Melting Mammography Measurement Minutes

SAM Session – Live and in Stereo: Mammography Tips and Tricks
2021 AAPM Spring Clinical Meeting
20 April 2021

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Radiation Services, Inc
Dover, Florida

Conflicts of Interest

• None
• This is NOT a sales pitch for medical physics services
  • The audience is not the provider, not the customer
  • The audience, at risk to Radiation Services, Inc, will gain some trade secrets
Overview

• An independent consultant’s perspective
• Efficiency in mammography physics support
  • General Tactics
  • QC record review
  • Reading workstation monitor evaluations
  • Program-Specific Tactics
• ACR accreditation support
• Alternative breast imaging technologies

Objectives

<table>
<thead>
<tr>
<th>Deliver</th>
<th>Deliver 1 SAM Credit in Mammography</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defeat</td>
<td>Defeat Final-Day, Post-Lunch Fatigue</td>
</tr>
<tr>
<td>Destroy</td>
<td>Destroy Partisan Misconceptions</td>
</tr>
</tbody>
</table>
Consultant Competence!

Consultant Commute

Your 2020 trends
Travel

26,807 mi (603 hr)

Jan May Sep Dec

Highlights
Cities visited

Your visits in 2020

110 Cities
503 Places
20 new
304 new
Medical Physics Consultation

Client Motivations
- COST
- RELATIONSHIPS
- REPUTATION FOR QUALITY

Our Priorities
1. Quality for Clients
   - Effective – Quality Medical Physics Support
   - Efficient – “Efficiency at any cost”
2. Relationships with Clients
3. Cost to Our Clients

“Virtue is the mean between the extremes”
-Aristotle [paraphrased]
Nicomachean Ethics, book II

Lowest Cost?
• “Don’t scare the normals”
• Be kind and professional
• Helpful in gathering background information
• Efficiency cost
• Tread carefully

Quality Medical Physics Support

Be Effective
• Quality medical physics support
  • Time and dollar cost
  • Compliance is a minimum standard
  • Match the effort of diligent and conscientious clients
  • Stay abreast of movements in the field

Be Efficient
• “Efficiency at any cost”
  • Time and dollar cost
  • Double-edge to cost to client for medical physics support
  • Keeps medical physicist engaged
  • Places value on time
  • Avoid diminishing returns when possible
General Efficiency in Mammography Physics

- Scheduling
  - Means of scheduling
  - Efficiency in travel
- Resource Availability
  - QA manuals
  - Past reports
  - ACR/MQSA guidance
  - Reach-back support
- Documentation Review

- Survey Equipment
  - Ease of transport and use
  - Functionality for all manufacturers
- Testing Spreadsheets
  - Site data population
  - Data collection
  - Report generation
- Order and Configuration of Survey
  - Minimize redundancies in set-up
  - Collect all beam data at one time

Mammography Physics Survey Kit
“Most major mammography equipment manufacturers, as well as the ACR, allow a medical physicist to deviate to some degree from the steps of the procedures described in their Quality Control manuals as long as the final outcome is in full compliance with the Recommended Performance Criteria and Corrective Action defined for each test.” - Sam
Collimation Measurements

Collimation Measurements

Radiation Services, Inc.

21

22
Collimation Measurements

Data Import

| Facility:  |  |
| City:      |  |
| State:     |  |
| Zip:       |  |
| MAPE:      |  |
| Expiration:|  |

Unit Type: 5

Load Adjustment:

CE/SM Option: 2

Survey Type:

Biomed Cover: N

RSO Cover: N

Other Cover: N

Serial Number:

Installation Date:

QC Manual Version:

QC Technology:

Breast Pad Used: N

Prior year file:

Date:

Physician:

Import from New Form:

Import from Other:

Baseline CNR and SNR:

QC Manual List:

- Selena: MAN-00095, Rev. 008 (2007)
- Selena (W): MAN-00029, Rev. 003 (2007)
- Selena (M and W): MAN-01470, Rev. 003 (2009)
- Selena Dimensions: MAN-16519, Rev. 001 (2010)
- Selena Dimensions: MAN-03288, Rev. 001 (2010)
- Selena Dimensions: MAN-01465, Rev. 008 (2014)
- Selena Dimensions: MAN-01206, Rev. 005 (2015)
- Selena Dimensions: MAN-01206, Rev. 005 (2015)

