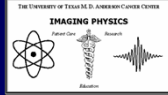
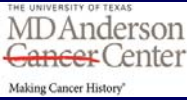


## BICOE – Stereotactic Breast Biopsy and Breast Ultrasound Accreditation

**William Geiser, MS DABR**  
Senior Medical Physicist  
MD Anderson Cancer Center  
Houston, Texas  
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## Introduction

- Objectives
- Program Requirements
- Physicists Role
- Testing Requirements

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## Educational Objectives

- Understand the annual test requirements for stereotactic breast biopsy systems accredited by the American College of Radiology for both upright add on systems and standalone prone biopsy systems.
- Understand the testing requirements for breast ultrasound systems for BICOE.
- Help facilities obtain the designation of Breast Imaging Center of Excellence.

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## What is it? - Requirements

- ACR Accreditation in:
  - Mammography – ACR or State Accreditation
  - Stereotactic Breast Biopsy
  - Breast Ultrasound
    - Must include ultrasound guided breast biopsy!



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## Physicists Role

- Mammography Accreditation
  - Annual testing (required)
  - QC Program Review (required)
  - Dose Measurement (required)
- Stereotactic Breast Biopsy Accreditation
  - Annual Testing (required)
  - QC Program Review (required)
  - Dose Measurement (required)

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## Physicists Role

- Ultrasound Accreditation (as of June 2014)
  - Annual testing (required)
    - The ACR strongly recommends that QC be done under the supervision of a qualified medical physicist. The qualified medical physicist may be assisted by properly trained individuals in obtaining data, as well as other aspects of the program
  - Acceptance testing (Optional)

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## Physicist Requirements

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- Initial Requirements
  - Mammography – MQSA
  - Stereotactic Breast Biopsy – ACR
  - Ultrasound – None listed
- Continuing requirements
  - Mammography – MQSA
  - Stereotactic Breast Biopsy – ACR
  - Ultrasound - None

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## Stereotactic Breast Biopsy Physicist

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- Initial Qualifications
  - Qualified to perform Mammography surveys under MQSA
  - Perform one (1) hands on survey of a stereotactic breast biopsy unit under a QMP or at least 3 independent surveys prior to 6/1/97
- Continuing Experience
  - Upon renewal, 2 SBB surveys in the prior 24 months
- Continuing Education
  - Upon renewal, 3 CEU's in SBB in prior 36 months

Ref: <http://www.acr.org/~media/ACR/Documents/Accreditation/SBB/Requirements.pdf>

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What are the minimum continuing education requirements for the physicist performing stereotactic breast biopsy system surveys for the ACR Accreditation program?

- 0% 1. 1 CEU in last 6 months
- 0% 2. 1 CEU in last 12 months
- 0% 3. 2 CEU's in last 24 months
- 0% 4. 3 CEU's in last 36 months
- 0% 5. 4 CEU's in last 48 months

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## Answer

### 4. 3 CEU's in last 36 months

Related to SBB

Ref: Stereotactic Breast Biopsy Program Requirements:  
American College of Radiology

<http://www.acr.org/~/media/ACR/Documents/Accreditation/SBB/Requirements.pdf>

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## Ultrasound - Physicist

- No requirements listed!

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## Stereotactic Breast Biopsy Program Requirements

- Quality Assurance Questionnaire
- Test Image Data Sheet
- Dosimeter
- Clinical Images (on film)
- Phantom Images with dosimeter in FOV (on film)
- Medical Physicists Annual Survey Report
- Daily, Weekly Tech QC (one month)
- Monthly, Quarterly, Semi-annual Tech QC records (one year)

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## Technologist Quality Control

- Daily – Localization Accuracy Test
- Phantom Imaging (weekly)
- Printer QC (monthly)
- Visual Checklist (monthly)
- Compression (semi-annually)
- Repeat Analysis (quarterly)
- Zero Alignment Test (per manufacturer)
- Dark Room Testing (if using film screen)



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## Daily Localization Accuracy Test



