. Airsd: 1.		
Channels	0513	0 0 1 1 2 0 1 1 0		C 339 6107
	ROI Area: 150.10	ROI Area: 146.06	ROI Area: 150.10	ROI Area: 146.06
l	Channel 1	Channel 2	Channel 3	Channel 4

RF Coil Performance Evaluation	ation	Test Date	:7/20/2008
Coil: Body Array Flex	A B	and the second second	: 07100048
Mfg.: Siemens		Revision	:
Mfg. Date: Coil ID:	1731	SN	: 3698
Phantom: <u>2 Long Cylinders</u>			# of Channels 2
SequenceTRTEPlaneSE30020T		y BW NSA 56 25.6 2	Thickness Gap 3 -
Coil Mode: BO 1,2			
	nalysis of Composit		
Measured D			ed Results
Label Mean Max Min g	Back Noise Noise ground SD Type	e Mean Normal- SNR ized	Max Uni- SNR formity
N 270 422 49	-0.1 1.55 NEM	A 123.2 40.2	192.5 20.8%
N 250 374 50	-0.1 1.49 NEM		177.5 23.6%
A 270 421 50	3.4 1.54 Air	114.9 37.5	179.1 21.2%
A 250 374 50	3.4 1.54 Air	106.4 34.7	159.1 23.6%
An;	alysis of Uncombine	ed Images	
Measured Data		Calculated	Results
Noise Ch Mean Max SD	Noise Type	Mean % of SNR Mean	Max % of SNR Max
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	Air	68.7 94%	165.2 89%
2 148 335 1.44	Air	67.4 92%	152.5 82%
3 161 410 1.44	Air	73.3 100%	186.6 100%
4 159 390 1.44	Air	72.4 99%	177.5 95%
Mean: 270 ROI M: -0.14	Mean: 250 ROI M: -0.06 Mea	n: 270 Air M: 3.36 Mean: 250	Air M: 3.35
ROIsd: 1.55	ROIsd 5049	Airsd: 1.54	Airsd: 1564
0422	0374	0421	O 3 74
Composites	0.014	0-121	
		the state of the s	
A01 Area: 535.76	ROI Area: 536.71 ROI	 Area: 535.76 ROI Area: 5	536.71
		an: 161 Air M: 2.25 Mean: 159	
Airsd: 1.44	Airsd: 1-44	Airsd: 1.44	Airsd: 1.44
0363		0410	
Channels		Second Second	
	⊖ <u>9</u> 85	O ₃	Deseo
ROI Area: 536.71	ROI Area: 536.71 RO	Area: 535.76 ROI Area:	535 76
Channel 1	Channel 2		annel 4

	RF C	F Coil Performance Evaluation						-		Test Date:	7/2	20/2008
	Coil:	Extren	nity CP			NETON	3	-			03	
	Mfg.:	Siemens					Z .	-	-	Revision:		
	Mfg. Date: Coil ID: 1728							TT	1	SN:		3651
P	Phantom: Long Cylinder										# of Ch	annels <u>1</u>
	Seque SI		R TE 00 20		e FOV 36	Nx 256	Ny 256		BW 25.6	NSA T	hickness 3	Gap _
	Coil Mo	de: <u>EX</u>										
					Anal	ysis of	Test Ima	ige				
			М	easured						alculate		
	Label	Mean	Max	Min	Back ground	Noise SD	Noise Type		Mean SNR	Normal- ized	Max SNR	Uni- formity
	N	1,392	1,552	1,215	-3.7 15.2	9.28	NEMA Air		106.1	94.4 98.6	118.3	87.8%
	A	1,396	1,554	1,222	15.2	8.25			110.9	98.0	123.4	88.0%
	Mean: 1392 ROI M: -3 ROIsd: 9 01215 01552					9.28 5	Mean: 13		Air	M: 15.2 sd: 8.25 1222 554	1	
			ROI Area	. 102.71		Test Ima		. 102				
						1000 1110	200					
1												

RF Coil Performance Evaluation Coil: Flex Large Mfg.: Siemens Mfg. Date: Coil ID: Phantom: Long Cylinder Sequence TR TE Plane FOV Nx Ny BW SE 300 20 T Coil Mode: FL Ports 1 and 4								BW	Model Revision SN	n:	20/2008 5512053 6584 annels 1 Gap -
				Anal	ysis of	Test Ima	age				
		M	easured	Data				C	alculate	ed Resu	ts
Label	Mean	Мах	Min	Back ground	Noise SD	Noise		Mean SNR	Normal- ized	Max SNR	Uni- formity
N1	531	660	417	-1.5	5.00	Type NEMA	1 F	75.1	66.8	93.4	77.4%
A1	532	661	427	5.7	3.29	Air		106.0	94.3	131.7	78.5%
N4	534	662	418	-1.0	4.05	NEMA		93.2	83.0	115.6	77.4%
A4	535	663	421	5.8	3.30	Air		106.2	94.5	131.7	77.7%
	Port 1 are first (upper) two, Port 4 are lower 2. Test Images Mean: 531 ROI M: -1.47 Mean: 532 Air M: 5.74 Airsd: 3.29 Image 3.29 Image 3.20 Image 3.20										
	ROI Area: 161.59 ROI Area: 161.59 Mean: 534 ROI M: -1.00 ROIsd: 4.05 Mean: 535 Air M: 5.82 Airsd: 3.30 Image: Area and Area										

RF Coil Performance Evaluation Coil: Flex Small Mfg.: Siemens Mfg. Date: Coil ID: 1723 Phantom: Small Bottle Sequence TR TE Plane FOV SE 300 20 T 25 Coil Mode: FS	Nx Ny 256 256	Test Date: 7/20/2008 Model: 05512038 Revision:
_	sis of Test Image	
Measured Data		Calculated Results
Back Label Mean Max Min ground	Noise Noise SD Type	Mean Normal- Max Uni- SNR ized SNR formity
N 744 1,033 318 -1.5	6.77 NEMA	77.7 143.4 107.9 47.1%
A 745 1,034 318 10.7	5.85 Air	83.5 153.9 115.8 47.0%
ROIsd: 6	1.51 Mean: 745 5.77 ROI Area: 88.4	Air M: 10.68 Airsd: 5.85

<u>RF (</u>	RF Coil Performance Evaluation							-	-	Fest Date:	7/2	0/2008
Co	Coil: <u>Head</u>									Model:		146037
Mfg	g.:	Siemens							D)	Revision:		
	Mfg. Date: Coil ID: 1727						~	1-		SN:		4617
Phantom: ACR Phantom											# of Cha	annels <u>1</u>
	SequenceTRTEPlaneFOVSE30020T40						x Ny 6 256		BW 25.6	NSA TI	hickness 3	Gap _
Coil N	/lod	le: <u>Head</u>	l									
					Anal	ysis o	f Test Ima	ge				
			М	easured						alculate		
Labe) 	Mean	Max	Min	Back ground	Noise SD		г	Mean SNR	Normal- ized	Max SNR	Uni- formity
		1,381 1,380	1,492 1,495	1,298 1,296	1.3 11.0	7.20 6.00	NEMA Air	ŀ	135.6 150.7	97.7 108.6	146.6 163.3	93.0% 92.9%
		1,000	1,175	1,270	11.0	0.00		L	100.7	100.0	100.0	///
		N	/lean: 13	81	BOI M.	1.32	Mean: 13	80	Air	M: 10.95	5	
				01	ROIsd:			00		sd: 6.00		
					~							
									-			
				01492				01	495			
				01492	298				495			
		F	ROI Area	: 235.61			ROI Area:	235	5.61			
						Test In						
l												

