MRI Equipment Acceptance Test Summary

Site: Wake Forest Baptist Health MRI building MR04   Report Date: 10/18/2017

System MRAP#:   Survey Date: 10/12/2017

MRI System Manufacturer: Siemens   Model: 3T Skyra

Medical Physicist/MRI Scientist: Megan Johnston, PhD / Youngkyoo Jung, PhD

Signature:

Equipment Evaluation Tests		Pass/Fail/NA
1.	Setup and Table Position Accuracy	Pass
2.	Center Frequency	Pass
3.	Transmitter Gain or Attenuation	Pass
4.	*Geometric Accuracy Measurements**	Pass
5.	*High-Contrast Spatial Resolution**	Pass
6.	*Low-Contrast Detectability**	Pass
7.	Artifact Evaluation	Pass
8.	Film Printer Quality Control (if applicable)	NA
9.	Visual Checklist	Pass
10.	Magnetic Field Homogeneity	Pass
	Method of Testing Phase Map	
11.	*Slice-Position Accuracy**	Pass
12.	*Slice-Thickness Accuracy**	Pass
13.	Radiofrequency Coil Checks	
	Were all clinically used coils evaluated? (Yes/No) Yes	
	a. SNR	Pass
	b. Volume Coil Percent Image Uniformity (PIU)	Pass
	c. Percent Signal Ghosting (PSG)	Pass
14.	Soft-Copy (Monitor) Quality Control	Pass
15.	Long Term Stability	Pass

tests that can be performed by scanning the ACR MRI Phantom

Medical Physicist's or MRI Scientist's Recommendations for Quality Improvement

The MR system meets ACR recommendations and local guidelines. The Mean drift measured with multiple EPI scans (see 15 in Data form) showed an exceesively higher linear trend, which is commonly presented in dynamic EPI. The linear drift should be taken into account during DSC or fMRI processing.

MRI Equipment Acceptance Test Data Form

Site: WFBH MRI building MR01   Date: 10/12/2017
System MRAP #:   Serial Number: 145332

Equipment:

MRI System Manufacturer: Siemens   Model: 3T Skyra
ACR MRAP Phantom Number used: J1267

1. Setup and Table Position Accuracy

From ACR Sagittal Localizer
Location of the superior edge of the grid structure: 1 mm from the magnet isocenter
ACR Criteria: **≤ ±5 mm**

2. Center Frequency: 123.255089   MHz

3. Transmitter Gain or Attenuation: Ref RF Voltage   298.121 V

4. Geometric Accuracy Measurements:

Series	Slice	Measurement Orientation	Measured (mm)	Actual (mm)	Difference (mm)	window level	window width
Sag Loc	slice 1	Middle	148.02	148	0.02	800	1600
ACR T1	slice 1	top-bottom	190.86	190	0.86	950	1900
ACR T1	slice 1	left-right	191.02	190	1.02	950	1900
ACR T1	slice 5	top-bottom	191.31	190	1.31	950	1900
ACR T1	slice 5	left-right	191.37	190	1.37	950	1900
ACR T1	slice 5	diagonal (/)	190.04	190	0.04	950	1900
ACR T1	slice 5	diagonal (\)	190.26	190	0.26	950	1900

ACR Criteria: **≤ ±2 mm**

5. High Contrast Spatial Resolution

From ACR T1, slice 1

Array	1.1 mm	1.0 mm	0.9 mm
UL (horizontal)	v	v	v
LR (vertical)	v	v	x

From ACR T2, slice 1

Array	1.1 mm	1.0 mm	0.9 mm
UL (horizontal)	v	v	v
LR (vertical)	v	v	x

ACR Criteria: **≤ 1 mm**

6. Low Contrast Detectability

ACR T1

Slice	# of Spokes
8	8
9	10

ACR T2

Slice	# of Spokes
8	8
9	10

10	10
11	10

Total score: 38

10	10
11	10

Total score: 38   ACR Criteria: **> 36 at 3T**

7. Artifact Evaluation

No noticiable artifacts in T1 or T2 ACR images.

8. Film Printer Quality Control (if applicable)

Not applicable

9. Visual Checklist

All the items were working properly and were mechanically and electrically stable.

10. Magnetic field homogeneity

Method Used :   Phase map

TE: 10 ms   Phantom diameter: 24.5 cm   FWHM: 81.2 Hz

Measured Homogeneity:

Plane	Phase change (cycles)	Phase change (Hz)	Homogeneity (ppm)
Axial	0.29	28.50	0.23
Sagittal	0.47	47.00	0.38
Coronal	0.31	31.00	0.25

Criteria: **< 1 ppm**

11. Slice position accuracy

	ACR T1	ACR T2
Slice location #1	-0.68 mm	-0.93 mm
Slice location #11	-2.8 mm	-3.32 mm

ACR Criteria: **≤ ±5 mm**

12. Slice thickness accuracy

From Slice Position #1 of the ACR phantom

ACR T1

Ramp Signal Level: 209.85

Slice thickness   Top: 54.68 mm   Calculated slice
(fwhm in mm)   Bottom: 50.11 mm   thickness (mm):   5.23 mm

ACR T2

Ramp Signal Level: 263.34

Slice thickness   Top: 50.07 mm   Calculated slice
(fwhm in mm)   Bottom: 46.99 mm   thickness (mm):   4.85 mm

ACR Criteria: **5.0 ± 0.7 mm**

13. RF Coil Performance Evaluation

A. Volume RF Coil

*Manufacturer's QC routine was performed on the following RF coils

1) RF coil description: Body (SN: 2311)   Date: 10/17/2017

	Body Coil 1	Body Coil 2	Combined
SNR:	26.7	27.3	37.3
Image Uniformity (%):	95.68	93.99	97.57

