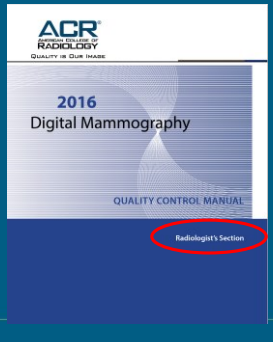
ACR AMERICAN COLLEGE OF RADIOLOGY
QUALITY IS OUR IMAGE

Implementation of the 2016 ACR Digital Mammography QC Manual

Medical Physicist Mammography Equipment Evaluation and Annual Survey

Eric A. Berns, PhD, FACR

Radiologist Responsibilities



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Radiologist Responsibilities

A. Radiologist's Responsibilities

1. Lead Interpreting Physician

900.12(d) Quality assurance—general. (1) Responsible individuals. (i) [redacted] individual shall be assigned or shall retain responsibility for quality assurance tasks unless the lead interpreting physician has determined that the individual's qualifications for, and performance of, the assignment are adequate.

Radiologist Responsibilities

A Quality Assurance Committee (QAC) can be useful to provide oversight of the QA program, setting the goals and direction, determining policies, and assessing the effectiveness of QA activities.

A QAC should consist of the following:

- One or more radiologists, including the lead mammography radiologist
- A medical physicist
- A facility manager
- A supervisory mammography technologist
- The quality control technologist
- Other radiology department personnel involved in caring for mammography patients (this may include a nurse, desk attendant, medical secretary, and others)

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Radiologist Responsibilities

1. Ensure that technologists have adequate training and continuing education in mammography.
2. Provide an orientation program for technologists based on a carefully established procedures manual.

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Radiologist Responsibilities

performed at the site. (The radiologist should provide motivation, oversight, and direction to all aspects of the QC program. One mechanism the radiologist can use to demonstrate commitment to QC is by routinely using the new Optional System QC for Radiologist procedure and form in the Radiologic Technologist's Section to quickly evaluate the entire mammographic imaging chain from the radiologist workstation.)

to perform the prescribed QC tests (in order to ensure consistency in QC test performance) and to oversee tests that have been delegated to other individuals. (It is not desirable, for example, to rotate this assignment among a group of technologists. Such a practice would introduce into the test results variability extraneous to the items being tested. However, properly trained backup QC technologists are essential to provide continuity when the primary QC technologist is unavailable.)

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Radiologist Responsibilities

[redacted]

to perform the technologist's QC tests.

[redacted]

to carry out the QC tests and to record and interpret the results. (Most tests take little time; however, the necessary time must be incorporated into the daily schedule.)

[redacted]

to technologists about clinical image quality and QC procedures. (The new Optional Radiologist Image Quality Feedback procedure and form in the Radiologic Technologist's Section was designed to assist radiologists with this responsibility.)

[redacted]

QC program and perform the medical physicist's tests.

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Radiologist Responsibilities

[redacted]

frequently if consistency has not yet been achieved. (See Facility QC Review in the Radiologic Technologist's Section.)

[redacted]

frequently when needed.

[redacted]

radiation protection program for employees, patients, and other individuals in the surrounding area.

[redacted]

mammography technique and procedures, infection control procedures, QC, safety, and protection are properly maintained and updated in the mammography QA/QC procedures manual.

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Radiologist Responsibilities

[redacted]