RF Coil Performance Evaluation		Test Date:	7/20/2008
Coil: Neck Array		Model:	03146540
Mfg.: Siemens		Revision:	
Mfg. Date: Coil ID: 1730		SN:	
Phantom: Long Cylinder			# of Channels 2
SequenceTRTEPlaneFOVSE30020S50	Nx Ny 256 256	BW NSA Th 25.6 1	nickness Gap 3 -
Coil Mode: <u>NE 1,2</u>	_		
Analysis	of Composite In	nage	
Measured Data		Calculate	d Results
Back Label Mean Max Min ground	Noise Noise SD Type	Mean Normal- SNR ized	Max Uni- SNR formity
N 522 1,323 173 -0.2	3.31 NEMA	111.5 51.4	282.7 23.1%
A 523 1,322 174 7.2	2.91 Air	117.8 54.3	297.7 23.3%
Analysis o	of Uncombined Ir	nages	
Measured Data	. –	Calculated	
Ch Mean Max SD Type	-	Mean % of <u>SNR Mean</u>	Max % of SNR Max
1 379 1,156 2.82 Air 2 248 1,135 2.66 Air		88.1 100% 61.1 69%	268.6 96% 279.6 100%
2 270 1,155 2.00 All	L	01.1	219.0
Mean: 522 ROI M: -0.21 Mean: 523 Air M: ROIsd: 3.31 Airsd:		Air M: 4.85 Mean: Airsd: 2.82	248 Air M: 4.57
	1		
01323		D 1156	
			01135
9 173		019	
ROI Area: 414.97 ROI Area: 414.97	ROI Area: 4	414.97 ROLA	rea: 414.97
Composites		Channel 1	Channel 2

Coil: Mfg.:	Neck A Siemens	rray						Revision:	03	146540
	Long Cy			1/30			b	5N:	# of Cha	annels _2
Seque				- <u> </u>	Nx 256	Ny 256	BW 25.6	NSA Tr	nickness 3	Gap -
SE Coil Mod	2 30 de: <u>Neck</u>			J L						
		2 slices		Analysis		nposite Im			d Resul]
		2 slices	easurec	Analysis		nposite Im		Calculated	d Resul	ts Uni- formity
Coil Mo	de: <u>Neck</u>	2 slices	easured	Analysis I Data Back	s of Cor	Noise	C Mean	Normal-	Max	Uni-
Coil Mo	de: <u>Neck</u> Mean	2 slices M Max	easurec Min	Analysis d Data Back ground	s of Cor	Noise Type	Mean SNR	Normal- ized	Max SNR	Uni- formity
Coil Moo	de: <u>Neck</u> Mean 735	2 slices M Max 1,208	easureo Min 317	Analysis d Data Back ground	s of Cor Noise SD 6.05	Noise Type NEMA	Mean SNR 85.9	Normal- ized 76.4	Max SNR 141.2	Uni- formity 41.6%

			i Uncombined images				
	Me	easured	Data		(Calculate	d Re
			Noise	Noise	Mean	% of	
h	Mean	Max	SD	Туре	SNR	Mean	5
a	731	1,205	5.39	Air	88.9	100%	1

	Me	easured	Data			Calculated Results				
Ch	Mean	Max	Noise SD	Noise Type	Mean SNR	% of Mean	Max SNR	% of Max		
1 a	731	1,205	5.39	Air	88.9	100%	146.5	100%		
2a	66	185	6.29	Air	6.9	8%	19.3	13%		
1b	446	1,099	7.49	Air	39.0	44%	96.2	66%		
2b	205	384	5.34	Air	25.2	28%	47.1	32%		

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

	Mean: 735 ROI M: -0.10 ROIsd: 6.05	Mean: 735 Air M: 16.36 Airsd: 6.23	Mean: 494 ROI M: -1.10 ROIsd: 7.34	Mean: 495 Air M: 19.15 Airsd: 7.07
Composites	0 1208	0 1207	201	01152
	ROI Area: 163.79	ROI Area: 163.79	ROI Area: 161.65	ROI Area: 161.65
	Mean: 731 Air M: 9.80 Airsd: 5.39	Mean: 66 Air M: 11.56 Airsd: 6.29	Mean: 446 Air M: 15.26 Airsd: 7.49	Mean: 205 Air M: 9.68 Airsd: 5.34
Channels	O 1205	0.135	01099	0384
	ROI Area: 163.79	ROI Area: 163.79	ROI Area: 161.65	ROI Area: 161.65
	Channel 1	Channel 2	Channel 3	Channel 4

RF Coil Performance Evaluation		Test Date: 7/20/2008	
Coil: Shoulder Array - Large		Model: 5516591	
Mfg.: Invivo	AT 2 PT	Revision:	
Mfg. Date: Coil ID: 1725		SN: 007093	
Phantom: Small Bottle		# of Channels	4
Sequence TR TE Plane FOV Nx	Ny BW	NSA Thickness Gap	
SE 300 20 T 30 256	256 25.6		
Coil Mode: <u>SH 1,2,3,4</u>			
Analysis of Comp	posite Image		
Measured Data		Calculated Results	
	Noise Mean Type SNR	Normal- Max Uni- ized SNR formity	
	NEMA 91.0	116.6 136.6 45.9%	1
A 1,323 1,984 591 18.3 5.19	Air 167.0	214.0 250.5 45.9%	
Analysis of Uncom	bined Images		
Measured Data	C	alculated Results	
Noise Noise Ch Mean Max SD Type	Mean SNR	% of Max % of Mean SNR Max	
1 505 951 4.56 Air	72.6	67% 136.7 68%]
2 597 711 4.30 Air	91.0	<u>83%</u> <u>108.4</u> <u>54%</u>	
3 843 1,547 5.07 Air 4 603 1,009 4.26 Air	109.0	100% 200.0 100% 85% 155.2 78%	
	Channe		
	Mean: 505 A	Air M: 8.19 Airsd: 4.56 Airsd: 4.30	
Mean: 1323 ROI M: -0.20 Mean: 1323 Air M: 18.2	28	Allou. 4.00	
ROIsd: 10.28 Airsd: 5.19	9	C 203 C 395	
		0711	
O 1985 C 592 O 1984 C 591	ROI Area: 85.89	ROI Area: 85.89	
JUSE JUSE	Mean: 843 A	Air M: 9.19 Mean: 603 Air M: 7.64	
	P C C C C C C C C C C C C C C C C C C C	Airsd: 5.07 Airsd: 4.26	
	0 1547	C 319 C 222	
ROI Area: 85.89 ROI Area: 85.89			
Composites	ROI Area: 85.89	ROI Area: 85.89	
	Channe		