Mammography Unit Evaluation

Collimation Assessment

Artificial Evaluation

VR Accuracy & Reproducibility

Beam Quality - M&L

Evaluation of Resolution

AEC Performance

Average Glanular Dose

Radiation Output

Phantoms Image Quality

SNR & CNR

Diagnostic Review Workstation

Online QC

Detector Calibration

Geometry Calibration

Compression Thickness

Compression Force

Detector Glowing

Create Template

Include

Include

Include

Include

Include

Include

Include

Include

Include
### Data Import

<table>
<thead>
<tr>
<th>Baseline Image</th>
<th>Current Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data:</td>
<td>April 9, 2018</td>
</tr>
<tr>
<td>Phantom SN:</td>
<td>203.276</td>
</tr>
<tr>
<td>Selected kVp setting:</td>
<td>20</td>
</tr>
<tr>
<td>AEC Mode:</td>
<td>Auto-Filter</td>
</tr>
<tr>
<td>Exposure Compensation:</td>
<td>0</td>
</tr>
<tr>
<td>AEC position:</td>
<td>2nd</td>
</tr>
<tr>
<td>mAs:</td>
<td>94</td>
</tr>
<tr>
<td>Filter:</td>
<td>Rh</td>
</tr>
</tbody>
</table>

### Signal-to-Noise Ratio Results

<table>
<thead>
<tr>
<th></th>
<th>Baseline Mean Signal</th>
<th>Current Image</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Background Mean Signal</td>
<td>412.8</td>
<td>401.5</td>
<td></td>
</tr>
<tr>
<td>Background Standard Deviation</td>
<td>6.8</td>
<td>7.05</td>
<td></td>
</tr>
<tr>
<td>Signal-To-Noise Ratio</td>
<td>53.0</td>
<td>49.9</td>
<td></td>
</tr>
</tbody>
</table>

### Contrast-to-Noise Ratio Results

<table>
<thead>
<tr>
<th>Previous Film</th>
<th>Current Image</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disk Mean Signal</td>
<td>338.1</td>
<td>328.6</td>
</tr>
<tr>
<td>Disk Standard Deviation</td>
<td>6.2</td>
<td>6.18</td>
</tr>
<tr>
<td>Contrast-To-Noise Ratio</td>
<td>10.9</td>
<td>10.3</td>
</tr>
<tr>
<td>CNR difference (%)</td>
<td>-5.34%</td>
<td></td>
</tr>
</tbody>
</table>

**Action Limit:** The SNR should be equal to at least 40 and the CNR should not change by more than 5%.

---

### Data Acquisition

**Acquisition Parameters**

<table>
<thead>
<tr>
<th></th>
<th>Conventional</th>
<th>Tomosynthesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast thickness (cm)</td>
<td>4.2</td>
<td>4.2</td>
</tr>
<tr>
<td>Phantom</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Nominal kVp setting</td>
<td>28</td>
<td>29</td>
</tr>
<tr>
<td>Auto-Filter</td>
<td></td>
<td>Auto-Filter</td>
</tr>
<tr>
<td>Exposure Compensation</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Anode material</td>
<td>W</td>
<td>W</td>
</tr>
<tr>
<td>Filter</td>
<td>Rh</td>
<td>Al</td>
</tr>
<tr>
<td>Measured HVL (mm Al)</td>
<td>#NUM!</td>
<td>#NUM!</td>
</tr>
</tbody>
</table>

**Breast Entrance Exposure and AEC Reproducibility**

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Calc. Exp (R)</th>
<th>AEC mAs</th>
<th>Displayed ASG (mGy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>#DIV/0!</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Action Limit: If coefficient of variation for either R or mAs exceeds 5.05, seek service.
Beam Data Capture

Data Population

Acquisition Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Conventional</th>
<th>Tomosynthesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast thickness (mm)</td>
<td>4.2</td>
<td>4.2</td>
</tr>
<tr>
<td>Phantom</td>
<td>203.276</td>
<td>203.276</td>
</tr>
<tr>
<td>Nominal kVp setting</td>
<td>28</td>
<td>29</td>
</tr>
<tr>
<td>AEC Mode</td>
<td>Auto-Fiber</td>
<td>Auto-Fiber</td>
</tr>
<tr>
<td>Exposure Compensation Step</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Anode material</td>
<td>W</td>
<td>W</td>
</tr>
<tr>
<td>Filter</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Measured HVL (mm Al)</td>
<td>0.54</td>
<td>0.52</td>
</tr>
</tbody>
</table>

