Stereotactic Breast Biopsy Unit QC Update

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Disclosure

- Subcommittee on Breast X-ray Imaging Physics – Chair
- Committee on Stereotactic Breast Biopsy Accreditation - *Ex Officio*
- Alliance Medical Physics LLC
  - Qualified Medical Physicist

Overview

I. Introduction

II. ACR Stereotactic Breast Biopsy Accreditation

III. 1999 ACR SBB QC Manual
- A. Technologist Tests
- B. Medical Physicist Tests

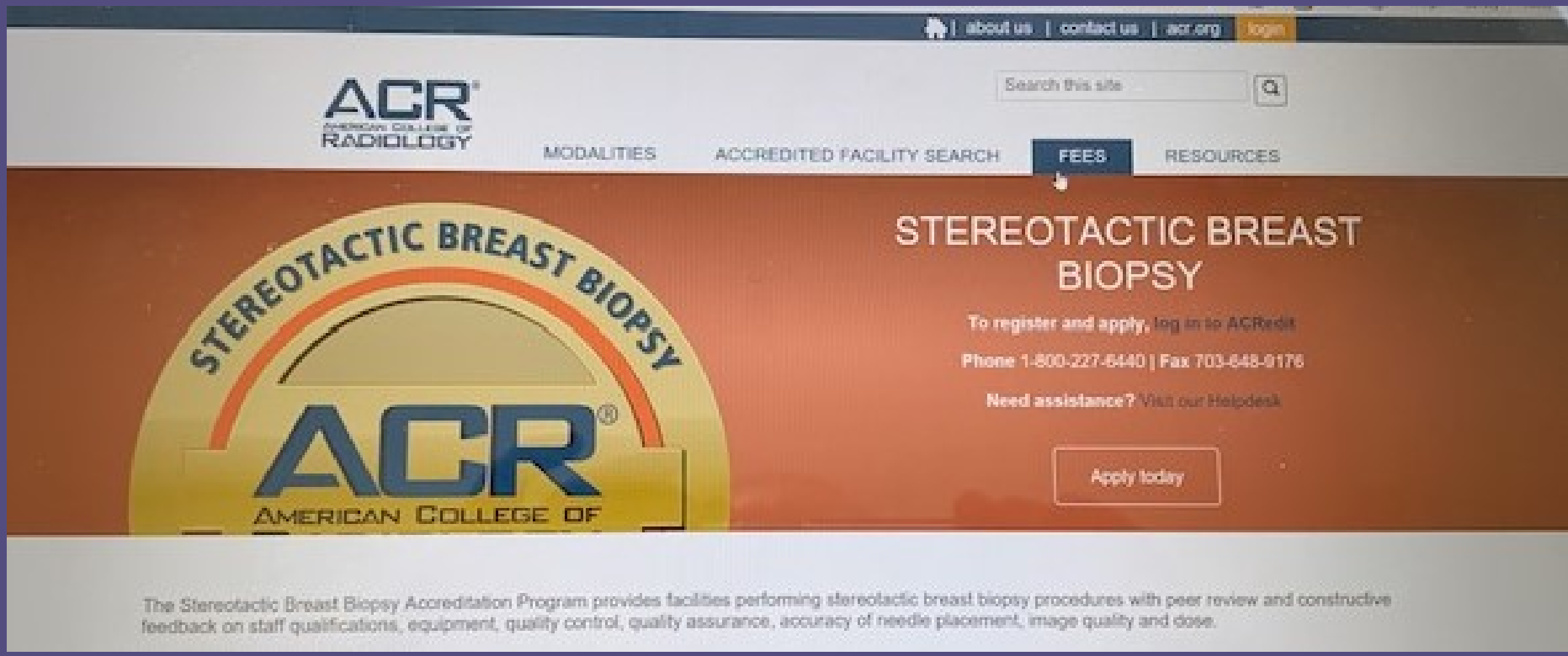
IV. SBB Unit Evolution

VI. QC Testing
- A. Add on Devices
- B. Prone Devices

VII. Future SBB QC Testing

Early SBB Units

SBB Accreditation Program



The ACR accredits only the following types of equipment:

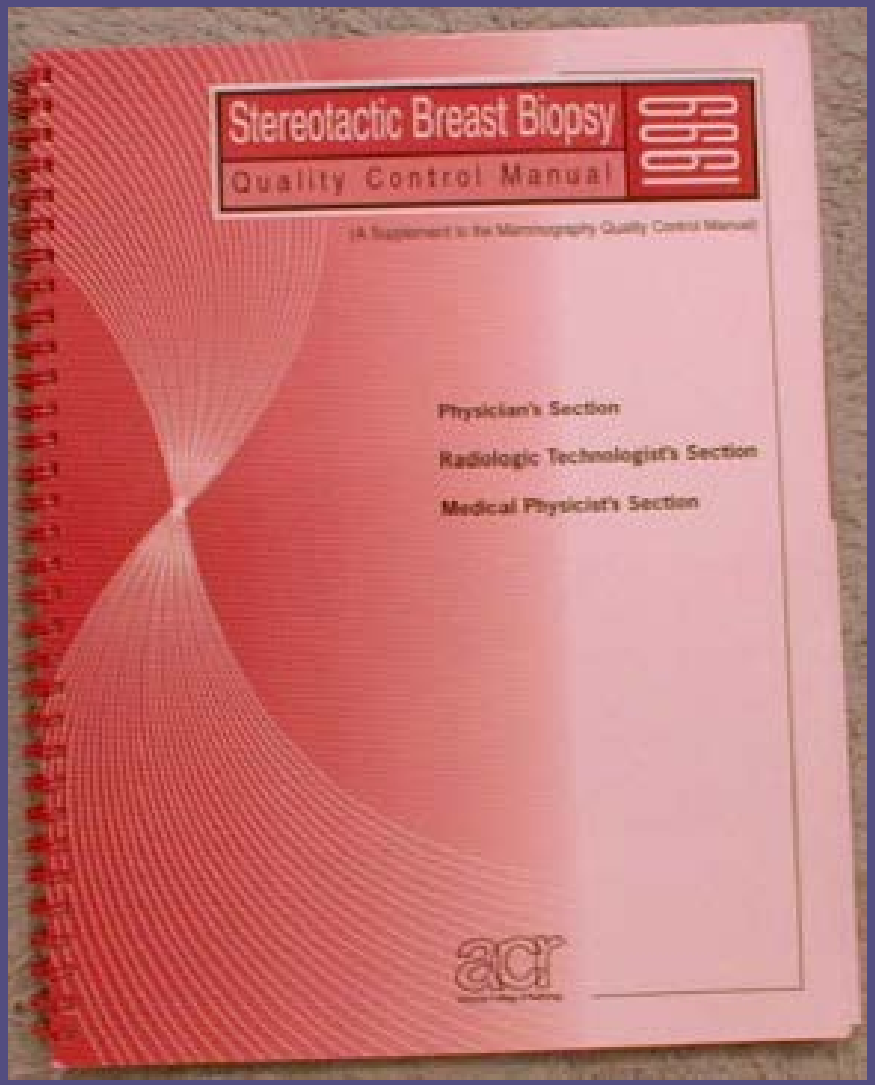
- **Specially designed, dedicated stereotactic breast biopsy units**
- **Mammographic units using a specially designed add-on device for breast biopsy**
- **Mammographic units exclusively using lateral arm devices, but only if the lateral arm device is the only option for biopsy and the needle can be seen in relation to the target calcification in two views**

Quality Control: Stereotactic Breast Biopsy Program (Revised 12-12-19)

- **Documentation of quality control (QC) is required as part of the application process.**
- **All facilities applying for accreditation must comply with the minimum frequencies listed below.**
- **Detailed instructions for each of the tests listed below are contained in the 1999 ACR Stereotactic Breast Biopsy Quality Control Manual.**
- **Upon acceptance of a facility's initial application, the ACR will send a QC manual to the modality's supervising physician at the practice site address.**

1999 ACR Stereotactic Breast Biopsy Quality Control Manual

SBBAP QC Requirements



Acceptance Testing

- **Initial performance testing should be performed upon installation of new stereotactic breast biopsy equipment.**
- **This testing should be more comprehensive than periodic performance and compliance testing and should be consistent with current acceptance testing practices.**

Preventive Maintenance

- **Preventive maintenance should be scheduled, performed, and documented by a qualified service engineer on a regular basis.**
- **Service performed to correct system deficiencies should also be documented and service records maintained by the facility.**

SBBAP QC Requirements Technologist QC Tests

1. Localization Accuracy Test (in air)
2. Phantom Images
3. Hardcopy Output Quality (if applicable)
4. Visual Checklist
5. Compression
6. Repeat Analysis
7. Zero Alignment Test (if required by manufacturer)
8. Other Manufacturer Tests

Technologist QC Tests (if applicable)

1. Darkroom Cleanliness
2. Processor Quality Control
3. Screen Cleanliness
4. Viewbox and Viewing Conditions
5. Analysis of Fixer Retention in Film
6. Screen-Film Contact
7. Darkroom Fog

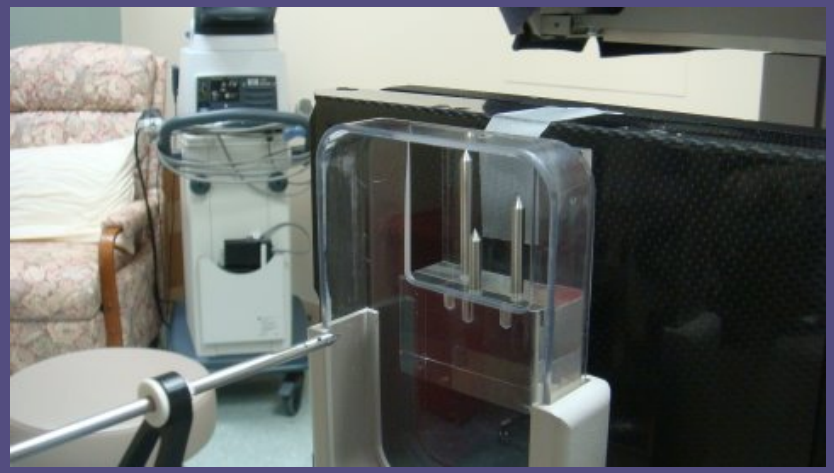
As directed by the 1999 ACR Mammography Quality Control Manual, Radiologic Technologist Section.

Localization Accuracy Test

- **Frequency**: Daily
- **Objective**: Verify x, y, and z positioning between the image receptor and physical space
- **Equipment**: Varies by Manufacturer
  - Provided by manufacturer

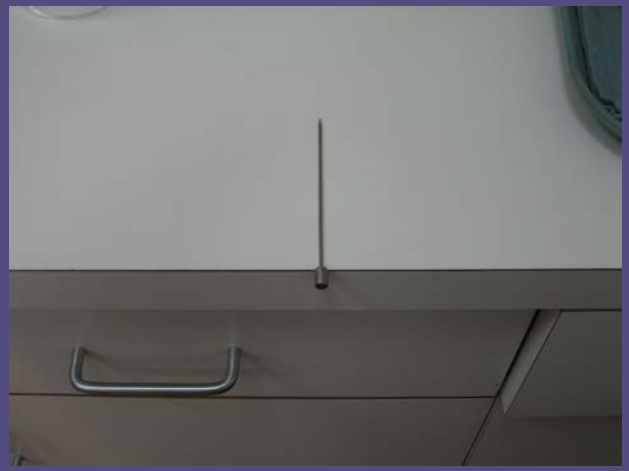
Localization Accuracy Test – Fischer Example

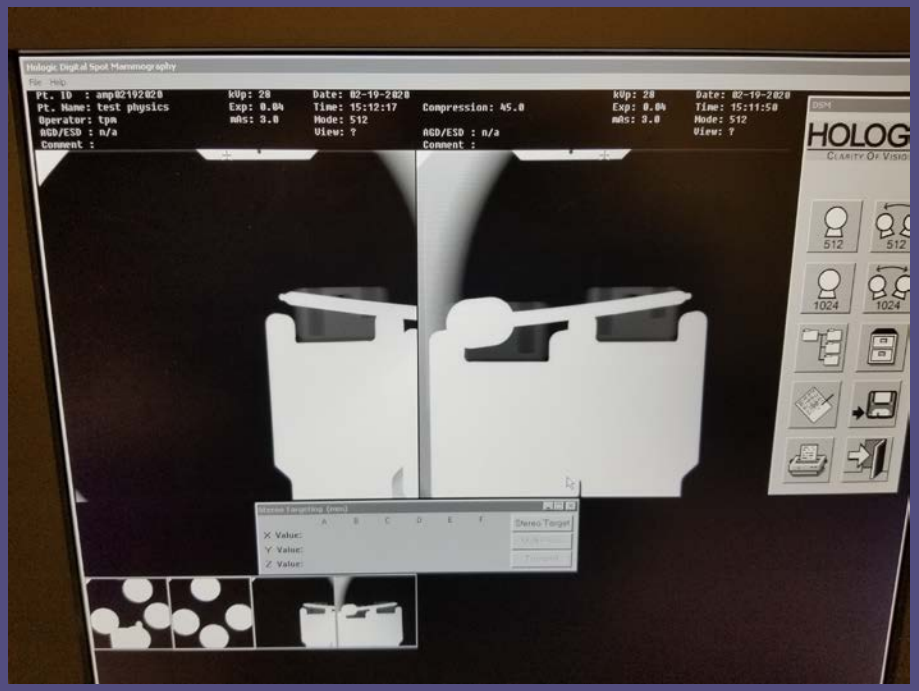
- Position needle phantom
- Acquire stereo views of phantom
- Transmit coordinates
- Position needle
- Needles should meet tip to tip



Localization Accuracy Test – Hologic Example

- QAS Needle Test
- Reverse of Fisher
- Compress Air Phantom
- Zero the needle as per Hologic instructions
- Set X=+10, Y=+20, and Z=+30
- Acquire stereo pair
- Verify coordinates on screen are with ±1mm of actual.




Hologic Digital Spot Mammography
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Operator: tpm
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Exp: 0.04
mAs: 3.0
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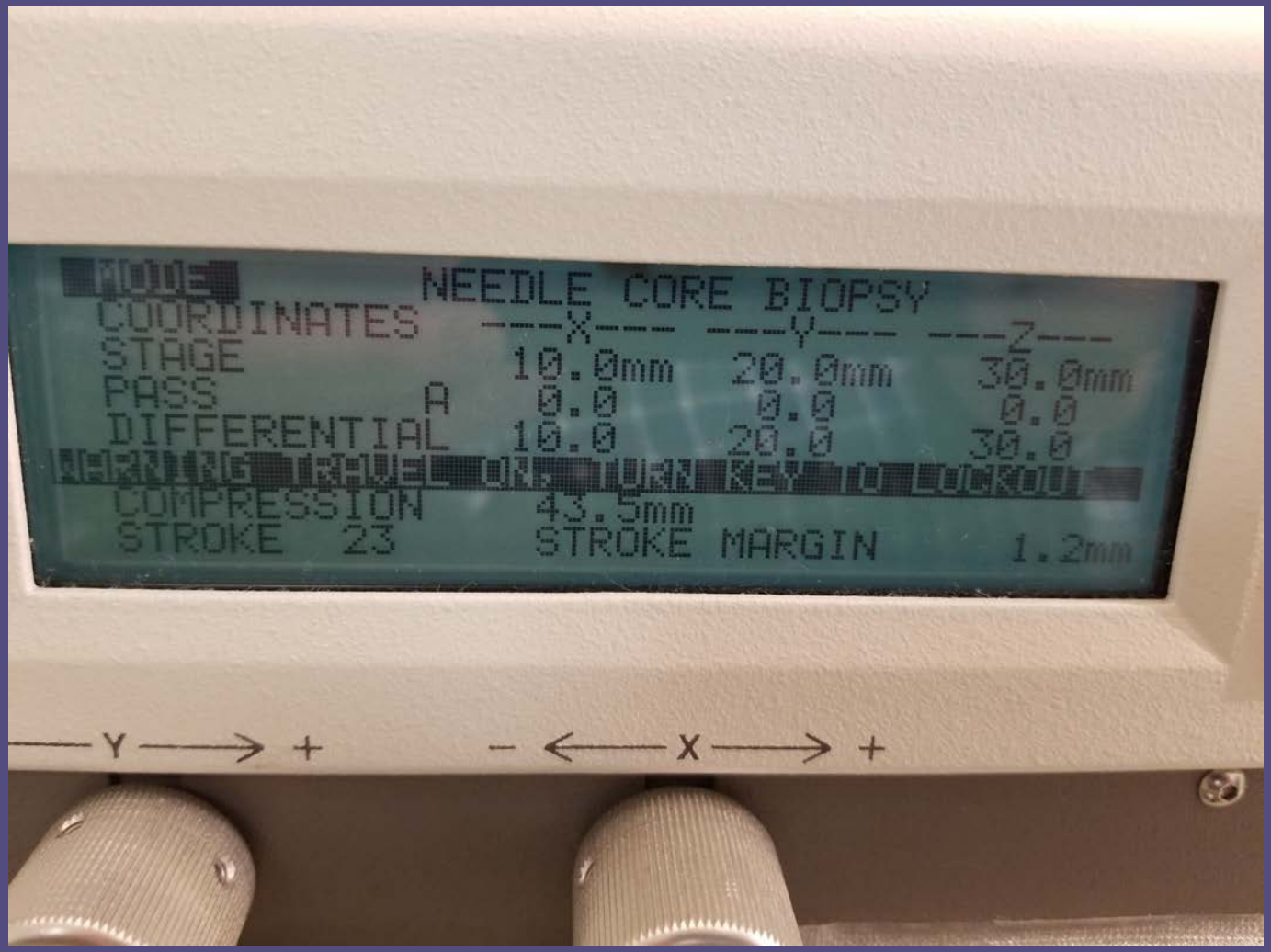
Mode: 512
View: ?
Compression: 45.0
AGD/ESD : n/a
Comment :
kVp: 28
Exp: 0.04
mAs: 3.0
Date: 02-19-2020
Time: 15:11:50
Mode: 512
View: ?
HOLOG
CLARITY OF VISIO
512
512
1024
1024
Stereo Targeting (mm)
X Value:
Y Value:
Z Value:
Stereo Target


Pt. ID : amp02192020
Pt. Name: test physics
Operator: tpm
AGD/ESD : n/a
Comment :
kVp: 28
Exp: 0.04
mAs: 3.0
Date: 02-19-2020
Time: 15:12:17
Mode: 512
View: ?
Compression: 45.0
AGD/ESD : n/a
Comment :
kVp: 28
Exp: 0.04
mAs: 3.0
Date: 02-19-2020
Time: 15:11:50
Mode: 512
View: ?
HOLOG
CLARITY OF VISIO
512
512
1024
1024
Reference Cursors OK?
Reference Cursors Positioned Correctly?
Yes
No
Stereo Targeting (mm)
X Value:
Y Value:
Z Value:
Stereo Target