RF Coil Performance Evaluation	Test Date: 7/20/2008
Coil: Shoulder Array - Large	Model: 5516591
Mfg.: Invivo	Revision:
Mfg. Date: Coil ID: 1725	SN: 007093
Phantom: Small Bottle	# of Channels
Sequence TR TE Plane FOV Nx M	lyBWNSAThicknessGap
SE 300 20 C 36 256 2	
Coil Mode: SH 1,2,3,4	
Analysis of Composi	te Image
Measured Data	Calculated Results
Back Noise Nois Label Mean Max Min ground SD Type	e Mean Normal- Max Uni- SNR ized SNR formity
N 908 1,929 371 -8.2 11.56 NEM	
A 916 1,932 384 12.4 3.61 Air	166.3 147.9 350.7 33.2%
Analysis of Uncombine	ed Images
Measured Data	Calculated Results
Noise Noise Ch Mean Max SD Type	Mean % of Max % of SNR Mean SNR Max
1 552 1,677 3.53 Air	<u>102.5</u> <u>100%</u> <u>311.3</u> <u>100%</u>
2 403 992 3.17 Air 3 367 572 2.94 Air	83.3 81% 205.1 66% 81.8 80% 127.5 41%
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$
The near NEMA value is award by variations in the shorting levels	
The poor NEMA value is caused by variations in the ghosting levels.	
	Channel 1 Channel 2 Mean: 552 Air M: 6.24 Mean: 403 Air M: 5.55
	Mean: 552 Air M: 6.24 Mean: 403 Air M: 5.55 Airsd: 3.53 Airsd: 3.17
Mean: 908 ROI M: -8.15 Mean: 916 Air M: 12.40 ROIsd: 11.56 Airsd: 3.61	0 992
01955	
9 371 9 384	
	ROI Area: 98.00 ROI Area: 98.00
	Mean: 367 Air M: 5.10 Mean: 396 Air M: 5.19 Airsd: 2.94 Airsd: 2.99
	0 572
ROI Area: 98.00 ROI Area: 98.00	0.126
Composites	ROI Area: 98.00 ROI Area: 98.00
	Channel 3 Channel 4

RF Co	oil Perf	orman	ce Eval	uation		_		Ta at Data	7/20/2008
Coil:	Shoulde	er Arrav	- Small		iymp	hr		Test Date:	5516583
	Invivo	a mag	Sinan			J.		Revision:	
Mfg. Date:			Coil ID:	1724		a i	1 -		006738
Phantom:	Small Bot	ttle		,				_	# of Channels
Seque SF				e FOV 30	Nx 256	Ny 256	BW 25.6	NSA T	hickness Gap 3 -
Coil Mo	de: <u>SH 1,</u> 2	2,3,4							
				Analysis	s of Con	nposite	Image		
		Μ	easured	Data			<u> </u>	Calculate	d Results
Label	Mean	Max	Min	Back ground	Noise SD	Noise Type	Mean SNR	Normal- ized	Max Uni- SNR formity
N	1,200	1,862	426	1.5	9.07	NEMA	93.6	119.9	145.2 37.2%
Α	1,198	1,860	426	19.3	5.37	Air	146.2	187.3	227.0 37.3%
				nalysis o	of Unco	mbined			-
	M	easured	Data Noise	Noise	-		Mean	Calculated % of	Results Max % of
Ch	Mean	Max	SD	Туре	1		SNR	Mean	SNR Max
$\frac{1}{2}$	724 472	1,179 931	4.78	Air Air			<u>99.3</u> 67.7	<u>100%</u> 68%	161.6 100% 133.5 83%
3	620	1,172	4.79	Air			84.8	85%	160.3 99%
4	495	696	5.01	Air			64.7	65%	91.0 56%
Mean: 1 ROI Are		ROI M: 1.: ROIsd: 9.0	53 Mean 07		Air M: 1 Airsd: 5	9.29 .37	Chann Mean: 724 OTH7 ROI Area: 86.18 Mean: 620	Air M: 8.61 Airsd: 4.78 19 194 ROLA Air M: 8.66 Airsd: 4.79 214 ROLA	Airsd: 4.57

RF Coil Performance Evaluation Test Date: 7/20/2008 Coil: Shoulder Array - Small Model: 5516583 Mfg.: Invivo Model: 5516583 Mfg. Date: Coil ID: 1724 Coil ID: 1724 Phantom: Small Bottle # of Channels Sequence TR TE Plane SE 300 20 C 36 256 25.6 1 3 - Coil Mode: SH 1,2,3,4 Analysis of Composite Image	
Analysis of Composite Image	
Measured Data Calculated Results	
Label Mean Max Min ground SD Type SNR ized SNR formit	/
N 906 2,311 309 2.9 11.26 NEMA 56.9 50.6 145.1 23.6%	
A 903 2,315 296 13.1 3.76 Air 157.4 140.0 403.5 22.7%	
Analysis of Uncombined Images	
Measured Data Calculated Results	
Noise Noise Mean % of Max % of	-
Ch Mean Max SD Type SNR Mean SNR Max 1 455 1,868 3.36 Air 88.7 100% 364.3 100%	
1 455 1,868 3.36 Air 88.7 100% 364.3 100% 2 407 796 3.33 Air 80.1 90% 156.6 43%	
3 356 982 3.19 Air 73.1 82% 201.7 55%	
4 444 1,310 3.50 Air 83.1 94% 245.3 67%	
The poor NEMA value is caused by variations in the ghosting levels.	
	•••••
Channel 1 Channel 2	
Mean: 906 ROI M: 2.94 Mean: 903 Air M: 13.11 02311 ROIsd: 11.26 02315 0156 064 064 0166	
ROI Area: 114.96 ROI Area: 114.96	
Mean: 356 Air M: 5.58 Mean: 444 Air M: 6.13 O 1310 O 1310	
Composites	
ROI Area: 114.96ROI Area: 114.96Channel 3Channel 4	

RF Coil Performance Evaluation Coil: Spine Matrix Mfg.: Siemens Mfg. Date: Coil ID: Mfg. Date: Coil ID: Phantom: Long Cylinder Sequence TR TE Plane FOV SE 300 20 S 50 Coil Mode: SP 12	Nx Ny BW 256 256 25.6	Test Date: 7/20/2008 Model: 03784498 Revision:
-	of Composite Image	
Measured Data		Calculated Results
Label Mean Max Min ground	Noise Noise Mean SD Type SNR	Normal- Max Uni- ized SNR formity
N 342 934 112 0.2	2.68 NEMA 90.2	41.6 246.5 21.4%
A 342 934 112 5.7	2.36 Air 95.0	43.8 259.3 21.4%
Analysis o	f Uncombined Images	
Measured Data	0	Calculated Results
ChMeanMaxNoise SDNoise Type12129262.24Air21988172.18Air	Mean SNR 62.0 59.5	% of Mean Max SNR % of Max 100% 270.9 100% 96% 245.6 91%
Mean: 342 ROI M: 0.24 ROIsd: 2.68 Older ROI Area: 435.51 Mean: 342 Airsd: Airsd: Airsd: Airsd: Bill ROI Area: 435.51 Composites		Air M: 3.63 Airsd: 2.18 Airsd: 2.18 Airsd: 2.18 Airsd: 2.18 Airsd: 2.18 Channel 2

