ACR MRI Accreditation:

Process and Pitfalls

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Ron Price
Vanderbilt University Medical Center
Nashville, TN

ACR MRI Accreditation: Process and Pitfalls

I. Evolution of the ACR MRI accreditation program
II. The Qualified Medical Physicist/MR Scientist: Role and Responsibilities
III. Overview of the ACR application process
   - Whole-body MRI
   - Breast MRI
   - Extremity MRI
IV. Common Problems: Phantom and Clinical
V. Expected updates to the ACR Quality Control Manual (2012)

Evolution of MRI Accreditation

- In 1996 the ACR initiated a voluntary whole-body MRI accreditation program utilizing the ACR "Large" phantom for application and QA
- In 2008, the whole-body program was converted to a modular program with six clinical modules (Head, Spine, MSK, Body, MRA, Cardiac)
- In 2008, the "Small" phantom was introduced for accreditation of special purpose orthopedic scanners. (Note: Is not required for MSK module accreditation on general purpose scanners)
- In 2010, the Breast MRI Accreditation Program was initiated as part of the mammography program not the MRI accreditation program
- As of January 1, 2012, MRI accreditation became mandatory for non-hospital based imaging facilities receiving Medicare payments.

CMS/MIPPA MRI Accreditation Requirements

As of January 1, 2012, **CMS/MIPPA*** requires that all **non-hospital based** facilities providing **Advanced Diagnostic Imaging**** (ADI) services and receiving Medicare payments for technical components of imaging services must be accredited by one of the CMS-approved accreditation organizations.

The American College of Radiology (ACR)
The Intersocietal Accreditation Commission (IAC)
The Joint Commission (TJC)
(Ambulatory Health Care Program)

*CMS: Centers for Medicare and Medicaid Services
MIPPA: Medicare Improvements for Patients and Providers Act

**ADI: MRI, CT and Nuclear Medicine/PET
(Note: ADI specifically excludes: x-ray, ultrasound and fluoroscopy)

Medical Physicist/MR Scientist Responsibilities

- A qualified medical physicist/MR scientist **must have the responsibility for overseeing the equipment** quality control program and for monitoring performance upon installation and routinely thereafter.
- All facilities applying for accreditation or renewal must demonstrate compliance with the ACR requirements for quality control (QC) by including a copy of the facility's most recent **Annual MRI System Performance Evaluation (must be performed by a medical physicist/MR scientist).**
- The annual medical physicist/MR scientist performance evaluation just also include and assessment of the MRI safety program (signage, access control, screening procedures and oxygen safety) as well as an inspection of the physical and mechanical integrity of the system.

MR System Performance Characteristics to be Monitored*

A. Acceptance Testing
B. Annual Equipment Performance Testing
C. Quality Control Program
D. Written Survey Reports and Follow-up Procedures

***ACR Technical Standard for Diagnostic Medical Physics Performance Monitoring of Magnetic Resonance Imaging (MRI) Equipment** (revised 2009)

Who is the Qualified Medical Physicist/MR Scientist?

- Board certified: ABR, ABMP or CCPM
- Not certified:
  1) Graduate degree in physical science
  2) Two courses in biological sciences and radiation biology
  3) Three (3) years of documented experience in clinical MRI
- Grandfathered:
  Conducted surveys of 3 MRI units between 1/1/2007 and 1/1/2010
- Upon renewal:
  1) Two (2) MRI surveys in prior 24 months
  2) Continuing Education Units (15 CME in prior 36 months)

The Role of the Medical Physicist

1) *The MRI team:*
   physician, technologist, administrator and physicist

2) *You are the primary resource for:*
   pulse sequences
   acquisition parameters
   system performance
   artifacts
   safety
   review and adequacy of submitted DICOM images
   changes in accreditation instructions and requirements

3) *Yes, you should determine that the system performance meets the ACR guidelines but more importantly, you should determine if the system meets your expectations based on your own knowledge and experience, e.g. a 1.5T system that has a LCD score of 9, can pass accreditation but is clearly not functioning properly.*

For non-hospital based facilities, which modalities have been designated by the Centers for Medicare and Medicaid Services (CMS) as "Advanced Diagnostic Imaging" services and thus, must be accredited by 1/1/2012.

0% 1. MRI, CT and Ultrasound
0% 2. MRI, Nuclear Medicine/PET and CT
0% 3. MRI, Ultrasound and Fluoroscopy
0% 4. MRI, Fluoroscopy and CT
0% 5. MRI, Ultrasound and Nuclear Medicine/PET

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For non-hospital based facilities, which modalities have been designated by the Centers for Medicare and Medicaid Services (CMS) as "Advanced Diagnostic Imaging" services and thus, must be accredited by 1/1/2012?