Breast Entrance Exposure and AEC Reproducibility

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Calc. Exp (R)</th>
<th>AEC mAl</th>
<th>Displayed AGD (mGy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>0.302</td>
<td>94.0</td>
<td>1.35</td>
</tr>
<tr>
<td>#2</td>
<td>0.413</td>
<td>95.0</td>
<td>1.32</td>
</tr>
<tr>
<td>#3</td>
<td>0.408</td>
<td>90.0</td>
<td>1.32</td>
</tr>
<tr>
<td>#4</td>
<td>0.413</td>
<td>90.0</td>
<td>1.32</td>
</tr>
<tr>
<td>Mean Value</td>
<td>0.406</td>
<td>97.5</td>
<td>1.31</td>
</tr>
</tbody>
</table>

Standard Deviation (SD): 2.38

Coefficient of Variation (CV): 0.00

Action Limit: If coefficient of variation exceeds 0.65, see Radiant.

Average Glomular Dose: 0
### Data Acquisition

<table>
<thead>
<tr>
<th>Paddle</th>
<th>Vp</th>
<th>Time(s)</th>
<th>Dose(mGy)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>60</td>
<td>234.25</td>
<td>60.72</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>120</td>
<td>234.25</td>
<td>60.72</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>View/Select</th>
<th>Tube Voltage (kVp)</th>
<th>Exposure Time (ms)</th>
<th>Exposure (mGy)</th>
<th>HVL (mm Al)</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>28.17</td>
<td>997.7</td>
<td>221.7</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>28.08</td>
<td>997.7</td>
<td>175.3</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>28.08</td>
<td>997.7</td>
<td>191.3</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>23.19</td>
<td>414.6</td>
<td>80.87</td>
<td>0.447</td>
</tr>
<tr>
<td>21</td>
<td>23.19</td>
<td>414.6</td>
<td>80.58</td>
<td>0.447</td>
</tr>
<tr>
<td>22</td>
<td>23.19</td>
<td>414.6</td>
<td>307.6</td>
<td>0.614</td>
</tr>
<tr>
<td>23</td>
<td>23.19</td>
<td>414.6</td>
<td>306.8</td>
<td>0.614</td>
</tr>
<tr>
<td>24</td>
<td>30.98</td>
<td>441.2</td>
<td>307.6</td>
<td>0.614</td>
</tr>
<tr>
<td>25</td>
<td>23.01</td>
<td>370.7</td>
<td>190.2</td>
<td>0.402</td>
</tr>
<tr>
<td>26</td>
<td>23.01</td>
<td>370.7</td>
<td>1418.0</td>
<td>0.829</td>
</tr>
</tbody>
</table>

### Data Population

#### X-ray Beam Quality (HVL) Measurement

**Dosimetry System Used:** RTI Model 657, Serial CB2-08006218  
**Calibration Date:** May 01, 2020

**Acquisition Parameters**

- Nominal kVp setting: 28, 28, 29  
- Anode: W, W, W  
- Filter: Rh, Ag, Al  
- mA setting: 100, 100, 50

**Exposure Measurements (mGy)**

<table>
<thead>
<tr>
<th>19</th>
<th>No aluminum filtration, E(0)</th>
<th>416</th>
<th>530</th>
<th>443</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>0.2 mm of added aluminum, E(1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>0.3 mm of added aluminum, E(2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>0.4 mm of added aluminum, E(4)</td>
<td>248</td>
<td>314</td>
<td>254</td>
</tr>
<tr>
<td>23</td>
<td>0.5 mm of added aluminum, E(5)</td>
<td>219</td>
<td>279</td>
<td>226</td>
</tr>
<tr>
<td>24</td>
<td>0.6 mm of added aluminum, E(6)</td>
<td>194</td>
<td>250</td>
<td>203</td>
</tr>
<tr>
<td>25</td>
<td>0.7 mm of added aluminum, E(7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>0.8 mm of added aluminum, E(8)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>No aluminum filtration, E(0)/2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Data Collection