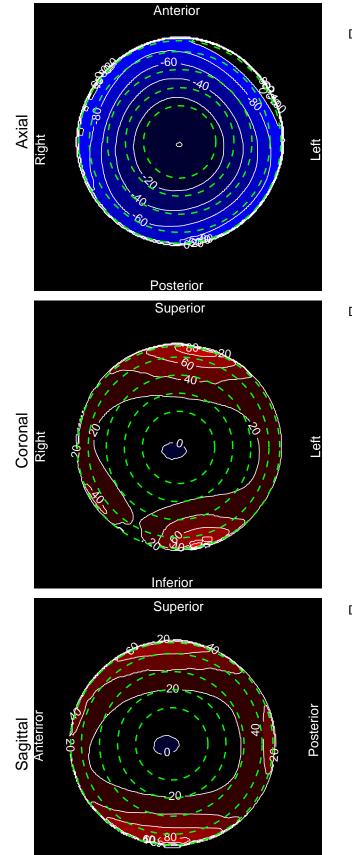
SE 300 20 S Coil Mode: SP 34	34 ph 34 50 Nx 50		Test Date: Model: Revision: SN: W NSA Th 5.6 1	
	_	iiposite iiiage	Oslaviata	
Measured Dat			Calculated	
	ack Noise ound SD	Noise M Type S	ean Normal- NR ized	Max Uni- SNR formity
N 333 799 79 -(0.2 2.42	NEMA 9	97.3 44.9	233.5 18.0%
A 334 799 79 5	.4 2.28	Air 9	6.0 44.3	229.6 18.0%
Analy	vsis of Unco	mbined Images	6	
Measured Data			Calculated I	Results
	loise	Mean	% of	Max % of
	ype	SNR	<u>Mean</u>	SNR Max
	Air Air	<u>63.9</u> <u>65.5</u>	98%	237.1 98% 241.1 100%
		05.5	100 / 0	
Mean: 333 ROI M: -0.24 Mean: 334 ROIsd: 2.42	Air M: 5.42 Airsd: 2.28		Air M: 3.44 Mean: Airsd: 2.07	215 Air M: 3.59 Airsd: 2.15
ROI Area: 488.99 Composites	C 799	ROI Area: 488.99 Channe	ROI Ar	0791 ea: 488.99 Channel 2

	RF C	oil Perf	ormano	ce Eval	uation	0	00100	1		Tost Dato	: 7/20/2008	
	Coil:	Spine N	latrix			ph	7				: 03784498	
		Siemens								Revision		
Mf	g. Date:			Coil ID:	1734				-	SN	: 4421	
Pł	antom:	Long Cyl	linder								# of Channels <u>6</u>	
	Sequ					Nx	Ny		BW		Thickness Gap	
	S	E 30	0 20	S	50	256	256		25.6	1	3 -	
	Coil Mo	de: <u>SP 56</u>	j									
	Analysis of Composite Image											
	Measured Data Calculated Results											
	Label	Mean	Max	Min	Back ground	Noise SD	Noise Type		Mean SNR	Normal- ized	Max Uni- SNR formity	
	N	348	860	95	0.3	2.55	NEMA		96.5	44.5	238.5 19.9%	
	Α	348	860	93	5.5	2.34	Air		97.5	44.9	240.8 19.5%	
				Α	nalysis	of Unco	mbined	Imag	es			
		М	easured			-				alculated		
	Ch	Mean	Max	Noise SD	Noise Type	_		Me SN		% of <u>Mean</u>	Max % of SNR Max	
	5	208	785	2.11	Air			64		97%	243.8 98%	
	6	226	845	2.23	Air]		66	.4	100%	248.3 100%	

ľ	Mean: 34	R	OI M: 0.26 Olsd: 2.55	Mean: 348		: 5.52 : 2.34	Mean: 20	8	Air M: Airsd:		h: 226 Air M: 3.70 Airsd: 2.23	
		0 95		ſ	93						012	
									<mark>0</mark> 785			
		0	360		<mark>0</mark> 860						0845	
									-			
	301 Area	: 472.16		ROI Area: 4	72 16		ROI Area		17	BOI	Area: 472.16	
			Compo				HOTAICU	Chan			Channel 2	
			Compo	51105				onan				

	1 30
<u>RF Coil Performance Evaluation</u>	Test Date: 7/21/2008
Coil: Wrist Array	Model: 101078
Mfg.: Invivo	Revision:
Mfg. Date: 3/8/2008 Coil ID: 1726	SN: 036538
Phantom: Wrist Phatnom	# of Channels
	NyBWNSAThicknessGap25625.613-
Coil Mode: WR	
Analysis of Compos	ite Image
Measured Data	Calculated Results
Back Noise Noi Label Mean Max Min ground SD Typ	
N 1,309 2,168 160 0.1 4.98 NEM	
A 1,309 2,173 160 14.9 4.21 Ai	r 203.8 587.3 338.2 13.7%
Analysis of Uncombir	ned Images
Measured Data	Calculated Results
Noise Noise Ch Mean Max SD Type	Mean % of Max % of SNR Mean SNR Max
1 644 1,570 4.03 Air	Interm Interm<
2 582 1,429 4.12 Air	92.6 88% 227.3 89% 100.2 2824 100.2 100.4
3 506 940 3.24 Air 4 516 977 3.29 Air	102.3 98% 190.1 74% 102.8 98% 194.6 76%
	Channel 1 Channel 2
Mean: 1309 ROI M: 0.14 BOIsd: 4.98 Older Older BOI Area: 44.38 Composites	Mean: 644 Air M: 7.18 Airsd: 4.03 Airsd: 4.03 J Mean: 506 Air M: 5.66 Airsd: 3.24 J J J J J J J J Mean: 506 Air M: 5.66 Airsd: 3.24 J J J J J J J J <

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



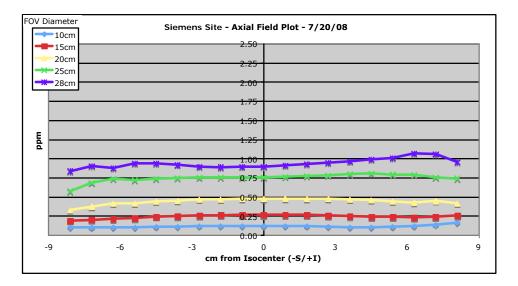
Inferior

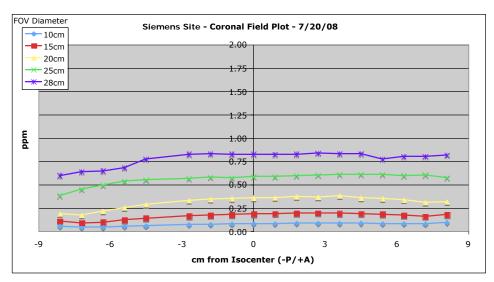
		A	Axial			
DIAMETER	MIN	MAX	RANGE	PPM	MEAN	STDEV
10	-15.2	0.0	15.2	0.12	-6.22	3.7
15	-34.0	0.0	34.0	0.27	-14.11	8.4
20	-61.0	0.0	61.0	0.48	-25.29	15.0
25	-97.7	0.0	97.7	0.77	-39.55	23.4
28 -	-115.9	0.0	115.9	0.91	-49.23	28.8