NEEDLE CORE BIOPSY
COORDINATES ---X--- ---Y--- ---Z---
STAGE 10.0mm 20.0mm 30.0mm
PASS A 0.0 0.0 0.0
DIFFERENTIAL 10.0 20.0 30.0
COMPRESSION 43.5mm
STROKE 23 STROKE MARGIN 1.2mm
Y
+
-
X
+

Phantom Image Quality

- **Frequency**: Weekly
- **Objective**: To ensure optimal image quality such that images can be compared with those from screening or diagnostic mammography.
- **Equipment**:
  - ACR Digital Mini Phantom OR
  - ACR MAP Phantom

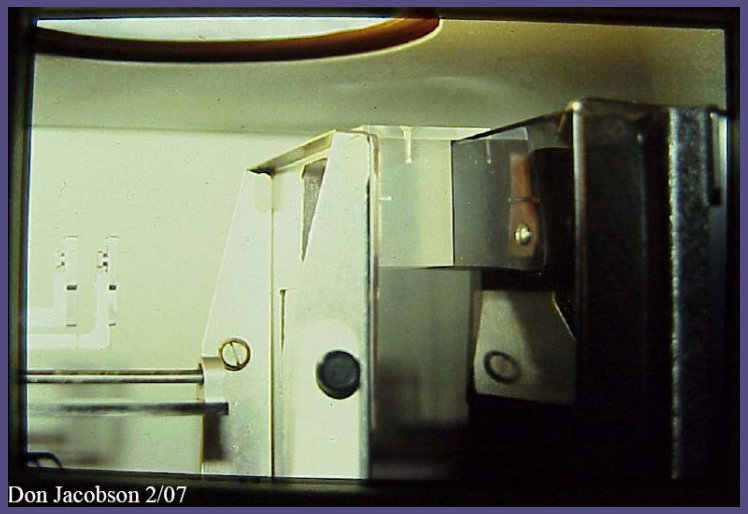
Phantom Image Quality

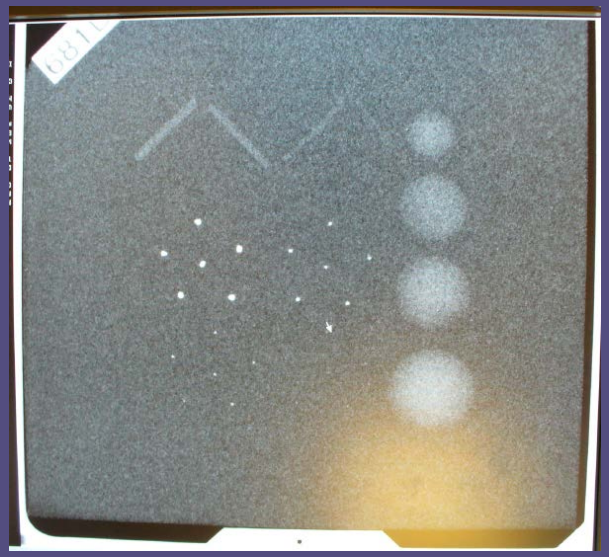
- Screen-Film
  - AEC – Select kVp, Target/Filter, focal spot, density control, photocell centered under phantom
  - Manual Technique – use 4.2 cm thickness
  - Record background optical density
- Digital
  - AEC – Select kVp, Target/Filter, focal spot, density control
  - Manual Technique – use 4.2 cm thickness
- Same Fiber, Speck, and Mass scoring method as MAP

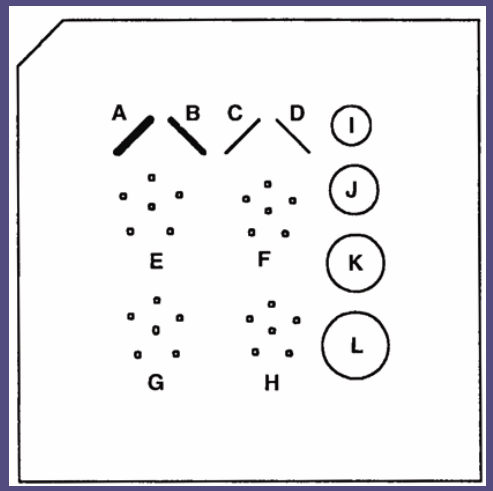
Phantoms approved by the ACR for use in the Stereotactic Breast Biopsy Accreditation Program:

Computerized Imaging Reference Systems, Inc.	Gammex, Inc.	Fluke Biomedical, RMS
(800) 617-1177; (757) 855-2765	(800 GAMMEX-1)	(800) 850-4608
Model Number: CIRS Model 015	Model Numbers: •Gammex Model 156 •Gammex Model 156D (mini)	Model Numbers: •Nuclear Associates Model 18-220 •Nuclear Associates Model 18-250 (mini)

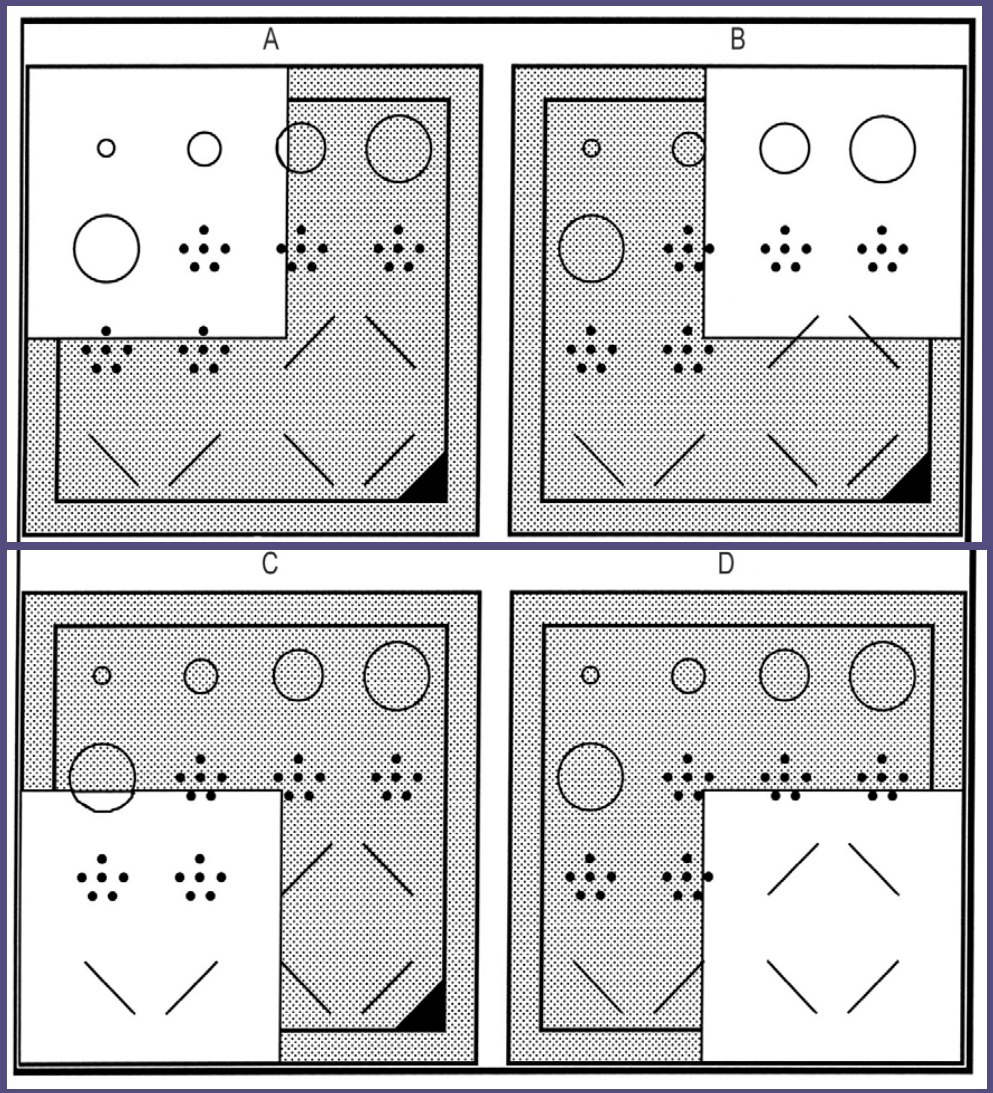
Digital Mini Phantom

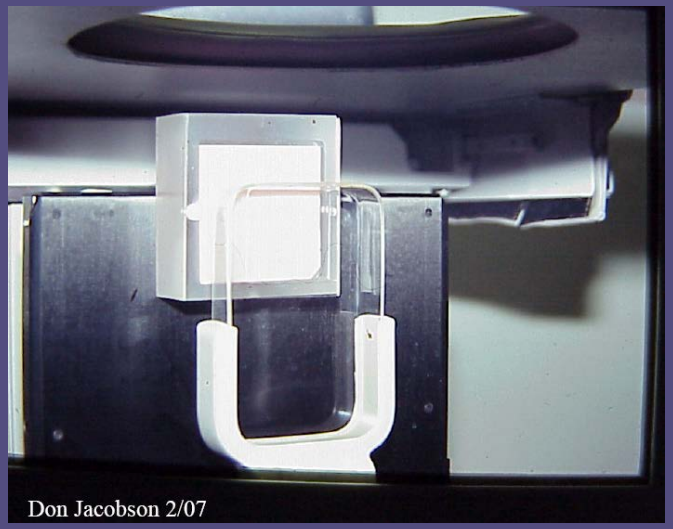






ACR MAP Phantom





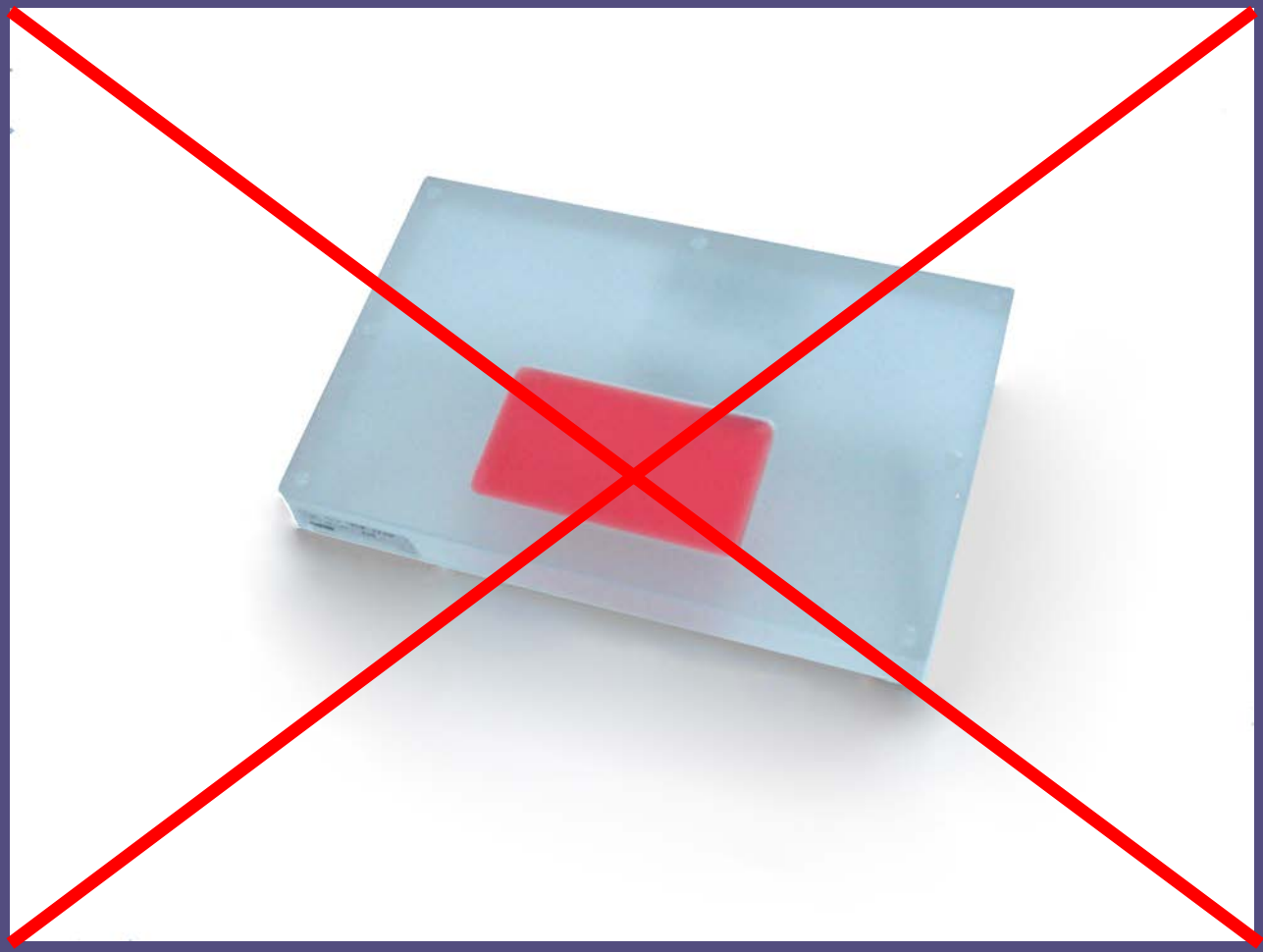
Figures from: ACR SBBAP Testing Instructions 2.13.2008

Phantom Image Quality

- Action Limits:

Test Object	Mammography Accreditation Phantom		Digital Mini-Phantom	
	Screen-Film	Digital	Screen-Film	Digital
Fibers	4.0	5.0	2.0	3.0
Specks	3.0	4.0	2.0	3.0
Masses	3.0	3.5	2.0	2.5

ACR Digital Mammography Phantom
Not for Submission



ACR Digital Mammography Phantom

- ACR does not currently allow the large phantom to be used for accreditation purposes.
- Working toward future implementation.
- Permitted for onsite QC
  - Use correct criteria (ACR DM QC manual)
  - Use when applicable
    - Not recommended on prone units

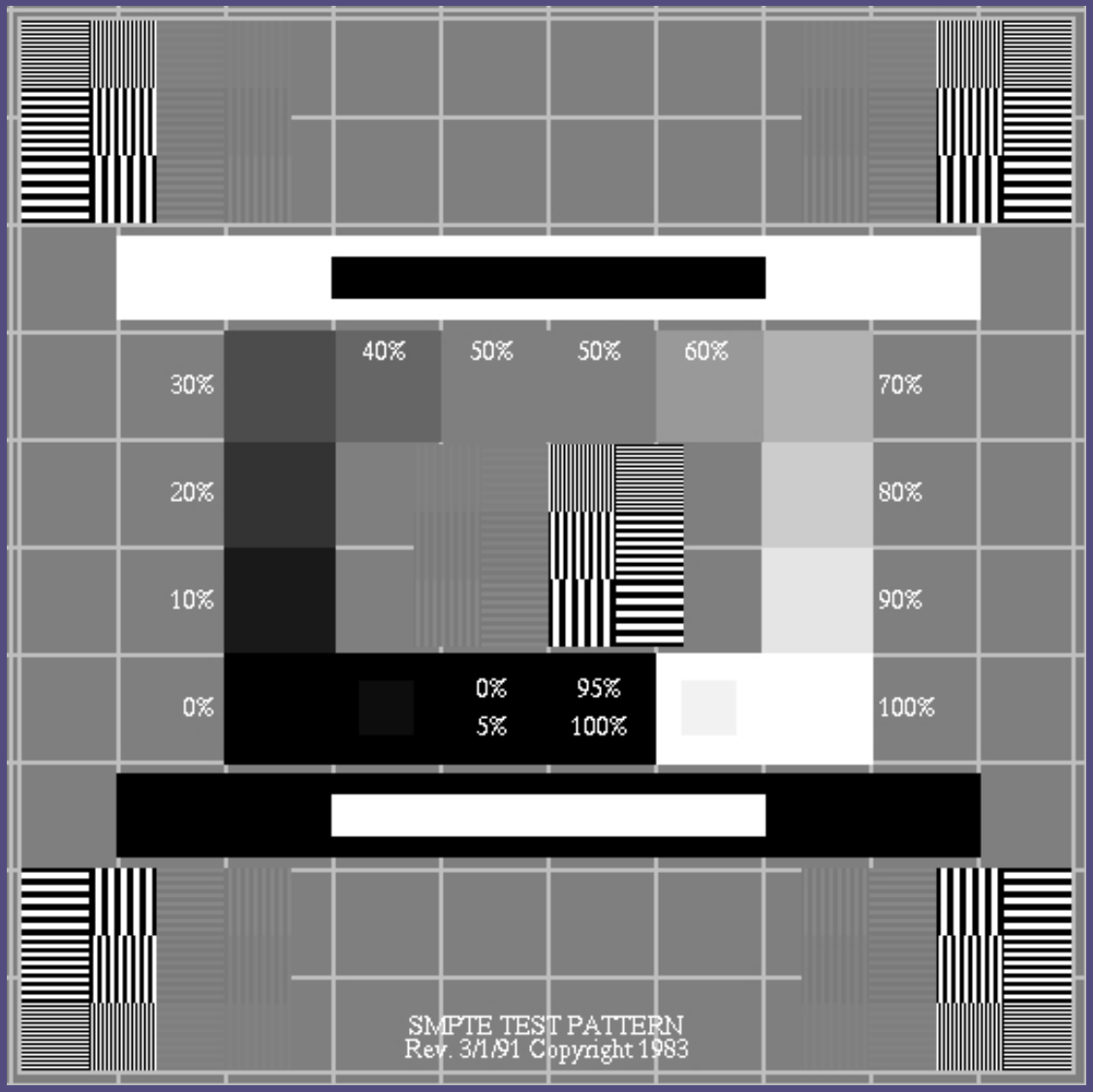
Hardcopy Output Quality (Digital)

- **Frequency**: Monthly
- **Objective**: To ensure that laser printer is consistent over time and that the printed image matches the monitor.
- **Equipment:**
  - SMPTE (Society of Motion Picture and Television Engineers) test pattern
  - Usually a patient file that needs to be installed by service
- **Procedure**:
  - Print test pattern
  - Measure optical densities of pre-determined steps
  - Verify that printed image matches the monitor

Hardcopy Output Quality

- SMPTE Test Pattern Evaluation
  - Contrast Steps
    - 0% within 5%
    - 95% within 100%
  - High Contrast and Low Contrast Resolution Patterns in center and around edges with no aliasing
  - All text should be readable
  - Geometry – anything squared or rectangular should be such without distortion
  - No artifacts

SMPTE Pattern



Hardcopy Output Quality

Stereotactic Breast Biopsy Hardcopy Output Quality Control

Site: _____ Room: _____ Year: _____

Hardcopy Display Unit: _____ Image(s) Used for Hardcopy Output Check: _____

Note: Circle Values Established as Control Values

Month		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Filming Window Level													
Filming Window Width													
Hardcopy & Monitor Demonstrate Comparable Gray Scales (Yes/No)													
FILM OD	Location #1_____												
	Location #2_____												
	Location #3_____												
	Location #4_____												
All measured Film ODs are within ±0.2 of Control Levels (Yes/No)													
Check Performed By (initials)													
Physician Review *													
Medical Physicist Review *													

Date: **Action:**

_____ _____

_____ _____

_____ _____

Figure 6. Stereotactic breast biopsy hardcopy output quality control form.

