Everything You Need to Know About the New ACR FFDM Manual
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Boulder Community Health

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ACR Representatives

- Priscilla (Penny) Butler, MS – Senior Director and Medical Physicist
- Marion Boston, RT(R) – Assistant Director
- Pam Platt, BSRT(R) – ACR Liaison to FDA

- Design ACR Accreditation Phantom for FFDM
- Write QC Manual for ACR FFDM Mammography Accreditation Program - STANDARDIZE
- Update the 1999 ACR Screen-Film QC Manual
QC Tests

- Based on a variety of sources
  - MQSA
  - SFM
  - ACRIN DMIST
  - Manufacturer’s QC programs
  - META
  - Subcommittee clinical experience
- Apply to all manufacturers
- Be clinically relevant
- Be user friendly

Phantom Design Goals

- More challenging targets
- More sensitive to changes
- Fewer digital processing artifacts
- Full field
- Same attenuation as current phantom
- Same Pass/Fail targets as current phantom

New Phantom
Cousins

New Phantom in Clinical Environment

ACR Phantom Prototype

Total Thickness = 4.10 + 0.03 cm
31.0 + 0.1 cm

Cover = Nominal 0.3 cm

Screws

CNR Cavity (0.1 + 0.005 cm Deep)
Depth of CNR Cavity = 0.1 + 0.005 cm

7.0 cm (+0.04, -0.00 cm)

Milled out wax insert area

Compensator = 0.023 cm

13.0 cm (+0.04, -0.00 cm)

Wax = 0.70 cm + 0.02 cm

Tolerances (Insert Well & CNR Cavity)
• Wax insert well depth: ± 0.005 cm (± 2 mils).
• Wax insert well width and length: +0.04 / -0.00 cm
• CNR cavity depth: ± 0.005 cm (± 2 mils).
• CNR diameter: ± 0.05 cm.
The New Insert

Specks are lime glass spheres

Test Object Comparison

<table>
<thead>
<tr>
<th>Fibers (mm)</th>
<th>Specks (mm)</th>
<th>Masses (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACR 156</td>
<td>FFDM</td>
<td>ACR 156</td>
</tr>
<tr>
<td>1.56</td>
<td>1.12</td>
<td>0.89</td>
</tr>
<tr>
<td>0.75</td>
<td>0.40</td>
<td>0.61</td>
</tr>
<tr>
<td>0.30</td>
<td>0.16</td>
<td>0.17</td>
</tr>
</tbody>
</table>

Phantom Scoring
CR Imaging

Screen-Film Imaging

Screen-Film Imaging

- Dark center to light edge
- Roller marks
- Dust
- Screen defects
- Heel effect
AEC Technique Comparison

<table>
<thead>
<tr>
<th>Mode</th>
<th>Phantom</th>
<th>Compression Thickness (cm)</th>
<th>Mode</th>
<th>Phantom</th>
<th>Target/Filter</th>
<th>kVp</th>
<th>mAs</th>
<th>Machine Reported Dose (mGy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto-Filter</td>
<td>FFDM</td>
<td>5.2</td>
<td>Fuig CR 18 x 24 cm</td>
<td>Auto-Filter</td>
<td>Mo/Mo</td>
<td>29</td>
<td>66.4</td>
<td>1.64</td>
</tr>
<tr>
<td>Auto-Filter</td>
<td>FFDM</td>
<td>5.2</td>
<td>FFDM 156</td>
<td>Mo/Mo</td>
<td>29</td>
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<td>1.61</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FFDM</td>
<td>5.2</td>
<td>FFDM 156</td>
<td>Mo/Mo</td>
<td>29</td>
<td>92.5</td>
<td>1.83</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FFDM</td>
<td>5.2</td>
<td>FFDM 156</td>
<td>Mo/Mo</td>
<td>28</td>
<td>97.6</td>
<td>1.68</td>
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<tr>
<td></td>
<td>AA</td>
<td>4.8</td>
<td>AA</td>
<td>Mo/Mo</td>
<td>27</td>
<td>90</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AA</td>
<td>4.8</td>
<td>AA</td>
<td>Mo/Mo</td>
<td>27</td>
<td>89</td>
<td>--</td>
<td></td>
</tr>
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</table>

Manual Technique Signal Comparison

<table>
<thead>
<tr>
<th>Mode</th>
<th>Phantom</th>
<th>Target/Filter</th>
<th>kVp</th>
<th>mAs</th>
<th>Signal in Wax</th>
<th>St. Dev. In Wax</th>
</tr>
</thead>
<tbody>
<tr>
<td>FFDM</td>
<td>Mo/Mo</td>
<td>Mo/Mo</td>
<td>29</td>
<td>65</td>
<td>542.0</td>
<td>9.7</td>
</tr>
<tr>
<td>SFM</td>
<td>Mo/Mo</td>
<td>Mo/Mo</td>
<td>29</td>
<td>65</td>
<td>546.5</td>
<td>9.7</td>
</tr>
</tbody>
</table>

Versatility!