1. MRI, CT and Ultrasound
2. MRI, Nuclear Medicine/PET and CT
3. MRI, Ultrasound and Fluoroscopy
4. MRI, Fluoroscopy and CT
5. MRI, Ultrasound and Nuclear Medicine/PET

Reference: Center for Medicare and Medicaid Services website
http://www.cms.gov/Medicare/Provider-Enrollment-and-Certification/MedicareProviderSupEnroll/AdvancedDiagnosticImagingAccreditation.html

ACR Accreditation Application Overview

The accreditation process consists of two phases:

Phase 1: ***"Entry Application"*** *(Must be completed online.)*

Essentially to request a Testing Material Packet for the Full Application

Phase 2: ***"Full Application"***

You will then receive a Testing Material Packet for the Full Application. Please note that within the year (2012) the full application submission will also be available online.

For the whole-body and extremity magnets the Full Application requires:

- *Phantom and Clinical Images*
- *Equipment Performance Report for each magnet (< 1 year) and last quarter QC documents*

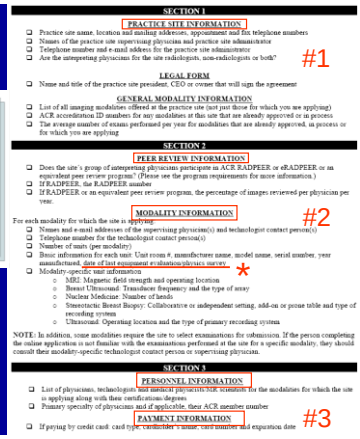
Note: ***At the present time the Breast MRI application does not require phantom images but does require the Physicist's Equipment Performance Report and QC documents.***

Online Application

https://acredit.acr.org/

Three Sections

* Date of last equipment evaluation/physics survey.


SECTION 1
PRACTICE SITE INFORMATION
LEGAL FORM
GENERAL MODALITY INFORMATION
#1
SECTION 2
PEER REVIEW INFORMATION
MODALITY INFORMATION
#2
SECTION 3
PERSONNEL INFORMATION
PAYMENT INFORMATION
#3

ACR MR Accreditation Phantoms

Manufacturer: J.M Specialty Parts
11689-Q Sorrento Valley Rd
San Diego, CA 92121
(619) 794-7200

"large phantom"

"small phantom"

Phantom Image Data

Phantom images must be submitted on DICOM CD-ROM format

CD must contain all five phantom imaging sequences for both large and small phantoms:

1) Sagittal localizer (TE/TR = 20/200 msec)

2) ACR T1-weighted sequence (TE/TR = 20/500 msec)

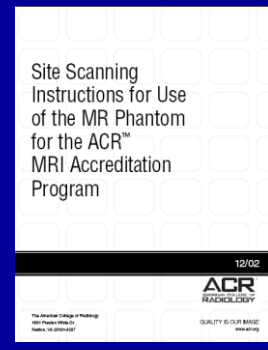
3) ACR T2-weighted Sequence (TE/TR = 20-80/2000 msec)

4) Site T1-weighted sequence and

5) Site T2-weighted sequence

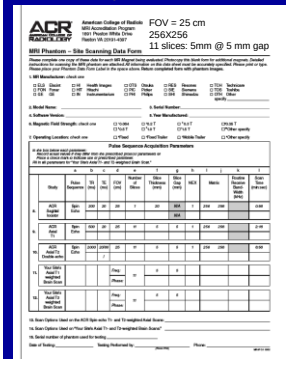
CD should not include an embedded viewer

Phantom Site Scanning Instructions

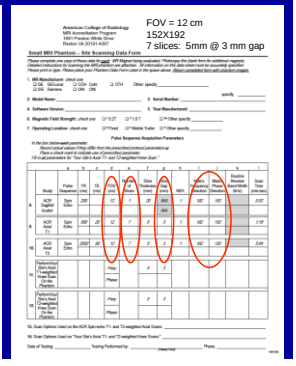


ACR Phantom Data Forms

Large Phantom

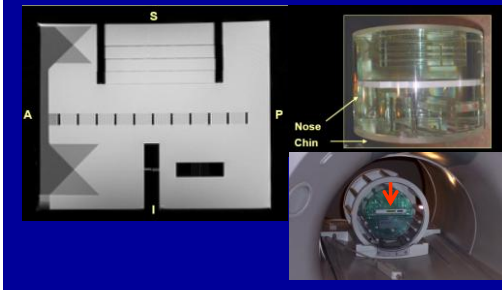


Small Phantom



Scan #1: ACR Sagittal Localizer

(SE 20/200 ms, FOV = 25 cm, 256X256, slice = 20 mm, NEX = 1, Time = 0.56 s)

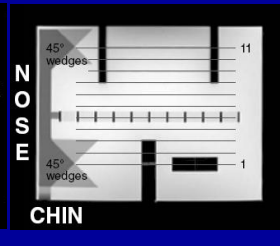


Accurate 3D alignment is essential!