Data Population Options!
Data Population

### Average Glandular Dose

<table>
<thead>
<tr>
<th></th>
<th>Conventional</th>
<th>Tomosynthesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inv Sq corrected skin exp</td>
<td>0.406</td>
<td>0.417</td>
</tr>
<tr>
<td>Dose Conversion factor from QC Manual Appendix I</td>
<td>277</td>
<td>281</td>
</tr>
<tr>
<td>Computed average glandular dose (mrad)</td>
<td>112</td>
<td>117</td>
</tr>
<tr>
<td>Percent Difference displayed AGD vs. Computed AGD</td>
<td>16.00%</td>
<td>23.72%</td>
</tr>
</tbody>
</table>

### Average Glandular Dose (Combination Acquisition):

<table>
<thead>
<tr>
<th>Exposure #1</th>
<th>Calc. Exp. (R)</th>
<th>AEC mAs</th>
<th>Calc. Exp. (R)</th>
<th>AEC mAs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.392</td>
<td>94.0</td>
<td>0.417</td>
<td>47.0</td>
</tr>
<tr>
<td></td>
<td>0.392</td>
<td>94.0</td>
<td>0.417</td>
<td>47.0</td>
</tr>
<tr>
<td></td>
<td>277</td>
<td>281</td>
<td>277</td>
<td>281</td>
</tr>
<tr>
<td></td>
<td>108</td>
<td>117</td>
<td>115</td>
<td>125</td>
</tr>
<tr>
<td>Total average Glandular dose (mrad)</td>
<td>226</td>
<td></td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

*Action Limit: If average glandular dose exceeds 300 mrad (3 mGy) for a 4.2 cm effective breast thickness, seek additional considerations.*

Data Acquisition

**Phantom Image Quality Results (Manual)**

<table>
<thead>
<tr>
<th>Acquisition Parameters (AOP-STD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phantom SN</td>
</tr>
<tr>
<td>Date</td>
</tr>
<tr>
<td>Target Filter Combination</td>
</tr>
<tr>
<td>Exposure Mode</td>
</tr>
<tr>
<td>kVp setting</td>
</tr>
<tr>
<td>mAs</td>
</tr>
<tr>
<td>Phantom Image Quality Results</td>
</tr>
<tr>
<td>Acquisition Workstation Display</td>
</tr>
<tr>
<td>Radiologists Review Workstation</td>
</tr>
<tr>
<td>Left Display</td>
</tr>
<tr>
<td>Right Display</td>
</tr>
<tr>
<td>Printer</td>
</tr>
<tr>
<td>Spec's*</td>
</tr>
<tr>
<td>Masses*</td>
</tr>
</tbody>
</table>

*Recorded result represents total phantom image quality results after any applicable deductions have been made.

**Phantom Image Quality Results (AOP-STD)**

<table>
<thead>
<tr>
<th>Acquisition Parameters (AOP-STD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phantom SN</td>
</tr>
<tr>
<td>Date</td>
</tr>
<tr>
<td>Target Filter Combination</td>
</tr>
<tr>
<td>Exposure Mode</td>
</tr>
<tr>
<td>kVp setting</td>
</tr>
<tr>
<td>mAs</td>
</tr>
<tr>
<td>Phantom Image Quality Results</td>
</tr>
<tr>
<td>Acquisition Workstation Display</td>
</tr>
<tr>
<td>Radiologists Review Workstation</td>
</tr>
<tr>
<td>Left Display</td>
</tr>
<tr>
<td>Right Display</td>
</tr>
<tr>
<td>Printer</td>
</tr>
<tr>
<td>Spec's*</td>
</tr>
<tr>
<td>Masses*</td>
</tr>
</tbody>
</table>
Beam Data Capture