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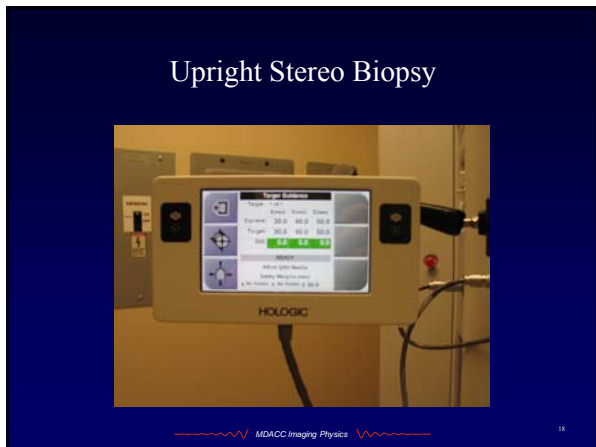
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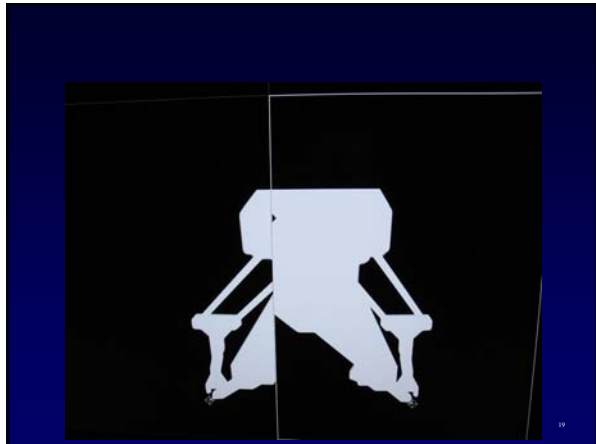
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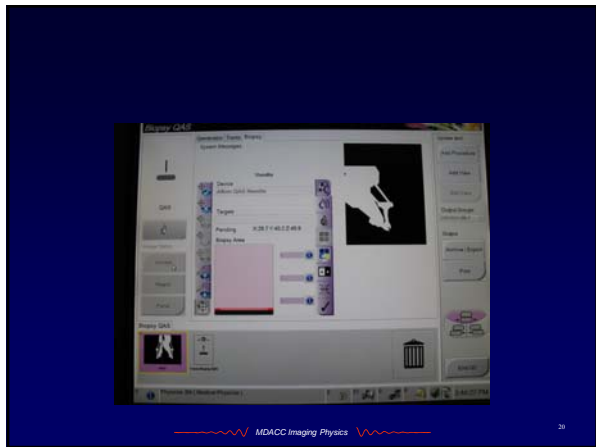
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## Stereotactic Breast Biopsy

- Annual testing required by physicist
- ACR QC Manual available



Ref: Stereotactic Breast Biopsy Quality Control Manual  
1999 American College of Radiology



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## Stereotactic Breast Biopsy Annual Test – Prone Table

- Unit Assembly Evaluation
- Collimation Assessment
- Focal Spot Performance and System Limiting Spatial Resolution
- kVp Accuracy
- Beam Quality Assessment (Half Value Layer)

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## Stereotactic Breast Biopsy Annual Test – Prone Table

- Automatic Exposure Control(AEC) or Manual Exposure Assessment
- Uniformity of Screen Speed (Screen Film Systems)
- Digital Receptor Uniformity (For Digital Image Receptors)
- Breast Entrance Exposure, Average Glandular Dose, and Exposure Reproducibility

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## Stereotactic Breast Biopsy Annual Test – Prone Table

- Image Quality Evaluation
- Artifact Evaluation
- Localization Accuracy Test

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## Stereotactic Breast Biopsy Annual Test – Upright Add On

- Unit Assembly Evaluation
- Beam Quality Assessment (Half Value Layer)
  - With paddle and at kVp for stereo phantom
- Breast Entrance Exposure, Average Glandular Dose
- Image Quality Evaluation (with mini phantom)
- Localization Accuracy Test

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## Unit Assembly Evaluation

- Mechanically Stable
- Moving parts
- Locks/Detents
- Image receptor no vibes
- Compressed breast thickness indicator
- No rough edges
- Technique charts
  - 512/1024 modes
- Radiation shielding
- Needle guides support needle

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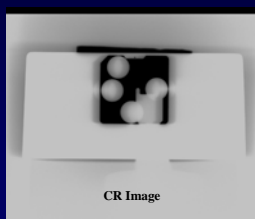
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## Collimation



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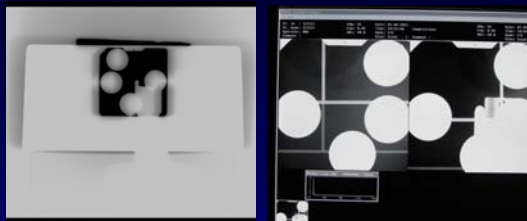
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## Collimation



If any edge of radiation field deviates more than 5 mm from the edge of the image receptor, or if any edge of the compression paddle projects into the X-ray field by more than 5 mm, then seek service adjustment.