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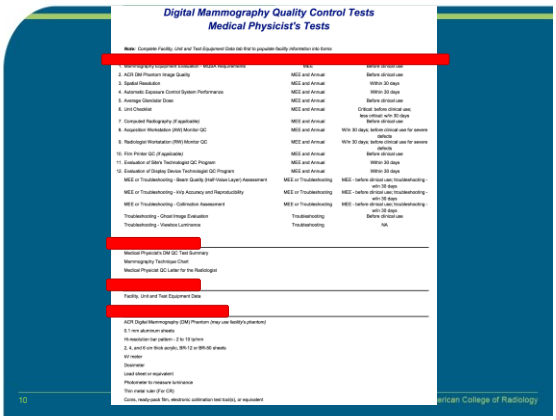
Digital Mammography Quality Control Tests
Medical Physicist's Tests
Note: Complete Facility, Unit and Test Equipment Data tab first to populate facility information into forms
1. Technologist Initial Training and Evaluation – MQSA Requirements
2. ACR DM Phantom Image Quality
3. Spatial Resolution
4. Automatic Exposure Control System Performance
5. Average Glandular Dose
6. Unit Checklist
7. Computed Radiography (if applicable)
8. Acquisition Workstation (AW) Monitor QC
9. Radiologist Workstation (RW) Monitor QC
10. Film Printer QC (if applicable)
11. Evaluation of Site's Technologist QC Program
12. Evaluation of Display Device Technologist QC Program
MEE or Troubleshooting - Beam Quality (Half-Value Layer) Assessment
MEE or Troubleshooting - Kerp Accuracy and Reproducibility
MEE or Troubleshooting - Collimation Assessment
Troubleshooting - Ghost Image Evaluation
Troubleshooting - Viewbox Luminance
MEE and Annual
Before clinical use
Within 30 days
Critical: before clinical use; less critical: w/in 30 days
Before clinical use
W/in 30 days; before clinical use for severe defects
W/in 30 days; before clinical use for severe defects
Within 30 days
MEE - before clinical use; troubleshooting - w/in 30 days
MEE - before clinical use; troubleshooting - w/in 30 days
MEE - before clinical use; troubleshooting - w/in 30 days
Troubleshooting
Before clinical use
NA
Medical Physicist's DM QC Test Summary
Mammography Technique Chart
Medical Physicist QC Letter for the Radiologist
Facility, Unit and Test Equipment Data
ACR Digital Mammography (DM) Phantom (may use facility's phantom)
0.1 mm aluminum sheets
Hi-resolution bar pattern – 2 to 10 lp/mm
2, 4, and 6 cm thick acrylic, BR-12 or BR-50 sheets
kV meter
Dosimeter
Load sheet or equivalent
Photometer to measure luminance
Thin metal ruler (For CR)
Cores, ready-pack film, electronic collimation test tool(s), or equivalent
10
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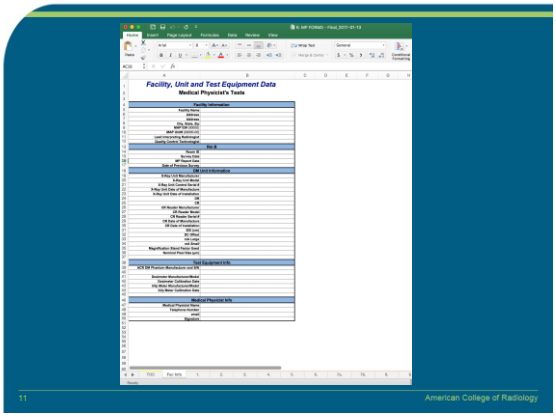
Facility, Unit and Test Equipment Data
Medical Physicist's Tests
11
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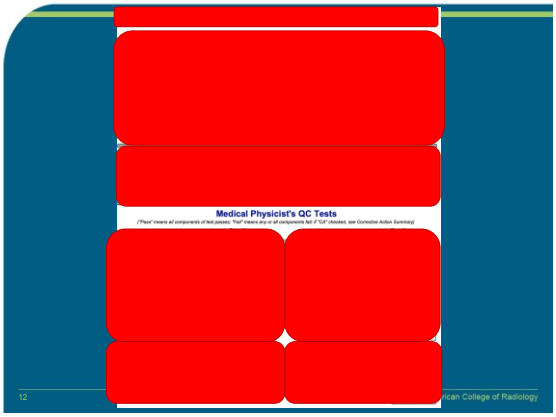
Medical Physicist's QC Tests
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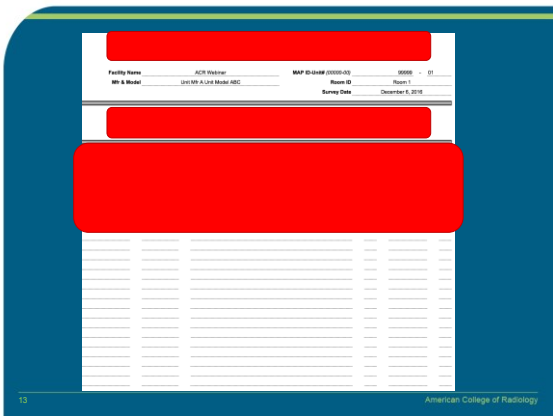
Facility Name
ACR Webinar
MAP ID-Unit# (00000-00)
99999 - 01
MN & Model
Unit MN A Unit Model ABC
Room ID
Room 1
Survey Date
December 8, 2016
13
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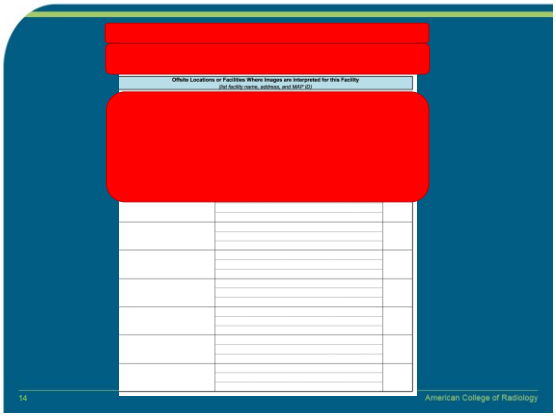
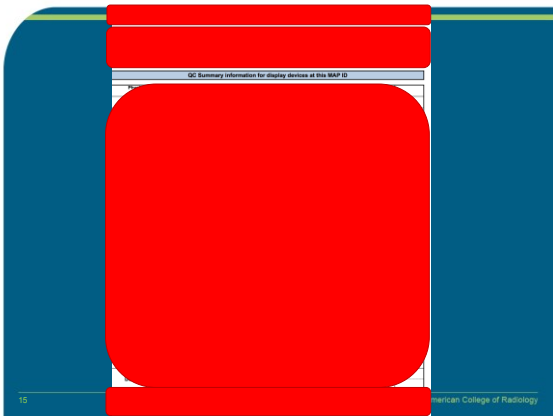

Offsite Locations or Facilities Where Images are Interpreted for this Facility
(list facility name, address, and MAP ID)
14
American College of Radiology