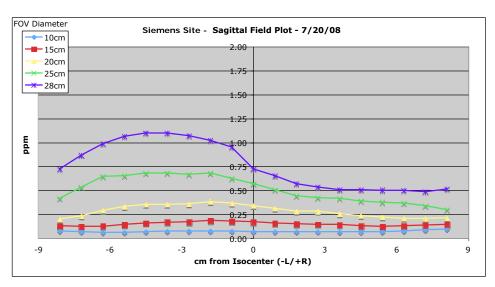
	Coronal											
DIAMETER	MIN	MAX	RANGE	PPM	MEAN	STDEV						
10	-0.5	10.3	10.7	0.08	2.78	2.3						
15	-0.5	23.7	24.2	0.19	6.69	5.0						
20	-0.5	45.6	46.0	0.36	12.38	9.3						
25	-0.5	74.4	74.9	0.59	19.58	14.7						
28	-4.2	109.0	113.2	0.89	24.31	18.4						

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

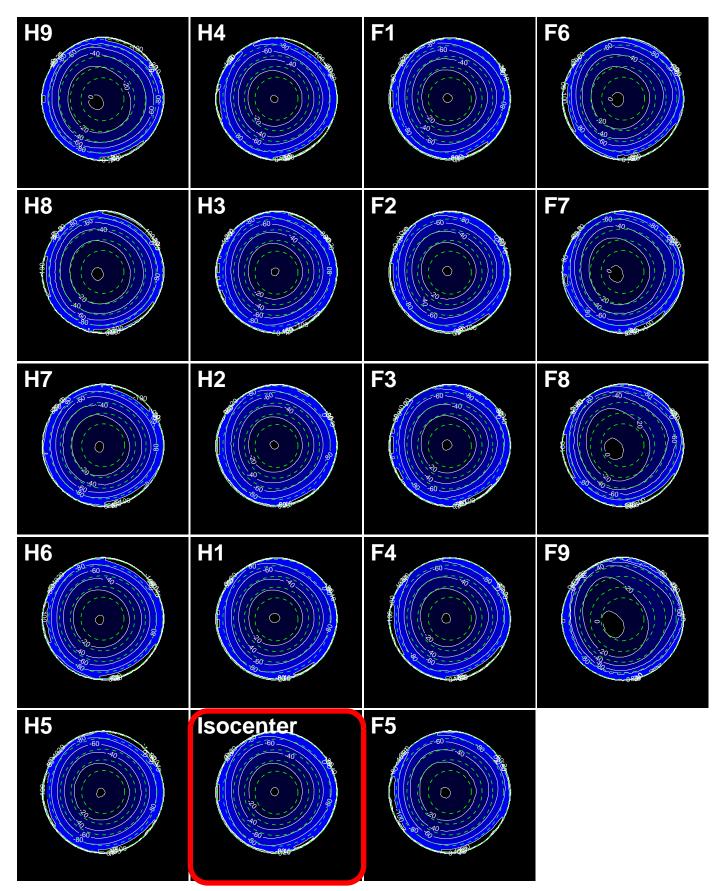
Appendix A: Magnet Homogeneity Field Maps Siemens Site Siemens Symphony 1.5T Measured July 20, 2008