Data Acquisition and Verification
Data Population

Medical Physicist's QC Tests

<table>
<thead>
<tr>
<th>Survey Type</th>
<th>Features</th>
<th>False</th>
<th>True</th>
<th>True</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mammographic Unit Assembly Evaluation</td>
<td>2D</td>
<td>FALSE</td>
<td>TRUE</td>
<td>TRUE</td>
</tr>
<tr>
<td>2. Collimation Assessment</td>
<td>2D</td>
<td>FALSE</td>
<td>TRUE</td>
<td>TRUE</td>
</tr>
<tr>
<td>3. Artifact Evaluation</td>
<td>2D</td>
<td>FALSE</td>
<td>TRUE</td>
<td>TRUE</td>
</tr>
<tr>
<td>4. kVp Accuracy and Reproducibility</td>
<td>2D</td>
<td>FALSE</td>
<td>TRUE</td>
<td>TRUE</td>
</tr>
<tr>
<td>5. Beam Quality Assessment – IHR Measurement</td>
<td>2D</td>
<td>FALSE</td>
<td>TRUE</td>
<td>TRUE</td>
</tr>
<tr>
<td>6. Evaluation of System Resolution</td>
<td>2D</td>
<td>FALSE</td>
<td>TRUE</td>
<td>TRUE</td>
</tr>
<tr>
<td>7. Automatic Exposure Control (AEC) Function Performance</td>
<td>2D</td>
<td>FALSE</td>
<td>TRUE</td>
<td>TRUE</td>
</tr>
<tr>
<td>8. Breast Entrance Exposure, AEC Reproducibility, and Average Glanular Dose</td>
<td>2D</td>
<td>FALSE</td>
<td>TRUE</td>
<td>TRUE</td>
</tr>
</tbody>
</table>

Average glandular dose for average breast is 30 mGy (300 mrad) (conversion)

Average glandular dose for average breast is 30 mGy (300 mrad) (conversion)

Radiation Output Rate

Table 1: Medical Physicist's QC Tests

Data Population

Medical Physicist's QC Tests

<table>
<thead>
<tr>
<th>Survey Type</th>
<th>Features</th>
<th>False</th>
<th>True</th>
<th>True</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. Phantom Image Quality Evaluation</td>
<td>2D</td>
<td>FALSE</td>
<td>TRUE</td>
<td>TRUE</td>
</tr>
<tr>
<td>10. Phantom Image Quality Evaluation</td>
<td>2D</td>
<td>FALSE</td>
<td>TRUE</td>
<td>TRUE</td>
</tr>
</tbody>
</table>

Signal-to-Noise Ratio and Contrast-to-Noise Ratio Measurements

Table 1: Medical Physicist's QC Tests

Data Population

Medical Physicist's QC Tests

<table>
<thead>
<tr>
<th>Survey Type</th>
<th>Features</th>
<th>False</th>
<th>True</th>
<th>True</th>
</tr>
</thead>
<tbody>
<tr>
<td>11. Phantom Image Quality Evaluation</td>
<td>2D</td>
<td>FALSE</td>
<td>TRUE</td>
<td>TRUE</td>
</tr>
<tr>
<td>12. Phantom Image Quality Evaluation</td>
<td>2D</td>
<td>FALSE</td>
<td>TRUE</td>
<td>TRUE</td>
</tr>
</tbody>
</table>

Data Population

Medical Physicist's QC Tests

<table>
<thead>
<tr>
<th>Survey Type</th>
<th>Features</th>
<th>False</th>
<th>True</th>
<th>True</th>
</tr>
</thead>
<tbody>
<tr>
<td>13. Phantom Image Quality Evaluation</td>
<td>2D</td>
<td>FALSE</td>
<td>TRUE</td>
<td>TRUE</td>
</tr>
</tbody>
</table>

Data Population

Medical Physicist's QC Tests

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Data Population
Report Generation

- I'm Done! (The Uber button)
- Sign Report
- Reviewer
- Create PDF

Which Kit?
- Pratha
- ABT Model 057, Serial CD02-0000218

Cal. Date: 5/1/2020
Calibration Due Date: 6/1/2022

Report Generation and Delivery

- Radiology Quality Control Checklist
- Radiology Equipment Performance Evaluation
- Annual Performance Evaluation

- Radiation Services, Inc.
Monitor QC Documentation

“21 CFR 900 and the ACR do not explicitly require that all routine mammography QC records be maintained on the forms provided by the ACR or the mammography equipment manufacturer.”

- Sam
Reading Workstation Evaluations

• All clients use monitors that are FDA Approved for Mammography
• None of our clients are accredited under the ACR Digital Mammo Program
• We keep copies of all monitor QA system manufacturer manuals
• Record conformity data acquired by the QA software
  • Sites must maintain their own “pucks”
  • Will occasionally spot check luminance on monitors with apparent issues
  • Unable to do cross calibrations at this time unless a site already has a puck
• AAPM TG18-QC (or SMPTE) test pattern
• AAPM TG18-UN10
• AAPM TG18-UN80
• We will try to help troubleshoot issues, but not to “in-house” levels

Program Specific Tactics
Fuji Testing Tips

- Prepare for a long day!
  - Good Coffee
  - Satisfying Breakfast
  - Comfortable Clothing and Shoes
  - Relaxing Music
  - Good Coffee
  - Healthy Snacks
  - Aroma Therapy
  - Sensible Lunch
  - Good Coffee
  - Cheat Snack Upon Completion
    - See if you can spot my go-to!