QC Summary Information for display devices at this MAP ID
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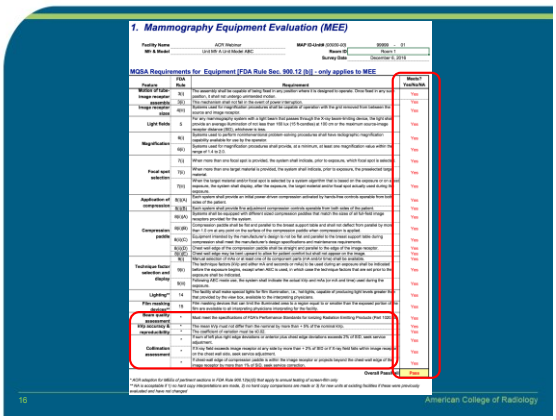
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MQSA Requirements for Equipment [FDA Rule Sec. 900.12 (b)] - only applies to MEE
16
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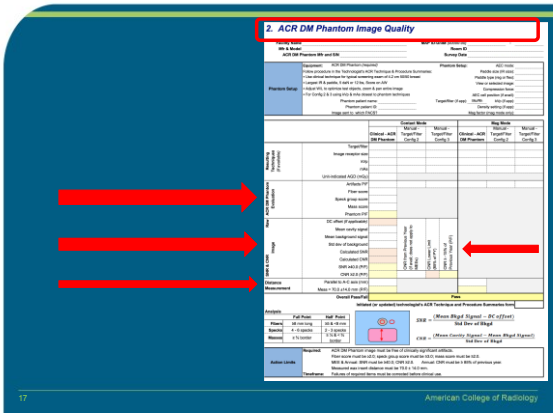
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17
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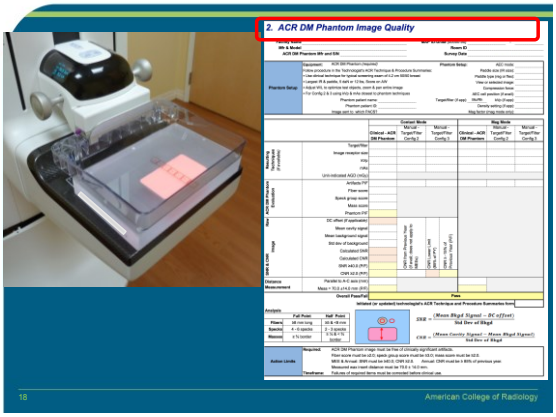
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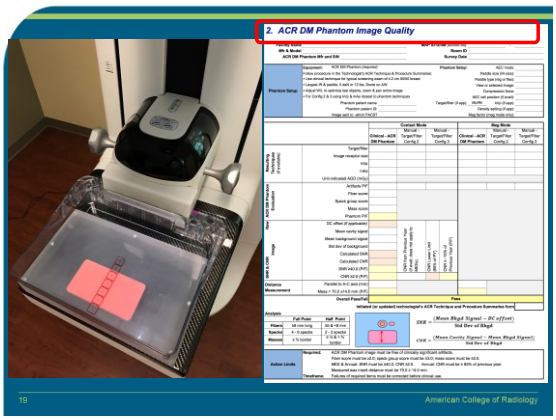
American College of Radiology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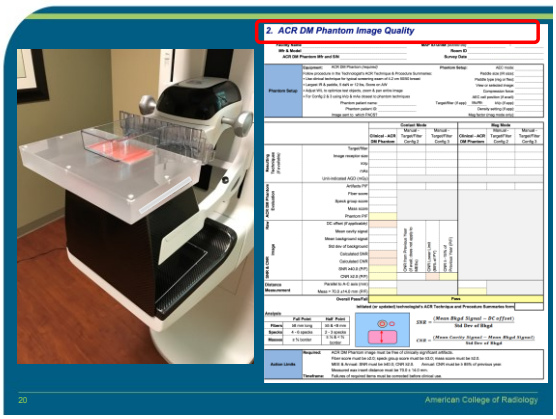
American College of Radiology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20
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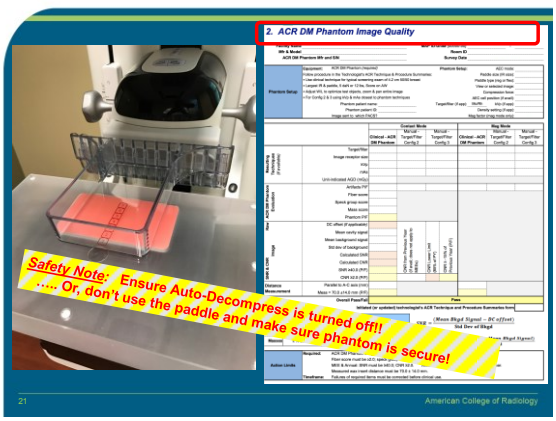
2. ACR DM Phantom Image Quality
Safety Note: Ensure Auto-Decompress is turned off!!
…. Or, don't use the paddle and make sure phantom is secure!
21
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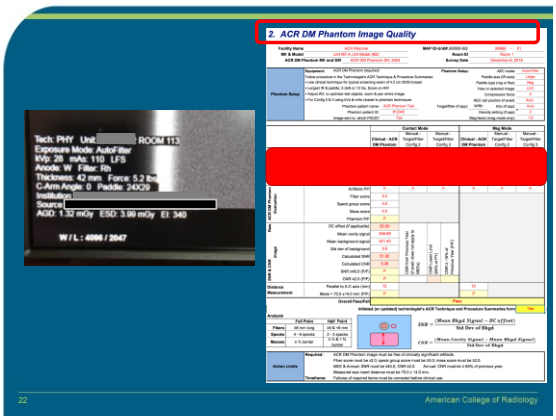
2. ACR DM Phantom Image Quality
Tech: PHY Unit: ROOM 113
Exposure Mode: AutoFilter
kVp: 28 mAs: 110 LFS
Anode: W Filter: Rh
Thickness: 42 mm Force: 5.2 lbs
C-Arm Angle: 0 Paddle: 24X29
Institution
Source
AGD: 1.32 mGy ESD: 3.99 mGy EI: 340
W / L : 4096 / 2047
22
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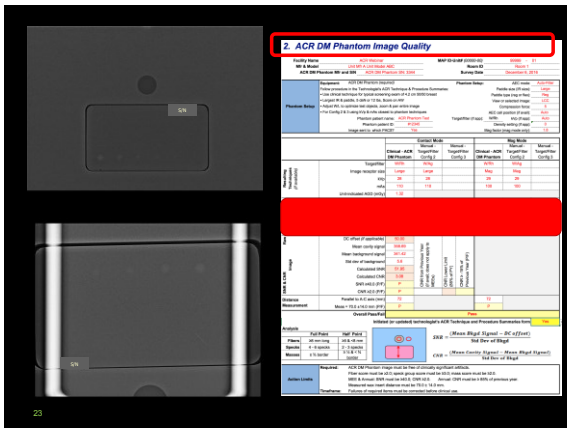
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S/N
S/N
23