Scan #2: ACR Axial T1

(Note: Also typically used for weekly QC Measurements.)

- Spin-echo sequence
- TE/TR=20/500ms
- Slice thickness / gap = 5/5 mm
- 11 slices graphically prescribed from sagittal localizer
- FOV = 25 cm
- Matrix: 256x256
- 1 average (NEX, NSA, *etc.*)
- Scan time: 2:16 min

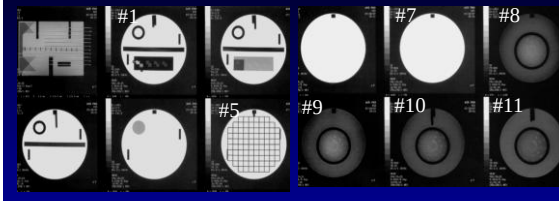


Compliments of Ed Jackson, PH.D.

ACR (large) Phantom Analysis

Scan #3: ACR Axial Dual Echo T2

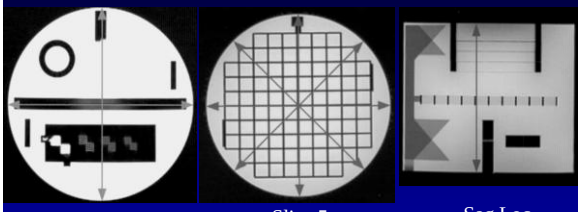
(SE 20-80/2000 ms, 25 cm, 256X256, multi-slice (11 at 5mm), 1 NEX, Time = 8:56 min)



#1) Slice thickness and position, geometric accuracy, high contrast resolution
#5) Geometric accuracy
#7) Percent image uniformity, ghosting
#8-11) Low contrast object detectability, and slice position (in #11)

Slide courtesy of E.F. Jackson, PhD

Large phantom - Geometric Accuracy

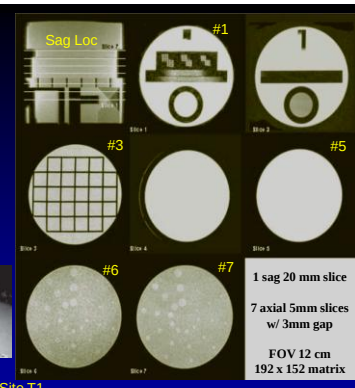


Slice 1 | Slice 5 | Sag Loc

Criteria: 190 ± 2 mm | **Criteria: 148 ± 2 mm**

ACR (small) Phantom

Sag localizer: Geometric accuracy
#1) Slice thickness and position, geometric accuracy, high contrast resolution
#3) Geometric accuracy
#5) PIU, ghosting
#6-7) LCD



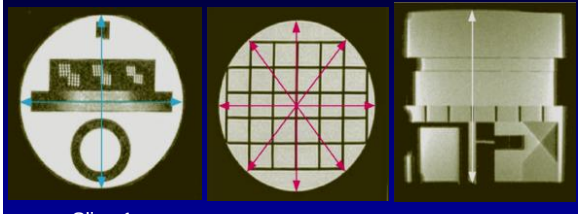
1 sag 20 mm slice

7 axial 5mm slices w/ 3mm gap

FOV 12 cm
192 x 152 matrix

Five Sequences
1) ACR Sagittal (20/200) 4) Site T1
2) ACR T1 SE (20/500) 5) Site T2
3) ACR T2 SE (80/2000)

Small phantom - Geometric Accuracy



Slice 1 | Slice 3 | Sag Loc

Criteria: 100 ± 2 mm

ACR Guidelines for Phantom Scans

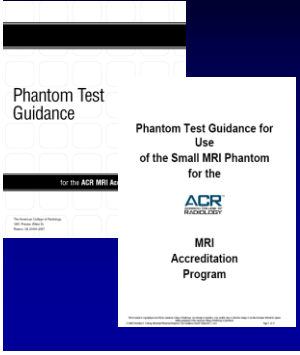
Large Phantom
(FOV = 25 cm, 256X256)