Visual Checklist

- **Frequency**: Monthly
- **Objective**: Ensure the following:
  - Light
  - Displays
  - Mechanical locks
  - Detents
  - Other mechanical
  - Mechanical rigidity and stability
- **Action Limits**:
  - Correct or replace items that do not pass immediately.

STEREOTACTIC BREAST BIOPSY VISUAL CHECKLIST

Year

	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEPT	OCT	NOV	DEC
Date												
Performed by												
Do all x-ray tube locks and detents work properly?												
Is the table immobilized relative to the compression device when locked?												
Do image receptor locks hold?												
Does the light field work properly?												
Is properly sized collimation or diaphragm being used?												
Do all moving parts move smoothly?												
Do all foot switches work properly?												
Is compression force adequate?												
Is compression force sustained during procedure?												
Does the localization system zero coordinates properly?												
Is the biopsy device properly immobilized to prevent recoil?												
Are needle guides free from excessive wobble?												
Are all needed paddles available and free from cracks, sharp edges, and other hazards?												
Is the operator shielded from radiation during exposure?												
Is the patient visible to the operator during exposure?												
Are technique charts posted?												
Are cleaning supplies and disinfectants available and used regularly?												
Has all blood been cleaned from the equipment? (Check cracks or joints for dried blood.)												
Is the digital system monitor clean?												
Other tests as recommended by manufacturer:												
Physician Review												
Medical Physicist Review												

Figure 7. Stereotactic breast biopsy QC visual checklist

Compression

- **Frequency**: Semi-Annually
- **Objective**: Ensure that the compression force is adequate to immobilize the breast during the entire biopsy procedure and that it is not excessive.
- **Equipment**:
  - Bathroom Scale (not digital)
  - Towels
  - Compression Paddle
- **Procedure**:
  - Automatic Compression
    - Record the initial power drive force
  - Manual Compression
    - Record the maximum manual compression force
    - Make sure unit maintains compression ~5 minutes

Compression (Cont.)

- **Action Limits**:
  - Initial Power Drive
    - 25-40lbs
  - Manual Compression
    - No limit
    - Ensure that patient is not harmed
    - Ensure equipment is not damaged

Repeat Analysis

- **Frequency**:
  - At least Semi-Annually
  - Or every 150 patients (1000 images)
- **Objective**:
  - To determine the number and cause of repeated patient exposures. Analyze to reduce exposures.
- **Action Limits**:
  - A higher repeat rate than mammography is to be expected due to positioning difficulties
  - < 20% ideally

STEREOTACTIC BREAST BIOPSY
SCREEN-FILM REPEAT ANALYSIS SUMMARY

Site: _____

Date From: _____ To: _____

Cause	Number of Films	Percentage Of Repeats
1. Positioning	𝍸 𝍸	50%
2. Patient Motion	𝍸	25%
3. Light Films		
4. Dark Films		
5. Black Film	𝍸	25%
6. Static		
7. Fog		
8. Incorrect Patient I.D., or Double Exposure		
9. Mechanical		
10. Artifacts		
11. Other		

$$\text{Repeat Rate} = \frac{\text{Total Repeated SBB}}{\text{Total SBB Films Used}} \times 100\%$$

Total Repeated SBB Films 1-11	20
Total SBB Films Used	200
Repeat Rate	(20/200)*100%= 10%

STEREOTACTIC BREAST BIOPSY
DIGITAL REPEAT ANALYSIS SUMMARY

Site: _____

Digital Stereotactic Breast Biopsy System: _____

Date From: _____ To: _____

Cause	Number of Exposures	Percentage of Repeats
1. Positioning	𝍸	25%
2. Patient Motion	𝍸 𝍸	50%
3. Detector Underexposure (excessively noisy images)		
4. Improper Detector Exposure (saturation)		
5. Incorrect Patient ID		
6. X-Ray Equipment Failure	𝍸	25%
7. Software Failure		
8. Blank Image		
9. Other		

$$\text{Repeat Rate} = \frac{\text{Total Repeated SBB}}{\text{Total SBB Films Used}} \times 100\%$$

Total Repeated SBB Films 1-9	20
Total SBB Films Used	400
Repeat Rate	(20/400)*100%= 5%

Zero Alignment Test (if required)

- **Frequency**: Prior To Each Patient.
- **Objective**: Ensure that computer zero matches the physical zero of the needle.
- Follow manufacturer's procedure.

ACR SBB QC Checklists

Stereotactic Breast Biopsy Quality Control Checklist

Site:_____

Daily and Weekly Tests

Year																													
Month																													
Date																													
Performed by																													
Darkroom Cleanliness (daily)																													
Processor QC (daily)																													
Phantom Images (weekly)																													
Screen Cleanliness (weekly)																													
Viewing Conditions (weekly)																													

Stereotactic Breast Biopsy Quality Control Checklist

Department of Diagnostic Radiology

Site:_____

Monthly, Quarterly, and Semi-Annual Tests

(date, initial and enter number where appropriate)

Year												
Month	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Visual Checklist (monthly)												
Repeat Analysis (≤20%) (Semi-annually)												
Fixer (≤0.05 gm/m^2) (quarterly)												
Darkroom Fog (≤ 0.05) (Semi-annually)												
Screen-film Contact (Semi-annually)												
Compression (25-40 lb) (Semi-annually)												

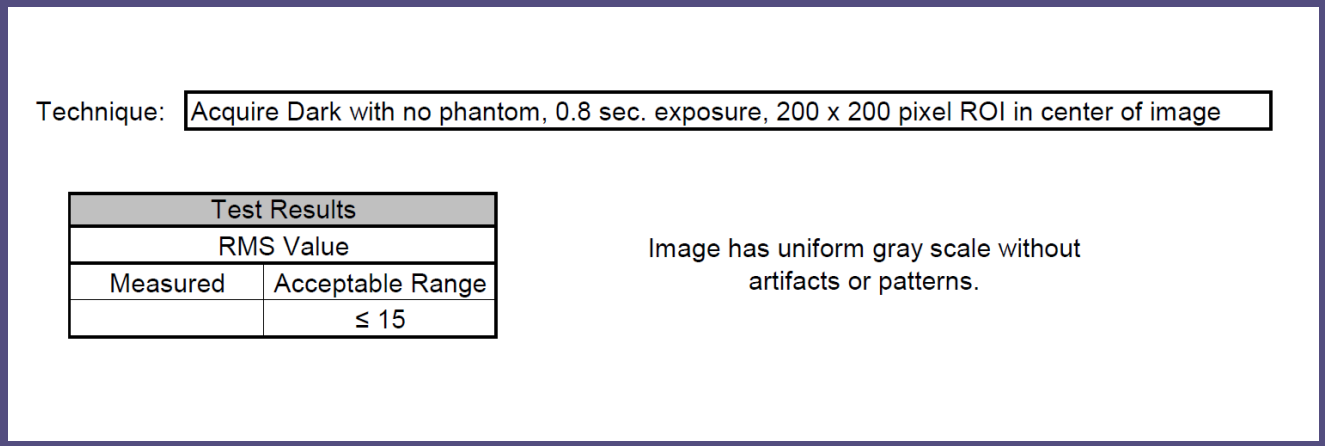
Date: _____ _____ _____

Test: _____ _____ _____

Comments: _____ _____ _____

Other Manufacturer Tests

- Siemens (Fischer)
  - Daily Flat-Field Calibration
    - 28 kVp and 110 mAs (Siemens Mammotest)
    - 26 kVp and 120 mAs (Fisher Mammotest)
    - MSV ~ 1500 +/- 20% (1200 – 1800)
  - Camera Noise and Dark Current Tests



Technique: Acquire Dark with no phantom, 0.8 sec. exposure, 200 x 200 pixel ROI in center of image

Test Results	
RMS Value	
Measured	Acceptable Range
	≤ 15

Image has uniform gray scale without artifacts or patterns.

SBBAP QC Requirements Medical Physicist Tests

1. Unit Assembly Evaluation
2. Collimation Assessment
3. Focal Spot Performance and System Limiting Spatial Resolution
4. kVp Accuracy and Reproducibility
5. Half-Value Layer
6. AEC or Manual Exposure Performance Assessment

Medical Physicist Tests (Cont.)

7. Uniformity of Screen Speed (if applicable) or Digital Image Receptor Uniformity
8. Average Glandular Dose
9. Phantom Image Quality
10. Artifact Evaluation
11. Localization Accuracy Test

Unit Assembly Evaluation

- Objective: Ensures that the mechanical components of the system are reliable and safe for patient use.

Unit Assembly Evaluation

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II. Stereotactic Breast Biopsy Equipment QC Tests

1. PROCEDURE: STEREOTACTIC BREAST BIOPSY UNIT ASSEMBLY EVALUATION

OBJECTIVE

Ensure that all locks, detents, angulation indicators, and mechanical support devices for the X-ray tube, compression plate and image receptor holder assembly are operating properly.

TEST PROCEDURE STEPS

1. Verify that the stereotactic breast biopsy unit is mechanically stable under normal operating conditions.
2. Verify that all moving parts move smoothly, without undue friction, that cushions or bumpers limit the range of available motions, and that no obstructions hinder the full range of motions within these limits. This includes table and X-ray assembly motions for prone units.
3. Set and test each stereo X-ray table location to ensure that movement from that position will not occur inadvertently.
4. Verify that the image receptor assembly, compression plate and biopsy window location are free from wobble and vibration during normal operation.
5. Verify that the image receptor is held in place for any clinical orientation of the image receptor holder assembly. For screen-film image receptors, verify that the cassette slides smoothly into the proper position in the image receptor holder assembly.
6. Verify that the indicated compressed breast thickness is accurate to within ±5 mm and reproducible to within ±2 mm.
7. Verify that in normal operation, the patient and operator are not exposed to sharp or rough edges, cracked compression paddles, or other hazards.
8. Verify that operator technique charts are posted.
9. Verify that the operator is protected during exposure by adequate radiation shielding.
10. Verify that the needle holder and needle guides are firmly attached and support the needle without allowing the needle to bend, curve, or droop excessively (i.e. by more than 1 mm in any direction).

MEDICAL PHYSICISTS SECTION

Alliance Medical Physics LLC

2500 Abbey Court · Alpharetta GA 30004 · 770.751.9707 · (fax) 770.753.4305

Facility:		Survey Date: 03/26/20	Report Date:
Street Address:		ACR SBBA ID:	Exp Date:
City, State ZIP:			
State X-Ray Registration Number:			
Surveyor:		Technologist:	

Equipment	Stereo Unit	X-Ray Tube Insert	Laser Imager
Manufacturer	Hologic	Varian	N/A
Model	MultiCare Platinum	M-149	N/A
Serial Number	(Generator), (Control)		-
Date of Manufacture			-
System ID Number		Local Focal Spot: 0.1 x 0.25	Film Size:
Room ID	Stereotactic Biopsy	Small Focal Spot: N/A	Film Type:
Detector SN		Software Version: 3.2.3.269	QC Manual:
Type of Unit	Prone Table	Operator Manual On-Site	MAN-00811 Rev. 002

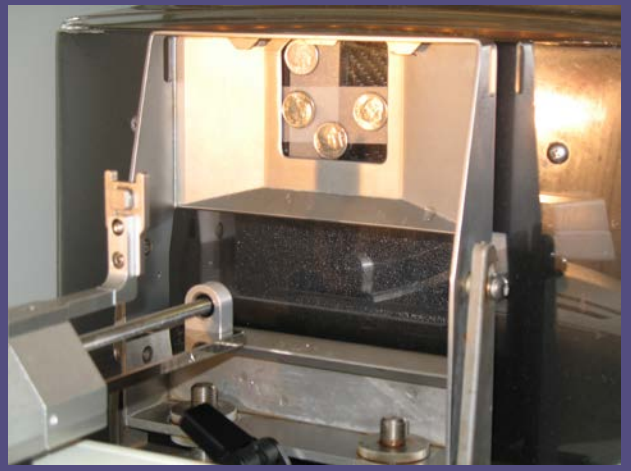
	RWS	RWS S/N	RWS	Location	Software Version
1	Make:	Left Monitor:			
	Model:	Right Monitor:			
	Resolution:	CPU:			
2	Make:	Left Monitor:	RWS QC Manual Version:		
	Model:	Right Monitor:	Dosimetry System Used*		
	Resolution:	CPU:	Unfors X2	Base Unit Display S/N	Survey Detector S/N
3	Make:	Left Monitor:	Last Calibration:		
	Model:	Right Monitor:	*Calibration certificate maintained on file at Alliance Medical Physics		
	Resolution:	CPU:			

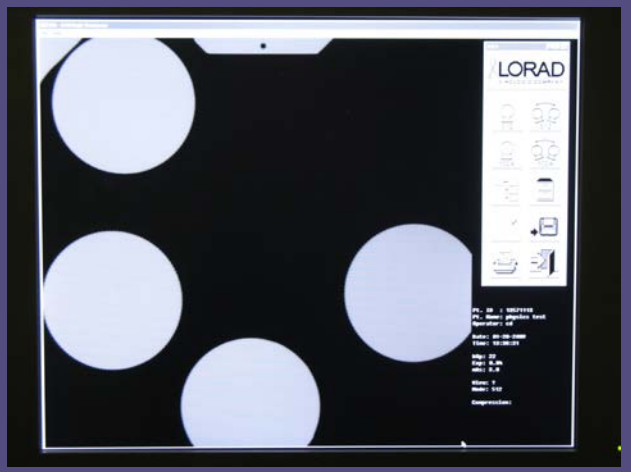
1. Stereotactic Breast Biopsy Unit Assembly Evaluation	Pass
Free-standing unit is mechanically stable.	Pass
All moving parts move smoothly without obstruction to motion.	Pass
All locks and detents work properly.	Pass
Image receptor holder assembly is free from vibrations.	Pass
Image receptor is held securely by assembly in any orientation.	Pass
Image receptor slides smoothly into holder assembly.	Pass
Compressed breast thickness scale accurate to +/- 1.0 mm at 0 compression.	Pass
Patient or operator is not exposed to sharp or rough edges or other hazards.	Pass
Operator technique control charts are posted.	Pass
Operator protected during exposure by adequate radiation shielding.	Pass
Needle holder and needle guides adequately support needle.	Pass
Control console displays techniques properly and all indicator lights work properly.	Pass

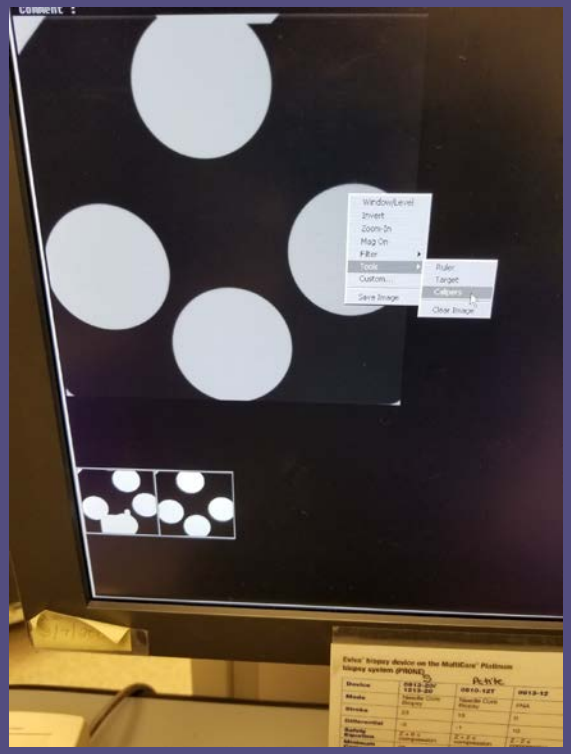
Comments:

Collimation Assessment

- Objective: Ensures that the x-ray collimation does not allow significant radiation to extend beyond the edges of the image receptor and that the biopsy window aligns with the x-ray field



