ACR Breast MRI Accreditation Program

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Making Cancer History®

Educational Objectives

- Provide an overview of the ACR Breast MRI Accreditation Program (BMRAP) including personnel qualifications, equipment requirements, the quality control program and clinical image quality requirements.
- Discuss the role of the medical physicist/MRI scientist in the BMRAP application process.
- Provide clinical examples illustrating common breast MRI artifacts and image quality issues.

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Outline

- ACR Breast MRI Accreditation Program
- Personnel qualifications
- Quality control requirements
- ACR breast MR image quality assessment criteria
- Examples of clinical images

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ACR Breast MRI Accreditation Program

ACR Breast Magnetic Resonance Imaging Accreditation Program (BMRAP) launched in May 2010.

- Separate from the ACR MR Accreditation Program (MRAP)
- Provides accreditation for MR systems used for diagnostic breast MR imaging:
  - Dedicated breast MRI systems
  - Whole body MRI systems with detachable table-top breast coil or dedicated tables with integrated breast coils

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Breast MRI RF Coils


www.auroramri.com


www.sentinellemedical.com


Philips MammoTrak SENSE 16 Channel


Invivo 3T Precision Breast Array 8 Channel

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Why get accredited?

- January 1, 2012: Medicare Improvements for Patients and Providers Act of 2008 (MIPPA) requires accreditation for *outpatient facilities* that furnish the technical component of advanced diagnostic imaging procedures (CT, MR, Nuclear Medicine, PET) in order to receive reimbursement from CMS.
- 3 approved accreditation programs: American College of Radiology, The Joint Commission, Intersocietal Accreditation Commission
- ACR BMRAP and MRAP are separate programs. Scanners performing both general and breast MRI, need to be accredited in both programs in order to be reimbursed.

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Guidance documents

www.acr.org

Breast Magnetic Resonance Imaging (MRI)
Accreditation Program Requirements

ACR
AMERICAN COLLEGE OF RADIOLOGY

Breast MRI Accreditation Program

Clinical Image Quality Guide

ACR
AMERICAN COLLEGE OF RADIOLOGY

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MRI System Requirements

- Any field strength
- Coils capable of simultaneous bilateral imaging
- Must accredit all MR systems at the facility that are used to perform ***diagnostic*** *breast MR imaging*. Does not include:
  - Dedicated systems used for radiation therapy treatment planning
  - Dedicated interventional MRI systems
  - Systems used for MR-guided breast biopsy but not breast MR imaging

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BMRAP Clinical Images

- Facilities must submit clinical images and corresponding data for each magnet performing breast MRI examinations at their site.

- Facilities performing breast MRI must have the capacity to perform mammographic correlation, directed breast ultrasound and MRI-guided intervention, or create a referral arrangement with a cooperating BMRAP accredited facility that could provide these services.
- 6 months to acquire clinical exams
- No phantom image submission is required at this time.

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ACR Breast MRI Accreditation Program

Step 1: Application

- MRI system information
- Personnel information
- $$$ fees

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Accreditation fees

Accreditation Fees

Facilities must submit the appropriate fee with their application. All fees are non-refundable and subject to change without notice.

Cycle	Fees
Accreditation *(Initial cycle and renewal)*	**$2,400** for the first unit **$2,300** each additional unit at the same geographic location
Repeat	**$700** for each unit
Reinstate/Corrective Action Plan	**$2,400** for the first unit **$2,300** each additional unit at the same geographic location
Add units *(mid cycle)*	**$1,400** for each unit
Replacement Certificate	**$65** per certificate

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www.acr.org Breast MRI Accreditation Program Requirements, 11/22/2011

ACR Breast MRI Accreditation Program

Step 2: Submit test materials

- Clinical* breast MRI exam on CD/DVD BIRADS category 6 (known, enhancing, biopsy-proven carcinoma) for each scanner to be accredited.
- Test image data form
- Medical physicist's annual system performance report
- Quality Assurance Questionnaire

**Currently program does not require phantom images*

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Outline

- ACR Breast MRI Accreditation Program
  - Personnel qualifications
- Quality control requirements
- ACR breast MR image quality assessment criteria
- Examples of clinical images

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Personnel Qualifications – Radiologist

Initial qualifications:

- Certification in Radiology or Diagnostic Radiology (ABR, American Osteopathic Board of Radiology, Royal College of Physicians and Surgeons of Canada or Le College des Medecins du Quebec)

AND

- Supervision, interpretation and reporting of 150 breast MRI exams in last 36 months or 100 breast MRI exams *in a supervised situation*.

OR

Not Board Certified

- Completion of an ACGME or AOA approved diagnostic radiology residency program

AND

- Interpretation and reporting of 100 breast MRI exams in the last 36 months *in a supervised situation*.

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Personnel Qualifications – Radiologist

AND

15 hours of Cat 1 CME in MRI (including clinical applications of MRI in breast imaging, MRI artifacts, safety and instrumentation in the last 36 months.

Continuing Experience:

- Upon renewal, 75 breast MRI examinations in prior 24 months.
- Double reading acceptable (2 or more physicians interpret the same exam)
- Can re-interpret a prior exam as long as physician did not do the initial read.

Continuing Education:

5 hours of Category 1 CME in breast MRI in the prior 36 months.

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Personnel Qualifications – Technologist

Initial qualifications:

1. Registered in MRI (ARRT, ARMRIT, or CAMRT)
2. OR Registered in radiography by ARRT and/or unlimited state license, and 6 months supervised clinical MRI scanning experience.
3. OR Associate's or Bachelor's degree in allied health field and certification in another clinical imaging field and 6 months supervised clinical MRI scanning experience.

AND

- Licensure in state in which he/she practices (if required for MRI techs)
- Supervised experience in breast MRI

AND

- Supervised experience in the IV administration of MR contrast (if performed by the technologist)

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Personnel Qualifications – Technologist

Continuing Experience:

Upon renewal, 50 breast MRI examinations in prior 24 months.