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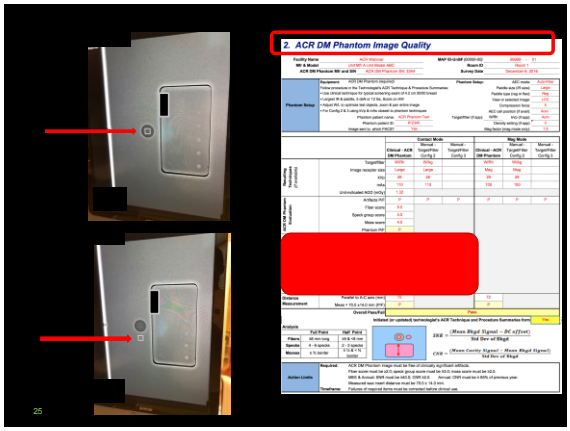
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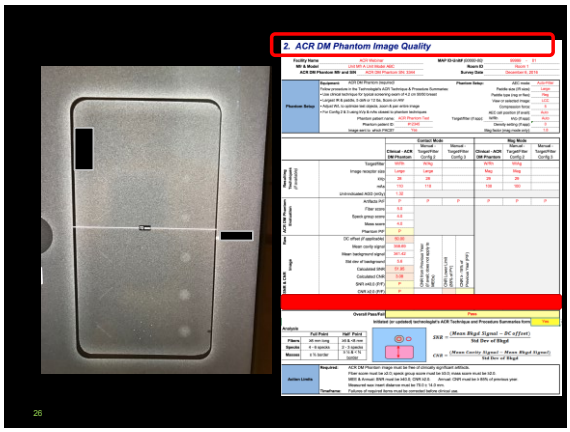
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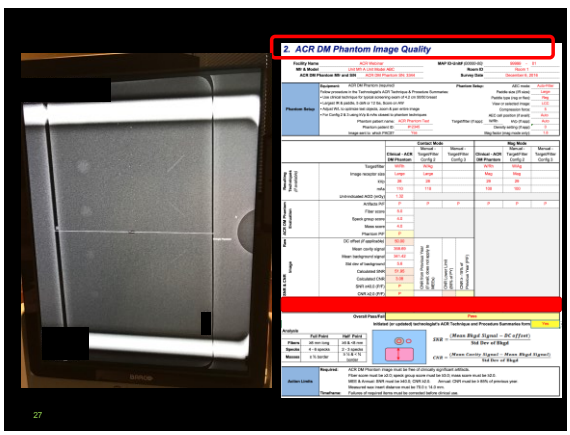
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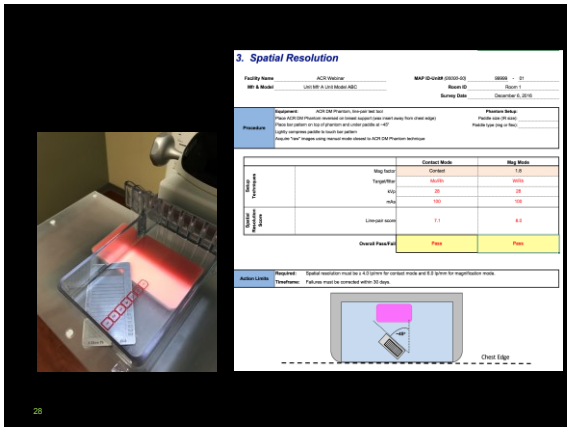
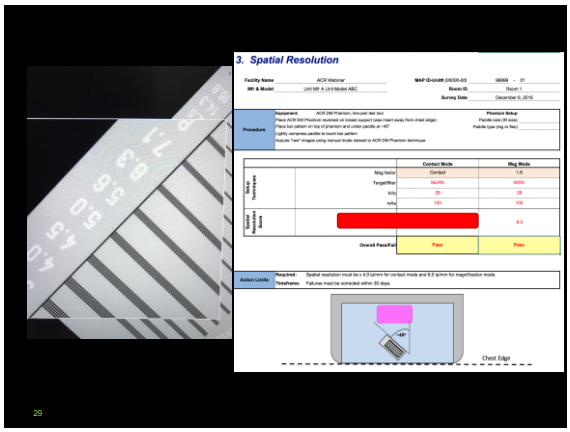

3. Spatial Resolution
Facility Name
MR & Model
Procedure
Action Limits
Chest Edge
28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Facility Name
MR & Model
Procedure
Action Limits
Chest Edge
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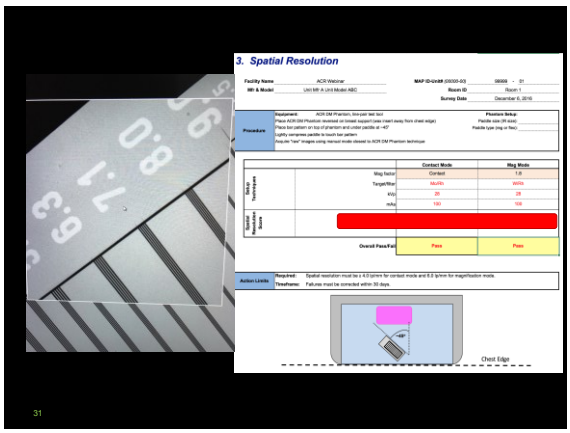
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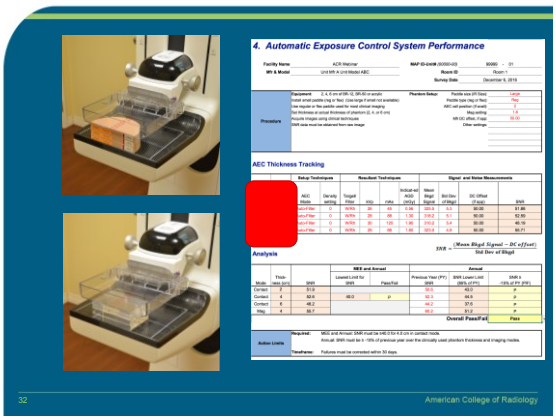
Facility Name
MR & Model
Procedure
Action Limits
Chest Edge
31


4. Automatic Exposure Control System Performance
AEC Thickness Tracking
Analysis
32
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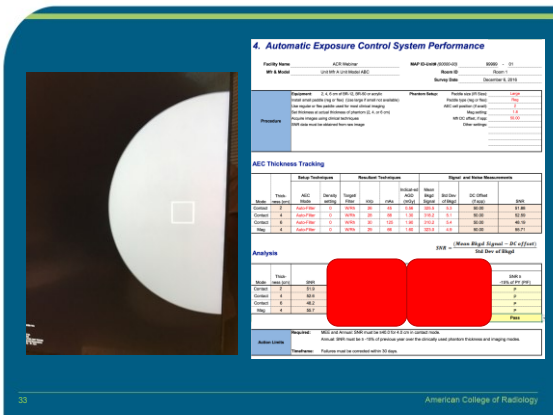
4. Automatic Exposure Control System Performance
AEC Thickness Tracking
Analysis
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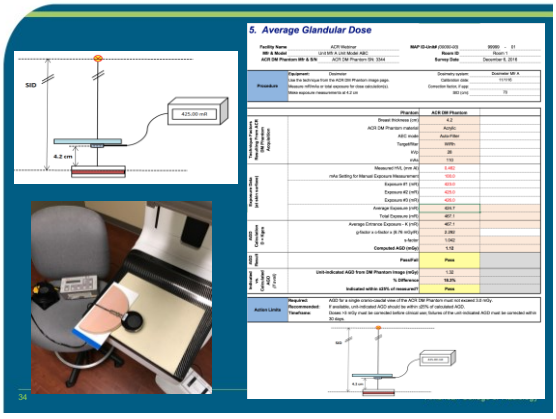
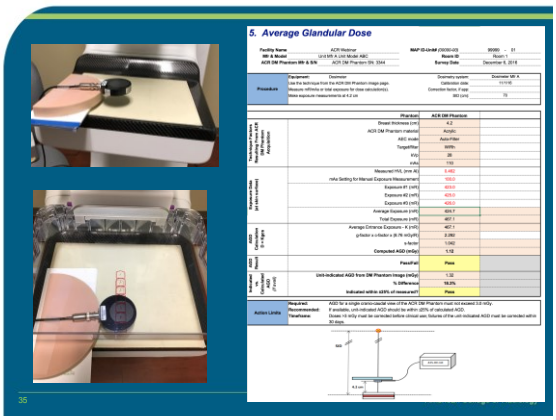