50% of the required RT and MP tests incorporate the new phantom
QC Manual

✦ Focusses on FFDM
✦ Selective, high-yield tests
  ✦ Challenge: Ensuring that all necessary tests are included, meaningful, and relevant
✦ Applicable to all units
  ✦ Challenge: Accounting for, and incorporating, all the different FFDM technologies
  ✦ Challenge: Predicting and accounting for future FFDM systems

QC Manual Structure

✦ Radiologist’s Section
✦ Radiologic Technologist’s Section
✦ Medical Physicist’s Section
✦ Appendices
  ✦ Revisions
  ✦ ACR Digital Mammography Phantom Scoring Guide
  ✦ Artifact Evaluation Guide

What Is New? Technologist Section

✦ Monitor QC for the interpretation workstations
✦ Management forms
  ✦ ACR Technique and Procedure Summaries
  ✦ Corrective Action Log
  ✦ Facility Offline Display Locations
  ✦ QC Summary Checklists
  ✦ Digital Mammography Unit QC Summary Checklist
  ✦ Facility Display Device QC Summary Checklist
✦ Facility Equipment Inventory
✦ Improved QC Forms
  ✦ Instructions for Mobile Units
  ✦ Reduced calculations
What Is New? Medical Physicist Section

- Theme: provide better documentation and communication
  - MP Summary Form
  - For Facility, ACR, State and MQSA Inspectors
  - Action Item Summary included
  - Improved form for evaluating and documenting RT QC
  - MP letter to the Radiologist (optional)
  - MP to use same Corrective Action Log form as Techs
  - Provide QC forms in both PDF and Excel Worksheets

What Is New? Facility

- Guidance on how to handle multiple units at multiple locations
- Guidance on who/what/when tests need to be performed when “major” and “minor” Corrective actions are performed on unit
- Facility QC Review (Tech Test)

Phantom Scoring

<table>
<thead>
<tr>
<th>Test Object</th>
<th>Full Point</th>
<th>Half Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fibers (6)</td>
<td>Full length visible (≥8 mm long)</td>
<td>At least half of length visible (≥5 and &lt;8 mm long)</td>
</tr>
<tr>
<td></td>
<td>Correct location</td>
<td>Correct location</td>
</tr>
<tr>
<td></td>
<td>Correct orientation</td>
<td>Correct orientation</td>
</tr>
<tr>
<td></td>
<td>1 break allowed (must be ≤ width of fiber)</td>
<td>1 break allowed (must be ≤ width of fiber)</td>
</tr>
<tr>
<td>Speck Groups (6)</td>
<td>4 - 6 specks visible</td>
<td>2 - 3 specks visible</td>
</tr>
<tr>
<td></td>
<td>Correct locations</td>
<td>Correct locations</td>
</tr>
<tr>
<td>Masses (6)</td>
<td>Density difference visible</td>
<td>Density difference visible</td>
</tr>
<tr>
<td></td>
<td>Border is continuous and generally circular (≥ 3/4 border visible)</td>
<td>Border is not continuous or generally circular (≥ 1/2 and &lt; 3/4 border visible)</td>
</tr>
<tr>
<td></td>
<td>Correct location</td>
<td>Correct location</td>
</tr>
</tbody>
</table>
1. Phantom Image Quality

- For CR, erase plate first
- Create patient
- Use whatever ID system you want
- Align phantom
- Insert on top toward chest wall
- Compress to 5 daN (12 lb)
- Use CLINICAL technique
- AEC cell under insert, if applicable
- 4.2 cm compressed, 50%/50% breast
- Acquire image
- Record resulting technical factors
- Evaluate Image
  - Count test objects
  - No artifact deduction
  - Must see 2 fibers, 3 speck groups
  - Artifacts must not interfere with interpretation
  - Corrective actions required prior to clinical use