Continuing Education:

All:

- 24 hours of CE every 2 years
- CE includes credits pertinent to the technologist's ACR accredited clinical practice

Registered technologists:

- CE in compliance with requirements of certifying organization

State licensed technologists, all others:

- CE relevant to imaging and the radiologic sciences, patient care

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Personnel Qualifications – Medical Physicist/MR Scientist

Initial qualifications

Medical Physicist:

1. Board Certification in Radiological Physics or Diagnostic Radiological Physics (ABR), in MRI Physics (ABMP), or in Diagnostic Radiology Physics or MRI Physics (CCPM)
2. Not board certified: graduate degree in relevant fields ***and*** formal course work in biological sciences ***and*** 3 years documented experience in a clinical MRI environment
3. Grandfathered: Surveys of at least 3 MRI units between January 1, 2007 and January 1, 2010.

MR Scientist:

- Graduate degree in a physical science involving nuclear MR or MRI
- 3 years experience in a clinical MRI environment.

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Personnel Qualifications – Medical Physicist/MR Scientist

Continuing Experience:
Upon renewal, 2 MRI unit surveys in prior 24 months.

Continuing Education:
Upon renewal, 15 CEU/CME (half must be Category 1) in the prior 36 months (must include credits pertinent to the accredited modality).

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Personnel Qualifications – Medical Physicist/MR Scientist

- Must be familiar with MRI safety, FDA guidance for MR diagnostic devices, other regulations pertaining to the performance of the equipment being monitored.
- Be knowledgeable about MR physics, MRI technology, including function, clinical uses, performance specifications of MRI equipment, calibration processes and limitations of the performance testing hardware, procedures, and algorithms.
- Working understanding of clinical protocols and optimization. Maintain proficiency in CE programs to ensure familiarity with current concepts, equipment, and procedures.

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Outline

- ACR Breast MRI Accreditation Program
- Personnel qualifications
  - Quality control requirements
- Clinical breast MR image quality
- ACR image quality assessment criteria
- Examples of clinical images

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BMRAP Quality Control Program

QC program identical to ACR MRAP.

- Acceptance, annual, post-upgrade/repair testing
- Annual testing of all RF coils

Daily/weekly QC:

Choice of phantom and action criteria determined by "qualified medical physicist/MR scientist in cooperation with the system vendor".

- Large ACR phantom in head coil
- Dedicated breast MR systems may choose to use small ACR phantom in breast coil.
- Other vendor-supplied phantom

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BMRAP Quality Control Program

MRI technologist:

- Daily/weekly phantom scans
- Visual checklist

Physicist:

- MRI system performance evaluation after scanner installation, annually and following major repair or hardware/software upgrade
- Annual QC of all RF coils (including breast MRI coils)

Service engineer:

- Documented periodic/preventative maintenance (PM). Frequency defined in service contract

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Quality Control - Technologist

Technologist QC test	Minimum frequency*
Center frequency	Weekly
Table positioning	Weekly
Set up & scanning	Weekly
Geometric accuracy	Weekly
High contrast resolution	Weekly
Low contrast resolution	Weekly
Artifact analysis	Weekly
Film QC	Weekly
Visual Checklist	Weekly

*daily recommended

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MRI Safety Policy

- Written MRI safety policies required.
- MR supervising physician must review policies at least annually.
- The annual medical physicist/MR scientist system performance report must include:
  - MRI safety assessment:
    - Signage
    - Screening procedures
    - Cryogen safety
  - Inspection of system physical, mechanical integrity

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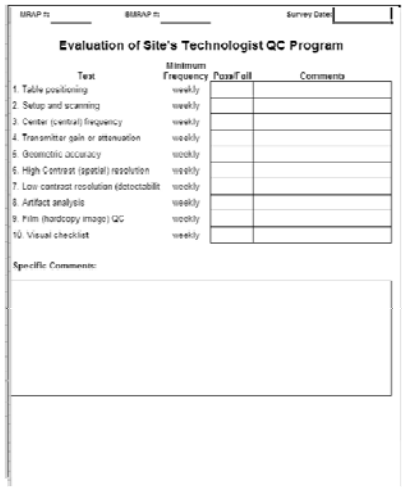
Annual System Performance Evaluation report

Must include:

- MRI Equipment Evaluation Summary form
- Include all data pages (entire report), not just summary page
- Indicate corrective action taken
- Evaluation of the Technologist QC program form.
  (physicist must repeat Tech QC)



MRAP ft: _____ BMRAP ft: _____ Survey Date: _____

Evaluation of Site's Technologist QC Program

Test	Minimum Frequency	Pass/Fail	Comments
1. Table positioning	weekly		
2. Setup and scanning	weekly		
3. Center (central) frequency	weekly		
4. Transmitter gain or attenuation	weekly		
5. Geometric accuracy	weekly		
6. High Contrast (spatial) resolution	weekly		
7. Low contrast resolution (detectabilit	weekly		
8. Artifact analysis	weekly		
9. Film (hardcopy image) QC	weekly		
10. Visual checklist	weekly		

Specific Comments:

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Medical Physicist: Annual System Performance Evaluation

Report must include tests defined in 2004 ACR MRI Accreditation manual:

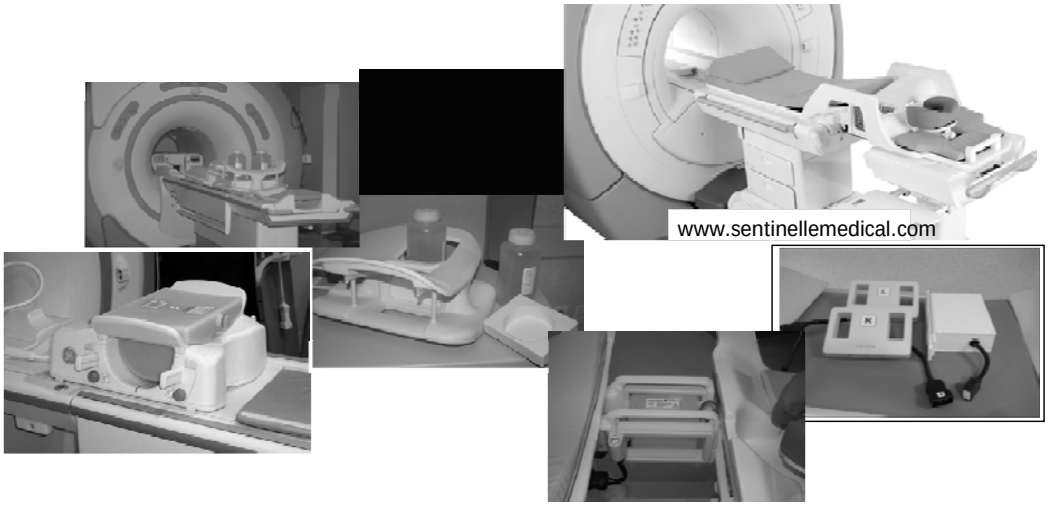
- *Magnetic Field Homogeneity*
- *Slice Position Accuracy*
- *Slice Thickness Accuracy*
- *Radiofrequency Coil Checks*
- *Soft-Copy Displays (Monitors)*

* *Inter-Slice Radiofrequency Interference no longer required*

Evaluation of technologist QC program:

- *Setup/positioning accuracy*
- *Center frequency*
- *Transmit gain/attenuation*
- *Geometric accuracy*
- *Spatial resolution*
- *Low contrast detectability*
- *Artifact analysis*
- *Film QC*
- *Visual checklist*

Breast RF Coil Quality Control



Medical Physicist or MR Scientist

- "You **must** utilize the services of a qualified medical physicist/MR Scientist for the Annual System Performance Evaluation.
- A qualified medical physicist/MR scientist **must** have the responsibility for overseeing the equipment QC program and for monitoring performance upon installation and routinely thereafter.
- The ACR **strongly recommends** using the services of a qualified medical physicist or MR scientist during both the process of accreditation and for oversight of your site's technologist quality control program."

Medical Physicist/MRI Scientist

Can be very helpful with the technical aspects of Breast MRI Accreditation process:

- Assist Radiologist with breast MRI protocol development and optimization. Ensure protocols meet ACR spatial and temporal resolution requirements.
- Review breast MRI cases for image quality and artifacts prior to submission.

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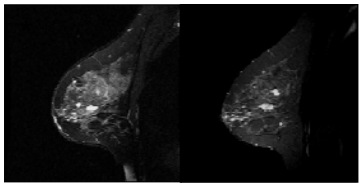
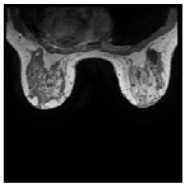
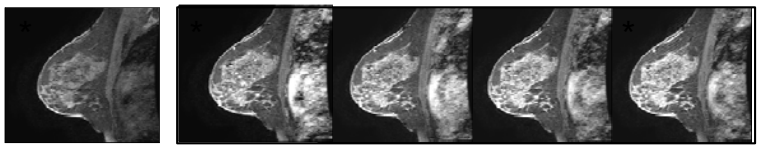
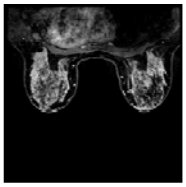
Example of Diagnostic Breast MRI Protocol









Protocols vary between facilities.
For BMRAP only submit to the ACR:

- *Localizer/scout
- *T2W bright fluid series
- *Pre-contrast T1
- *Post-contrast early phase, last phase

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BMRAP Clinical Images

Submit 1 bilateral breast MRI case per scanner

- BI-RADS category 6: Known, enhancing, biopsy-proven carcinoma, clearly visible in breast parenchyma.
- *BIRADS category 1 or 2 case no longer required*

Cases may not be older than 6 months from the date on the testing memorandum. Allows time to select cases that are examples of "best work".

Actual patients, not volunteers.

All images from same patient.

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BMRAP Clinical Images

ACR image assessment categories:

A. Pulse sequences and image contrast

B. Positioning and anatomical coverage

C. Artifacts

D. Spatial and temporal resolution

E. Exam identification

www.acr.org Breast MRI Accreditation Program Clinical Image Quality Guide, 9/23/2011

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A. Pulse sequences and image contrast

T2, bright fluid series:

- Bright fluid contrast distinguishable from background
- Must demonstrate sufficient SNR (not too grainy)

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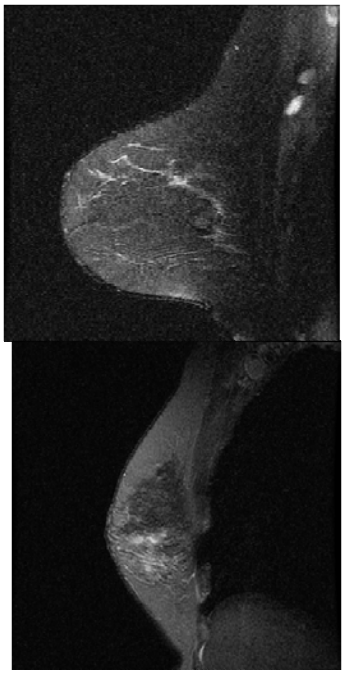
SNR

Potential causes of low SNR:

- Low field strength
- Poor coil connection
- Coil element failure
- Incorrect center frequency selection
- Protocol parameters:
  - Small voxels (large matrix, small FOV, thin slices)
  - trade-offs: speed, SNR, resolution

$$SNR \propto \rho_{1_H} \frac{FOV_\upsilon \; FOV_\phi}{\sqrt{N_\upsilon \; N_\phi \; \Delta\upsilon_{samp}}} \; \delta_s \; \sqrt{N_{ave}} \; B_0 \; f$$