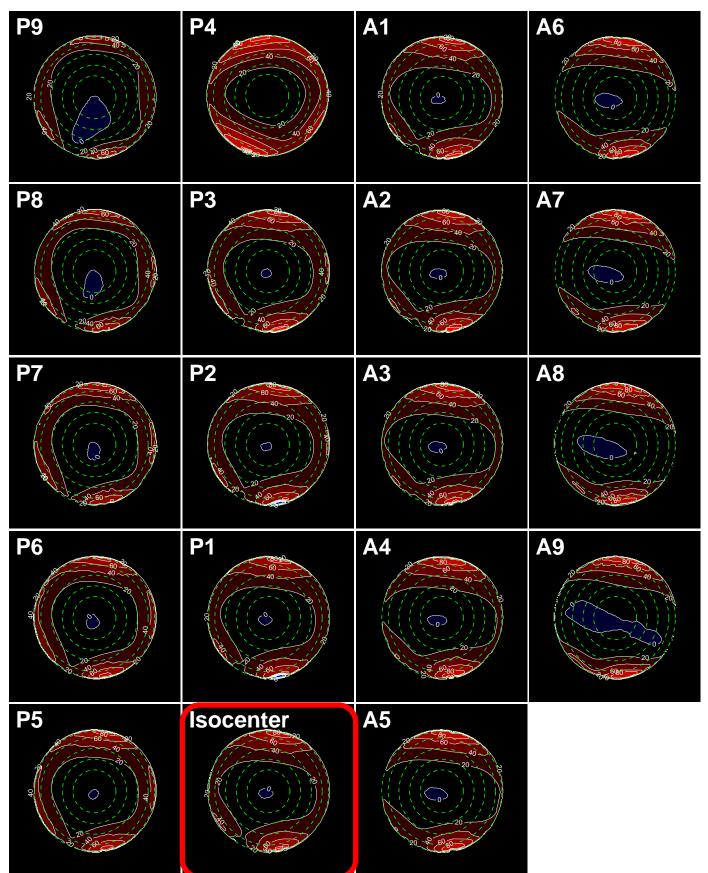


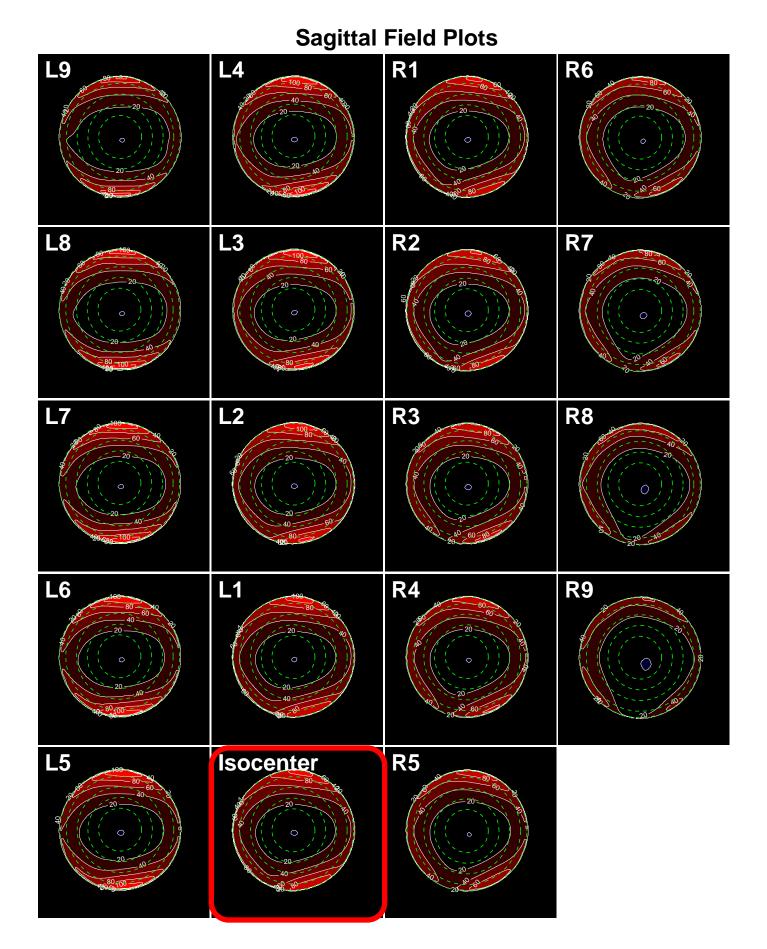


Axial Field Plots



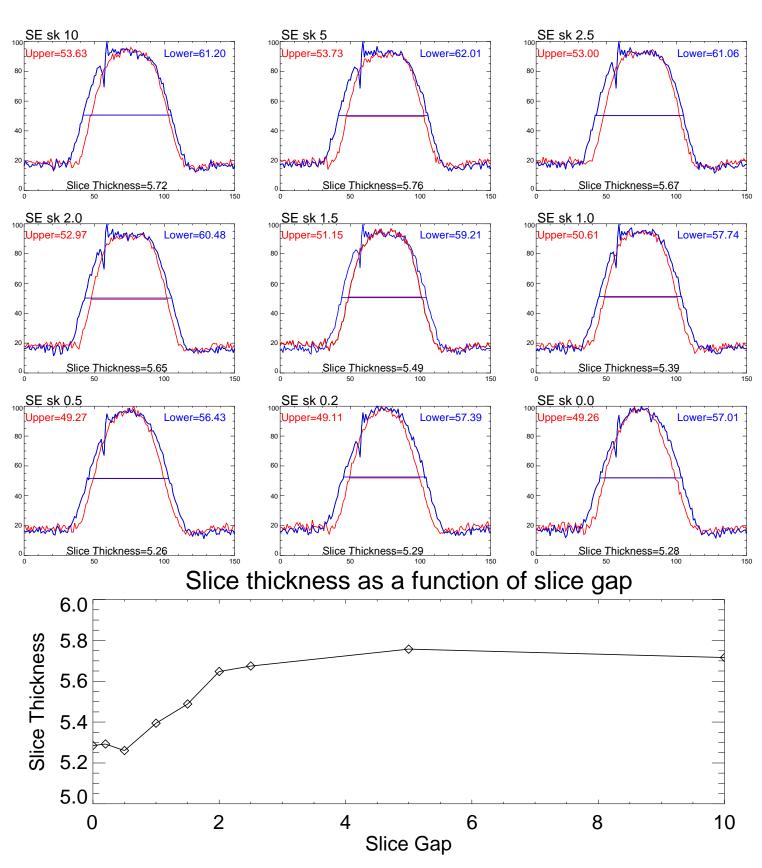
Coronal Field Plots





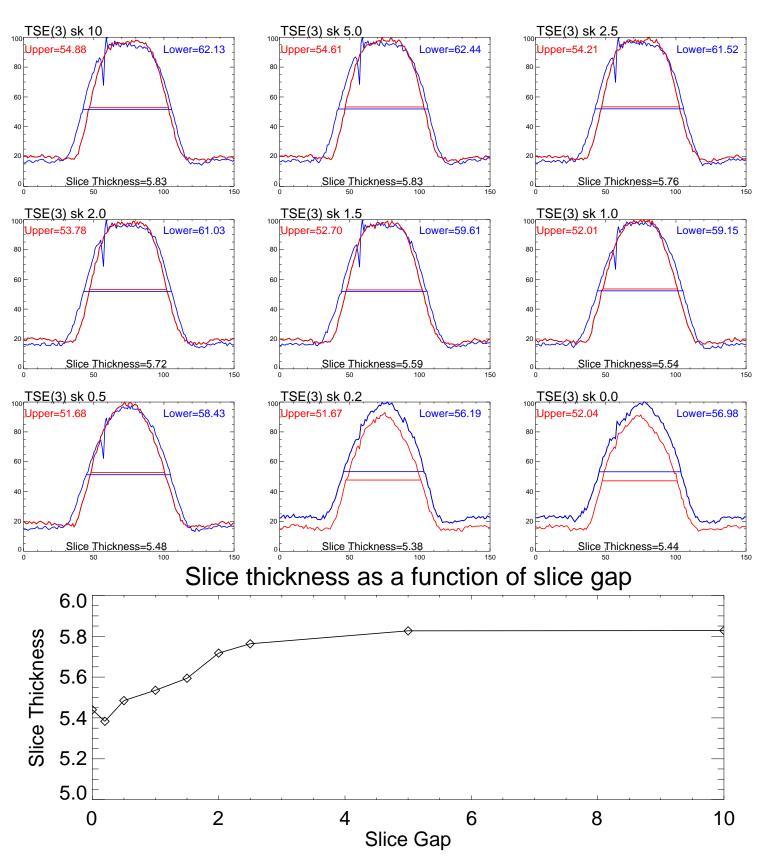
Appendix B: RF Crosstalk and Slice Profiles

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



Appendix B: RF Crosstalk and Slice Profiles

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



Siemens Site

Coil Used: Head

Symphony

Test Date:

7/20/2008

	Sagittal Locator					
1	Length of phantom, end to en	nd (mn 148± 2)	14	7.2	=	calculated field
		(SE 500/20)	(SE 2000/20)	(SE 2000/80)	(Site T1)	(Site T2)
	Slice Location #1	ACR T1	ACR PD	ACR T2	Site T1	Site T2
2	Resolution ••••	0.9	0.9	0.9	0.9	0.9
3	(1.10, 1.00, 0.90 mm)	0.9	0.9	0.9	0.9	0.9
4	Slice Thickness Top		57.3	47.9	62.0	66.2
5	(fwhm in mm) Bottom	50.1	49.8	42.3	53.1	57.6
6	Calculated value 5.0±0.7	5.38	5.33	4.49	5.72	6.16
7	Wedge (mm) 📲 = + F = -	0.7	0.7	0.6	0.8	0.8
8	Diamator (mm) (100+2)	191.6	191.6	191.6	191.5	191.3
9	Diameter (mm) (190 \pm 2) \bigcirc	190.4	190.4	190.4	190.5	190.4
	Slice Location #5					
10	Φ	191.3	191.3	191.3	191.3	190.8
11	Diameter (mm) (190 \pm 2) Θ	190.3	190.3	190.3	190.3	190.0
12	\bigcirc	190.8	190.7	190.8	190.8	190.6
13	\otimes	190.4	190.4	190.4	190.5	190.4
	Slice Location #7	1	•			
14	Signal Big ROI	1682	1749	941	1691	1102
15	(mean only) High	1785	1850	999	1757	1124
16	Low	1629	1707	916	1603	1062
17	Uniformity (>87.5%)	95.4%	96.0%	95.7%	95.4%	97.2%
18	Background Noise Top		22.2 ± 10.2	14.0 ± 7.6	22.2 ± 10.5	28.3 ± 14.4
19	Bottom		22.7 ± 10.8	13.8 ± 7.5	23.0 ± 11.4	27.8 ± 15.1
20	(mean ±std dev) Left	64.5 ± 10.3	40.6 ± 13.8	15.8 ± 8.6	38.1 ± 10.1	47.0 ± 20.0
21	Right	55.8 ± 10.5	31.5 ± 12.4	12.9 ± 7.2	39.0 ± 9.5	67.1 ± 27.2
22	Ghosting Ratio (<2.5%)	2.3%	0.8%	0.0%	0.9%	2.6%
23	SNR (no spec)	162	167	125	173	75
	Low Con Detectability]				
24	Slice Location #8 1.4%	5	8	5	5	0
25	Slice Location #9 2.5%	10	10	7	10	0
26	Slice Location #10 3.6%		10	10	10	6
27	Slice Location #11 5.1%	10	10	10	10	10
28	Total # of Spokes (>=9)	35	38	32	35	16
	Slice Location #11]				10
29		0.2	0.2	0.1	0.4	1.0
30	Slice Position Error	-0.5	-0.5	-0.5	-0.5	0.2
00		-0.5	-0.5	-0.5	-0.5	0.2