- Fuji can provide test spreadsheets for 2D/DBT to help streamline your Cristalle testing day(s)
  - The spreadsheet is very helpful and useful with good instructions!
    - Kudos to the Fuji Team!
  - Be warned...the spreadsheet gives the impression that it will provide a full report for you from your data
  - Go ahead and try to save/print this report...I dare you!
  - “What!? Where in the censored did my censoreding data go!?" - Anonymous
Spatial Resolution Measurements

- Spatial Resolution measurements are performed:
  - With 1-Shot phantom shifted to the right
  - In magnification mode
    - Without the magnification stand
  - With the “1ShotM” submenu
    - This submenu has not always [or ever] been available without intervention
To Disable or Enable the Mag Stand

• Do NOT close out the Fuji Platform
• Press the Start Key (aka the Windows Key)
• Select RUPC Tool
• Select 192........100
• Select MUTL
• Move the pointer over to System Check Status
• Select Mag Table On/Off
• Repeat steps to turn this feature back on

OR

Retractable Sharpie

Adding a Test Menu in Fuji

1. Click Green Arrow
2. Click Fuji Film
3. Go to User Utility
4. **Hold shift + Click Terminate**
5. Go to Desktop
6. Tap the Start Key (aka the Windows Key)
7. Click IIP User Utility
8. Click Menu Settings
9. Select Task (drag and drop that task to an empty spot on the menu window)
10. Close out of Windows mode
11. Return to Fuji Platform
Fuji Tomo QC Calculation Tool

Required for: AEC Performance Test
Exporting Images for Tomo Calc Tool

1. Click on “Today” menu
2. Choose the exam to export
3. Right click on that exam
4. Choose the last option “Export RAW file”
5. A menu will appear

5. Insert a large.remaining.storage.capacity thumb drive (around 32GB) into the computer
6. Choose the thumb drive as the export location
7. Tomo Calc Tool now available on the AWS as well as available for download

Fuji Tomo QC Calculation Tool

Required for: AGD Test
Fuji Tomo QC Calculation Tool

Required for:
Short Term Reproducibility Test

Fuji Tomo QC Calculation Tool

Required for:
Z-Resolution Test
Final Fuji Testing Thoughts

• Great images, cost competitive, tech friendly (once you get the hang of it)
• Fuji will provide a Service Engineer on sight for new install MEEs
  • Excellent learning opportunity
• Phantoms look remarkably similar whether 2D, 3D, or synthetic
• Based on feedback (i.e., whining) from Medical Physicists, Fuji Service Engineers recommend pursuing ACR Digital Program
  • 50/50 split
  • Saves time in testing
  • $1100 phantom cost versus physics services charging by the hour
• Fuji is finalizing a guidance document for exporting images to ImageJ for ACR QC Program

Information courtesy of Samuel Smith (FujiFilm)
General Electric

Focal Spot vs. Sub-System MTF
Senographe Essential Order of Operations

1. Flat Field (Contact)
2. Artifact (Contact)
3. IQST
4. Artifact (1.8x Mag)
5. Artifact (1.5x Mag)
6. Focal Spot (1.5x Mag)
7. Focal Spot (Contact)
8. AOP-SNR
9. Thickness Indicator/Mammo Assembly
10. Paddle Deflection
11. Phantom Image Quality (Auto-Push to PACS)
12. Ent Exp/AGD/AEC Reproducibility
13. Beam Data (Rad Output/AGD/HVL/kVp)
14. Collimation
15. Paddle Alignment
16. SenoClaire/CESM (if applicable)

Senographe Pristina Order of Operations

1. Acquisition Monitor
2. Artifact (Contact)
3. Flat Field (Contact/2D & 3D)
4. IQST
5. Artifact (1.5x Mag)
6. Flat Field (1.5x Mag)
7. Artifact (1.8x Mag)
8. Flat Field (1.8x Mag)
9. Sub-System MTF (Mag)
10. Sub-System MTF (Contact)
11. AOP and SNR (2D & 3D)
12. Thickness Indicator/Mammo Assembly
13. Paddle Deflection
14. Volume Coverage (Auto-Push to PACS)
15. Phantom Image Quality (2D & 3D) (Auto-Push to PACS)
16. Ent Exp/AGD/AEC Reproducibility (2D & 3D)
17. Beam Data (2D & 3D) (Stationary Gantry)
18. Collimation
Lorad Selenia Order of Operations