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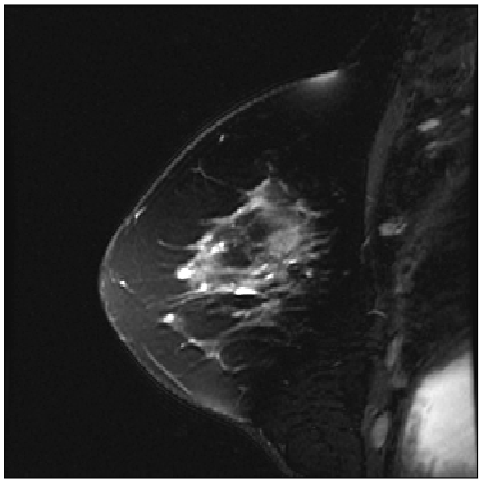
Clinical example

T2W bright fluid series:

- Bright fluid contrast
- Non-uniform fat saturation
- Non-uniform signal

1.5T GE HDXT
2D T2W, sagittal
FSE, ETL 17, fat sat
TR/TE 4950/89 ms
256x192, NEX 2
FOV 220mm,
4.0mm thk, 0 gap



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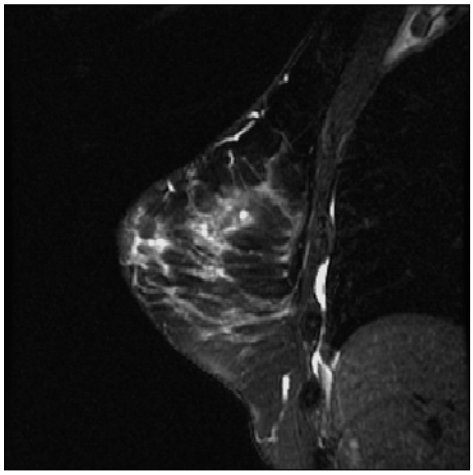
Clinical example

T2W bright fluid series:

- Bright fluid contrast
- Fat saturation fairly uniform

GE 1.5T HDXt
2D T2W, sagittal
FSE, ETL 17, fat sat
TR/TE 4950/89 ms
256x192, NEX 2
FOV 220mm,
4.0mm thk, 0 gap



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A. Pulse sequences and image contrast

T1W multi-phase series:

- Pre-contrast and post-contrast series: identical scan parameters.
- Post-contrast T1W images must either be fat suppressed or provide subtractions (early and delayed phases)
- IV contrast must be evident in post-contrast images
- Must demonstrate sufficient SNR (not too grainy)
- If possible, should be sequential (i.e. not "stacked" or "interleaved")

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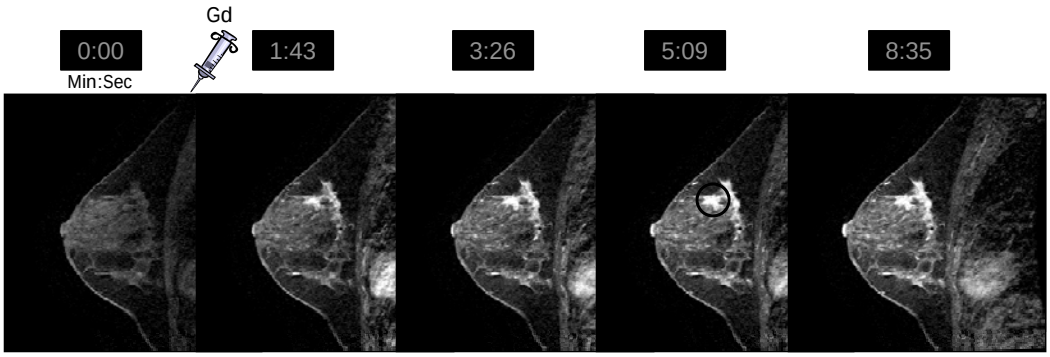
T1W Multi-phase series



Pre-contrast | Early/first phase Phase 1 | Phase 2 | Phase 3 | Late/last phase Phase 4

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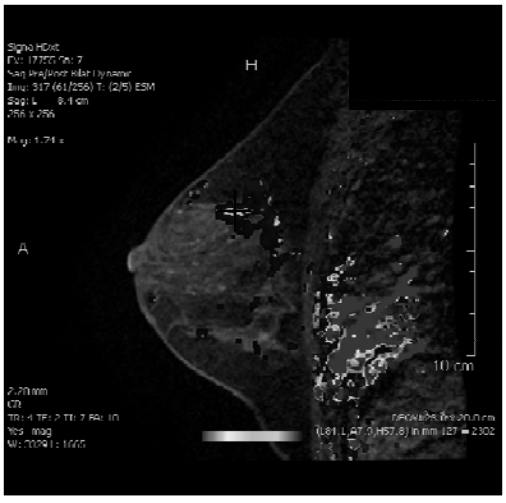
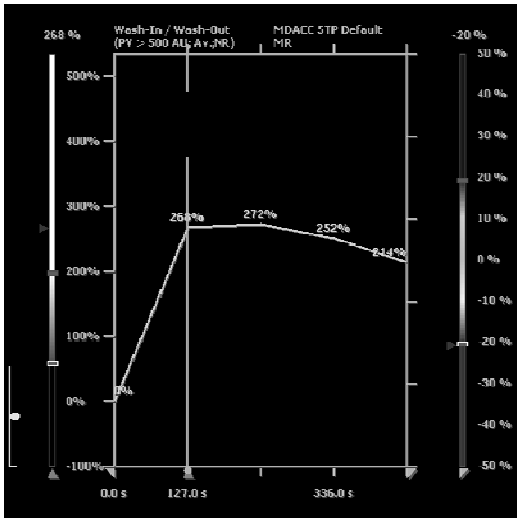
T1W Multi-phase series