2. CR Cassette Erasure (if applicable)

- Perform erasure procedure for all cassettes
- Document completion of the task
3. Compression Thickness Indicator

- Use any easily available object that’s about 4-6 cm thick
  - Two tape rolls work well
  - Note actual dimension
- Use smallest, non-flex paddle available
- Compress to about 5 daN (12 lb)
  - Record value and be consistent
  - Record indicated thickness
- Must be accurate to ±5 mm
- Corrective actions within 30 days

4. Visual Checklist

- Pretty much the same as it always is
- Make sure all bells and whistles are acting properly
- Be sure to rotate the C-arm the way you would for patient imaging
- When checking for cracks in paddles, face shields, and breast supports, only indicate issues that impact patient safety and image quality
- It may be necessary to add additional items to the checklist that are specific to your particular equipment or procedures
- Corrections required:
  - Prior to clinical use for critical tests
  - Within 30 days for non-critical tests

5. Acquisition Workstation Monitor QC

- Need TG18-QC test pattern or equivalent
  - If this is not possible, this part of the test cannot be performed
- Inspect monitor for fingerprints, etc.
  - Clean as needed
- View test pattern
  - 5%, 95% boxes visible
  - Line-pairs distinguishable center and corners
- Corrective actions prior to clinical use
- Perform manufacturer automated QC if prescribed
  - Corrective actions within 30 days
6. Radiologist Workstation
Monitor QC

- Need TG18-QC test pattern or equivalent
  - If this is not possible, this part of the test cannot be performed
- Inspect monitor for fingerprints, etc.
- Clean as needed
- View ACR DM Phantom image
  - Score and inspect for artifacts as in Test 1
  - View test pattern
    - 5% , 95% boxes visible
    - Line-pairs distinguishable center and corners
- Corrective actions prior to clinical use
- Perform manufacturer automated QC if prescribed
  - Corrective actions within 30 days

7. Film Printer QC (if applicable)

- Required if images are printed for referring physicians and patients
- If printer used less than monthly, do before clinical films are printed
- Print ACR DM Phantom image
  - Do not adjust WW/WL
  - Print true size
  - Film size use for majority of clinical printing
  - Score and inspect for artifacts as in Test 1
  - Measure OD inside and outside of the cavity
  - Calculate contrast = ODcavity / ODbackground
  - Measure Dmax
- Same phantom score requirements
  - Background OD must be ≥1.6, should be 1.7-2.2 (2.0 optimal)
  - Dmax must be ≥3.1, should be ≥3.5
- Corrective actions prior to clinical use

8. Viewbox Cleanliness (if applicable)

- Required if prior or outside images are viewed on viewboxes
- Viewboxes must be clean and free of marks
- If viewboxes appear non-uniform, all lamps must be replaced
- Masks must be functioning
- Corrective actions prior to clinical use
9. Facility QC Review

- Review of RT and MP QC efforts
  - Must be done by
    - Lead interpreting physician
    - Facility manager
    - In person or by remote means
  - Record MP test results on form
  - Enter prior week of RT QC data
  - Review most recent quarter of data with LIP and manager
  - Review each QC test and results
  - Note corrective action documentation present as needed
  - Discuss reasons for failures
  - Review MP results
  - Document the review

10. Compression Force

- Few changes from the 1999 ACR Mammography QC Manual
- **Must check that adequate force (≥25 lb) for length of average exposure**
- Corrective actions prior to clinical use

11. Manufacturer Detector Calibration (if applicable)

- Required if a manufacturer specifies that a **calibration** must be performed
- Must follow manufacturer’s procedure
- Must follow manufacturer’s schedule
- Corrective actions prior to clinical use
Optional Tests

- Repeat analysis
- System QC for Radiologist
- Radiologist Image Quality Feedback

ACR Digital QC Manual - MP Tests

<table>
<thead>
<tr>
<th>Test</th>
<th>Minimum Frequency</th>
<th>Corrective Action Timeframe</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. MEE - MQSA Requirements for Equipment</td>
<td>Nothing really new</td>
<td>- Reformatted</td>
</tr>
<tr>
<td></td>
<td>- Alignment with approved changes</td>
<td>- &quot;Lighting&quot; and &quot;Film masking&quot; may be marked as &quot;NA&quot; if</td>
</tr>
<tr>
<td></td>
<td>- No hardcopy interpretations are made</td>
<td>- No hardcopy comparisons are made</td>
</tr>
<tr>
<td></td>
<td>- Beam limiting device illumination</td>
<td>- May be NA if systems such as slot scan</td>
</tr>
<tr>
<td></td>
<td>- Compression paddle deflection</td>
<td>- Test according to manufacturer design</td>
</tr>
</tbody>
</table>
2. Phantom Image Quality