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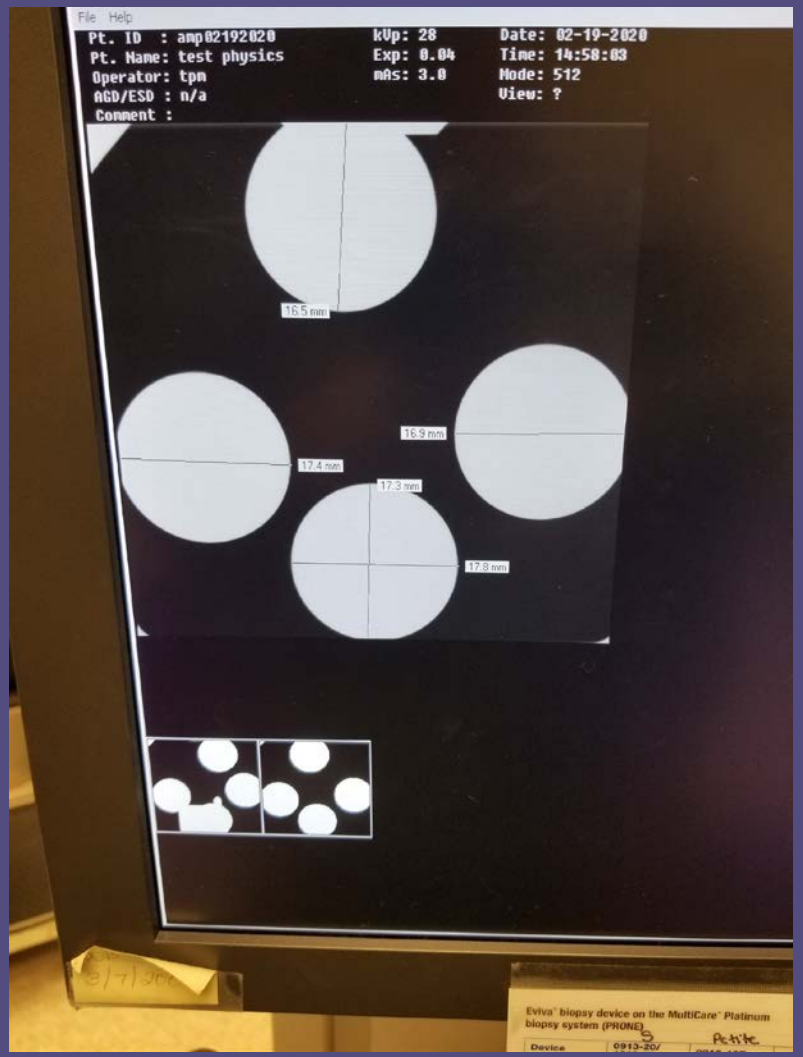
Window/Level
Invert
Zoom In
Mag On
Filter
Tools
Custom...
Save Image
Ruler
Target
Calipers
Clear Image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Date: 02-19-2020
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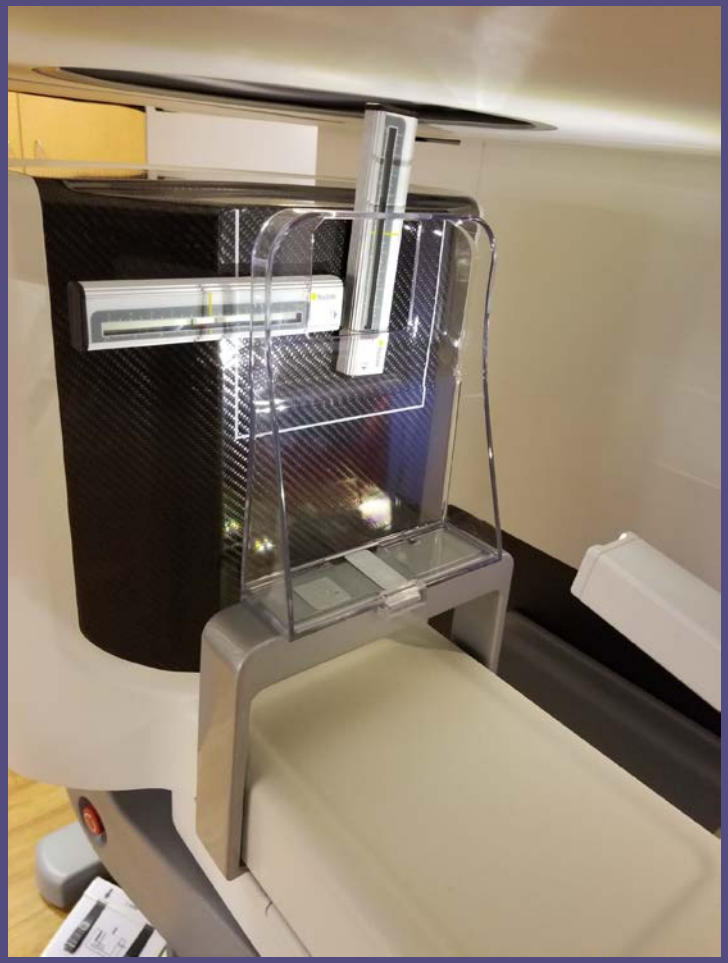
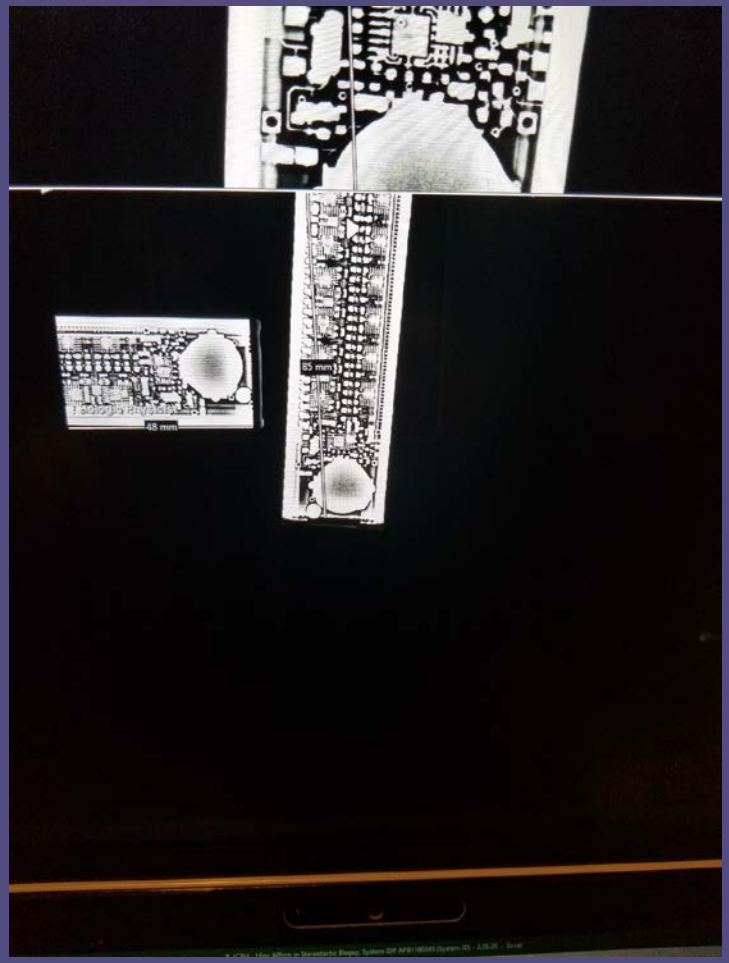
Mode: 512
View: ?
16.5 mm
16.9 mm
17.4 mm
17.3 mm
17.8 mm
Eviva biopsy device on the MultiCare Platinum biopsy system (PRONE)

Collimation Assessment





Collimation Assessment

- The x-ray field may extend beyond the edge of the IR on all 4 sides
  - No more than 5 mm on any side
- The biopsy window should be generally centered over the IR

Collimation Assessment

2. Collimation Assessment	Pass

Source to image receptor distance (SID):

77.0 cm	Screen-Film
88.5 cm	Digital

Screen-Film Units

X-ray field contained within the IR on all 3 non-chest wall edges	N/A
X-ray field extends beyond IR on chest wall edge	N/A

Distance of x-ray field from chest wall edge of IR	cm
2% of SID	cm

X-ray field does not extend beyond IR by more than 2% of SID	N/A

Digital Units

		Collimator (cm)	5 x 5	5 x 5			
		Paddle	Large	Small			
Digital Image	Left Edge:	Deviation (mm)					
	Right Edge:	Deviation (mm)					
	Anterior Edge:	Deviation (mm)					
	Chest Edge:	Deviation (mm)					
Film Image	Left Edge:	Deviation (mm)					
	Right Edge:	Deviation (mm)					
	Anterior Edge:	Deviation (mm)					
	Chest Edge:	Deviation (mm)					

Action Limit: If any edge 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.

Biopsy window generally centered over digital IR	Yes

Comments:

3. QAS Needle Test	Pass

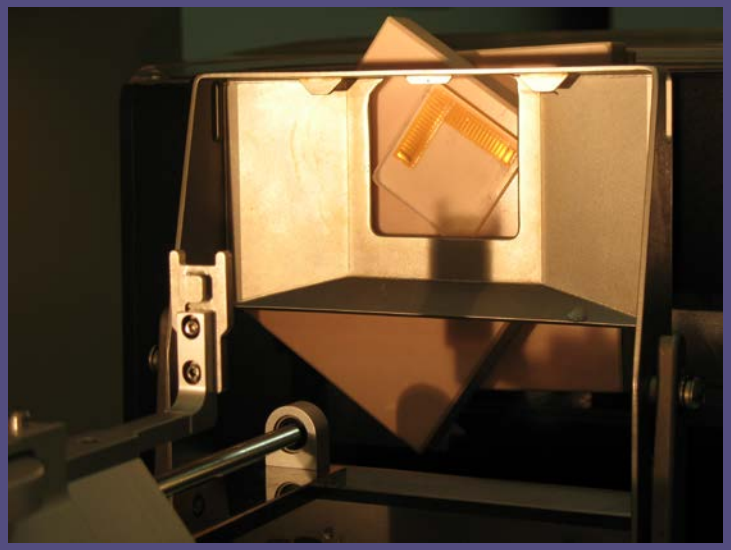
Technique: Follow operator manual procedure for Multicare or MIV System. Use 28 kVp @ 8 mAs.

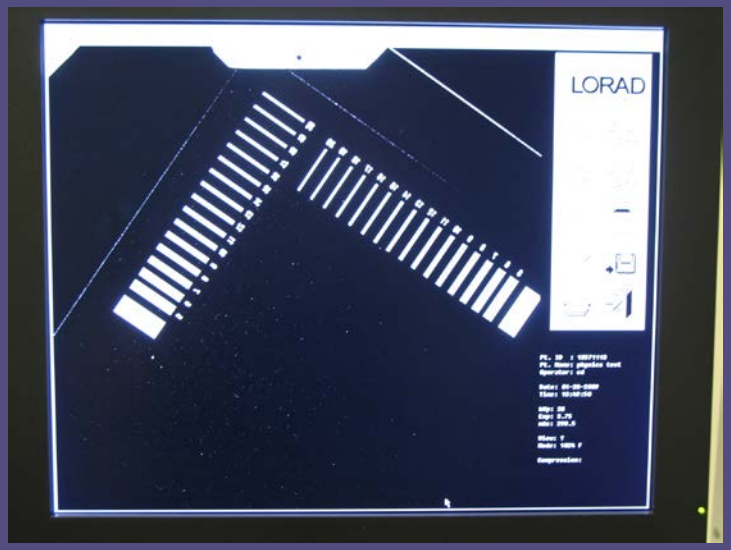
Coordinates	Set	Actual	Acceptable Range (mm)	Results
X	10		+9 mm to +11 mm	Acceptable
Y	20		+19 mm to +21 mm	Acceptable
Z	30		+29 mm to +31 mm	Acceptable

Action Limit: If coordinates are not within ± 1.0 mm, call service.

Comments:
1. If X error - check position of compression paddle
2. If Y error - check that movable needle guide is all the way forward
3. If Z error - check that hub of QC needle rests against rear needle guide and/or check that the compression paddle is locked

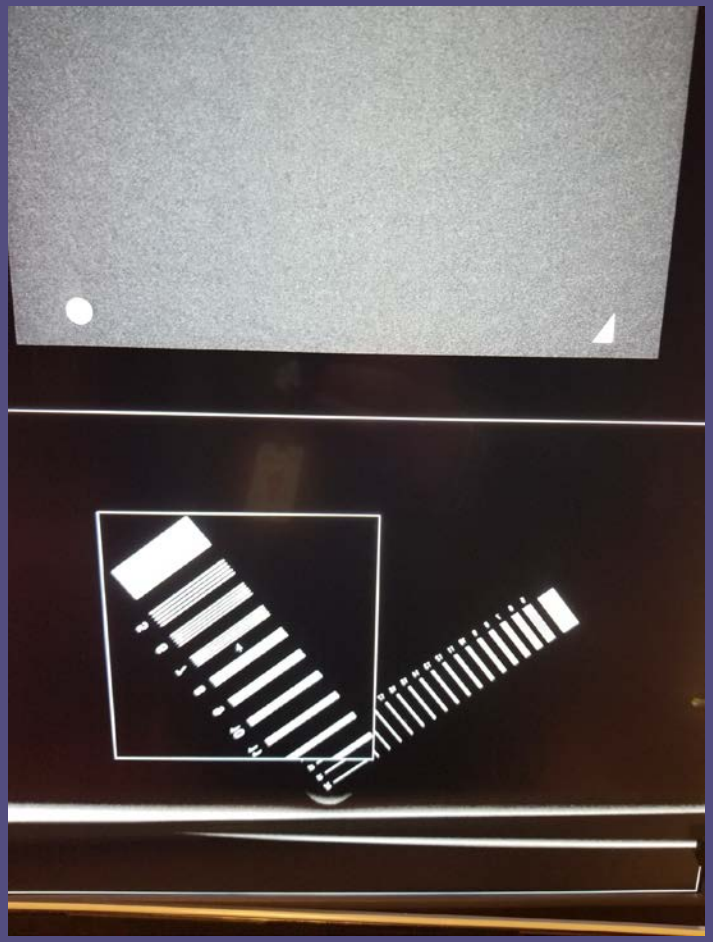
System Resolution



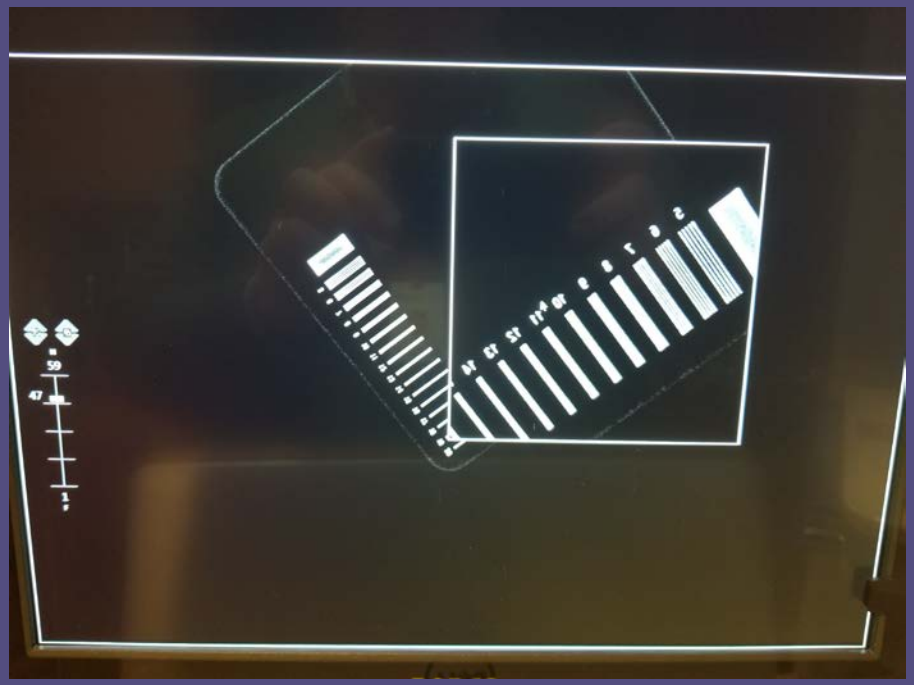


- Objective:
  - Ensures that the focal spot performance is adequate to minimize geometric blur in the image, and that the system-limiting resolution is adequate for the imaging requirements of the procedure

System Resolution



System Resolution



System Resolution

- Pattern shows distinctly the correct number of bars
- No longer resolved
  - Blur across entire length
  - Phase shift of bars (bright/dark)
  - Aliasing (decrease in bars)
- Manual does not define for digital
  - Typically 9-10 lp/mm
  - Establish baseline
    - Evaluate for consistency

System Resolution

4. Focal Spot Performance and System Limiting Spatial Resolution

A. Evaluation of Focal Spot Performance (high-contrast resolution pattern)	N/A

Image Receptor		Screen-Film
Viewing Mode		Film
kVp/mAs		
Limiting Resolution	bars parallel to A-C axis	
	bars perpendicular to A-C axis	

Action Limit: If the limiting resolution is < 13 line-pairs per mm with the bars parallel to the anode-cathode axis or is < 11 line-pairs per mm with the bars perpendicular to the anode-cathode axis, then a more detailed investigation of the reason should be made using a slit camera.

B. Digital System Limiting Spatial Resolution (digital imaging systems only)	Pass

Acquisition Monitor Display System

Digital Image Receptor Matrix Size		512	1024	
kVp/mAs				
Limiting Resolution	bars parallel to A-C axis			
	bars perpendicular to A-C axis			
Stage position		4.5	4.5	

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

Hard copy, if available (☑ Not Applicable)

Digital Image Receptor Matrix Size		512	1024	512
Viewing Mode		Hardcopy	Hardcopy	Hardcopy
Limiting Resolution	bars parallel to A-C axis			
	bars perpendicular to A-C axis			

Action Limit: Lorad specification: 9-10 lp/mm for 1024 matrix.
Note any significant degradation from previous measurement and seek service.

Comments:

kVp Accuracy and Reproducibility

Objective: Ensures that the indicated peak x-ray energy is accurate and reproducible, so that consistent contrast may be maintained

kVp Accuracy

kVp Reproducibility

HVL

5. kVp Accuracy/Reproducibility — Pass

Nominal kVp setting	24.0	25.0	26.0	27.0	28.0	30.0	34.0		
Focal spot	L	L	L	L	L	L	L		
mA/mAs	80/16	80/16	80/16	80/16	80/16	70/16	70/16		
Measured kVp values 1									
Measured kVp values 2									
Measured kVp values 3									
Measured kVp values 4									
Mean kVp									
Standard deviation (SD)									
Mean kVp - Nominal kVp									
0.05 X nominal kVp	1.20	1.25	1.30	1.35	1.40	1.50	1.70		
Percent Error	########	########	########	########	########	########	########		
COV (SD/Mean)									

Action Limit: ACR/MQSA - If the mean kVp differs from the nominal by more than 5% of the nominal kVp, or if the coefficient of variation (COV) excess 0.02, then seek service correction. Lorad specification: Actual kVp within ± 1 kV of indicated value.