1. Artifact
2. AEC Function Performance
3. System Resolution
4. Phantom Image Quality (auto-push to PACS)
5. SNR & CNR
6. Ent. Exp/Reproducibility/AGD
7. Beam Data
   - Beam Output
   - ESE
   - kVp
   - HVL
8. Collimation
Selenia Dimensions/3Dimensions Order of Operations

1. Artifact
2. AEC Function Performance (2D & 3D)
3. System Resolution (2D & 3D)
4. Phantom Image Quality (2D & 3D) (auto-push to PACS)
5. SNR & CNR
6. Ent. Exp/Reproducibility/AGD (2D & 3D)
7. Beam Data (2D & 3D)
   • Beam Output
   • ESE
   • kVp
   • HVL
8. Collimation (2D & 3D)

Siemens

Katie Hulme (Cleveland Clinic Foundation) – thank you sincerely for this information!
# Siemens Order of Operation

Tomo tests all at the end
- Artifact Detection & Radiation Field
- Glandular Dose
- MQSA Glandular Dose with ACR Phantom (for extra credit)
- Phantom Image Quality
- Z-Resolution

---

## Siemens Tips

- Copy and Paste the ROIs used for the Z-Resolution test (you’re welcome!)
- SNR/CNR is measured off the largest mass, which is *spherical*
  - ROI size will make a difference in these measurements
  - Be consistent with the recommended size (~0.2 cm²)
  - This applies to routine QC as well

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Information courtesy of Katie Hulme (Cleveland Clinic Foundation)
Siemens Tips

• There are many features that are not seen in other manufacturers
  • The detector elements are the AEC
  • AEC Segmentation – considers the majority of the anatomy, identifies course segmentation of dense regions
  • PRIME – Progressive Reconstruction Intelligently Minimizing Exposure, gridless, software scatter correction, approximately 30% dose reduction
  • First View – in DBT-only mode, it is a first exposure taken at 0 degrees; in combo mode, it is based off the 2D image
  • Bounding Box – displayed only on First View, can be adjusted to include or exclude tissue in additional tomo reconstructions
  • EMPIRE – Enhanced Multiple Parameter Iterative Reconstruction, combination of IR and ML algorithms; Uses FBP and iterative process for image quality improvement

Information courtesy of Katie Hulme (Cleveland Clinic Foundation)
ACR Digital Mammography Order of Operations

1. Manufacturer Calibrations
2. Phantom Image Quality
3. Spatial Resolution
4. DBT Volume
5. AEC
6. AGD (recording HVL for bonus points)
7. Collimation
8. Mechanical Checklist
9. AWS Testing
10. RWS Testing
11. QC Evaluation
12. Z-Resolution

Information courtesy of Stephanie Leon (University of Florida)
ACR Digital Program Tips

• There have not been problems with state inspections!
• There have not been problems with the passing annuals vs baseline
• With experience, time on machine is similar to Hologic annual
  • Additional processing required for the z-resolution test and AEC test
• Program very popular with QC techs!
  • Will likely require physicist establishment of QC program for the transition
• Quarterly QC review required—already required in Florida!
  • Between Tech, Radiologist, Facility Manager vs Physicist (in Florida)
• Huge potential benefit to sites with multiple vendors
• Must plan ahead for successful launch of program
  • Issues with manual, forms, phantoms, equipment, monitors, logistics

Information courtesy of Stephanie Leon (University of Florida)

ACR Digital Program Tips

• “Facilities performing Contrast Enhanced Spectral Mammography (CESM) imaging must follow all the manufacturer’s quality control procedures for both the digital mammography application as well as the CESM application. The FDA has not approved the ACR Digital Mammography QC Manual for use with digital mammography systems performing CESM.” – Sam

• “Regardless of whether a site has incorporated the legacy ACR/Manufacturer QC Program or the 2018 ACR Digital Mammography Program, the radiologist workstation monitor QC must demonstrate compliance with the monitor manufacturer’s QC tests (if available).” -Sam
ACR Digital Program Tips