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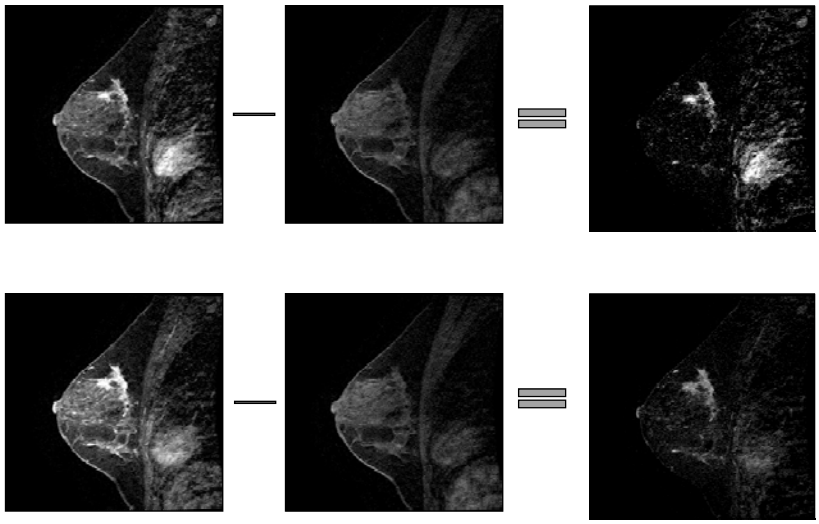
Multiphase T1 series w/o fat sat: subtractions



*Submit pre- and post-contrast series and both subtracted series

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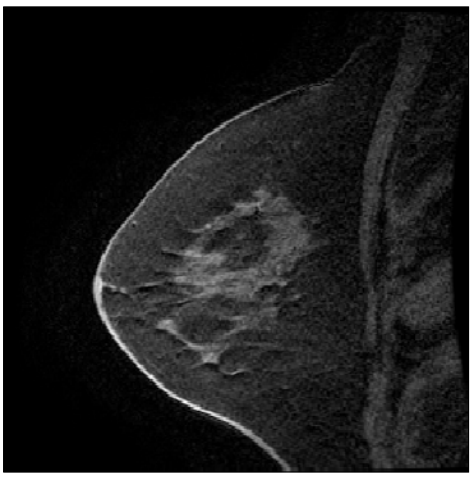
Clinical example

T1 weighted dynamic (multi-phase) series:

- Uniform signal
- Uniform fat sat
- Low SNR, images grainy

1.5T GE HDXt
3D, T1W, sagittal
FGRE, fat sat, α 10^0
TR/TE 4.3/2.0 ms
256x256, NEX 0.5
FOV 220mm,
2.6 mm thk, 50% overlap
Sequential



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B. Positioning and anatomical coverage

- Adequate breast tissue in coil
- Proper positioning of breast tissue
- Full coverage from axillary tail to inframammary fold
- Absence or minimal skin folds
- Appropriate FOV

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C. Artifacts

- Excessive artifacts can interfere with interpretation
- Some are unavoidable on certain images
- Images do not have to be “artifact free”
- Some are due to pulse sequence errors, inadequate equipment, improper maintenance (PM, QC) of equipment

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Breast MRI Artifacts

Common artifacts in breast MRI

- Motion
- Truncation artifacts
- Out of volume wrap
- Susceptibility artifacts
- Signal non-uniformity
- Poor or non-uniform fat saturation

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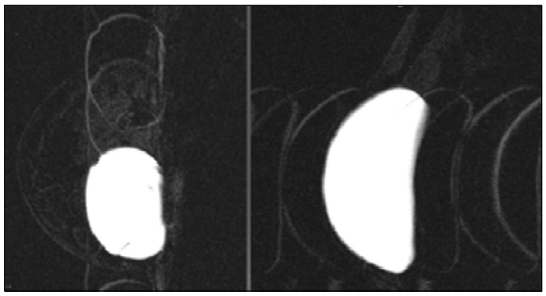
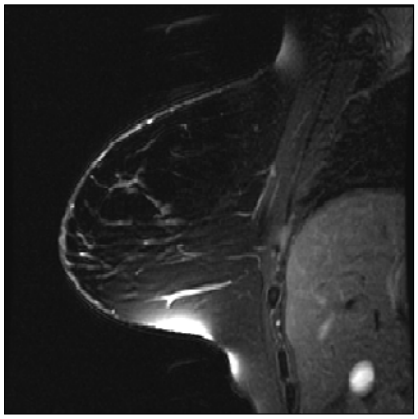
Motion artifacts

Occur in the phase encoding direction. Caused by cardiac motion, respiration, patient movement. Results in phase mis-mapping in k-space due the time delay between phase-encoding and signal readout.





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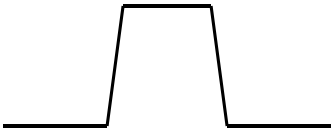
Truncation Artifacts

- Occur at high contrast edges.
- Also known as Gibbs or "ringing" artifact.
- Can occur in either phase or frequency direction, but typically seen in phase direction.
- Minimized by increasing matrix size
  - Improves high contrast spatial resolution, but reduces SNR
  - Also increases scan time if phase matrix is increased



Object profile

Measured intensity profile

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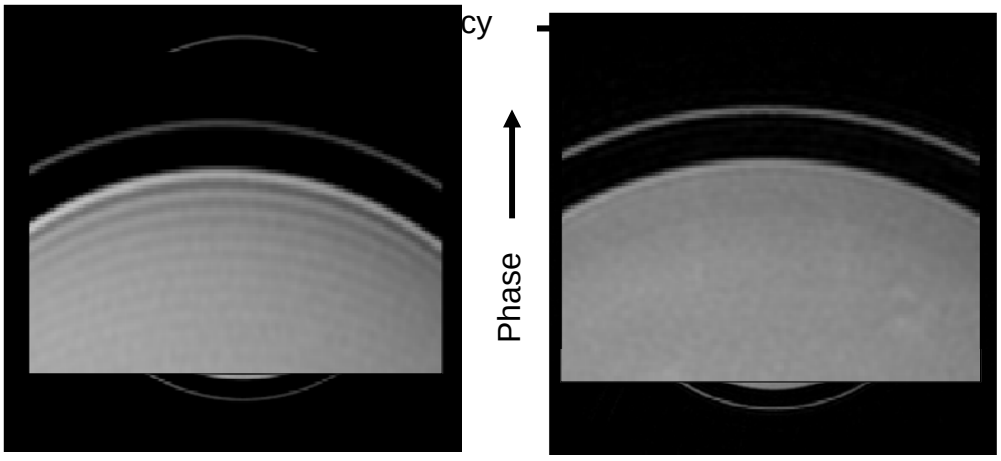
Truncation Artifacts