5. Average Glandular Dose
SID
425.00 mR
4.2 cm
34


5. Average Glandular Dose
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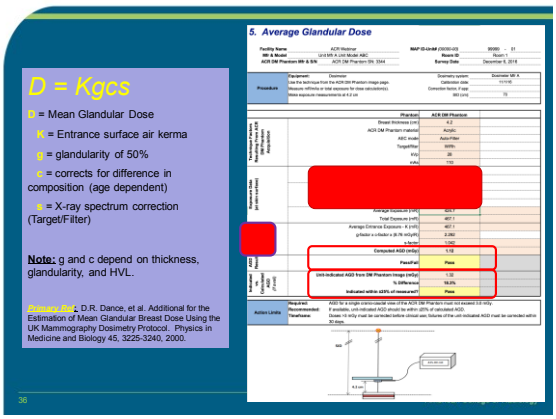
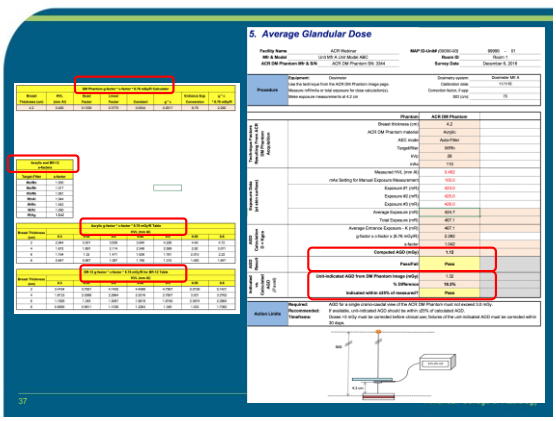

D = Kgcs
D = Mean Glandular Dose
K = Entrance surface air kerma
g = glandularity of 50%
c = corrects for difference in composition (age dependent)
s = X-ray spectrum correction (Target/Filter)
Note: g and c depend on thickness, glandularity, and HVL.
Reference: D.R. Dance, et al. Additional for the Estimation of Mean Glandular Breast Dose Using the UK Mammography Dosimetry Protocol. Physics in Medicine and Biology 45, 3225-3240, 2000.
5. Average Glandular Dose
36


5. Average Glandular Dose
37


6. Unit Checklist
Facility Name
Mfr & Model
Procedure
Item
Yes/No/NA
Action Limits
Overall Pass/Fail
Pass
38
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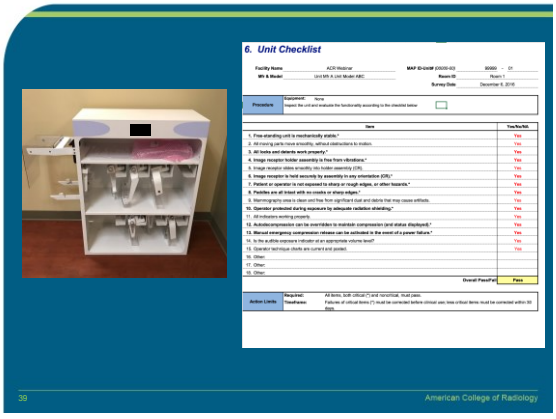
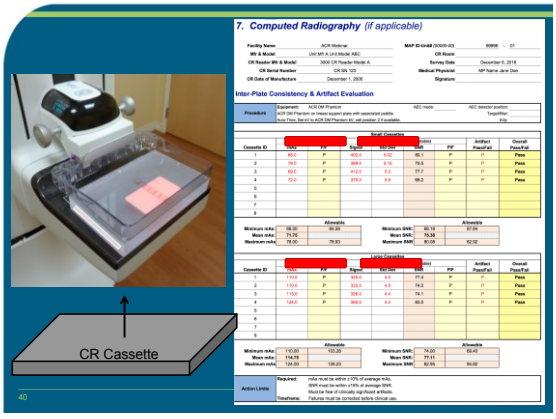
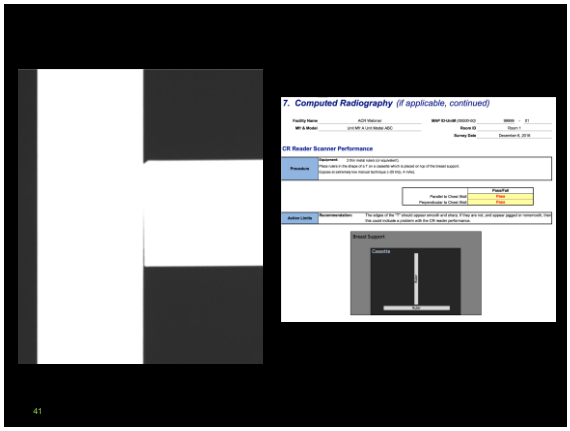
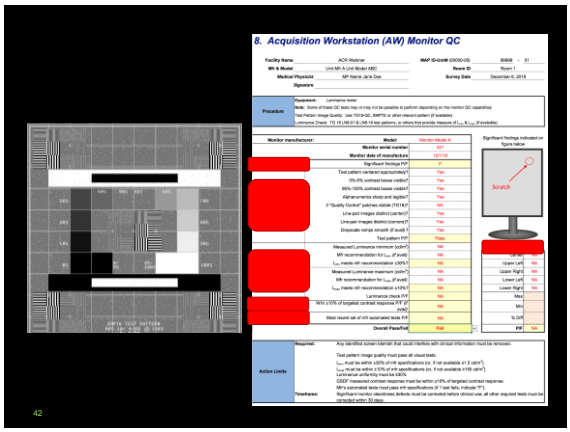
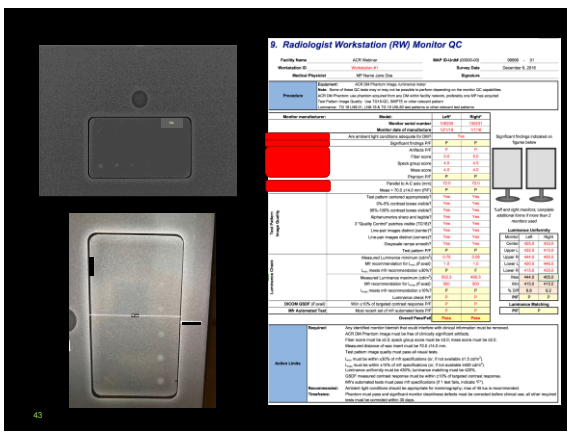

6. Unit Checklist
Facility Name
Mfr & Model
Procedure
Item
Yes/No/NA
Action Limits
Overall Pass/Fail
Pass
39
American College of Radiology