Comments:

6. Beam Quality (HVL) Measurement — Pass

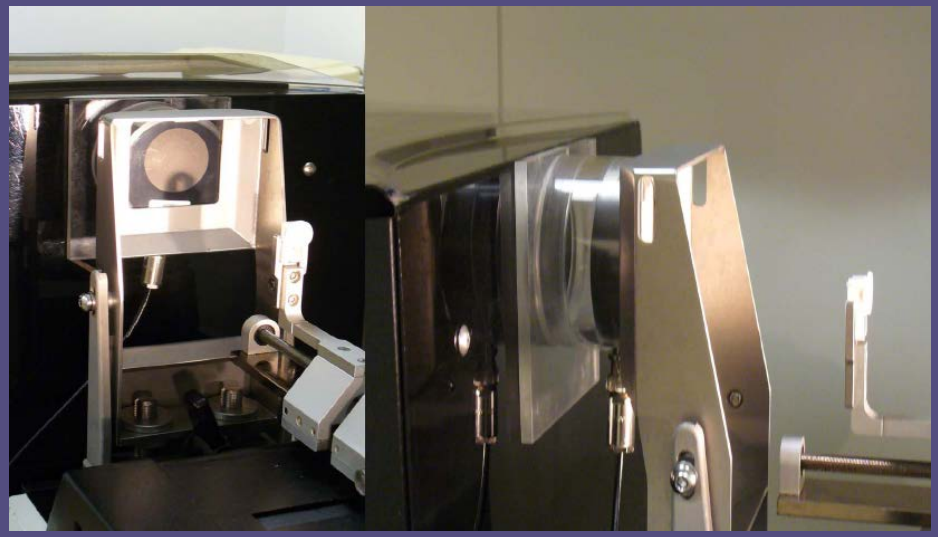
Nominal kVp setting	26	28			
Target material	Mo	Mo			
Filter	Mo	Mo			
mA/mAs	80/40	80/40			
Exposure measurements (mR)					
No aluminum filtration, E(0a)	0	0.0			
0.2 mm of added aluminum, E(2)					
0.3 mm of added aluminum, E(3)					
0.4 mm of added aluminum, E(4)					
0.5 mm of added aluminum, E(5)					
0.6 mm of added aluminum, E(6)					
No aluminum filtration, E(0b)					
Average E(0)					
Average E(0)/2					
Calculated HVL (mm Al)					
Minimum allowed HVL					
Maximum allowed HVL					

$$HVL = \frac{t_a \ln[E_{a1}/E_0] - t_a \ln[E_{a2}/E_0]}{\ln[E_{a1}/E_{a2}]}$$

Added filtration: 0.030 mm Al

Action Limit: ACR - If measured HVL < (kVp/100) (in mm Al) or if measured HVL > (kVp/100) + C (in mm Al), where C = 0.12 for Mo/Mo; C = 0.19 for Mo/Rh; C = 0.22 for Rh/Rh; and C = 0.30 for W/Rh, then seek service correction.
MQSA - The HVL must meet the specifications of FDA's Performance Standards for ionizing Radiation Emitting Products (Part 1020.30): HVL kVp/100

HVL and Average Glandular Dose



- Objective (HVL): Ensures that the x-ray beam is sufficiently penetrating to minimize patient dose, but not so penetrating that contrast is reduced Used to determine DCF for AGD
- Objective (AGD): Ensures that breast radiation doses are adequately low to protect the patient and sufficient to maintain adequate image quality

HVL & AGD

- HVL

Action Limit:	ACR - If measured HVL < (kVp/100) (in mm Al) or if measured HVL > (kVp/100) + C (in mm Al), where C = 0.12 for Mo/Mo; C = 0.19 for Mo/Rh; C = 0.22 for Rh/Rh; and C = 0.30 for W/Rh, then seek service correction. MQSA - The HVL must meet the specifications of FDA's Performance Standards for ionizing Radiation Emitting Products (Part 1020.30): HVL kVp/100

- AGD
  - AGD to an average (4.2 cm compressed) breast should not exceed 3.0 mGy (0.3 rads or 300 mrads) per view/exposure

Average Glandular Dose

9. Breast Entrance Exposure, Average Glandular Dose and Exposure Reproducibility — Pass

Imaging Mode	Digital
Exposure Mode	Automatic
Phantom Used	ACR Digital Mini

Breast thickness (cm)	4.2	4.2		4.2
Exposure Mode	Auto-Time	Auto-Time		*Max mAs to be within 300 mrad dose limit*
Receptor/Matrix	Digital/512	Digital/1024		
Nominal kVp setting	28	28		28
Density control/mAs setting	See Below	See Below		See Below
Target/Filter	Mo/Mo	Mo/Mo		Mo/Mo
Measured HVL (mm Al)				
Output (mR/mAs)				#VALUE!

Measured Entrance Exposure								
Exposure	mR	mAs	mR	mAs	mR	mAs	mR	mAs
#1	0.0		0.0					
#2	0.0		0.0					
#3	0.0		0.0					
#4	0.0		0.0					
Mean Values	0.00		0.00				########	########
Standard Deviation	0.000	#DIV/0!	0.000					
COV	#DIV/0!		#DIV/0!					

Action Limit: If coefficient of variation (COV) for either R or mAs exceeds 0.05, seek service.

Average Glandular Dose (AGD):				
Inv. Sq. corrected skin exp				
Dose conversion factor from Tables 1-3 (mrad/R)				
Computed average glandular dose (mrad)				

Action Limit: If average glandular dose exceeds 300 mrad (3 mGy) for 4.2 cm effective breast thickness, seek service or technique adjustment.

Dose Conversion Factors (from ACR Manual)

Mo/Mo

HVL	X-Ray Voltage (kVp)							
	24	25	26	27	28	29	30	WIN
0.24	124							
0.25	129	131						
0.26	133	135	138					
0.27	138	140	142	143				
0.28	142	144	146	147	149			
0.29	145	148	150	151	153	154		
0.30	151	153	155	156	157	158	159	170
0.31	156	157	159	160	161	162	163	175
0.32	160	162	163	164	166	167	168	180
0.33	165	166	168	169	170	171	173	185
0.34	170	171	172	173	174	176	175	190
0.35	174	175	176	177	178	179	180	194
0.36		179	181	182	183	184	185	199
0.37			185	186	187	188	189	204
0.38				190	191	192	193	208
0.39					196	197	198	213
0.40						201	202	217
0.41							206	221

Mo/Rh

HVL	X-Ray Voltage (kVp)								
	25	26	27	28	29	30	31	32	33
0.28	149	151	154						
0.29	154	156	158	159					
0.30	158	160	162	162	163				
0.31	163	164	166	166	166	167	167		
0.32	167	169	171	171	171	171	172	172	
0.33	171	173	175	176	176	176	176	177	
0.34	176	178	179	179	180	180	180	181	181
0.35	180	181	183	183	184	185	185	186	187
0.36	185	186	187	187	188	188	189	190	191
0.37	189	190	191	191	192	193	193	194	195
0.38	193	194	196	196	197	197	197	198	199
0.39	198	199	200	200	201	202	202	202	203
0.40	202	203	204	204	205	205	206	207	208
0.41	206	207	208	208	209	209	210	211	212
0.42	211	211	212	212	213	213	214	215	216
0.43	215	216	217	217	218	218	219	219	220
0.44	220	220	221	221	222	222	223	223	224
0.45	224	224	225	225	226	226	227	227	228
0.46		228	229	229	230	231	231	232	233
0.47			233	233	234	235	235	236	237
0.48			238	238	239	240	240	241	241
0.49				242	243	243	244	244	245
0.50					247	247	248	248	249

Rh/Rh

HVL	X-Ray Voltage (kVp)						
	25	26	27	28	29	30	31	32
0.28	150	155	159					
0.29	155	160	164	168				
0.30	160	164	168	172	176			
0.31	165	168	172	174	180	182		
0.32	169	173	177	181	184	186	188	
0.33	174	178	181	185	188	190	192	
0.34	179	183	186	190	193	195	196	199
0.35	184	187	190	194	197	199	201	203
0.36	189	192	195	198	201	204	205	207
0.37	193	196	199	202	205	207	209	211
0.38	198	201	204	207	209	211	213	215
0.39	203	206	208	211	214	216	217	219
0.40	208	211	213	216	218	220	221	223
0.41	213	215	217	220	222	224	225	227
0.42	218	220	222	226	226	228	229	231
0.43	222	224	226	228	230	232	233	235
0.44	227	229	231	233	235	237	238	239
0.45	232	234	235	237	239	241	242	243
0.46			239	241	243	245	246	247
0.47					247	249	250	251
0.48					251	253	254	255
0.49						257	258	259
0.50						261	262	263

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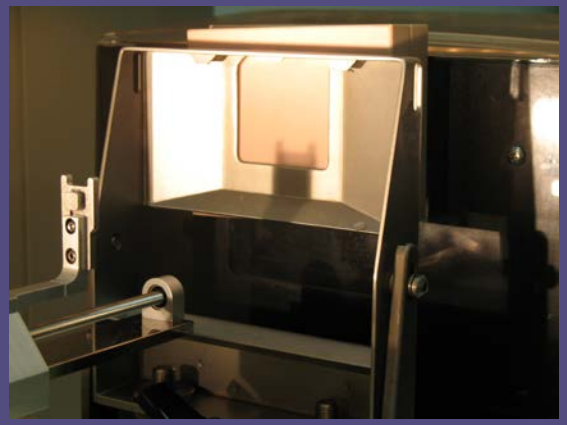
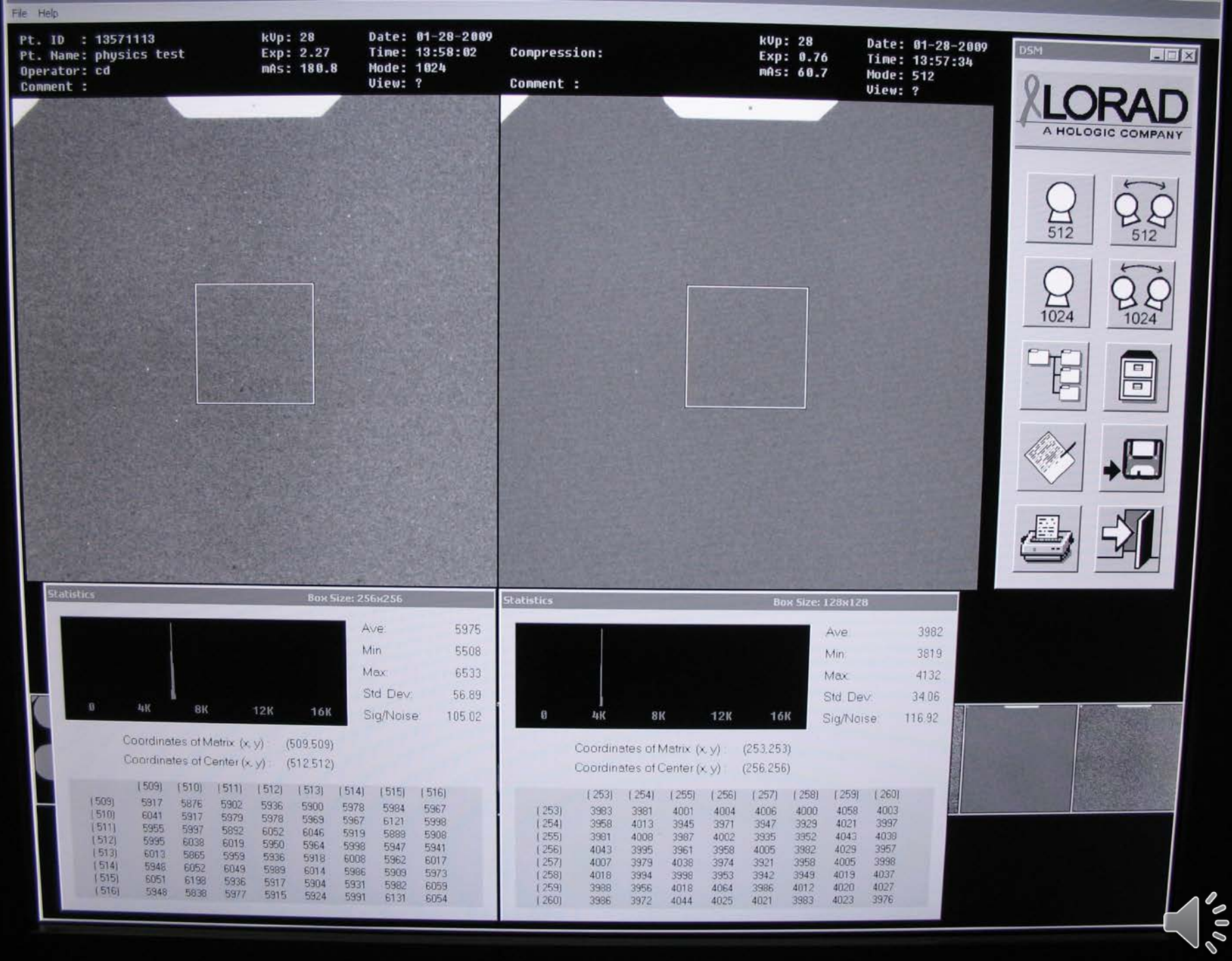
AEC Performance



- Objective: Assesses the performance of the system's AEC or manual techniques regarding appropriate detector signal levels over a range of breast thicknesses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mAs: 180.8
Date: 01-28-2009
Time: 13:58:02
Mode: 1024
View: ?
Compression:
Comment :
kVp: 28
Exp: 0.76
mAs: 60.7
Date: 01-28-2009
Time: 13:57:34
Mode: 512
View: ?
DSM
LORAD
A HOLOGIC COMPANY
512
512
1024
1024
Statistics
Box Size: 256x256
0
4K
8K
12K
16K
Ave: 5975
Min: 5508
Max: 6533
Std. Dev: 56.89
Sig/Noise: 105.02
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Coordinates of Center (x, y): (512,512)
(509) (510) (511) (512) (513) (514) (515) (516)
(509) 5917 5876 5902 5936 5900 5978 5984 5967
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(511) 5955 5997 5892 6052 6046 5919 5889 5908
(512) 5995 6038 6019 5950 5964 5998 5947 5941
(513) 6013 5865 5959 5936 5918 6008 5962 6017
(514) 5948 6052 6049 5989 6014 5986 5909 5973
(515) 6051 6198 5936 5917 5904 5931 5982 6059
(516) 5948 5838 5977 5915 5924 5991 6131 6054
Statistics
Box Size: 128x128
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4K
8K
12K
16K
Ave: 3982
Min: 3819
Max: 4132
Std. Dev: 34.06
Sig/Noise: 116.92
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Coordinates of Center (x, y): (256,256)
(253) (254) (255) (256) (257) (258) (259) (260)
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(254) 3958 4013 3945 3971 3947 3929 4021 3997
(255) 3981 4008 3987 4002 3935 3952 4043 4039
(256) 4043 3995 3961 3958 4005 3982 4029 3957
(257) 4007 3979 4038 3974 3921 3958 4005 3998
(258) 4018 3994 3998 3953 3942 3949 4019 4037
(259) 3988 3956 4018 4064 3986 4012 4020 4027
(260) 3986 3972 4044 4025 4021 3983 4023 3976

AEC Performance

The signal value shall remain within +/- 20% of the signal obtained for the 4 cm phantom, assuming the signal for the 4 cm phantom is appropriate.

If this does not pass, then the physicist should develop a technique chart using techniques that pass this criteria.

Manufacturer's provide target signal values.

7a. Automatic Exposure Control System Performance — Pass

Exposure Mode	AEC
Image Receptor	Digital
Max mAs	at 5 seconds
mA Setting	≤ 28 kVp = 80, > 28 kVp = 70

Comments
Mo/Mo, 4.5cm support position, with comp. paddle, 256 x 256 ROI at center
Ave = Average signal value (ROI Ave)

Thickness - Compensation

Mode	Auto-Time (512 matrix)			Auto-Time (1024 matrix)					
Phantom	kVp	mAs	Ave	kVp	mAs	Ave	kVp	mAs	Ave
2 cm BR12	22			23					
4 cm BR12	28			28					
6 cm BR12	32			33					
8 cm BR12	34			30-34	Not allowed				
4.2 cm Mini ACR	28			28					

Results

Mode	Target Type	Engineer Target Values	Hologic Allowed Range (DN +/- 500)			ACR Allowed Range (± 20% of 4cm)		
Auto-Time (512 matrix)	DN 512			to			to	
Auto-Time (1024 matrix)	DN 1024			to			to	

Action Limit: "Ave" should be DN 512 Target (± 500) for the 512 matrix and DN 1024 Target (± 500) for the 1024 matrix. If the signal range exceeds specifications, contact service. New systems are compared to values established by service on a site by site basis.

Comments:
1. Rule-of-thumb: Double the mAs from 512 matrix when going to the 1024 matrix in order to keep the same signal value.

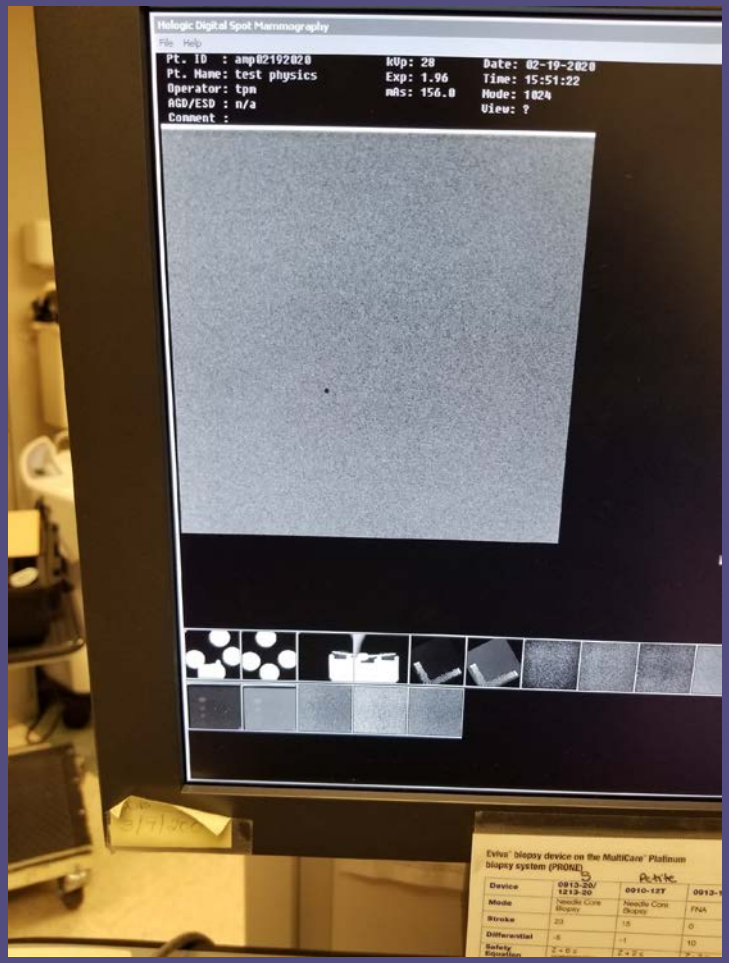
Clinical Breast Platform Positions	
cm	Compressed breast (cm)
0.0	Not used with DSM
3.0	< 4.0
4.5	4.0 - 5.5
6.0	> 5.5