Small ACR phantom in 3T GE HD Breast array

320x192 matrix 320x320 matrix

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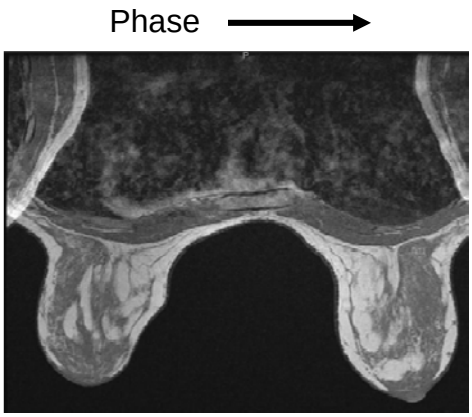
Aliasing or "Wrap-Around" Artifacts



- Increase FOV to include entire object - increase phase-encode steps to maintain resolution (trade-off: may impact scan time, SNR)
- Swap phase and frequency-encoding directions : shorter dimension in phase-encoding direction. (trade-off: motion artifacts)
- Use "No phase wrap" or "anti-aliasing" techniques.

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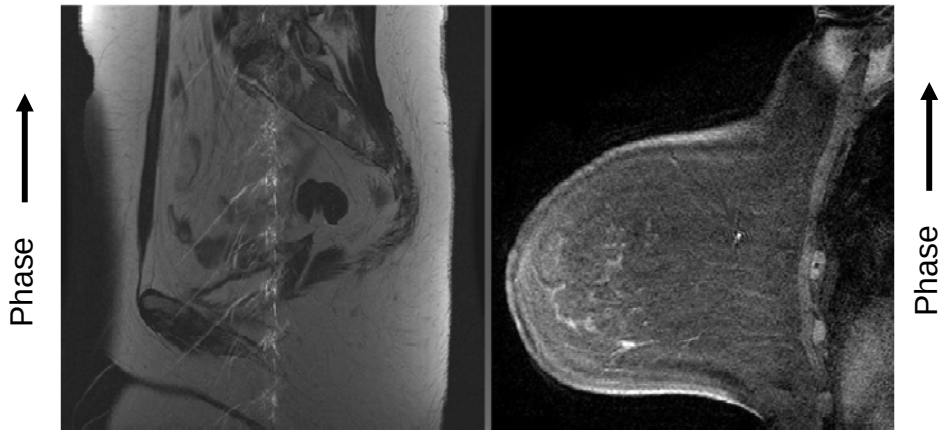
Peripheral signal artifact (annefact, star artifact)



FSE: Spine exam using phased array CTL coil .

FSE: Star artifact – bright signal close to center of 3D images.

Signal originates in region outside FOV where gradients are nonlinear. FID from 180^0 pulses not crushed – aliases back into image.

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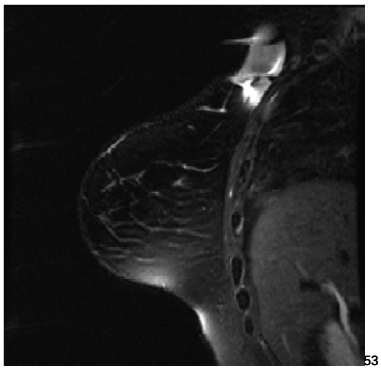
Magnetic Susceptibility Artifacts

Metallic objects can cause distortions of the static and gradient fields, RF fields, or both

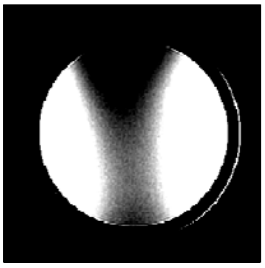
- Ferromagnetic objects - distort B_o and B_1 fields
- Non-ferromagnetic metal objects - distort B_1 fields

Typical effects are signal voids and geometric distortions.

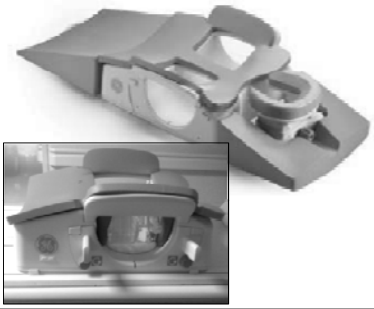
Most noticeable on GRE (rather than SE or FSE). Appearance reduced with wider receive BW, shorter TE.

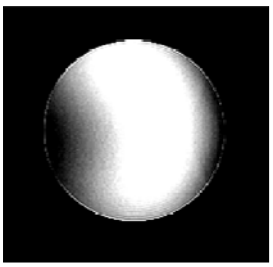


Signal uniformity and breast coil design



1.5T Sentinelle coil - axial image of small ACR phantom





3T GE HD array - axial image of small ACR phantom

Frequency selective fat sat

Frequency-selective fat or silicone saturation is routinely used in breast imaging. Frequency of saturation pulse must match resonant frequency of fat/silicone.

Selection of resonant peak usually automated, but may require manual adjustment → Technologist training essential.