7. Computed Radiography (if applicable)
Facility Name
Mfr & Model
CR Reader Mfr & Model
CR Serial Number
CR Date of Manufacture
Inter-Plate Consistency & Artifact Evaluation
Procedure
Cassette ID
Action Limits
CR Cassette
40


7. Computed Radiography (if applicable, continued)
CR Reader Scanner Performance
Breast Support
Cassette
41


8. Acquisition Workstation (AW) Monitor QC
Scratch
42


9. Radiologist Workstation (RW) Monitor QC
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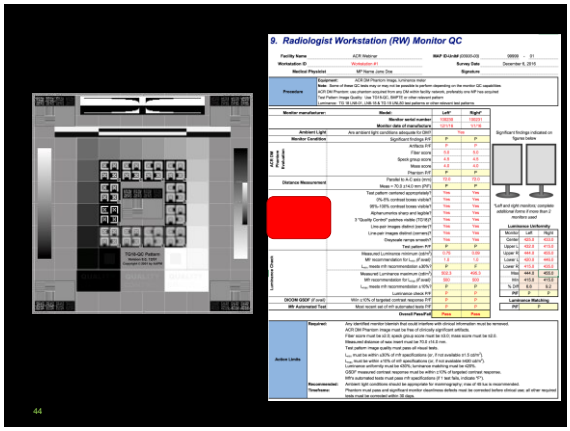
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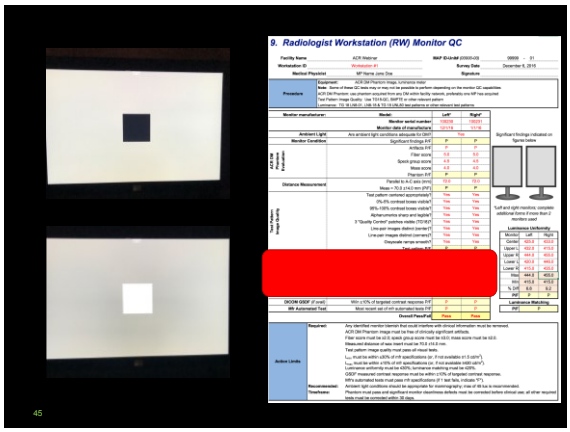
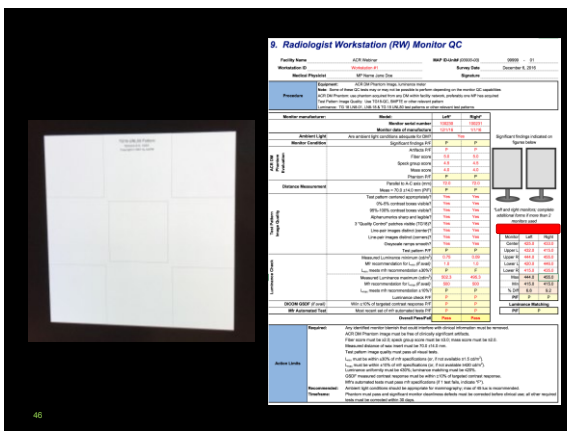
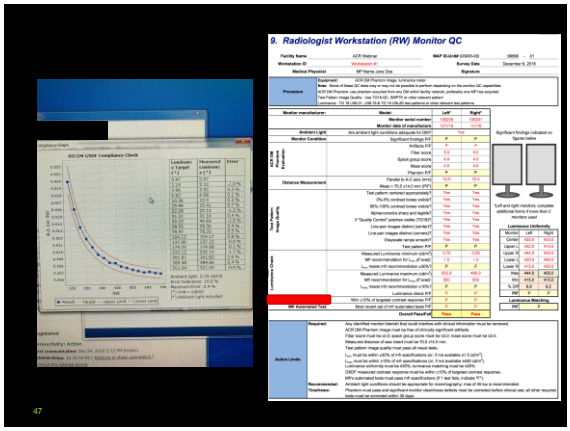