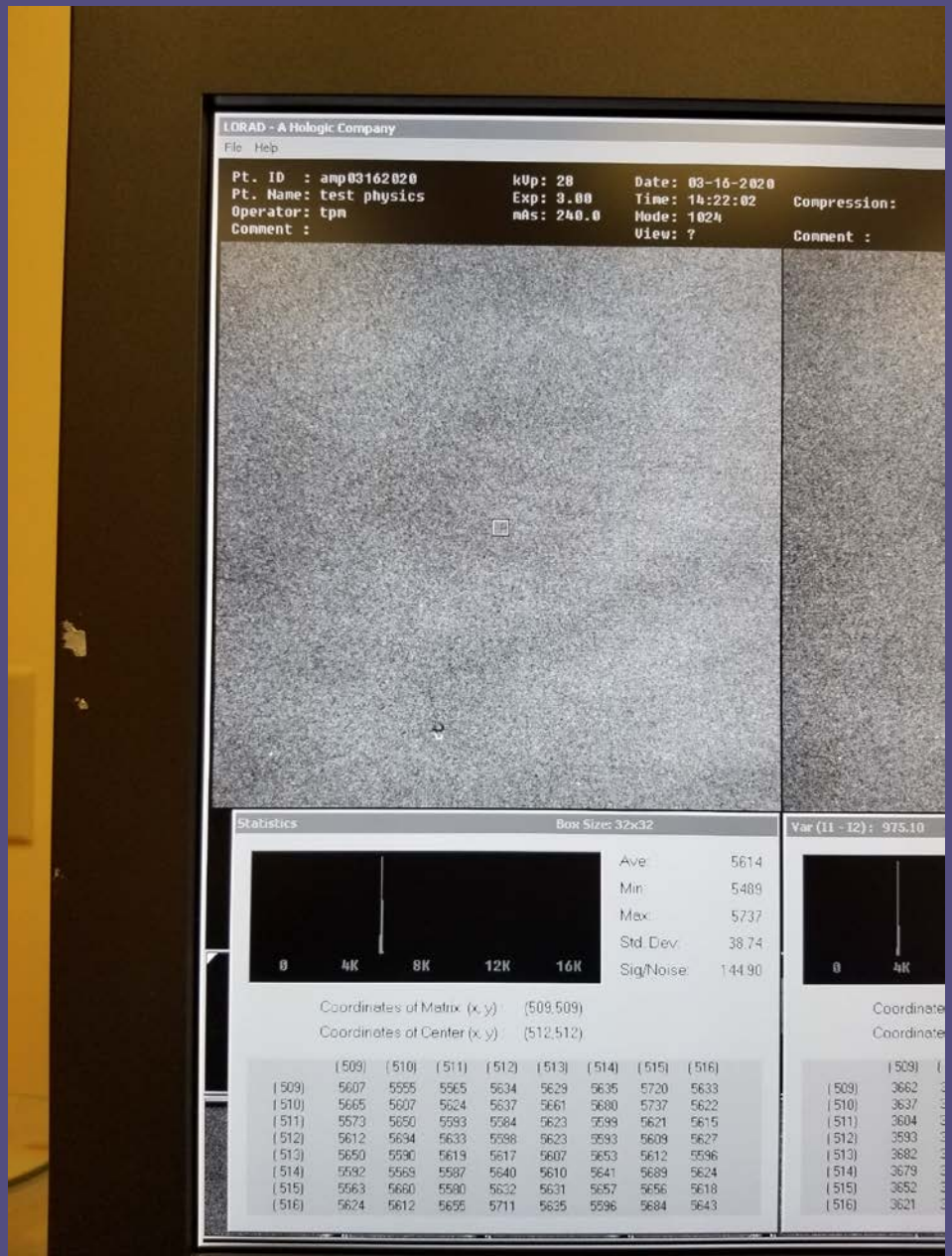
Digital Receptor Uniformity

Objective:

Ensures that the digital detector is adequately uniform across its entire useful area

Hologic Affirm Prone SBB Unit




LORAD - A Hologic Company
File Help
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Exp: 3.00
mAs: 240.0
Date: 03-16-2020
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View: ?
Compression:
Comment :
Statistics
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Min: 5489
Max: 5737
Std Dev: 38.74
Sig/Noise: 144.90
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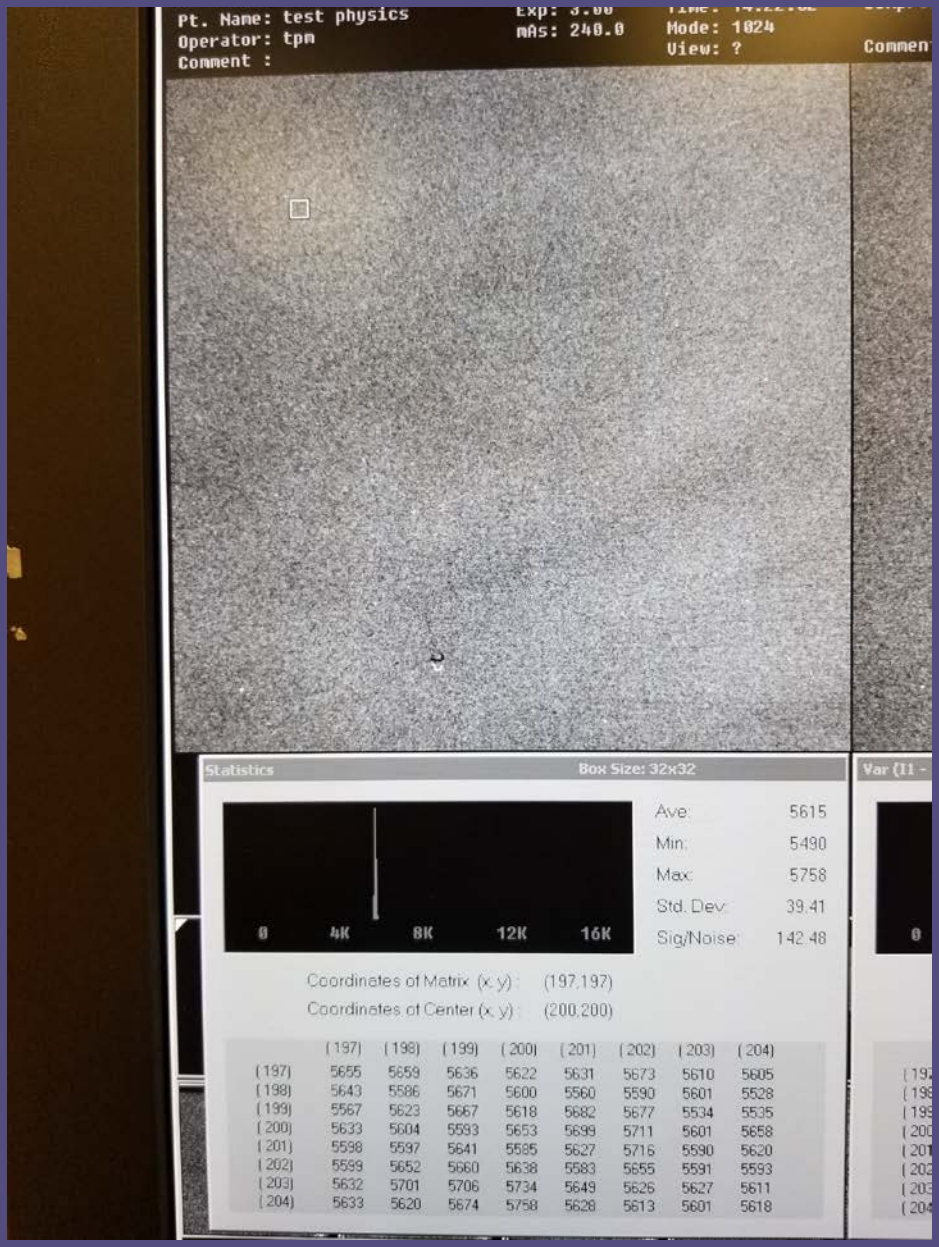
0 4K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Comment :
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mAs: 240.0
Mode: 1024
View: ?
Statistics
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8K
12K
16K
Ave: 5615
Min: 5490
Max: 5758
Std. Dev: 39.41
Sig/Noise: 142.48
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(199) 5567 5623 5667 5618 5682 5677 5534 5535
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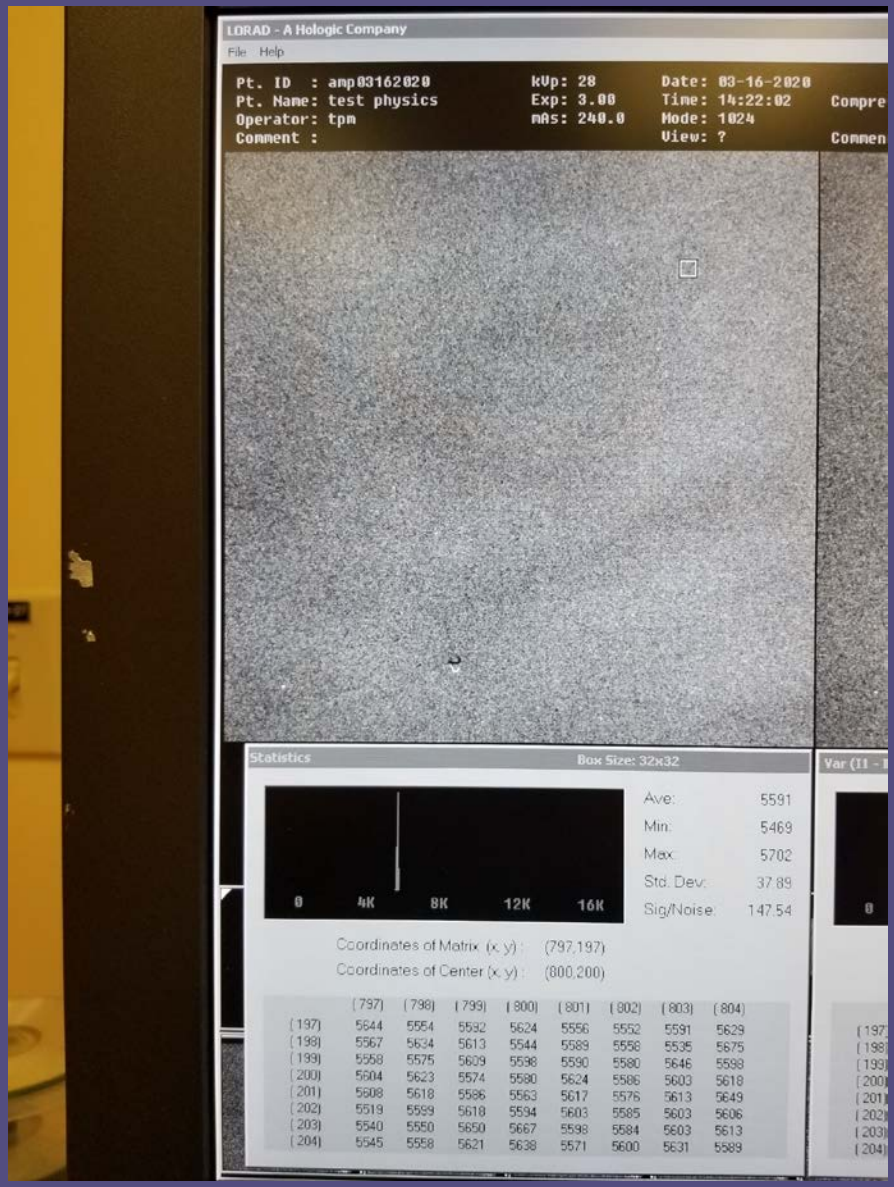
LORAD - A Hologic Company
File Help
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Comment :
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Exp: 3.00
mAs: 240.0
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Mode: 1024
View: ?
Compre
Commen
Statistics
Box Size: 32x32
0
4K
8K
12K
16K
Ave: 5591
Min: 5469
Max: 5702
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Sig/Noise: 147.54
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Coordinates of Center (x, y): (800,200)
Var (11 -
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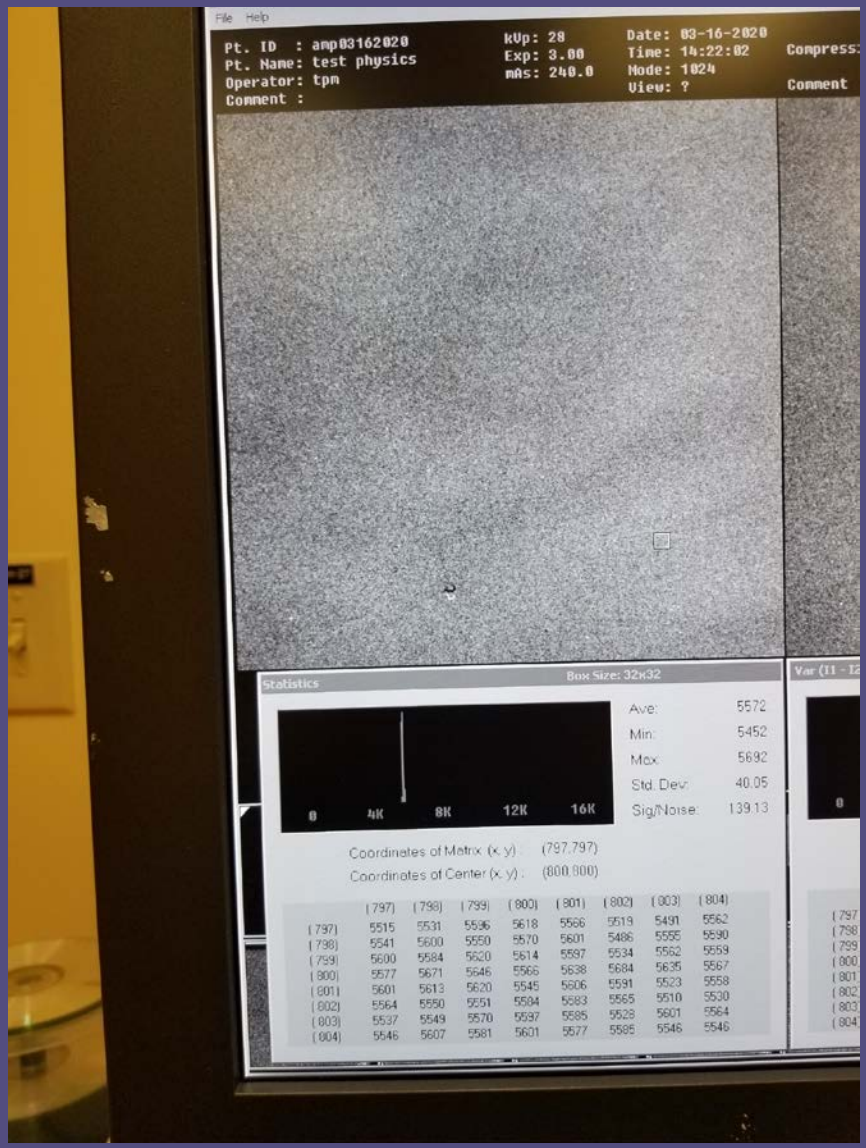
File Help
Pt. ID : amp03162020
Pt. Name: test physics
Operator: tpm
Comment :
kVp: 28
Exp: 3.00
mAs: 240.0
Date: 03-16-2020
Time: 14:22:02
Mode: 1024
View: ?
Compress:
Comment
Statistics
Box Size: 32x32
0
4K
8K
12K
16K
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Std. Dev: 40.05
Sig/Noise: 139.13
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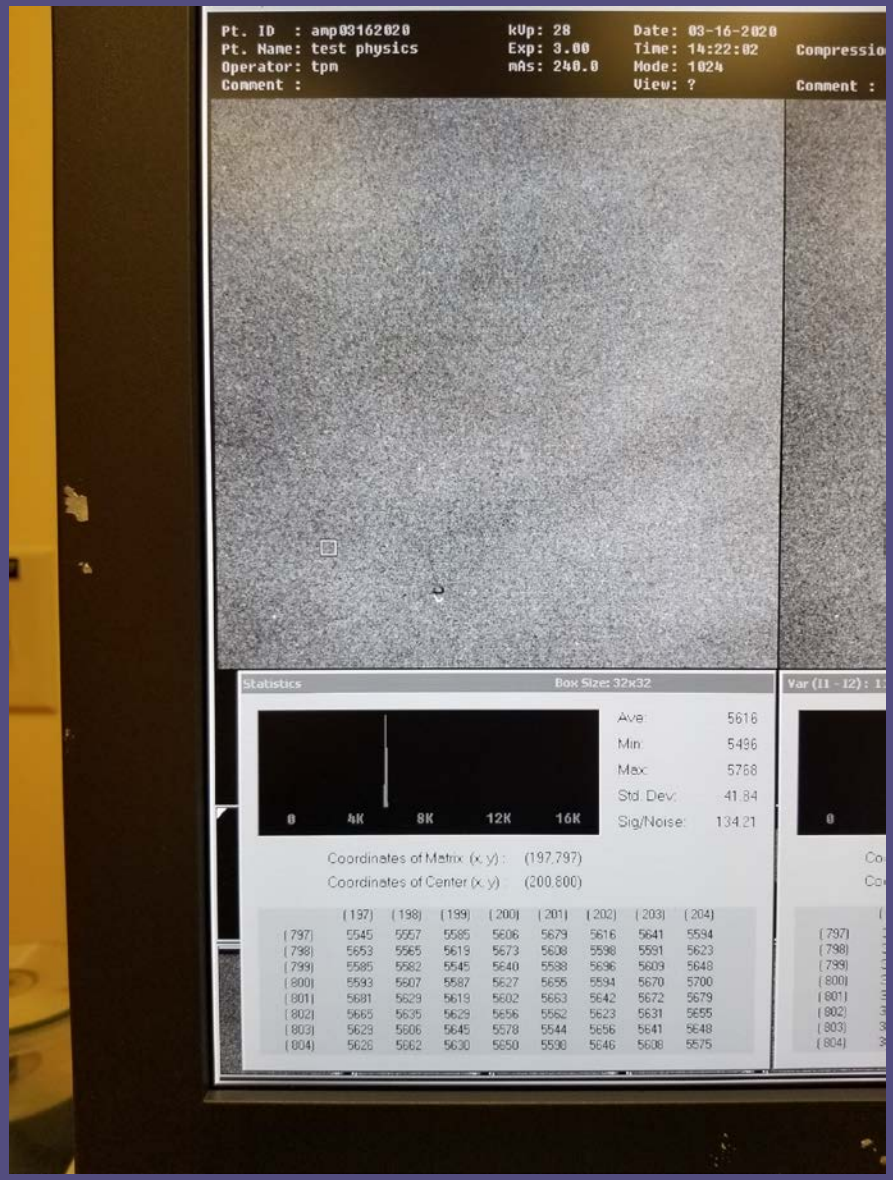
Coordinates of Center (x,y): (800,800)
(797) (798) (799) (800) (801) (802) (803) (804)
(797) 5515 5531 5596 5618 5566 5519 5491 5562
(798) 5541 5600 5550 5570 5601 5486 5555 5590
(799) 5600 5584 5620 5614 5597 5534 5562 5559
(800) 5577 5671 5646 5566 5638 5684 5635 5567
(801) 5601 5613 5620 5545 5606 5591 5523 5558
(802) 5564 5550 5551 5594 5583 5565 5510 5530
(803) 5537 5549 5570 5597 5585 5528 5601 5564
(804) 5546 5607 5581 5601 5577 5585 5546 5546