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

Siemens Site

Sequence parameters

Coil Used:Head

Symphony

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

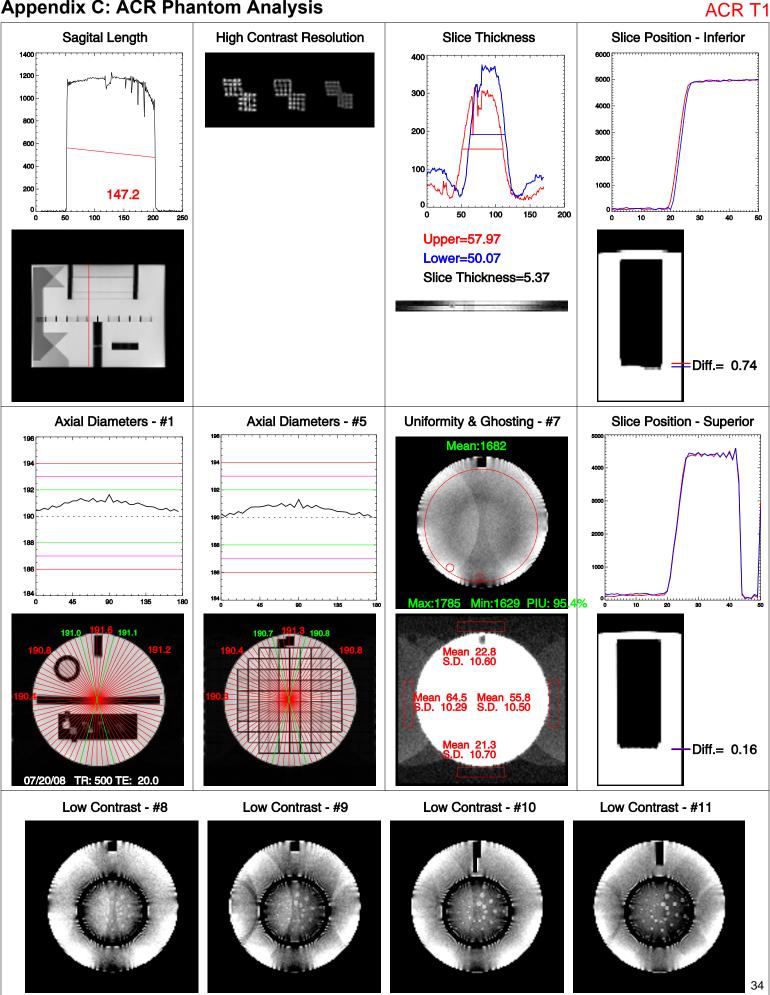
Test ID 314

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

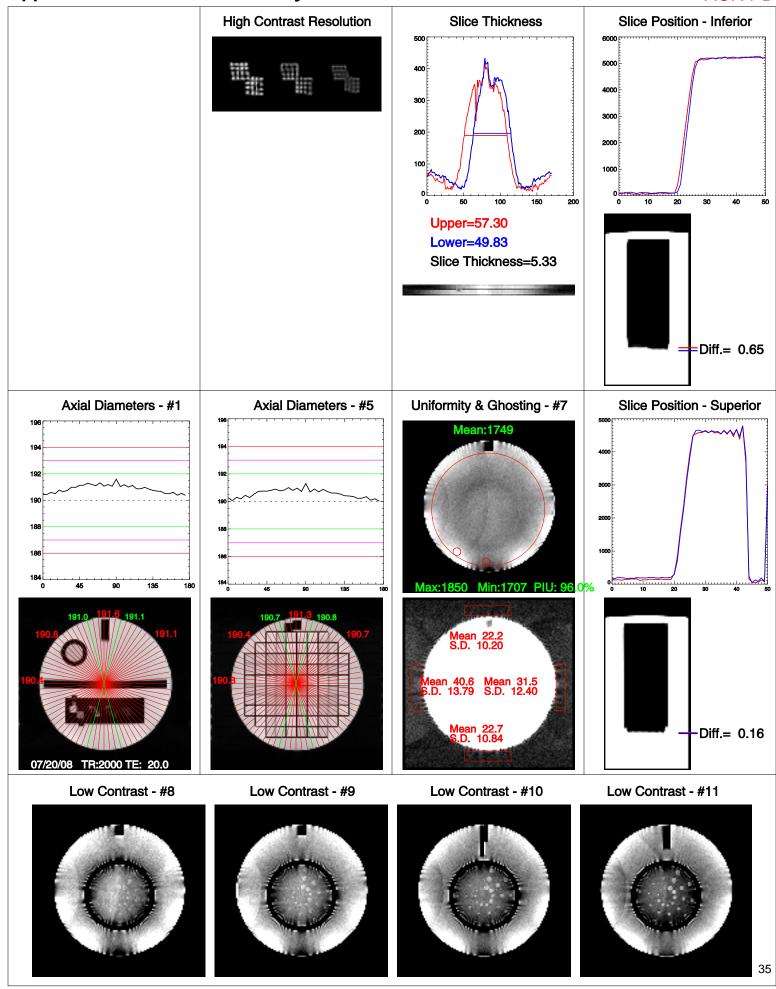
Magnet ID: 219

Coil ID: 1727

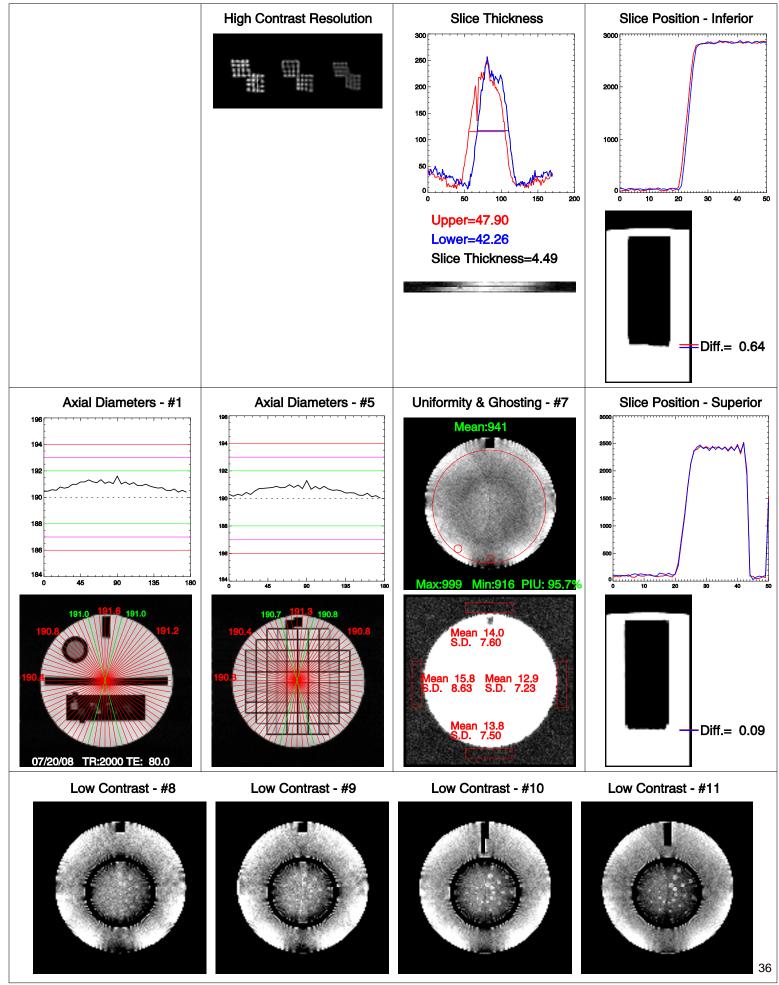
TestID: 314

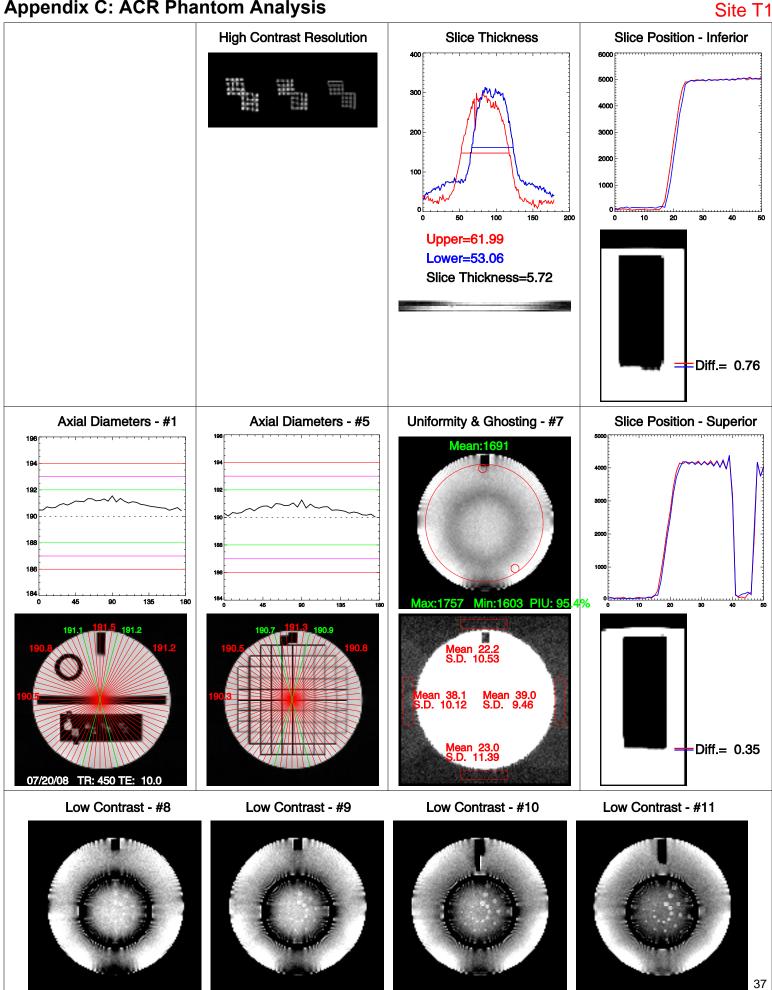


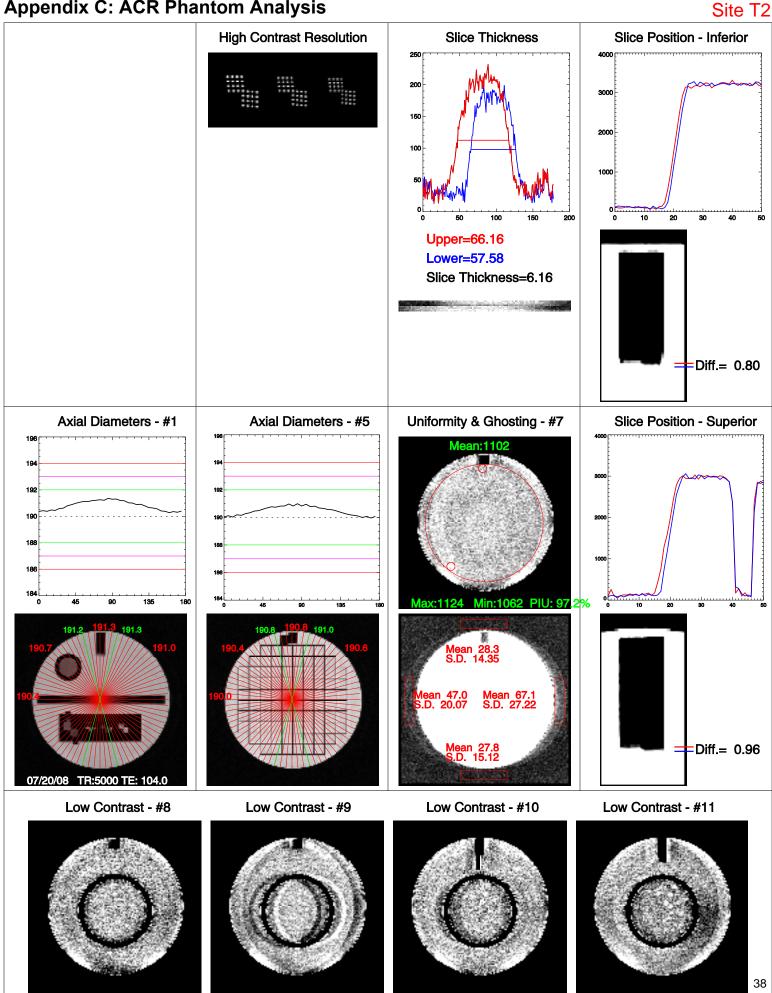
ACR PD



ACR T2







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.

<u>SNR</u>

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

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

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

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

Scan parameters also significantly affect measured SNR. For most of the testing performed in this document I used a simple Spin Echo with a TR of 300, a TE of 20 and a slice thickness of 3mm and a receiver BW of 25.73KHz (200 Hz/pixel). The FOV was varied depending on the size of the coil and the phantom used. All of the parameters used for each test can be found on each page immediately below the coil description.

Report Layout

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

There is usually one image for each composite image measurement and one image for each separate channel measurement. Each image shows the ROI (red line) where the mean signal was measured and two smaller ROIs (green lines) where the signal minimum and maximum was found. In the top left corner of each image is the mean signal in the large ROI. The bottom left corner contains the large ROI's area (in mm²). The top right corner contains two numbers a mean and a standard deviation. If the NEMA method was used, then the top right corner will list the mean and SD of the large ROI (labeled ROI M and ROIsd) applied to the subtraction image. If the noise was measured in the background air the the numbers are labeled Air M and AirSD.

Data Tables

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

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

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

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