Uniform saturation dependent on homogeneity of B_0 field within the imaged volume:

- challenge (breasts off isocenter)
- shimming is important

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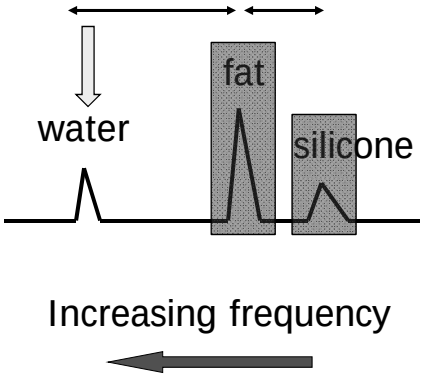
Fat/silicone saturation - peak selection

~440 Hz ~200 Hz 3T

~220 Hz ~100 Hz 1.5T

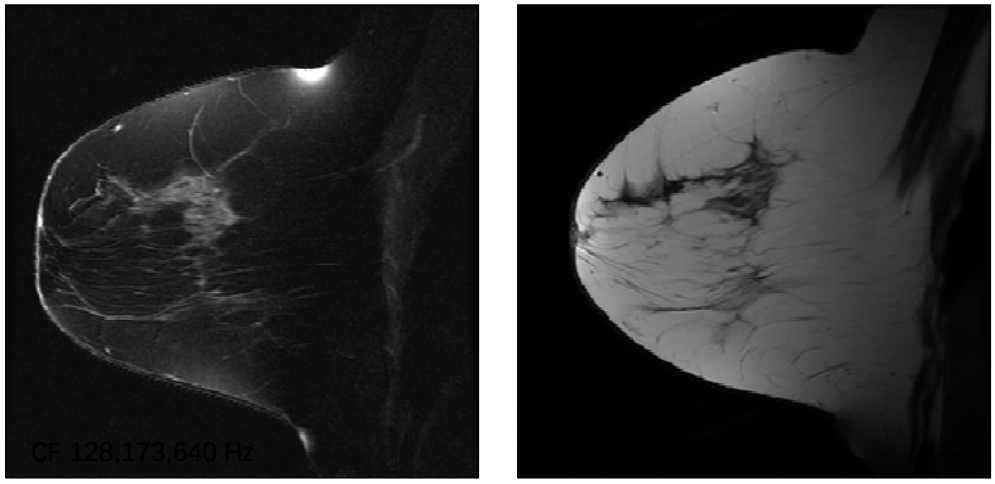
(fat-water separation 3.5 ppm)



Effective chemically-selective fat or silicone saturation depends on accurate peak selection.

GE: center on water, saturates fat signal at -220Hz

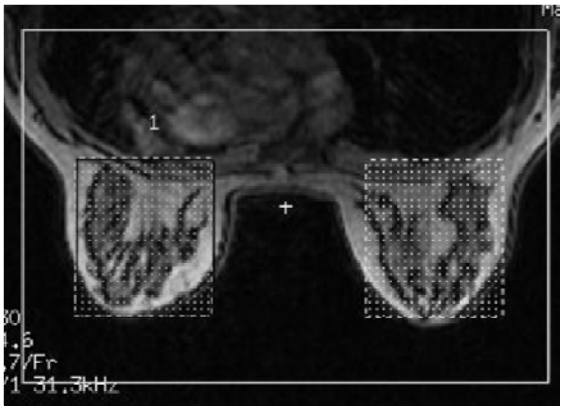
T2W FSE



Difference in center frequency 440 Hz (3.5 ppm) = 3T difference in resonant frequency between fat-water. Centered on fat peak → fat sat failure.

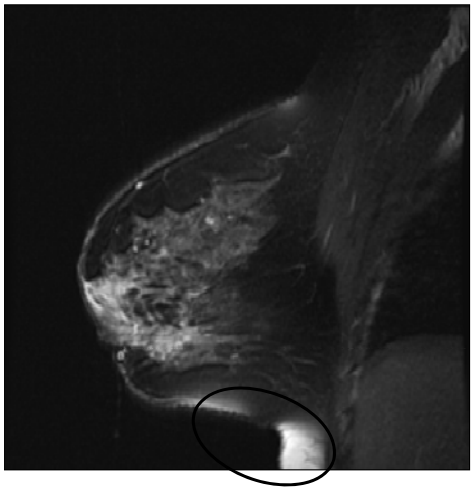
Shimming

- Shim volume – user prescribes graphically
- Current in shim coils adjusted to optimize B_0 field uniformity within the volume. Improves uniformity of signal and frequency-selective fat saturation.



Clinical example

- Non-uniform signal
- Non-uniform fat suppression



1.5T GE HDXt
Sag T2W FSE
TR =4367ms / TE_{eff} =81 ms
echo train length = 17
122 Hz/pixel bandwidth
256x192 matrix, 220 mm FOV
4mm thickness/ 0mm gap
2 averages
fat sat

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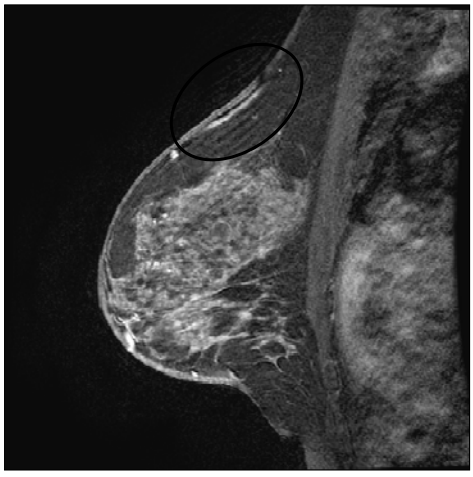
Clinical example

- Uniform fat saturation
- Truncation artifacts
- Low SNR
- Motion artifacts



3T GE HDXt
3D T1W Multiphase
TR =5.4 ms / TE =2.3 ms
Flip angle 10^{O}
NEX=0.5
244.1 Hz/pixel bandwidth
320x320 matrix, 200 mm FOV
2.4mm thickness/ 1.2mm spacing
(slices overlap)
fat sat

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D. Spatial and Temporal Resolution

Spatial Resolution: Criteria only apply to pre- and post-contrast T1-weighted multi-phase series:

- Acquired (not interpolated) thickness must be ≤ 3mm, >4.0mm will fail.
- 3-4mm: may fail if there are deficiencies in other categories.
- In-plane resolution must be ≤ 1mm (phase and freq), >1.2mm will fail, 1.0-1.2mm may fail if deficiencies in other categories.
- Interslice gap must be ≤ 0mm (i.e. slices either overlap or are contiguous with no gap), >0mm will fail

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Spatial Resolution

$\delta_\upsilon = FOV_\upsilon / N_\upsilon$	In-plane pixel size (frequency-encoding direction
$\delta_\phi = FOV_\phi / N_\phi$	In-plane pixel size (phase encoding direction)
δ_{slice}	Prescribed slice thickness (not interpolated)

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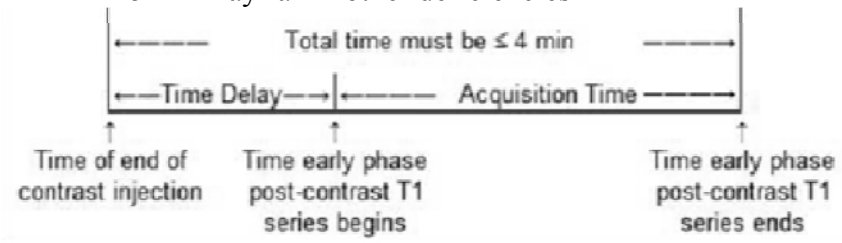
D. Spatial and Temporal Resolution

Temporal Resolution: Criteria apply to T1-weighted multi-phase series:

- Total time between contrast injection completion and end of early phase:
  - ≤4min
  - >5min will fail
  - 1min-5min may fail if other deficiencies



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E. Exam Identification

- Information must be displayed or easily accessed through DICOM header on CD/DVD.
- Patient name, ID
- Age or DOB
- Facility name, exam date
- Laterality (left or right of midline)
- Interslice gap

Will fail if laterality is absent of incorrect.

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Test Image Data Form

- Provide patient, scanner and exam information
- Lead Interpreting Physician must review and approve images
- Test image data form must be signed by Lead Interpreting Physician.

ACR Breast MRI Accreditation Program
1891 Preston White Drive, Reston, VA 20191-4397 — Test Image Data

PRIVILEGED and CONFIDENTIAL • PEER REVIEW

TEST IMAGE DATA • SYSTEM IDENTIFICATION

1. Scanner serial #: _____ 2. Manufacturer: _____
3. Model name: _____ 4. Field Strength: ____Tesla 5. Year manufactured: _____
6. Person completing form: _____ 7. Telephone: _____ 8. Date: _____
9. Signature of lead interpreting physician reviewing and approving submitted cases and forms: _____

TEST IMAGE DATA • KNOWN, ENHANCING BIOPSY PROVEN CARCINOMA

1. Exam date: _____ 2. Patient name: _____ 3. ID#: _____ 4. Age: _____
5. Patient weight, if available: _____ kg 6. Contrast type: _____ 7. Contrast volume: _____ ml
8. Contrast rate: _____ ml per sec 9. Time delay between end of injection and beginning of the 1st post-contrast series: _____ sec
10. Reason for exam: _____
(Please include laterality and location of the abnormality)

11. Submit only unenhanced images plus the following 4 sequences. All technical factors below must be completed.

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* (only check "see pre-contrast T1W" if Aurora)	☐ see pre-contrast T1W			
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
Interslice gap (mm)	mm	mm	mm	mm
Total number of slices				
FOV phase-encoding (mm)	mm	mm	mm	mm
FOV frequency-encoding (mm)	mm	mm	mm	mm
N_P (# 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			

*Sequence name/type – This is the name given by your MRI unit manufacturer for each sequence you use for breast imaging (for example, "SPGR", "T2 FSE", "Vibrant", "Fast STIR", etc). Sequence names vary with each manufacturer; if you have questions, please contact your manufacturer for assistance.

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Test Image Data Form

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** *(only check "see pre-contrast T1W" if Aurora)*	☐ see pre-contrast T1W			
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
Interslice 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_P (# 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			

**Sequence name/type* – This is the name given by your MRI unit manufacturer for each sequence you use for breast imaging (for example, "SPGR", "T2 FSE", "Vibrant", "Fast STIR", etc). Sequence names vary with each manufacturer; if you have questions, please contact your manufacturer for assistance.

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CDs or DVD media

- Burn 2 copies of each case, each on a separate CD/DVD
- Include embedded DICOM viewer
- On a different PC verify that CD/DVD is readable. Confirm that viewer displays the following:
  - Patient name, patient age/DOB
  - Patient ID number
  - Facility name
  - Exam date
  - Laterality, left or right of midline section
  - If this information is not displayed, it should be available in DICOM metadata
- Confirm that the exam opens *within 2 minutes*

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Tips for Success

- Form a BMRAP team
- Ensure scanner and coils are working properly, address equipment performance deficiencies before beginning the accreditation process.
- Establish/review QC program
- Check medical physicist's system/coils reports for content, deficiencies
- Evaluate protocols and clinical image quality
- Choose clinical cases that represent your best work
- Have a 2nd person review forms, images, CD/DVDs
- Call the ACR if you have questions

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References

1. ACR Technical Standards for Diagnostic Medical Physics Performance Monitoring of MRI Equipment, revision 2009. www.acr.org

2. BMRAP Clinical Imaging Quality Guide, 9/23/2011. www.acr.org

3. Breast MRI Accreditation Program Requirements, 11/22/2011. www.acr.org

4. Breast MRI Accreditation Update, Accreditation E-newsletter, Issue 13, 03/16/2011. http://www.acr.org/accreditation/Accred-E-News.aspx

5. Jackson EF, et al. Acceptance testing and quality assurance procedures for magnetic resonance imaging facilities: report of AAPM MR Subcommittee Task Group 1, 2010.

6. Weinreb, et al. ACR Magnetic Resonance Imaging (MRI) Quality Control Manual, 2004.

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