Pt. ID : amp03162020
Pt. Name: test physics
Operator: tpm
Comment :
kVp: 28
Exp: 3.00
mAs: 240.0
Date: 03-16-2020
Time: 14:22:02
Mode: 1024
View: ?
Compressio
Comment :
Statistics
Box Size: 32x32
0
4K
8K
12K
16K
Ave: 5616
Min: 5496
Max: 5768
Std Dev: 41.84
Sig/Noise: 134.21
Coordinates of Matrix (x, y): (197,797)
Coordinates of Center (x, y): (200,800)
Var (11 - 12) : 1
0

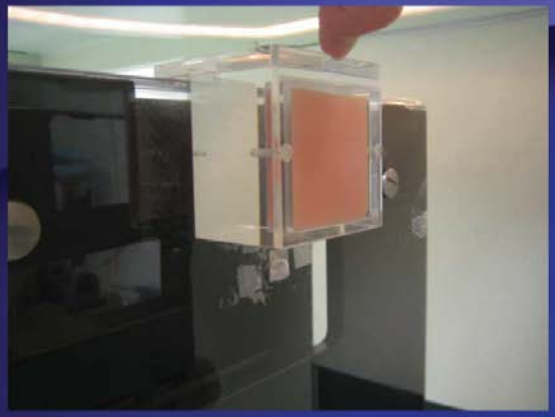
Digital Receptor Uniformity

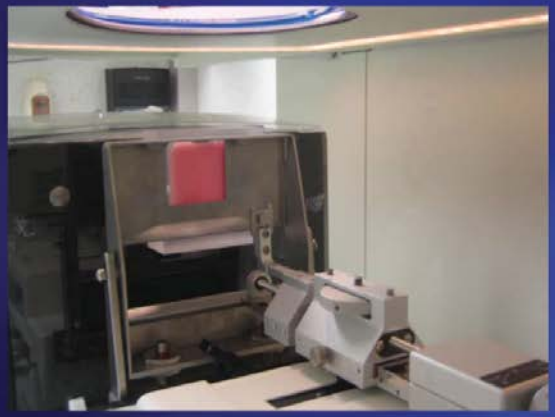
- The SNR (or Signal Values) measured in each corner of the image should be within 15% of the SNR (or signal) measured at the center of the field of view on a properly calibrated digital system.
- If this fails, then service correction of receptor homogeneity should be sought

Image Quality Evaluation

- Objective: Ensures that image quality is consistently high enough to meet the demands of the procedure

Stereo Phantom Setup





Score Objects

13. Image Quality Evaluation

Pass

Imaging Mode	Digital			
Exposure Mode	Automatic			
Phantom Used	Digital Mini			
	mA:	80	Cassette I.D.:	

Exposure Mode	Auto-Time	Auto-Time		
Comment				
kVp setting	28	28		
mAs				
Target/Filter	Mo/Mo	Mo/Mo		
Background density/Matrix	512	1024		
Image viewed on	Acquisition	Acquisition		
Number of fibers seen				
Number of speck groups seen				
Number of masses seen				
Total Score	0	0		

Action Limit: Minimum acceptable score described below.

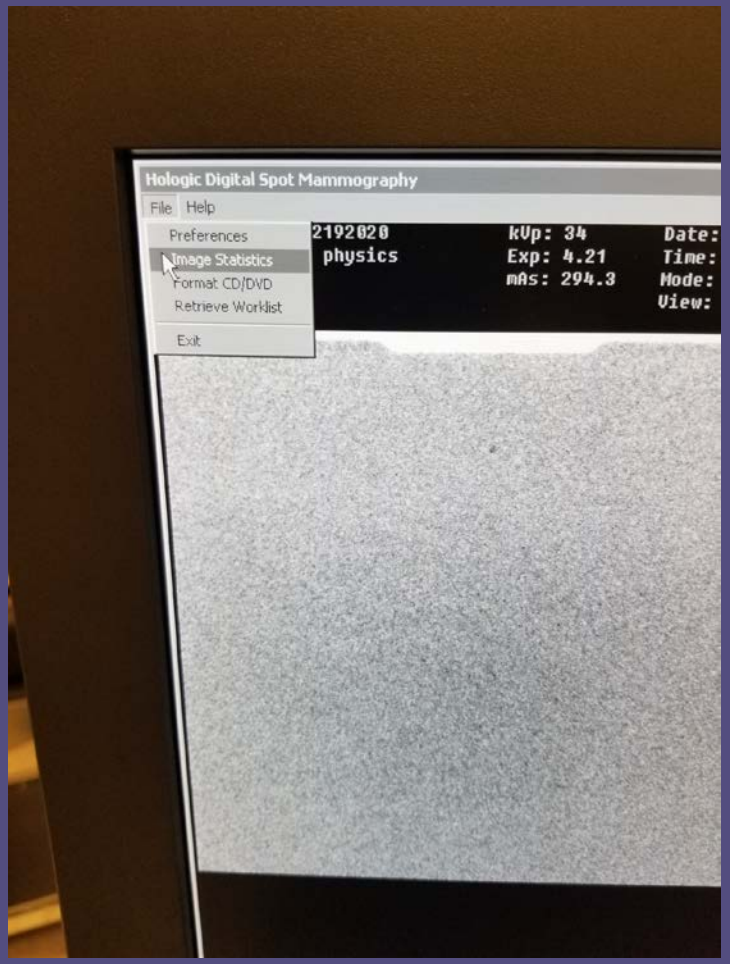
Test Object	Mammography Accreditation Phantom		Digital Mini-Phantom	
	Screen-Film	Digital	Screen-Film	Digital
Fibers	4.0	5.0	2.0	3.0
Specks	3.0	4.0	2.0	3.0
Masses	3.0	3.5	2.0	2.5

Comments:

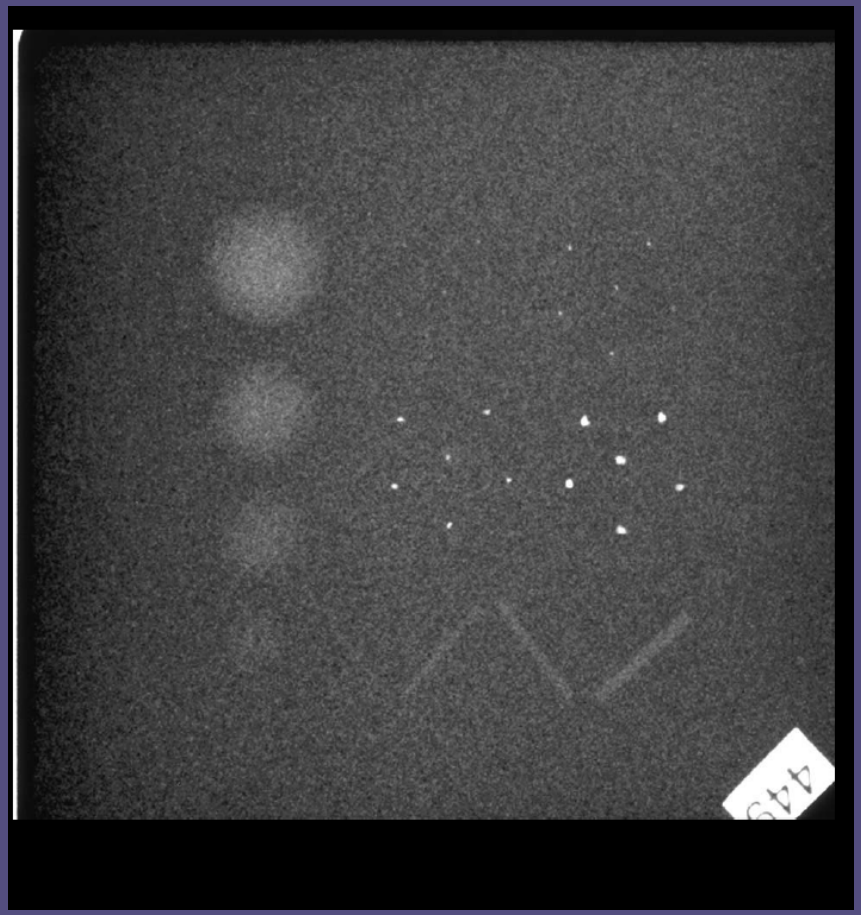
Artifact Analysis

- Objective: Detects the presence of artifacts, isolates their sources and ensures that they are eliminated or minimized

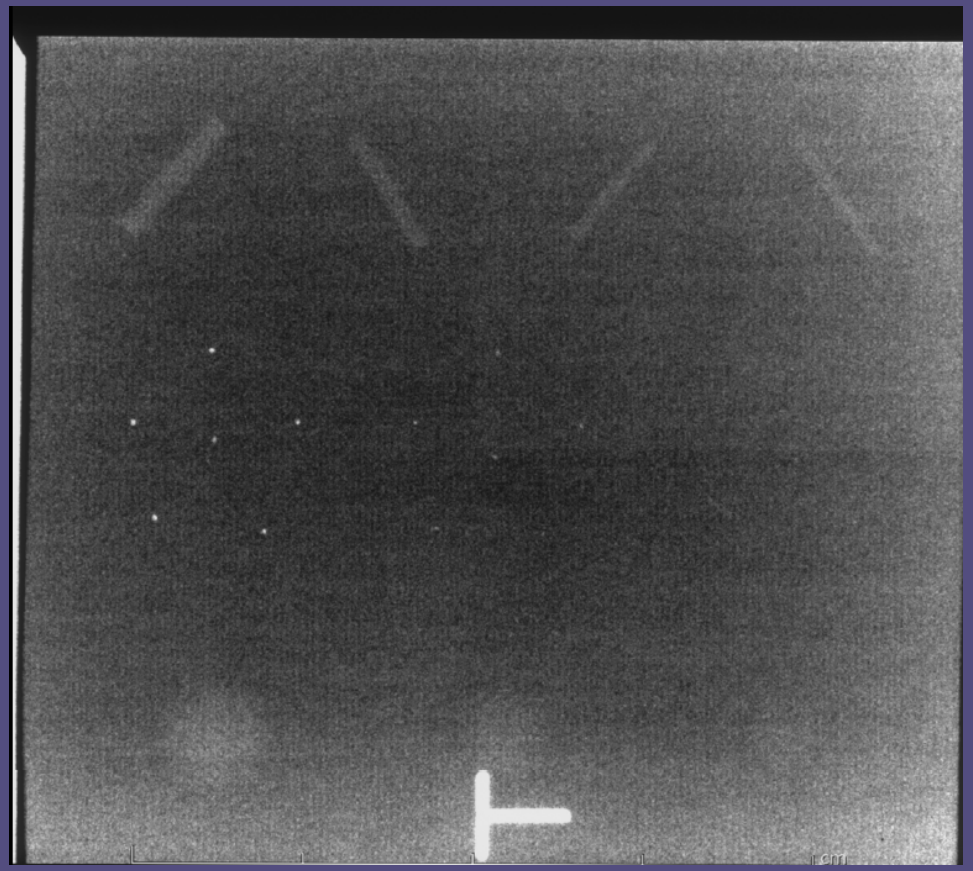
Artifact Analysis



Artifact Analysis



Non Uniform Background



Gridlines, Non Uniform Background

Artifact Analysis

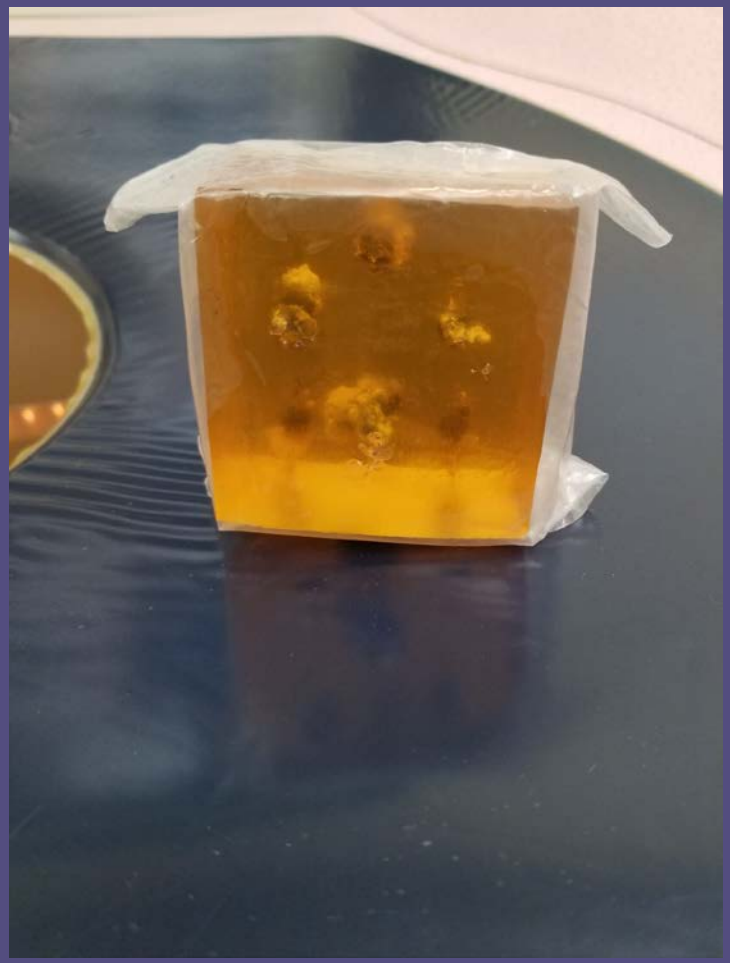
16. Artifact Evaluation				Pass
Attenuator type and thickness:			0, 2, 4, 6, 8 cm BR 12	Other:
kVp setting range:	25	to 34	mAs range:	to
Tested target/filter combinations:			Mo/Mo	Other:
Image Receptor	Film/Screen		Digital	
Resultant Film O.D./Matrix			512 and 1024	
Artifacts Visible?	N/A		No	
Laser Imager	N/A		No	
Image Receptor	N/A		No	
X-ray Equipment/Breast Support	N/A		No	

Description of Artifacts:

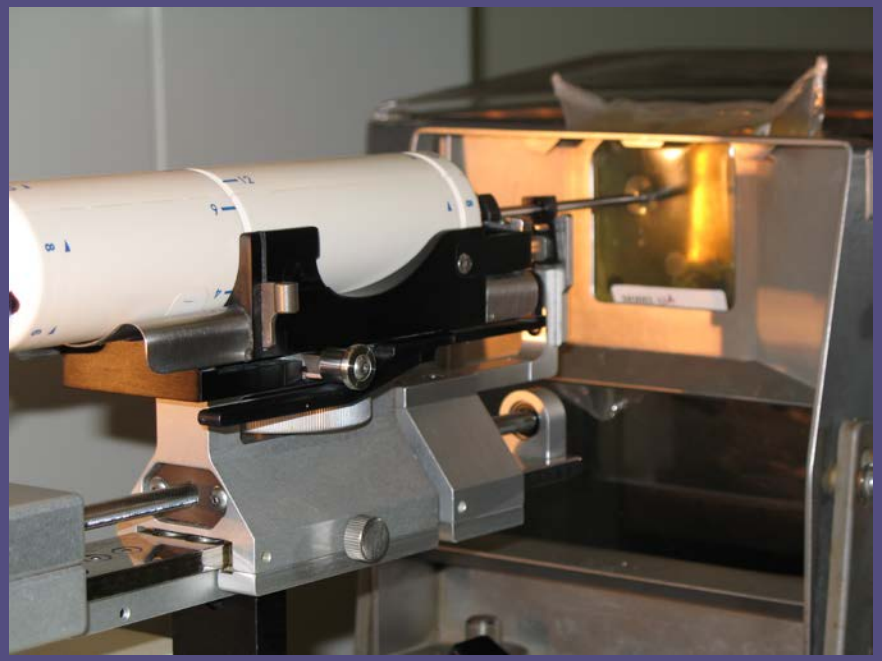
No significant artifacts observed.

Action Limit: If significant artifacts are visible, contact the appropriate person maintaining or servicing the processor or x-ray equipment. For digital systems, significant artifacts include detector non-uniformity, clusters of missing pixels and areas of detector dropout. Any artifact greater than 4 pixels requires that the camera be returned to the factory to be replaced, or the phosphor and carbon fiber to be cleaned or replaced.

Localization Accuracy



Localization Accuracy



- Objective: Ensures the accuracy of the localization system, including needle position, stereo position calculations and the user interface
- The medical physicist should observe the Technologist performing the localization.