Dimensional accuracy (Sagittal)	148 ± 2 mm
Dimensional accuracy (Axial)	190 ± 2 mm
Slice Thickness	5 ± 0.7 mm
Slice Position	≤ 5mm
Image Uniformity (PIU)	≥ 87.5% (< 3T) ≥ 82.0% (3T)
Percent Signal Ghosting	≤ 2.5%
High-contrast Resolution	1 mm
Low-contrast Detectability Score	≥ 9 (<3T) ≥ 37 (3T)

Small Phantom
(FOV = 12 cm, 152X192)

Dimensional accuracy (Sagittal)	100 ± 2 mm
Dimensional accuracy (Axial)	100 ± 2 mm
Slice Thickness	5 ± 0.7 mm
Slice Position	≤ 5mm
Image Uniformity (PIU)	≥ 87.5% (< 3T)
Percent Signal Ghosting	≤ 2.5%
High-contrast Resolution	0.8 mm
Low-contrast Detectability Score	≥ 9 (<3T)

ACR Phantom Test Guidance Documents



Instructions for:

- *How to evaluate images using DICOM viewer (Kpacs , ClearCanvas, Osiris/Osirix)*
- *Performance criteria that must be met by each unit*
- *Common reasons for failure*
- *Sent to site with Full Application packet*
- *Also available at ACR website*

What are the ACR phantom performance guidelines for the percent image uniformity (PIU) and low-contrast detectability (LCD) for 3T and 1.5T systems, respectively?

0% 1. PIU=87.5%(3T) and 82%(1.5T), and LCD guidelines are the same

0% 2. PIU guidelines are the same, and LCD = 37(3T) and 9(1.5T)

0% 3. PIU= 87.5% (3T) and 82%(1.5T), and LCD = 37 (3T) and 9 (1.5T)

0% 4. PIU= 82%(3T) and 87.5%(1.5T), and LCD 37(3T) and 9(1.5T)

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1. PIU=87.5%(3T) and 82%(1.5T), and LCD guidelines are the same
2. PIU guidelines are the same, and LCD = 37(3T) and 9(1.5T)
3. PIU= 87.5% (3T) and 82%(1.5T), and LCD = 37 (3T) and 9 (1.5T)
4. PIU= 82%(3T) and 87.5%(1.5T), and LCD 37(3T) and 9(1.5T)

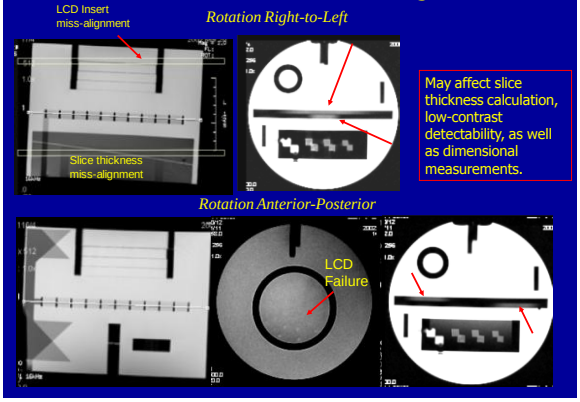
Reference: ACR website www.acr.org

http://www.acr.org/~/media/ACR/Documents/Accreditation/MRI/LargePhantomGuidance.pdf
http://www.acr.org/~/media/ACR/Documents/Accreditation/MRI/SmallPhantomGuidance.pdf