- For CR, erase plate first
- Create patient
  - use whatever ID system you want
- Align phantom
  - insert on top toward chest wall
- Compress to 5 daN (12 lb)
- Use CLINICAL technique
  - AEC cell under insert, if applicable
  - 4.2 cm compressed, 50%/50% breast
- Acquire image
  - Repeat for magnification mode and commonly used T/F combinations
- Record resulting technical factors
- Repeat for magnification mode and commonly used T/F combinations
  - Evaluate image
    - Count test objects
    - Artifacts
    - Use full resolution (1/1 pixel ratio)
    - Note no artifact deduction
    - Can fail image just for objectionable artifacts
  - Must see 3 fibers, 3 speck groups, 2 masses
  - Artifacts must not interfere with interpretation

3. Spatial Resolution

- Turn off all image processing
- Position phantom with wax insert up and away from chest wall edge
- Large compression paddle
- Position resolution target at 45° angle
  - Must at least have frequencies up to 10 lp/mm
- Manual technique close to phantom technique
  - Repeat for all clinically used targets
  - Install most clinically used magnification stand
  - Repeat exposures for all clinically used targets
- Record highest frequency at which at least half the length of the lines continuously resolved
  - Beware of polarity reversal (false resolution)
- Performance criteria
  - ≥4.0 lp/mm contact mode
  - ≥6.0 lp/mm magnification mode
- All corrections within 30 days

4. Calculate SNR

\[ \text{SNR} = \frac{I_{	ext{signal}}}{\sqrt{I_{	ext{noise}}}} \]

- Must be ≥40

5. Calculate CNR

\[ \text{CNR} = \frac{I_{	ext{signal}} - I_{	ext{background}}}{\sqrt{I_{	ext{noise}}}} \]

- Must be ≥2.0 and ≥85% of prior year (MEE if available)

6. Measure A-C insert dimension

- Must be 70.0 mm ±14.0 mm
- All corrections prior to clinical use
4. Automatic Exposure Control Performance

- Attenuator:
  - Acrylic, BeoZ, BM0, etc.
  - Approximately 2, 4, 6 cm
  - Large enough to enclose the breast
- Position phantom aligned to breast
- Compress to approximately 5 to 8
- AEC setting used clinically (e.g., GE = AOP STD)
- Density control setting = 0
- AEC sensor in center of phantom
- Make exposure using 2, 4, 6 cm phantoms
- Record relevant technical information
- Include incident and mean glandular dose

5. Average Glandular Dose

- Now using Dance method
  - Dance DL, Skinner CL, Young KC, et al. Additional factors for the
    estimation of mean glandular breast dose using the UK mammography
- Protect the detector during dosimetry exposures
- Position dosimeter
  - 4.2 cm above breast support
  - Centred laterally
  - 4 cm in from chest wall edge
- Position compression paddle just in contact with dosimeter
- Set manual techniques as close as possible to those from the
  phantom image as possible
- Tables provided for calculating doses for other breast sizes

### Table 3

<table>
<thead>
<tr>
<th>HVL (mm Al)</th>
<th>Thickness (cm)</th>
<th>Spectrum 1</th>
<th>Spectrum 2</th>
<th>Spectrum 3</th>
<th>Spectrum 4</th>
<th>Spectrum 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.30</td>
<td>0.30</td>
<td>0.0763</td>
<td>0.0859</td>
<td>0.1106</td>
<td>0.1233</td>
<td>0.1357</td>
</tr>
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<td>0.0981</td>
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<tr>
<td>0.30</td>
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<td>0.50</td>
<td>0.1207</td>
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<td>0.1543</td>
<td>0.1723</td>
<td>0.1917</td>
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</tbody>
</table>

### Table 4

<table>
<thead>
<tr>
<th>Spectrum 1</th>
<th>Spectrum 2</th>
<th>Spectrum 3</th>
<th>Spectrum 4</th>
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</table>

### Formula

\[ D = \frac{K \cdot g}{c} \cdot \text{cGy} \]