9. Radiologist Workstation (RW) Monitor QC
45


9. Radiologist Workstation (RW) Monitor QC
46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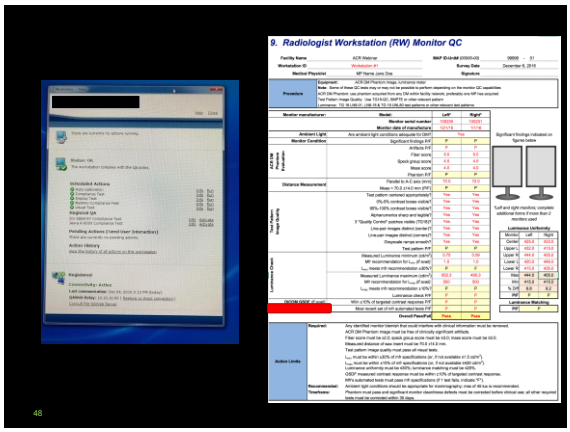
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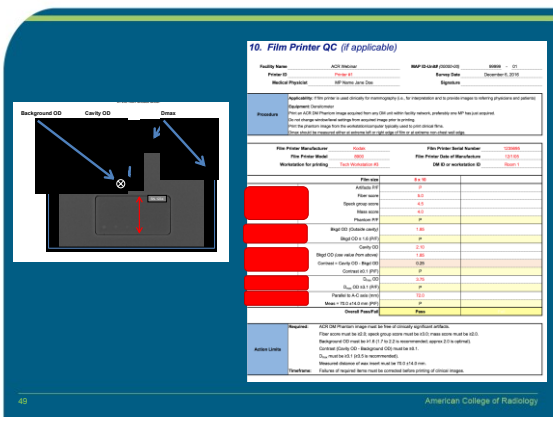
10. Film Printer QC (if applicable)
Background OD
Cavity OD
Dmax
49
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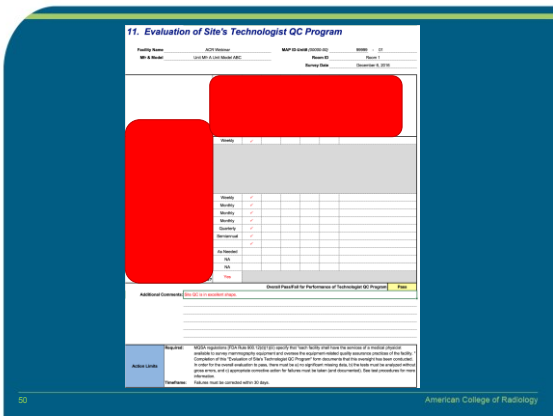
11. Evaluation of Site's Technologist QC Program
Facility Name
MR & Model
Survey Date
Weekly
Monthly
Monthly
Monthly
Quarterly
Semiannual
As Needed
NA
NA
Yes
Overall Pass/Fail for Performance of Technologist QC Program
Pass
Additional Comments:
Action Limits
Required:
Timeframe:
50
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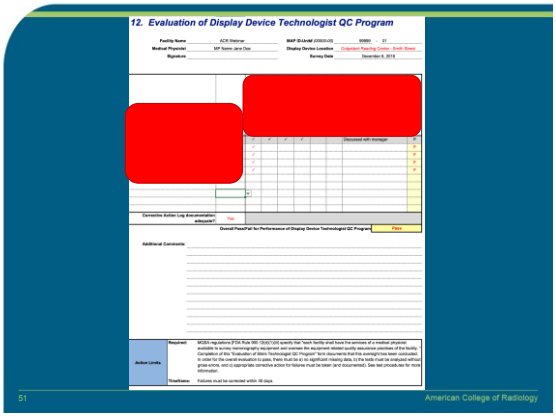
12. Evaluation of Display Device Technologist QC Program
Facility Name
Medical Physicist
Signature
Display Device Location
Survey Date
Discussed with manager
Corrective Action Log documentation adequate?
Yes
Overall Pass/Fail for Performance of Display Device Technologist QC Program
Pass
Additional Comments:
Action Limits
Required:
Timeframe:
51
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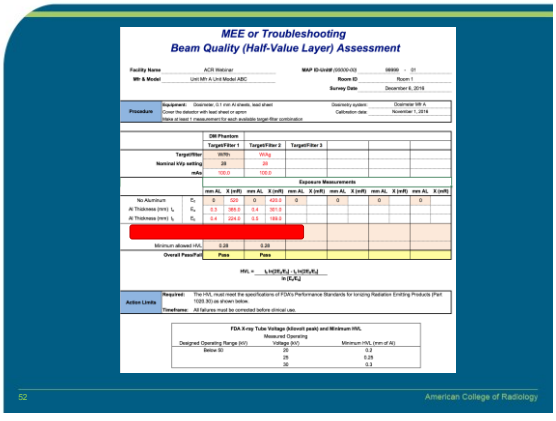
MEE or Troubleshooting
Beam Quality (Half-Value Layer) Assessment
Facility Name
MR & Model
Survey Date
Procedure
Target/Filter
Nominal kVp setting
mAs
Exposure Measurements
No Aluminum
Al Thickness (mm) t_1
Al Thickness (mm) t_2
Minimum allowed HVL
Overall Pass/Fail
Action Limits
Required:
Timeframe:
FDA X-ray Tube Voltage (kilovolt peak) and Minimum HVL
Designed Operating Range (kV)
Measured Operating Voltage (kV)
Minimum HVL (mm of Al)
Below 50
30
0.3
52
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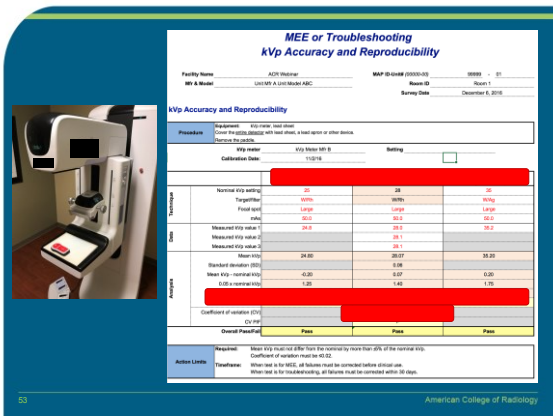
MEE or Troubleshooting
kVp Accuracy and Reproducibility
kVp Accuracy and Reproducibility
Procedure
Action Limits
53
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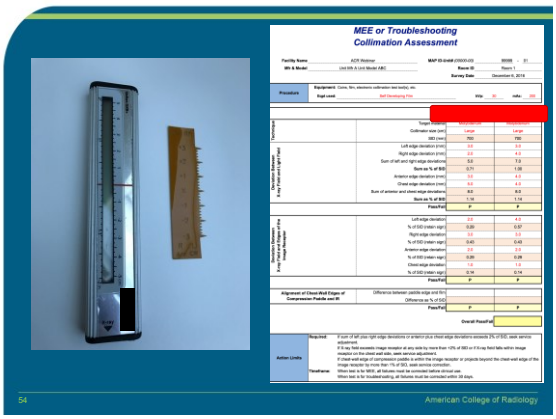
MEE or Troubleshooting
Collimation Assessment
54
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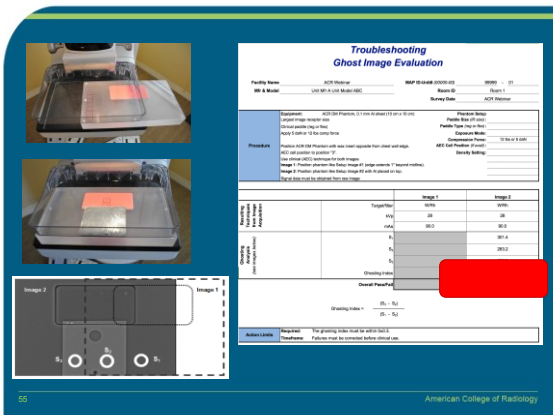
Troubleshooting
Ghost Image Evaluation
Image 1
Image 2
55
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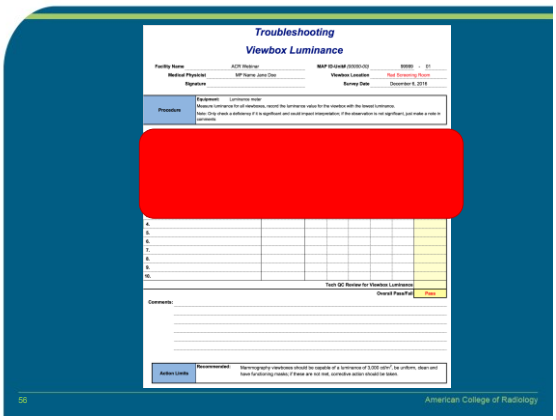