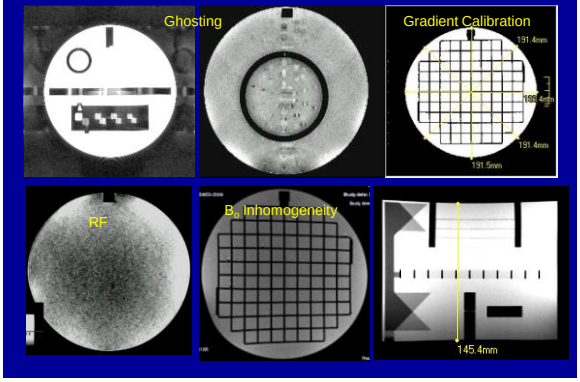
Common Phantom Image Failures

1. ***Poor phantom alignment***
   - a. *Low-contrast detectability (LCD insert miss-alignment)*
   - b. *Slice-thickness (ramps rotated with respect to slice)*
   - c. *Slice position accuracy (laser alignment or gradient calibration)*
2. ***Ghosting/Artifacts (gradient instability, motion, eddy currents, narrow BW, etc)***
   - a. *Interference with LCD spokes*
   - b. *RF leaks and others leading to "Unacceptable Artifacts" designation*
3. ***Signal-to-Noise (<1.5T as well as 3T)***
   - a. *Low-field: LCD score < 9*
   - b. *High-field (3T): LCD score < 37*
4. ***Gradient non-linearity (uncorrected)/B_0 inhomogeneity (poor magnet shim)***
   - a. *Geometric distortion*
   - b. *Dimensional accuracy*
5. ***Array coil based failures (non-function element or no image intensity correction)***
   - a. *Percent Image Uniformity (PIU) failure*
   - b. *Image intensity correction not used*
6. ***Other:***
   Incorrect sequence parameters: FSE vs SE, Half Fourier, acceleration (SENSE, GRAPPA, etc), excessive filtering, narrow BW distortions or combined effects

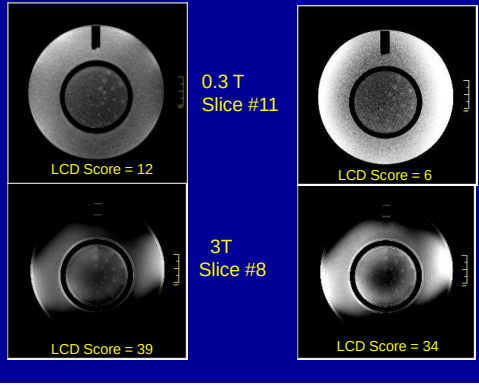
Poor Phantom Positioning



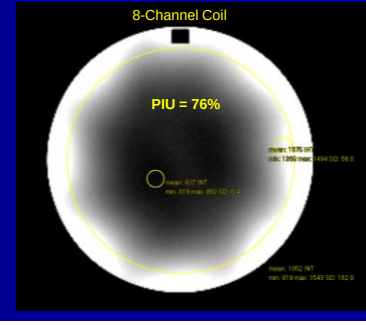
Ghosting/Artifacts/Spatial Distortion



SNR: Low-Contrast Detectability



No image Intensity Correction: Multi-element Coils (SCIC, CLEAR, PURE, …)



Common Clinical Image Failure

- *Unacceptable acquisition parameters*
- *Each Clinical Module has specific technical requirements.*
- *The Medical Physicist should review the DICOM header information to confirm appropriate acquisition parameters prior to submission.*

MRI Accreditation Program
Clinical Image Quality Guide
ACR AMERICAN COLLEGE OF RADIOLOGY
www.acr.org

Sequence	Slice thickness	Gap	Maximum Pixel Dimensions
Brain – Sagittal & Axial and/or Coronal	≤ 5 mm	≤ 2 mm	≤ 1.2 mm
Cervical Spine – Sagittal	≤ 3 mm	≤ 1 mm	≤ 1 mm
Cervical Spine – Axial	≤ 3 mm	≤ 1 mm	≤ 1 mm
Lumbar Spine – Sagittal	≤ 5 mm	≤ 1.5 mm	≤ 1.5 mm
Lumbar Spine – Axial	≤ 4 mm	≤ 1 mm	≤ 1.5 mm
Knee – Sagittal & Coronal	≤ 4 mm	≤ 1 mm	≤ .75 mm

Breast Magnetic Resonance Imaging (MRI) Accreditation Program Requirements

ACR AMERICAN COLLEGE OF RADIOLOGY

OVERVIEW 1

At the present time there is no specific ACR MRI phantom.

For Breast MRI Accreditation, the Medical Physicist/MR Scientist has the added responsibility of choosing the phantom to be used for the weekly QA measurements and determining the specifics of the QC program.

Currently, the ACR Breast MRI Accreditation application does not require phantom images.

However because of the specific and detailed requirements for the clinical image acquisition parameters, the Medical Physicist has an important roll in the submission process to confirm that the images meet the technical requirements.