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## Focal Spot Performance and System Limiting Resolution



Action Limit: Note any significant degradation from previous measurement and seek service.

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## kVp



Action Limit: If the mean kVp differs from the nominal by more than +/- 5% of the nominal kVp, or if the coefficient of variation exceeds 0.02, then seek service correction.

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What is the maximum allowable COV for kVp reproducibility?

- 0% 1. 0.01
- 0% 2. 0.02
- 0% 3. 0.03
- 0% 4. 0.04
- 0% 5. 0.05

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### Answer

- 2. 0.02

Ref: Stereotactic Breast Biopsy Quality Control Manual 1999, Medical Physicist Section, kVp Accuracy and Reproducibility, American College of Radiology

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### Beam Quality – Half Value Layer

- $HVL \geq kVp/100$



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## Automatic Exposure Control (AEC)




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## Technique Chart

Breast Thickness	Exposure Mode	kVp Setting	Density Control Setting	Phototimed (Yes or No)
< 3 cm	512	26	N/A	Yes
3 to 5 cm	512	28 - 30	N/A	Yes
5 to 7 cm	512	30 - 32	N/A	Yes
> 7 cm	512	34	N/A	Yes

Breast Thickness	Exposure Mode	kVp Setting	Density Control Setting	Phototimed (Yes or No)
< 3 cm	1024	28	N/A	Yes
3 to 5 cm	1024	30 - 32	N/A	Yes
5 to 7 cm	1024	32 - 34	N/A	Yes
> 7 cm	1024	34	N/A	No - 400 mAs

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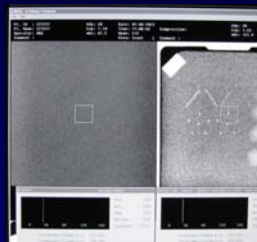
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## AEC Performance

- Select kVp
- Use AEC and make exposure
- Measure mean pixel value in center of field
- Meet manufacturers specifications




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## AEC

- Ideally, clinical techniques (whether AEC or manual) should keep exposure times under 2 seconds while meeting manufacturers signal requirements

Ref. Stereotactic Breast Biopsy Quality Control Manual 1999

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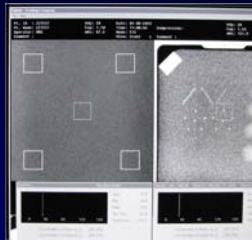
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## Digital Field Uniformity

Both 512 and 1024 modes



- Action Limit: If  $SNR(I) / SNR(Center)$  is  $> 1.15$  or  $< 0.85$ , seek service correction.

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## Digital Field Uniformity

- May require manufacturers service manual for procedure.

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## Dose

- Check both 512 and 1024 modes
- Made change to technique chart to get 1024 mode to be less than 300 mrad (3 mGy)
- “The average glandular dose to an average (4.2 cm compressed) breast should not exceed 3 mGy (300 mrad) per view for film-screen or digital image receptors”

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## Technique Chart

Breast Thickness	Exposure Mode	kVp Setting	Density Control Setting	Phototimed (Yes or No)
< 3 cm	512	26	N/A	Yes
3 to 5 cm	512	28 - 30	N/A	Yes
5 to 7 cm	512	30 - 32	N/A	Yes
> 7 cm	512	34	N/A	Yes

Breast Thickness	Exposure Mode	kVp Setting	Density Control Setting	Phototimed (Yes or No)
< 3 cm	1024	28	N/A	Yes
3 to 5 cm	1024	30 - 32	N/A	Yes
5 to 7 cm	1024	32 - 34	N/A	Yes
> 7 cm	1024	34	N/A	No - 400 mAs

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What is the maximum allowable dose per view to a 4.2 cm compressed breast as recommended by the ACR?