- \( D \): isometric dose
- \( K \): conversion factor
- \( g \): incident air kerma
- \( c \): correction factor

### Calculation

- All corrections within 30 days
- SNR must be ≥85% of the prior SNR for all
  phantom images
- Breast glandularity SNR must be ≥40.0 for the 4 cm phantom
- Density control setting = 0
- AEC setting used clinically (e.g., GE DMR (GE Medical Systems, Milwaukee, USA) x-ray unit measured by Thilander-Klang

### Notes

- For glandularities of 0.1–100% in the central region of the breast, breast thicknesses of 2–8 cm are taken from Dance (1990).
- For thicknesses of 2–11 cm and HVL range 0.30–0.60 mm Al. Surface layers of 100% adipose tissue are used.
5. Average Glandular Dose

- Compute AGD
  - In spreadsheet
  - Enter measured HVL
  - Enter mAs used for exposure measurements
  - Enter exposure measurements in mR (it converts mR to R)
  - Correction factor g·c·s·8.76 computed automatically
  - Dose computation automatic
- Limits
  - AGD ≤ 3.0 mGy
  - Corrected prior to use
  - Displayed AGD within ±25% of measured
  - Corrected within 30 days

6. Unit Checklist

- Have identified critical and non-critical items
- All must pass
- Correction time frame:
  - Prior to use for critical items
  - Within 30 days for non-critical items

7. Computed Radiography

- Plate-to-plate uniformity
  - Erase all cassettes
  - Position DM Phantom on breast support and compress to 5 daN
  - Expose all plates using manual techniques as close as possible to AEC phantom technique
  - Process with as little image processing as possible
  - Measure signal and standard deviation within 5 cm² ROI in center of uniform area
  - Calculate SNR for all plates
- Review each image for artifacts
- Scanner performance
  - Place cassette on top of breast support
  - Place two steel rulers perpendicular on the cassette
  - Expose at approximately 25 kVp, 4 mAs
  - Process the cassette
7. Computed Radiography

- Performance requirements
  - Plate-to-plate uniformity
    - mAs of any one plate must not differ by more than ±10% from the mean mAs of that size
    - SNR of any one plate must not differ by more than ±15% from the mean SNR of that size
  - Artifacts
    - Must not obscure or mimic important structure or pathology
  - Scanner performance (recommended)
    - Edges of steel ruler crisp and linear
    - Corrections required prior to clinical use

8. Acquisition Workstation Monitor QC

- Desired test patterns
  - TG18-QC test pattern or equivalent
    - TG18-LN01 and TG18-LN18 test pattern or equivalent
    - TG18-UNL80 test pattern or equivalent
    - If this is not possible, this part of the test cannot be performed
  - Monitor condition
    - Inspect monitor for fingerprints, etc.
    - Document findings
    - Corrections prior to clinical use

- Luminance measurements
  - Measure Lmin (TG18-LN01) and Lmax (TG18-LN18)
  - Lmin within ±30% of manufacturer specification (or ≤ 1.5 cd/m²)
  - Lmax within ±20% of the manufacturer specification (or ≥ 150 cd/m²)
  - Corrections within 30 days

- Luminance uniformity
  - Measure luminance at center and four corners of TG18-UNL80
  - Calculate %difference
  - Lmax and Lmin are from the uniformity measurements on TG18-UNL80!
  - %difference must be ≤30%
  - Corrections within 30 days

- GSDF verification
  - Use manufacturer software to verify GSDF compliance
  - May make external measurements if felt necessary or if software not provided
  - Measured contrast response must match targeted response to within ±10%
  - Corrections within 30 days

- Manufacturer automated tests
  - Review settings for frequencies and actions limits to verify appropriate for mammography
  - All manufacturer tests must pass
  - Corrections within 30 days
9. Radiologist Workstation Monitor QC