ACR AMERICAN COLLEGE OF RADIOLOGY 1891 Preston White Drive, Reston, VA 20191-4397

Breast MRI Accreditation Program Testing Instructions

A. Required items for testing:
1. MRI Equipment Evaluation Summary form (also see page 131 in the *2004 ACR Magnetic Resonance Image Quality Control Manual*)
2. Evaluation of Site's Technologist QC Program form (also see page 129 in the *2004 ACR Magnetic Resonance Image Quality Control Manual*)
3. Identification labels to be affixed to the forms

B. Compliance with the ACR requirements for the medical physicist/MR scientist's Annual MRI System Performance Evaluation and QC:
1. The ***entire***, most recent ***Annual System Performance Evaluation*** report that includes:
   - ❒ A completed ***MRI Equipment Evaluation Summary*** form signed by the medical physicist/MR scientist (with a survey date within 1 year of the application date for ACR accreditation)
   - ❒ A completed ***Evaluation of Site's Technologist QC Program*** form

CLINICAL IMAGES

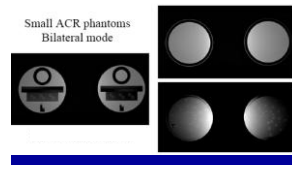
A. Required items for testing:
1. Breast MRI Test Image Data form to record your data for the online submission
2. Identification labels to be affixed to the clinical image discs and the Test Image Data section printout

B. Select clinical images for accreditation:
1. Review the ***Program Requirements*** and ***Clinical Image Quality Guide*** for guidance on image quality.
2. Submit 1 case with a ***known, enhancing, biopsy-proven carcinoma*** clearly visible in the breast parenchyma. Indicate its ***laterality and location*** on the form.

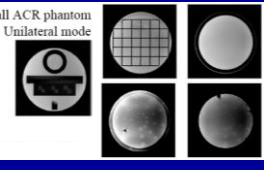
Breast Weekly QC Options

- Daily/weekly QC:
  - Choice of phantom and action criteria is up to facility. Decision made by "qualified medical physicist/MR scientist in cooperation with the system vendor".
    - Large ACR phantom in head coil
    - Dedicated breast MR systems may use small ACR phantom in breast coil.
    - Other vendor-supplied phantom

Small ACR phantoms Bilateral mode



Small ACR phantom Unilateral mode



The Medical Physicist will need to review the DICOM header information for the site to confirm that the images meet the ACR guidelines, e.g. slice thickness, phase and frequency-encoding steps, FOV and image acquisition time.

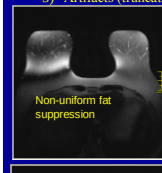
Parameters	T2-Weighted/Bright Fluid Series	Multi-Phase T1-Weighted Series: Pre-Contrast T1	Early Phase (1st) Post-Contrast T1	Delayed Phase (last) Post-Contrast T1
Sequence name/type				
Sequence #				
2D or 3D sequence (check one)	☐ 2D ☐ 3D	☐ 2D ☐ 3D	☐ 2D ☐ 3D	☐ 2D ☐ 3D
Slice orientation				
Acquisition time (min, sec)	min, sec	min, sec	min, sec	min, sec
Slice thickness (mm) (not interpolated)	mm	mm	mm	mm
Intersilice gap (mm)	mm	mm	mm	mm
Total number of slices				
$FOV_{phase\text{-}encoding}$ (mm)	mm	mm	mm	mm
$FOV_{frequency\text{-}encoding}$ (mm)	mm	mm	mm	mm
N_ϕ (# of phase-encoding steps)				
N_f (# of frequency-encoding steps)				
# Acquisitions per phase-encoding step (NEX)				
TE (msec)	msec	msec	msec	msec
TR (msec)	msec	msec	msec	msec
Flip Angle (degrees)		degrees	degrees	degrees
TI (only applicable for STIR sequences)	msec ☐ NA			

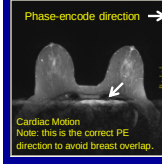
For the pre-contrast and post-contrast T1-weighted series, the following parameters *must* be met:

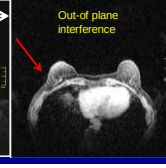
Sequence	Slice Thickness	Gap	Maximum Recommended In Plane Pixel Dimension for Phase and Frequency
Sagittal, Axial and/or Coronal	≤3 mm	0 mm	≤1 mm

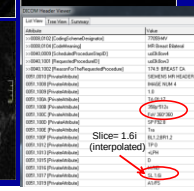
Common Clinical Image Problems in Breast MRI Accreditation.

1) Incorrect acquisitions parameters (pixel > 1 mm, slice > 3 mm or gaps > 0 mm)
2) Poor fat suppression or no pre-post contrast subtraction images
3) Interpolated images
4) Poor Position of breast within coil (skin folds)
5) Artifacts (truncation, wrap (slice and phase), motion, …









In regard to ACR Breast MRI accreditation, only one of the following is correct?