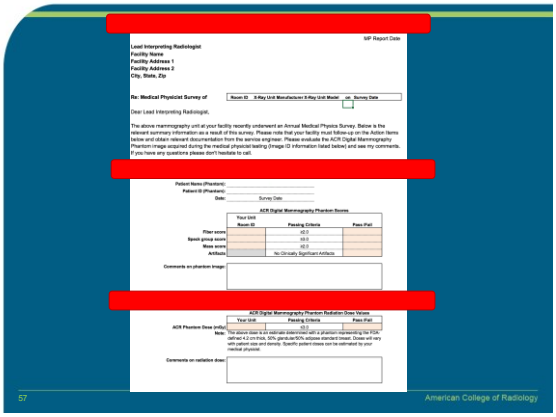

Phantom Scoring: Artifact Evaluation

Artifacts	Only fail for artifacts if they are in a location that could impact clinical interpretation ***and*** they are clinically significant. Fail if: • Artifacts are as prominent as (or more prominent than) the visible test objects in the phantom image, or • Artifacts obscure test objects in the phantom, or • Artifacts could affect clinical interpretation

There are 2 important distinctions here:

Artifacts that fail vs. Artifacts that don't fail

- The MP & Tech ***must fail*** if artifact evaluation meets the above criteria
- If artifact ***doesn't fail*** per above criteria, the MP & Tech should still comment, troubleshoot, and/or recommend for repair.

Just because the artifact does not "Fail" doesn't mean it should be ignored.

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Phantom Scoring: Artifact Evaluation

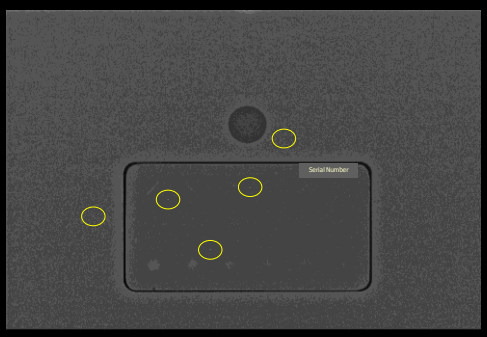
Phantom image failure
Will depend on the number of artifacts that appear and where they are located:

---- If **only *1 to 3 speck-like* *artifacts appear in a location that could impact clinical interpretation, the image should not fail***.

----- However, the artifacts should be evaluated and eliminated if possible.

---- If speck-like artifacts are more ***widespread and appear in a location that could impact clinical interpretation***, these are probably clinically significant and the image should fail. These artifacts must be eliminated in order for the phantom image to pass.

Artifact Example Series



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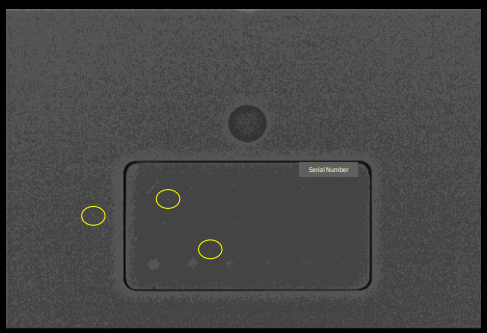
Artifacts Fail

Artifact Example Series



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Artifacts do not Fail but troubleshooting and comments are important

Artifact Example Series

Artifacts may not Fail but troubleshooting and comments are important
(2 outer specks may not be in location that could impact clinical interpretation)*

Description: Massive amounts of dust & debris, texture or grid can be seen

Pass or Fail for Artifacts?:
--Detector blotchiness & visible texture: Fail
--White speck-like: Fail

Phantom image failure
Will depend on the number of artifacts that appear and where they are located.

---- **If *only 1 to 3 speck-like* artifacts appear in a location that could impact clinical interpretation, the image should *not* fail.**

----- However, the artifacts should be evaluated and eliminated if possible.

---- If speck-like artifacts are more ***widespread and appear in a location that could impact clinical interpretation***, these are probably clinically significant and the image should fail. These artifacts must be eliminated in order for the phantom image to pass.

Artifacts	Only fail for artifacts if they are in a location that could impact clinical interpretation **and** they are clinically significant. Fail if: • Artifacts are as prominent as (or more prominent than) the visible test objects in the phantom image, or • Artifacts obscure test objects in the phantom, or • Artifacts could affect clinical interpretation

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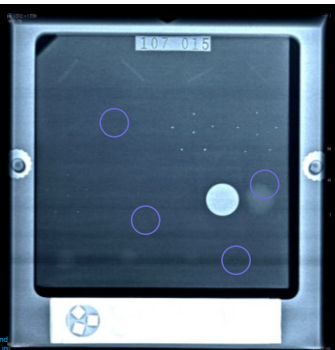
Description: Blotchy background and linear artifacts

Pass or Fail for Artifacts?:
--Detector blotchiness & horizontal lines: Fail
--White speck-like: Fail



Phantom image failure
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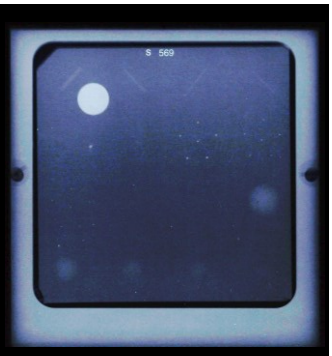
Description: Non-uniformities, white speck like artifacts

Pass or Fail for Artifacts?:
--White speck-like: Fail



Phantom image failure
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---- If speck-like artifacts are more ***widespread and appear in a location that could impact clinical interpretation***, these are probably clinically significant and the image should fail. These artifacts must be eliminated in order for the phantom image to pass.

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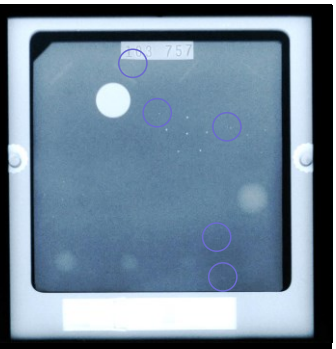
Description: White dots

Pass or Fail for Artifacts?:
--White speck-like: Fail



Phantom image failure
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----- However, the artifacts should be evaluated and eliminated if possible.

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Description: Non-uniformities, white speck like artifacts

Pass or Fail for Artifacts?:
--Linear artifacts: Fail

--White speck-like: Fail

Phantom image failure
Will depend on the number of artifacts that appear and where they are located.

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Description: White speck like artifacts

Pass or Fail for Artifacts?: Fail

Phantom image failure
Will depend on the number of artifacts that appear and where they are located.

---- If ***only 1 to 3 speck-like artifacts appear in a location that could impact clinical interpretation, the image should not fail.***

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Thank you,

And now for questions.