- Needed test patterns
  - TG18-QC test pattern or equivalent
  - TG18-LN01 and TG18-LN18 test pattern or equivalent
  - TG18-UNL80 test pattern or equivalent
- Ambient light
  - Verify that conditions in reading area are appropriate for mammographic interpretation
- Monitor condition
  - Impact monitor for fingerprints, etc.
  - Document findings
  - Corrections prior to clinical use
- DM Phantom Image Quality
  - Display phantom acquired during annual or QC testing
  - Evaluate for artifacts and score the phantom test objects like in Test #2 DM Phantom Image Quality
  - Same criteria as above for artifacts and object scores
  - Corrections prior to clinical use
- Distance Measurement
  - Display phantom acquired during annual or QC testing
  - Measure A/C insert dimension
  - Must be 70.0 mm ±14.0 mm
  - Corrections prior to clinical use
  - View TG18-QC test pattern
  - Pattern properly centered
  - 5%, 95% boxes visible
  - Line-pairs distinguishable center and corners
  - Alphanumerics sharp and legible
  - Gray-scale ramps smooth and continuous
  - Corrections within 30 days
- Luminance measurements
  - Measure Lmin (TG18-LN01) and Lmax (TG18-LN18)
  - Lmin within ±30% of manufacturer specification (or ≤ 1.5 cd/m²)
  - Lmax within ±10% of the manufacturer specification (or ≥ 420 cd/m²)
  - Corrections within 30 days
- Luminance uniformity
  - Measure Lmin and Lmax at center and four corners of TG18-LN80
  - Calculate %difference
  - %difference must be ≤10%
  - Corrections within 30 days
- GSDF verification
  - Use manufacturer software to verify GSDF compliance
  - May make independent measurements if felt necessary or if software not provided
  - Measured contrast response must match targeted response to within ±10%
  - Corrections within 30 days
- Manufacturer automated tests
  - Review settings for frequencies and actions limits to verify appropriate for mammography
  - All manufacturer tests must pass
  - Corrections within 30 days
10. Film Printer QC (if applicable)

- Required if images are printed for referring physicians and patients
- If printer used less than monthly, do before clinical films are printed
- Print ACR DP Phantom image
  - Do not adjust WW/WL
  - Film size use for majority of clinical printing
- Score and inspect for artifacts as in Test 1
- Measure OD inside and outside of the cavity
- Calculate contrast = ODcavity - ODbackground
- Measure Dmax
- Measure A-C insert dimension
- Same phantom score requirements
- Background OD must be ≥1.6, should be 1.7-2.2 (2.0 optimal)
- Dmax must be ≥3.1, should be ≥3.5
- Insert dimension must be 70.0 mm ±14.0 mm
- Corrective actions prior to clinical use

11. Evaluation of Site RT QC Program

- Evaluate if each technologist QC test
  - Is being performed correctly, at the appropriate frequency, and that QC data appear to be correct
  - Is analyzed correctly, that calculations are performed according to the Technologist Section procedures, and that results are compared to the procedures' action limits
  - Needed corrective actions being performed and documented
  - Record any deficiencies or give positive feedback
- Performance requirements
  - No significant missing data
  - Analyzed without gross errors
  - Corrective action performed and documented
- The following FDA Level 2 non-compliance items can be used as guidance to determine whether the Overall Technologist QC Program fails:
  - Not conducting a phantom image test for 2-3 weeks in a consecutive 12-week working period
  - Failure to conduct a phantom image test at clinical settings
  - Not taking timely corrective action for failed items
- Corrective actions within 30 days

12. Evaluation Display Device RT QC Program

- Display devices include
  - RW monitors
  - Film printers
  - Viewboxes
- Verify that QC is properly performed for each device used by that facility
- Review corrective action log for appropriate documentation
- Perform for all local devices
  - For off-site devices
    - QC evaluation may be performed by another medical physicist
    - Annual documentation must be provided to the local site
- Completed Evaluation of Display Device Technologist QC Program form
- Performance criteria
  - QC must be performed correctly
  - Needed corrective actions must be performed and documented
- Corrective actions within 30 days
Beam Quality / HVL

- Only required at MEE or for troubleshooting
- Typical protocol
  - No C-factors
- Automatic determination by solid state detectors is acceptable
- Check phantom kVp, low kVp, high kVp
- At least one measurement for each target-filter combination
- Performance criteria

<table>
<thead>
<tr>
<th>Energy (keV)</th>
<th>Measured HVL (mm Al)</th>
<th>Specified HVL (mm Al)</th>
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<td>30</td>
<td>0.30</td>
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</tbody>
</table>

- Corrective actions prior to clinical use

kVp Accuracy and Reproducibility

- Only required at MEE or for troubleshooting
- Typical protocol
  - Check
    - Lowest measurable kVp
    - Most commonly used kVp
    - Highest clinically used kVp
  - Make three exposures at most commonly used kVp for reproducibility
  - Ensure that measuring device properly calibrated for the T-F combination used
- Performance criteria
  - Accurate to within ±5% of the nominal value
  - Coefficient of variation ≤0.02
- Corrective actions
  - MEE - prior to clinical use
  - Troubleshooting - within 30 days