0% 1. The MRI system must be a dedicated breast facility
0% 2. Routine QA does not require the use of a phantom
0% 3. The MRI field strength must be at least 1.5T
0% 4. No phantom images are required as part of the accreditation application
0% 5. The use of a bilateral coil is optional

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Reference: ACR website www.acr.org

http://www.acr.org/~/media/ACR/Documents/Accreditation/BreastMRI/Requirements.pdf

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Anticipated Changes in the ACR MRI Quality Control Manual
(Revision expected 2012)

(Note: Changes have yet to be approved)

1. Annual Physics Report must include verification of technologist weekly QC measurements (i.e. repeated weekly QA at annual visit)
2. Annual Physics Report must include evaluation of all pulse sequences required for accreditation submission.
3. Revised method for slice-thickness calculation w/background correction
4. Description of additional methods for field uniformity assessment
   - Spectral Peak
   - Phase-angle Difference
   - **Phase Map**
   - **Bandwidth-Difference**
5. Improved description of slice-position accuracy guidelines
6. Removal of slice cross-talk requirement
7. Recommends NEMA methods for SNR, PIU and PSG
8. Required review of site safety policy

Medical Physics Annual Performance Report Clarification
1. Must have some form of field uniformity assessment
2. Must have monitor assessment

ACR Annual Performance Report Measurements, ct'd

Current Requirements:
1. Magnetic field uniformity
2. Slice Position Accuracy
3. Slice Thickness Accuracy
4. RF Coil Checks
   a. Volume Coils
      - Signal-to-Noise Ratio (SNR)
      - Percent Image Uniformity (PIU)
      - Percent Signal Ghosting (PSG)
   b. Surface Coils (Coil arrays)
      - Maximum SNR
5. Soft Copy (Monitor) Display
   - Max and Min Luminance
   - Luminance Uniformity
   - SMTE pattern evaluation

New:
6. Safety Assessment

Annual Site Safety Review (Proposed 2012 ACR Manual)

At the time of the annual performance testing, the qualified medical physicist/MRI scientist should review the site's written safety policies, determine that the written policies are readily accessible to facility staff and make recommendations for improvement. The categories listed below should be included in the review.

MR Safety Policies and Procedures Checklist

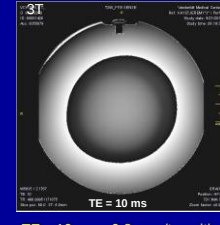
- Site Access Restrictions (MR Zones)
- Documented MR Safety Education/Training for all personnel
- Patient and non MR Personnel Screening
- Pediatric Patient Policy
- Designated MR Safety Officer
- Disaster Policy
- Quench Policy
- Cryogen Safety Policy
- Acoustic Noise Policy
- Pregnancy Policy
- Contrast Agent Safety Policy
- Sedation Policy
- Thermal Burns Policy
- Emergency Code Procedures
- Device and Object Screening and designation of MR Safe/MR Conditional status
- Procedures for Reporting MR Safety Incidents or Adverse Incidents
- Patient Communication
- Infection Control

Criteria for Compliance

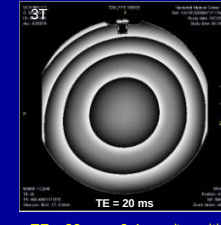
1. Written policies are present and are being reviewed and updated on a regular basis.
2. Facility has appropriate signage and methods of controlled access.
   Documentation of regular MR safety training for each facility staff member

Magnetic Field Uniformity: (Proposed 2012 ACR Manual)
Phase Map Method

GE Sequence: TE ~ 1/resonance frequency (ppm)
(e.g. 1.5T = 1/63 Hz = 15.6 ms)



TE = 10 ms ~ 0.8 ppm/transition



TE = 20 ms ~ 0.4 ppm/transition

Magnetic Field Uniformity: (proposed 2012 ACR Manual)
BW-Difference Method

Axial Sagittal Coronal

$$H_B(\text{ppm}) = \frac{\text{BW}_1 \cdot \text{BW}_2 \cdot (x_1' - x_2')}{\gamma \cdot B_0 \cdot \text{FOV}_x(\text{BW}_2 - \text{BW}_1)}$$

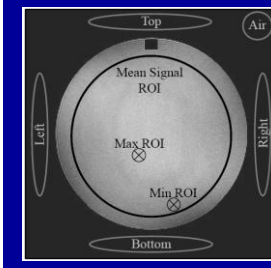
8 Hz/pixel 155 Hz/pixel Difference

Routine testing of magnetic field homogeneity on clinical MRI systems

Hua-Hsuan Chen, Rex D. Boykin, and Geoffrey D. Clarke[a)]
Department of Radiology, The University of Texas Health Science Center at San Antonio, San Antonio, Texas 78284
Jia-Hong T. Gao[b)] and John W. Roby III
Research Imaging Center, University of Texas Health Science Center, San Antonio, Texas 78284