- 0% 1. 1.5 mGy
- 0% 2. 2.0 mGy
- 0% 3. 2.5 mGy
- 0% 4. 3.0 mGy
- 0% 5. 3.5 mGy

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Answer

4. 3.0 mGy

Ref: Stereotactic Breast Biopsy Quality Control Manual, Medical Physicist Section  
Breast Entrance Exposure, Average Glandular Dose, and Exposure Reproducibility

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Image Quality Evaluation – Mini Phantom



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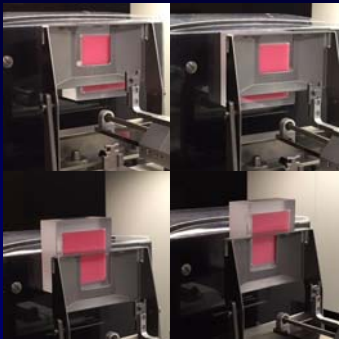
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Image Quality Evaluation – ACR Mammography Phantom



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## Required Minimum Scores - Digital Receptor

- Mammography Accreditation Phantom
  - 5.0 Fibers
  - 4.0 Specs
  - 3.5 Masses
  - Total: 12.5
- Mini-phantom
  - 3.0 Fibers
  - 3.0 Specs
  - 2.5 Masses
  - Total: 8.5

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## What are the minimum scores for a digital receptor when using the mini-phantom?

- 0% 1. 1.0 Fibers, 1.0 Spec groups, 1.0 Masses
- 0% 2. 2.0 Fibers, 2.0 Spec groups, 2.5 Masses
- 0% 3. 3.0 Fibers, 3.0 Spec groups, 2.5 Masses
- 0% 4. 3.5 Fibers, 3.5 Spec groups, 3.0 Masses
- 0% 5. 4.0 Fibers, 4.0 Spec groups, 4.0 Masses

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## Answer

- 3. 3.0 Fibers, 3.0 Spec groups, 2.5 Masses
- Ref: Stereotactic Breast Biopsy Quality Control Manual, Medical Physicist Section Image Quality Evaluation

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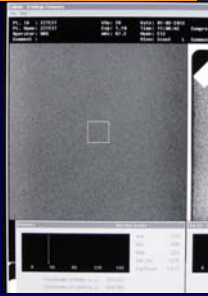
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## Artifact Evaluation

- Note any artifacts or non-uniformities in the field.
- Both 512 and 1024 modes



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## Localization Accuracy Test



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## Localization - Prefire



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## Localization - Postfire



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## Add On Biopsy Systems



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## Beyond Annual Testing

- HVL at Phantom kVp with Stereo Paddle
- HVL Measurement for Tomo Biopsy
- Dose Measurement for Phantom for Both
- Image Quality with Stereo Phantom
- Localization

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## HVL - Upright Stereo Add On



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## Image Quality – Mini Phantom



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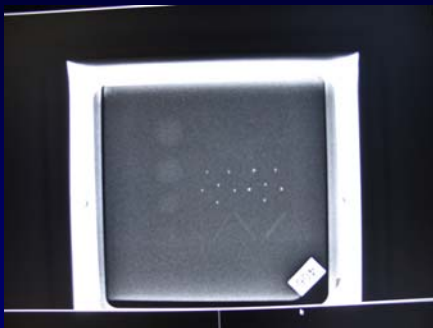
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## Image Quality – Mini Phantom



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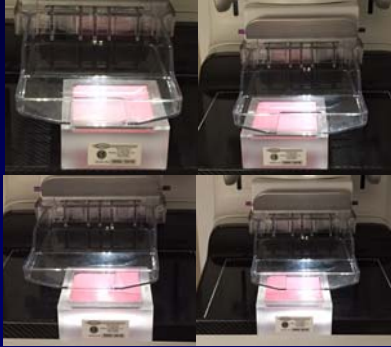
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### Image Quality – ACR Mammography Phantom



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### Image Quality – ACR Mammography Phantom



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### Tomosynthesis Guided Biopsy



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## Tomosynthesis Guided Biopsy

- FDA approved
- No ACR Accreditation Program
- No Manufacturers QC Program
  - Do what you think is best

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## Breast Ultrasound Accreditation