- For the AEC test, define the ROI size and position in the benchmark
  - For consistency, or else the measurements will vary—DBT may vary regardless
  - For troubleshooting, some manufacturers will require EI to be recorded as well

- The phantom image quality test combines multiple assessments
  - Artifact Analysis (obtained in contact, mag & all commonly used Target/Filters)
  - Phantom Image Quality (contact, mag & all commonly used Target/Filters)
  - SNR/CNR (obtained only at contact 2D technique appropriate for phantom size)
  - Distance Measurements (all phantom images—difficult in mag mode)
  - Z-Resolution

- Reverse direction of the phantom for Spatial Res and Volume Coverage

Information courtesy of Stephanie Leon (University of Florida)

ACR Digital Program Tips

- AGD calculation is a departure from some manufacturers’ approach
  - Test 2D and DBT...not combo mode
  - Phantom size necessitates separate phantom/chamber shots
  - 25% AGD Accuracy Tolerance
  - AGD=Kgcs [in mGy]
    - K is Entrance Exposure (in mR)
    - Tables are provided for g*s*8.76 mGy/R for acrylic and BR12 (use acrylic)
    - Another table is provided for s

- Collimation not required annually for 2D only units, but is required for DBT
  - Guidance is confusing
  - For DBT enabled systems: Large FOV (annual); Large & Small (C/L/R) (MEE)
    - No DBT test seemingly required

Information courtesy of Stephanie Leon (University of Florida)
ACR Digital Program Tips

- RWS and AWS have same req’ts
- RWS testing requires luminance measurements beyond the edge
- Manufacturer specs can be difficult to obtain
- 10% tolerance can create photometer cross-calibration issues
- Must compare R/L monitor luminance
- Radiologist monitors at multiple sites can also be an issue
  - Transitioned to new program at next annual

Information courtesy of Stephanie Leon (University of Florida)

ACR Accreditation Support/Tips

“If a program is executing manufacturer FFDM QC program, the original (4-inch) ACR phantom image must display 4 fibers, 3 speck groups, 3 masses after artifact subtraction” - Sam

- 2D images must be submitted in DICOM, “For Presentation” quality, with a clinically appropriate technique
- DBT images can be submitted in any format, “For Presentation” quality, with a clinically appropriate technique
- Do not send the entire DBT series, or the wrong slice (i.e., the first image) in the series
- Beware of Digital ACR Phantom artifacts
- Beware of choosing the Digital ACR Program on the application and submitting materials describing a manufacturer’s FFDM program with the original (4-inch) ACR phantom – or vice versa
Alternative Breast Imaging Technologies

Ultrasound-Based Imaging
Molecular Breast Imaging (MBI)

- GE Discovery NM750b
  - Recently acquired by SmartBreast
  - Rebranded as Eve Clear Scan e750
- 12 per 1,000 cancers discovered in dense breasts vs 3.2 per 1,000 in mammo (2015 study)
- Good for dense breasts, indeterminant findings, bx alternative, contrast allergy, claustrophobia
- Vein Injection, light compression, image immediately, 5-10 min per view

Information courtesy of Carly Williams (Radiation Services, Inc)

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Cone Beam CT Guided Biopsy
Contrast Enhanced Guided Biopsy

- GE Serena Bright
  - Possible alternative to MRI-guided biopsy
    - Cost
    - Procedure/Staff Time
    - Exam Competition
    - MRI Contraindications
    - Staff-Patient Familiarity
  - Allows like-to-like comparison with CESM diagnostics

Information courtesy of Jan Tackett (Lake Medical Imaging, The Villages, Florida)

Conclusions

- It is possible to melt mammography measurement minutes
  - The hours and dollars spent may exceed the gain

- “In-House” versus Independent Consultant physicists
  - Both important parts of our field
  - Both can benefit by reaching across the aisle
  - Each fill somewhat different clinical niches
  - Each contribute to the field in unique ways
  - Deeper versus Wider...maybe

- Congratulations on achieving 1 SAM credit in Mammography
Acknowledgements

- Lindsey Berkowitz, PhD
- Ken Coleman, ME
- Travis Greene, MS
- Bo Hartmann, MS
- Katie Hulme, MS
- Stephanie Leon, PhD
- Maureen Ruppel
- Samuel Smith
- Jan Tackett
- Carly Williams, MS
- Kristina Weber
- Bud Wendt, PhD