MEDICAL PHYSICIST'S STEREOTACTIC UNIT QC TEST SUMMARY

Site Name		Report Date	
Address		Survey Date	
X-Ray Unit Manufacturer		Model	
Date of Installation		Room ID	
Film (mfr & type)		Screen (mfr & type)	
Film Processor Mfr		Model	
Digital Image Receptor Mfr		Model	
Medical Physicist's Name		Signature	

Medical Physicist's QC Tests

PASS/FAIL

1. **Stereotactic Breast Biopsy Unit Assembly Evaluation**
2. **Collimation Assessment**
   - A. X-ray field adequately matches image receptor
   - B. Biopsy window generally centered over digital image receptor *(NA if film used)*
3. **Focal Spot Performance and System Limiting Resolution**
   - A. Focal spot performance acceptable *(NA if digital used)*
   - B. Digital system spatial resolution acceptable *(NA if film used)*
4. **kVp Accuracy and Reproducibility**
   - Measured average kVp within ±5% of indicated kVp
   - kVp coefficient of variation ≤ 0.02
5. **Beam Quality Assessment (Half-Value Layer Measurement)**
   - HVL is within acceptable lower and upper limits at all kVp values tested
6. **AEC System or Manual Exposure Performance Assessment**
   - Optical density or signal range acceptable
7. **Receptor Speed Uniformity**
   - Screen speed uniformity or digital receptor uniformity acceptable
8. **Breast Entrance Exposure, Average Glandular Dose and Exposure Reproducibility**
   - Exposure reproducibility is within acceptable limits
   - Average glandular dose to a 4.2 cm thick breast is ≤ 3 mGy (300 mrad) _____ mrad
9. **Image Quality Evaluation**
   - Phantom image quality is acceptable
   - Phantom type: ☐ ACR Mammography Accreditation Phantom ☐ Mini Phantom
   - Phantom image quality scores: Fibers _____ Specks _____ Masses _____
10. **Artifact Evaluation**
    - Artifacts were not apparent or not significant:
    - Artifacts identified:
11. **Localization Accuracy Test**
    - Localization and sampling accurate/object captured

*** YOUR MEDICAL PHYSICIST MUST SUMMARIZE HIS/HER RESULTS ON THIS FORM ***

MEDICAL PHYSICIST'S STEREOTACTIC UNIT
QC TEST SUMMARY *(continued)*

Evaluation of Site's Technologist QC Program

		Frequency	PASS/FAIL
1.	Localization Accuracy Test	Daily	
2.	Darkroom Cleanliness *(NA if digital used)*	Daily	
3.	Processor Quality Control *(NA if digital used)*	Daily	
4.	Phantom Images	Weekly	
5.	Screen Cleanliness *(NA if digital used)*	Weekly	
6.	Viewboxes and Viewing Conditions *(NA if digital used)*	Weekly	
7.	Hardcopy Output Quality *(if hardcopy produced from digital data)*	Monthly	
8.	Visual Checklist	Monthly	
9.	Analysis of Fixer Retention in Film *(NA if digital used)*	Quarterly	
10.	Compression	Semi-annually	
11.	Repeat Analysis	Semi-annually	
12.	Screen-Film Contact *(NA if digital used)*	Semi-annually	
13.	Darkroom Fog *(NA if digital used)*	Semi-annually	
14.	Zero Alignment Test *(if required by manufacturer)*	Before each patient	
15.	Any additional tests required by manufacturer	As required by manufacturer	

Medical Physicist's Recommendations for Quality Improvement

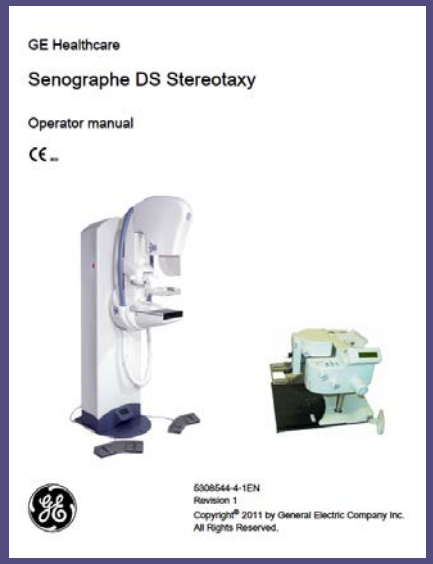
Comments:

SBB Unit Evolution

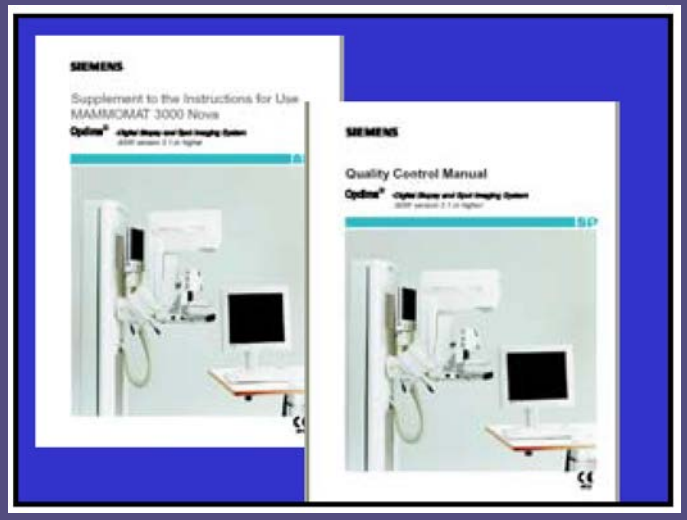
Hologic Multicare Platinum

Siemens Mammotest

Fischer Mammotest



GE Stereotaxis



Siemens OPDIMA

SBB Unit Evolution

Hologic Affirm
Add on Biopsy Unit
2D/3D Biopsies

SBB Unit Evolution

GE Serena Biopsy Unit
2D/3D Biopsies

SBB Unit Evolution

- Siemens Biopsy with Mammomat Inspiration/Revelation (2D/3D)

New Add on Units

- Follow manufacturer's guidance, if available
- May be able to use 2D/3D QC for some tests
  - kVp accuracy and Reproducibility
  - Collimation
  - Volume coverage for 3D/DBT
    - If same set up other than compression paddle

New Add on Units

- *HVL
  - Compression paddle window
- AEC or Manual Exposure Performance
  - Same detector?
  - Same calibration?
    - Add on Affirm uses separate calibration
- *Breast Entrance Exposure and AGD
  - Compression paddle window
  - Geometry
    - Different breast support
    - Different SID

- *QC performed even if performed in 2D or 3D

New Add on Units

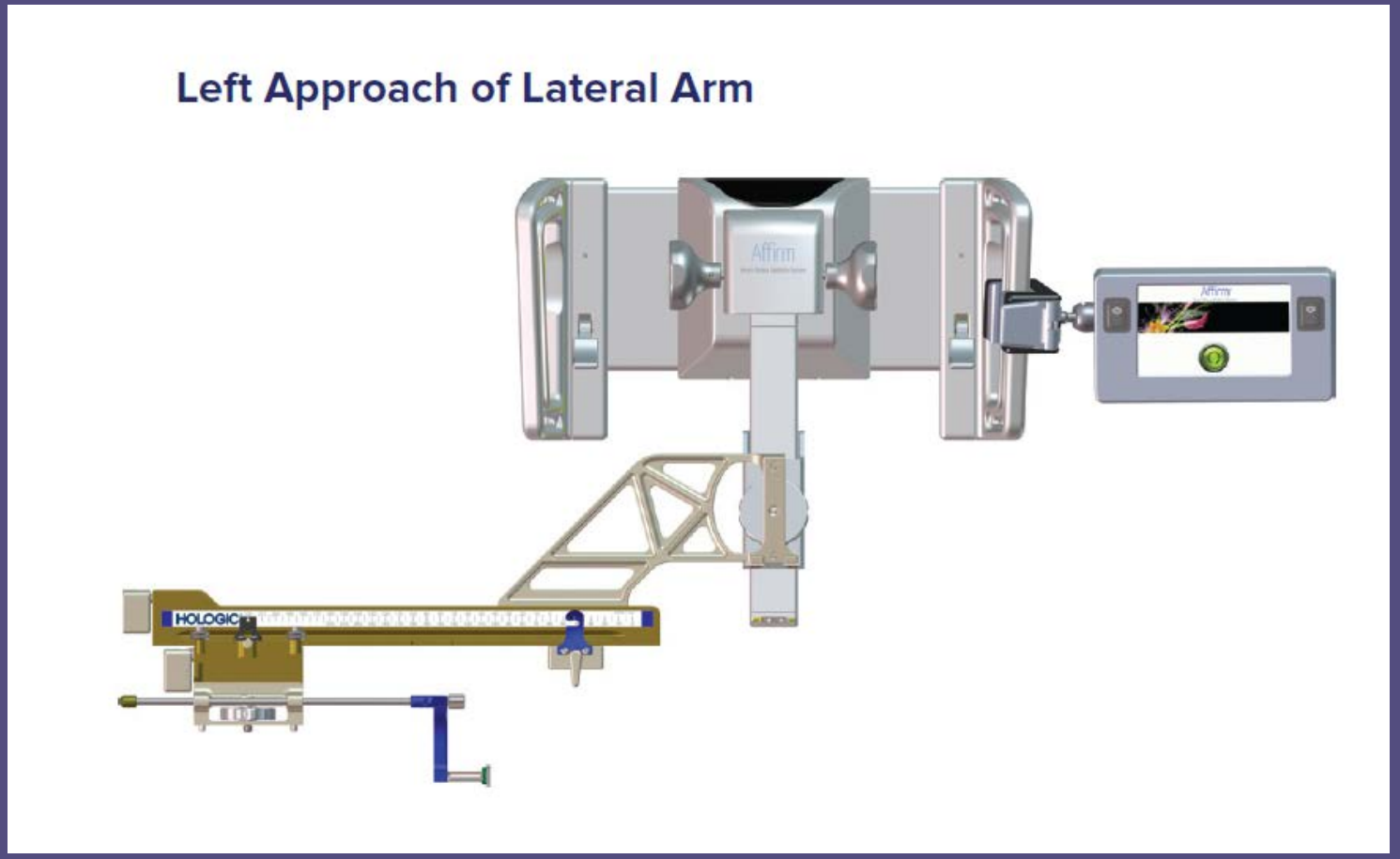
- *Image Quality
- *Spatial Resolution
- *Artifact Evaluation
- Volume coverage for 3D/DBT units
  - *If SBB configuration differs from 3D/DBT FFDM QC
- Localization Accuracy
  - Different Configurations
    - Vertical Approach
    - Lateral Approach
      - Left/Right

*QC performed even if performed in 2D or 3D

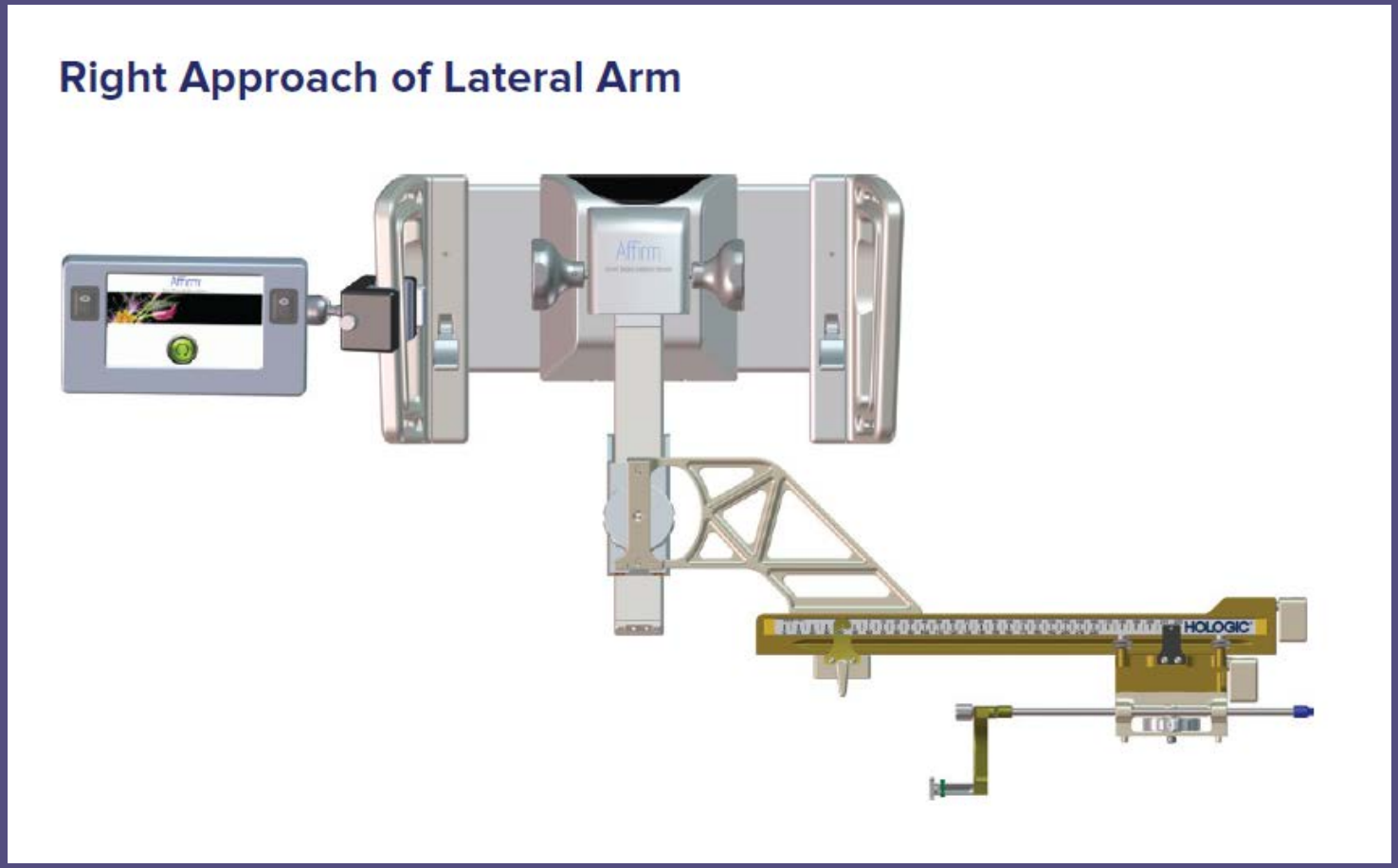
HOLOGIC®
The Science of Sure

Hologic Affirm®
Lateral Arm Upright Biopsy Accessory

Hologic Lateral Arm Upright Biopsy Accessory



Hologic Lateral Arm Upright Biopsy Accessory



Future SBB QC Testing Guidance

- ACR Website Guidance
- **ACR–AAPM TECHNICAL STANDARD FOR DIAGNOSTIC MEDICAL PHYSICS PERFORMANCE MONITORING OF STEREOTACTIC / TOMOSYNTHESIS-GUIDED BREAST BIOPSY SYSTEMS**
  - Awaiting Approval at Annual ACR meeting in May 2020
- ACR SBB QC Manual Update

Resources

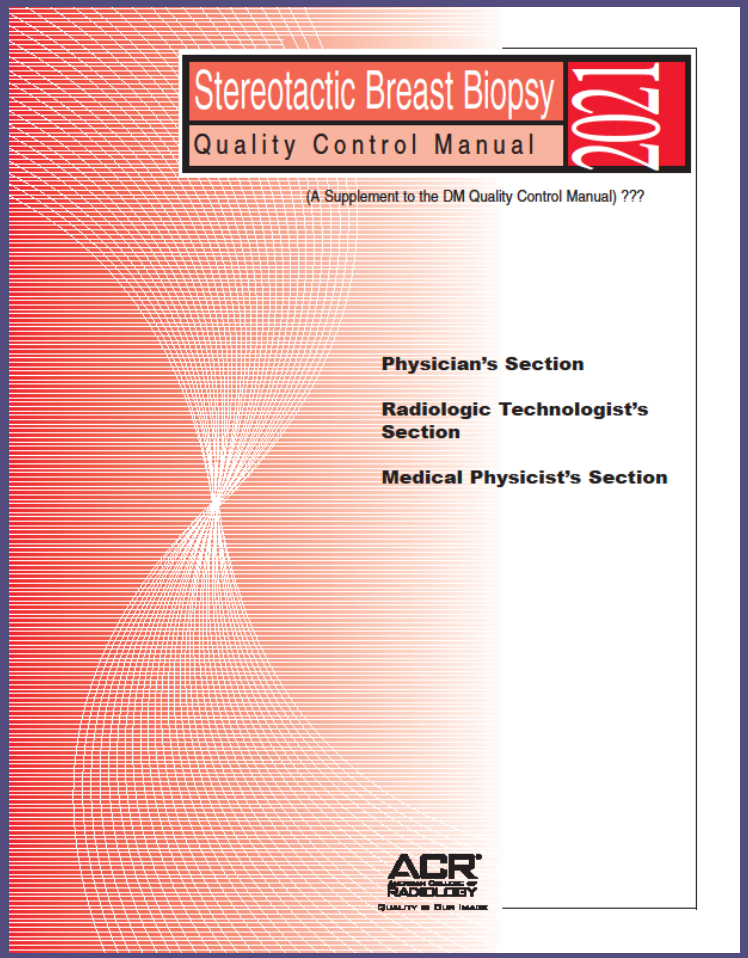
ACR Accreditation Information:

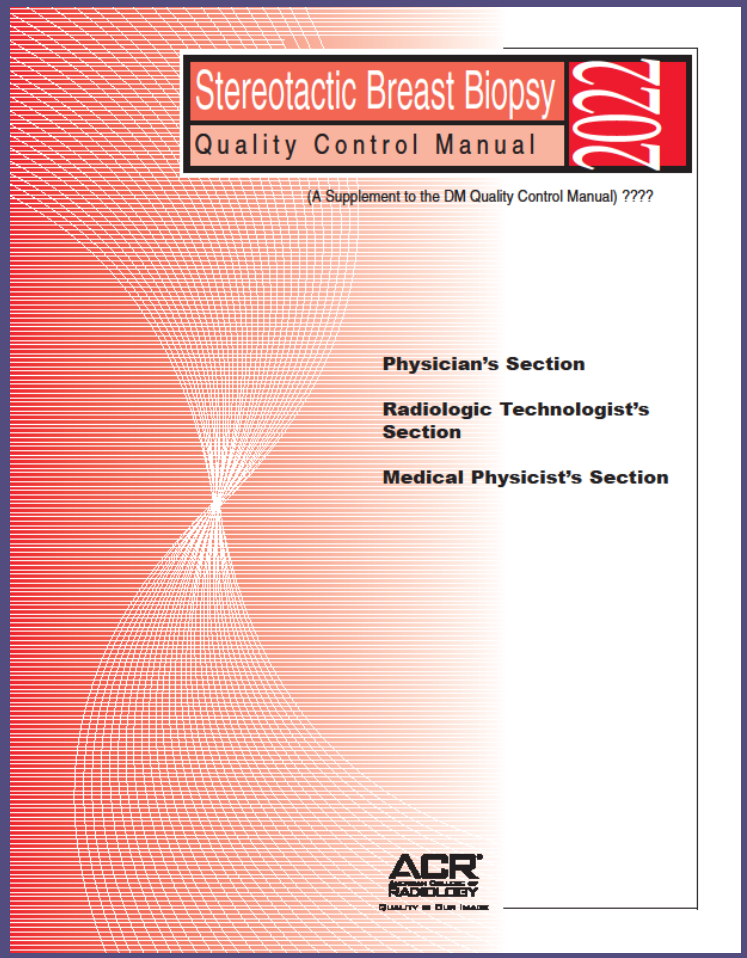
https://www.acraccreditation.org/Modalities/Stereotactic-Breast-Biopsy

ACR QC Forms in PDF format:

https://www.acraccreditation.org/Modalities/Stereotactic-Breast-Biopsy

Questions?


Stereotactic Breast Biopsy
Quality Control Manual
2021
(A Supplement to the DM Quality Control Manual) ???
Physician's Section
Radiologic Technologist's Section
Medical Physicist's Section
ACR
AMERICAN COLLEGE OF RADIOLOGY
QUALITY IS OUR IMAGE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Radiologic Technologist's Section
Medical Physicist's Section
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