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## Changes to Breast Ultrasound Program – Effective June 2014

- Acceptance Testing (recommended)
- Quality Control Tests (optional)
- Annual Survey (required)

S:\AccredMaster\Umbrella Program\Application DMAP  
V2\overview\_reqs\reqs\breast\_ultrasound\_reqs\_5-29-13.DOCX

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## Acceptance Testing

- Initial performance testing of newly installed imaging equipment must be performed and should be completed before clinical use

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## Continuing Quality Control

- A continuous QC program is essential to assure the proper functioning of all ultrasound equipment and to identify problems before the diagnostic utility of the equipment is significantly impacted<sup>7,8</sup>. Routine QC is typically performed by appropriately trained sonographers or equipment service engineers.
- Regular preventive maintenance should be performed and documented by a qualified equipment service engineer following the recommendations of the equipment vendor

– 7. Mårtensson M, Olsson M, Brodin LA. Ultrasound transducer function: annual testing is not sufficient. *Eur J Echocardiogr*. 2010 Oct;11(9):801-5.  
– 8. Hangandroux NJ, Stekel SF, Trudup DJ, Gony KR, King DM. Four-year experience with a clinical ultrasound quality control program. *Ultrasound Med Biol*. 2011 Aug;37(6):1256-7.

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## 5 Tests for the Technologist

1. Physical and Mechanical Inspection
2. Image Uniformity and Artifact Survey
3. Geometric Accuracy (mechanically scanned transducers only)
4. Ultrasound scanner Electronic Display Performance
5. Primary Interpretation Display Performance\*
  - Only required if located at the facility where ultrasound is performed

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## Annual Survey

- The QC tests listed in the table below *are required* (unless they are designated as optional) and must be performed at least annually on all machines and transducers in routine clinical use.

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## Program Requirements – Annual Survey

- Physical and Mechanical Inspection
- Image Uniformity and Artifact Survey
- Geometric Accuracy (optional)
- System Sensitivity
- Ultrasound Scanner Electronic Image Display Performance
- Primary Interpretation Display Performance\*

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## Program Requirements – Annual Testing

- Contrast Resolution (Optional)
- Spatial Resolution (Optional)
- Evaluation of QC Program (if applicable)

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As of June 2014 what is the recommended frequency for equipment surveys of ultrasound equipment for the ACR's breast ultrasound accreditation program?

- 0% 1. Quarterly
- 0% 2. Semiannually
- 0% 3. Annually
- 0% 4. Every other year
- 0% 5. None

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### Answer

- 3. Annually

Ref: Stereotactic Breast Biopsy Accreditation Program Requirements

<http://www.acr.org/accreditation/breast.aspx>

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### Electrical – Mechanical Condition

- Power cord
- Wheel Locks, Brakes
- Housing
- Scan Head Cable, Plugs
- Scan Head Housing, Window
- Monitor
- Air Filters
- VCR
- Printer Function

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## System Sensitivity – Depth of Pen



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## Uniformity and Artifacts



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## Vertical Distance Accuracy



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## Horizontal Distance Accuracy



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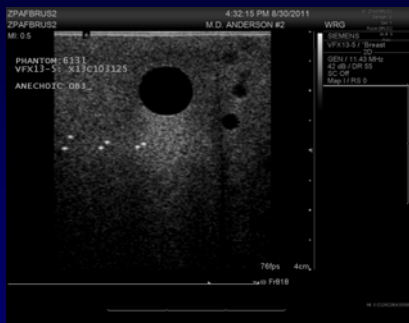
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## Anechoic Void Perception



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## Ring Down – Dead Zone



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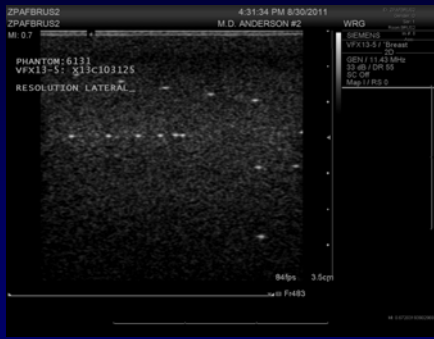
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## Lateral Resolution



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## Axial Resolution



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## Evaluation of Sites QC Program

- Review semiannual QC results

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Questions?



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