Pass/Fail: **Pass**

B. RF Surface Coil (Phased array)
*Manufacturer's QC routine was performed on the following RF coils

1) RF coil description: Body 18ch (SN: 30321) H Tra   Date: 9/11/2017
SNR:

B11: 71.3	B12: 66.9	B13: 68.3	B14: 67.1	B15: 67.3	B16: 63.6
B21: 60.9	B22: 68.4	B23: 73.8	B24: 69.1	B25: 65.3	B26: 62.5
B31: 68.8	B32: 64.3	B33: 70	B34: 72.6	B35: 67.3	B36: 67.7

Pass/Fail: Pass

2) RF coil description: Body 30ch (SN: 30164)   Date: 9/11/2017
SNR:

B11: 51.7	B12: 43.5	B13: 47.4	B14: 46.9	B15: 52	B16: 54.3
B21: 50.6	B22: 42.6	B23: 48.1	B24: 40.4	B25: 51	B26: 48.7
B31: 48.9	B32: 50.4	B33: 57	B34: 55	B35: 51.2	B36: 45.4
B41: 49.1	B42: 44.3	B43: 56.2	B44: 43.7	B45: 54.1	B46: 50.4
B51: 49.2	B52: 44.4	B53: 47	B54: 51.5	B55: 48.8	B56: 55.7

Pass/Fail: Pass

3) RF coil description: Head Neck 20ch (SN: 30397)   Date: 9/11/2017
SNR:

H11: 65.3	H12: 57.4	H13: 63.4	H14: 60.9
H21: 68.9	H22: 63.3	H23: 67.9	H24: 68.6
H31: 34.9	H32: 25.6	H33: 37.2	H34: 32.8
H41: 44	H42: 29.7	H43: 42.2	H44: 41.5
N11: 26.5	N12: 25	N21: 38	N22: 31.7

Pass/Fail: Pass

4) RF coil description: Spine 32ch (SN: 30365)   Date: 9/11/20017
SNR:

S11: 41.9	S12: 46.3	S13: 37.7	S14: 57.7
S21: 43.4	S22: 38.3	S23: 29	S24: 38.5
S31: 38.5	S32: 40.8	S33: 31.3	S34: 49.9
S41: 41.2	S42: 34	S43: 31.9	S44: 43.2
S51: 37.1	S52: 41.6	S53: 35	S54: 54.3

S61:	42.1	S62:	34.4	S63:	30.3	S64:	46.1
S71:	36.9	S72:	39.1	S73:	37	S74:	54.5
S81:	23.6	S82:	21.6	S83:	19.1	S84:	26

Pass/Fail: Pass

5) RF coil description: __Knee 15ch (SN: 1112)__   Date: __9/11/2017__
SNR:

K1:	46.4	K2:	49.6	K3:	41.7	K4:	40.4
K5:	48.7	K6:	47.7	K7:	47.3	K8:	46.2
K9:	46.5	K10:	47.7	K11:	52.2	K12:	54
K13:	45.4	K14:	45.5	K15:	45		

Pass/Fail: Pass

6) RF coil description: __FlexLarge 4ch (SN: 8625761)__   Date: __9/11/2017__
SNR:

FL1:	29.7	FL2:	39.7	FL3:	30.2	FL4:	39.7

Pass/Fail: Pass

7) RF coil description: __FlexSmall 4ch (SN: 8625761)__   Date: __9/11/2017__
SNR:

FS1:	35.1	FS2:	36.6	FS3:	31.7	FS4:	29.9

Pass/Fail: Pass

14. Soft Copy Quality Control

Luminance Meter Make/Model: Nuclear Associates Model No. 07-621   Cal expires: N/A
with a fiber-optic probe (Model 07-634)
Monitor Description: DCS1913-D (S/N: 16BD25)
Luminace measured: Cd/m^2

Monitor	Center of	Top Left	Top Right	Bottom Right	Bottom Left
Consol of MR01	127	116	110	114	110

Maximum & minimum luminance

Maximum in the center: __127__   ACR Criteria: **>90 Cd/m^2**
Minimum in the center: __0.9__   ACR Criteria: **<1.2 Cd/m^2**

Luminance uniformity

Average of values obtained in four corners of screen __112.5__ Cd/m^2
Percent difference: __4.3478__ %   ACR Criteria: **≤ 30%**

$$\% \text{ difference} = 200 * (L_{max} - L_{min})/(L_{max} + L_{min})$$

Resolution

The SMPTE pattern was displayed and the high-contrast line-pair images in each of the corners and center were distinguishable and sharp

Spatial accuracy

The grid pattern of SMPTE was inspected and all the vertical and horizontal lines depicted on the monitor were stright to within +/- 1mm

15. Long Term Stability Test

RF coil description: 20ch Head/Neck (SN: 30397)

Phantom description: spherical agar phantom (fBIRN)

Pulse sequence: Type: EPI   TR: 2000ms   TE: 30 ms   flip angle: 77   degrees

FOV: 22x22   cm2   Matrix: 64x64   BW: 2298 Hz/Px; Reps: 200

No. of slices: 33   Slice thickness: 4   mm;   spacing   1   mm

SNR: 381   SFNR: 348   Mean % fluctuation: 0.03   Mean Drift   **1.13**

Criteria   >200   >200   <0.15   <0.7

Specific Comments:

1. The initial measurement of field homogeneity failed to meet the ACR and manufacturer's specifications but this issue has been resolved after shim coil tune-up. Field inhomogeneity was measured again and it passed the test.

2. The Mean drift measured with multiple EPI scans showed a higher linear trend, which is commonly presented in EPI. The linear drift should be taken into account during DSC or fMRI post-processing.