Collimation Assessment and Paddle Alignment

- Only required at MEE or for troubleshooting
- Typical protocol
  - For paddle alignment, tape coin to the underside of the compression paddle and within the paddle so that the outer edge of the coin is aligned with the inner chest-wall edge of the paddle:
    - Measure
      - large and small field sizes
      - all paddle positions (if paddle shifts)
      - all anode tracks for field sizes and paddle positions
  - Performance criteria
    - Light field coincidence within 2% SID each direction
    - Radiation field does not extend beyond any side by more than 2% SID
    - Radiation field extends at least to the chest wall edge of the receptor
    - Compression paddle extends just beyond chest wall edge of image receptor does not extend by more than 2% SID
- Corrective actions
  - MEE - prior to clinical use
  - Troubleshooting - within 30 days
Ghost Image Evaluation

- Only required for troubleshooting
- Turn off all image processing
- Large compression paddle
- Position DM phantom
  - Wax insert away from chest wall
  - Extending about 2.5 cm beyond the lateral center line
  - Ensure that AEC cells, if present, are covered
- Compress to 5 daN
- Expose using clinical AEC technique
- Reposition phantom
  - Centered laterally
  - 0.1 mm Al centered laterally at chest wall edge
- Wait 1 minute
- Expose using the same techniques as the first image

Ghost Image Evaluation

- Analyze the image
  - Three ROIs as in image
- Calculate the Ghosting Index
  \[ \text{Ghosting Index} = \frac{S_3 - S_2}{S_1 - S_2} \]
- Performance criteria
  - \(-0.03 \leq \text{Ghosting Index} \leq +0.03\)
- Corrective actions prior to clinical use

Viewbox Luminance

- Only required for troubleshooting
- Typical protocol
  - Measure ambient illuminance on the viewbox
  - Measure luminance of each viewbox
  - Visually evaluate brightness uniformity between panels
- Performance criteria
  - Ambient illuminance should be \(\leq 45\) lux
  - Luminance should be \(\geq 3000\) cd/m²
- Corrective actions
  - No time limit specified
Testing Scenarios

FAQs

- FAQ available at http://www.acraccreditation.org/~/media/ACRAccreditation/Documents/Mammography/DMQFCFAQs.pdf?la=en
- Don’t have a copy of the manual? Contact one of your facilities; they’re supposed to share the link with you.
- Electronic forms? RT and MP forms are available in Excel format. Equations are embedded.
- Keep using old phantom with new manual? No! They are too different and the manual was designed around the new phantom.
- Transition to new manual? MP must first conduct an annual survey and display devices using new manual to establish techniques and QC procedures.
- Pick and choose? No! It’s all or nothing. Must fully transition to the new manual for a unit or fully stick with the manufacturer’s manual.
- It is, however, ok to continue to perform some of the manufacturer tests if the facility desires, but the entire ACR manual must be followed.
- Switch back? Yes, after an annual survey is completed by the MP using the manufacturer’s manual.
- When can we start? Manual goes into effect July 2017, so that’s when ACR will start accepting QC testing results for accreditation. Encouraged to start using it prior to that along side current QC to become familiar with it.

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DBT?

- DBT is not included in the manual at this time
  - Appendix in progress
- Will need to follow manufacturer QC until DBT included by FDA
- OK to use new manual for another unit that only does 2D imaging

Status

- FDA has approved the manual as an alternative standard under current regulations
- Allows facilities to use this instead of the manufacturer’s manuals
- ACR is determining manufacturer interest in adopting the new manual as their own after DBT appendix is available

Be Physicists!

- Nothing in the ACR DM QC Manual precludes performing tests from the manufacturer’s QC manuals
- You may determine that additional testing is appropriate
- If something seems awry, dive deeper into the system with an appropriate manufacturer test
Other Questions

✦ Implementation and roll-out?
  * ACR is developing a plan to provide training - various modes and methods
  * NB: Yes, there are some typographical and other errors still extant, despite extermination efforts!
  * Tell the ACR (Penny Butler or Pam Platt), but be nice!

✦ Phantom availability?
  * CIRS and Gammex are currently approved to produce phantom
  * List price from one: $1290

New Webpage:

Many Thanks...

✦ Eric Berns, PhD
✦ Penny Butler, MS