Med. Phys. 33 (11), November 2006

Volume Coil Measurements: (Proposed 2012 ACR Manual)



Signal-to-Noise Ratio*

$$SNR = \frac{Mean\ Signal}{\left(\sigma_{air} / \sqrt{2 - \pi/2}\right)} = 0.655 \frac{Mean\ Signal}{\sigma_{air}}$$

Percent Image Uniformity (same)

$$PIU = 100 \bullet \left(1 - \frac{Max\ ROI - Min\ ROI}{Max\ ROI + Min\ ROI}\right)$$

Percent Signal Ghosting (same)

$$PSG = 100 \bullet \left(\frac{|(Left + Right) - (Top + Bottom)|}{2 \bullet Mean\ Signal}\right)$$

AAPM REPORT NO. 100: Acceptance Testing and Quality Assurance Procedures for Magnetic Resonance Imaging Facilities (2010), One Physics Ellipse, College Park, MD.

*NEMA MS 1-2008: Determination of Signal-to-Noise Ratio in Diagnostic Magnetic Resonance Images (Method 4)
Note: No longer subtracts background and now X 0.655 for Rician noise correction.

SNR Image-Difference Method*
(Proposed 2012 ACR Manual)

$$SNR = \sqrt{2}\,\frac{Mean\ Signal}{\sigma_{diff}}$$

√2 corrects for error propagation.

AAPM REPORT NO. 100: Acceptance Testing and Quality Assurance Procedures for Magnetic Resonance Imaging Facilities (2010), One Physics Ellipse, College Park, MD.

*NEMA MS 1-2008: Determination of Signal-to-Noise Ratio in Diagnostic Magnetic Resonance Images (Method 1)

Testing Coil Arrays
(Proposed 2012 ACR Manual)

It is recommended that the images from **each coil element** be reconstructed and displayed individually to check for bad array elements.

This is increasingly important with high-density arrays. A single SNR and/or uniformity measurement often will not detect a single bad element.

Some vendors provide the option for operator selection of individual elements. On other systems a service or research-mode may be required.

Comments

- *The quality of your contributions to the accreditation process will often determine if the site passes or fails.*
- *However of considerably higher importance, is that your contributions can often determine if the site is providing the best possible clinical results.*

Final Comment

Please remember: The ACR Accreditation Review will be delayed until all required medical physics documents are included in the submitted documents.

Clinical Examination Choices by Module

Examination choices for MR Accreditation by module (specialty examinations denoted by asterisk*)

Head/Neck	Spine	MSK
• Brain for transient ischemic attack (TIA) • Internal auditory canal (IAC/temporal bone) for hearing loss • Brain for suspected demyelinating disease* • Pituitary with dynamic contrast enhancement* • Orbits for vision loss*	• Lumbar Spine • Thoracic Spine • Cervical Spine* • Cervical Spine with contrast for intramedullary disease*	• Knee such as for internal derangement • Shoulder such as for internal derangement • Wrist such as for internal derangement* • Elbow such as for internal derangement* • Forefoot for Morton's neuroma*
Body	**MRA**	**Cardiac**
• Male pelvis such as for prostate cancer • Renal • Hepatobiliary to Include MRCP* • Female pelvis such as for uterine or adnexal disease*	• Brain • Carotid • Thoracic aorta • Distal peripheral runoff • High resolution arch and carotid* • Abdomen for renal artery stenosis *	• Black blood • Basic • Delayed enhanced cine 1 • Delayed enhanced cine 2 • Delayed enhanced cine + black blood*

Typical requirements: 4-6 exams per scanner depending upon the number of modules. Exams must include a "specialty" exam.

Revised Wording for Annual System Performance Evaluation

1. **Repeat and Verify Weekly QC Measurements**

- Setup and positioning accuracy (mechanical inspection)
- Central frequency.
- Transmitter gain or attenuation (head coil RF calibration)
- Geometric accuracy (gradient calibration)
- High contrast spatial resolution
- Low contrast detectability
- Image artifact assessment
- Hard copy (film) QC
- Soft copy (Monitor) QC
- Visual checklist

2. **Perform the scans required for accreditation submission and evaluate per the criteria in the MRI Accreditation Phantom Guidance Document**