

Diagnostic Imaging and QC

1. Fixed Radiographic units
 - a. Daily visual checks
 - b. Annual checks
 - 1) Beam quality
 - 2) Light field / xray field alignment
 - 3) X-Y Scale Accuracy
 - 4) Positive Beam Limitation
 - 5) X-ray beam to bucky alignment
 - 6) Focal spot size
 - 7) Reproducibility
 - 8) kV calibration
 - 9) mA station to station linearity
 - 10) Timer accuracy
 - 11) Beam quantity (mR/mAs)
 - 12) Automatic exposure control
 - 13) Grids
 - 14) Artifacts

2. Portable Xray units
 - a. Daily visual checks
 - b. Annual checks
 - 1) Beam quality
 - 2) Light field / xray field alignment
 - 3) Focal spot size
 - 4) kV calibration
 - 5) Reproducibility
 - 6) mAs station to station linearity
 - 7) Timer accuracy
 - 8) Beam quantity
 - 9) Artifacts

3. Fluoroscopic units

- a. Daily visual checks
- b. Weekly Fluoro Phantom checks
- c. Annual checks
 - 1) Typical exposure rates
 - 2) Maximum exposure rates
 - 3) Image Quality
 - a) High Contrast
 - b) Low Contrast
 - 4) Spatial resolution
 - 5) kV calibration
 - 6) Beam quality
 - 7) Collimation

4. CT Scanners

- a. Daily
 - 1) CT number accuracy of water
 - 2) Image noise
 - 3) Image Uniformity
 - 4) Artifacts
- b. Annual
 - 1) Image slice thickness
 - 2) Dose profile width
 - 3) Slice positioning accuracy
 - 4) CT number scale accuracy
 - 5) Laser alignment lights
 - 6) Spatial resolution
 - 7) Low contrast detectability
 - 8) Dosimetry of axial scans
 - 9) Video Monitor
 - a) Gray scale
 - b) Image distortion
 - c) Artifacts
 - 10) Z-axis characteristics (Multislice CT's)

5. View Boxes
 - a. Weekly cleaning
 - b. Annual
 - 1) Clean diffuser panel and view box
 - 2) Measure light output
6. Darkrooms, Processors, Film, Cassettes, Protective Apparel
 - a. Daily sensitometry on the processor
 - b. Weekly Darkroom cleanliness
 - c. Monthly
 - 1) Film storage and rotation
 - 2) Darkroom temperature and humidity
 - d. Semi-annual
 - 1) Film fog
 - 2) Cassette cleaning and inventory
 - e. Annual
 - 1) Medical Physicist Review
 - 2) Lead Protective Apparel safety check and inventory
7. Photostimulable Phosphor Systems (CR)
 - a. Daily Imaging Plate inspection and cleaning (as needed)
 - b. Weekly
 - 1) Clean all air filters and vents
 - 2) Perform a primary erasure of all PSP plates
 - 3) Clean all PSP plates
 - 4) Check for light leaks at the junction between the CR unit and the processor
 - c. Monthly – analyze repeat image trends
 - d. Semiannual
 - 1) Linearity and Sensitivity
 - 2) Image quality

- e. At Acceptance and annually thereafter
 - 1) System inventory and visual inspection
 - 2) Dark noise
 - 3) Plate-to-plate uniformity and reproducibility
 - 4) Image Geometric Uniformity and Distance measurements
 - 5) Spatial Resolution
 - 6) Laser evaluation
 - 7) Low contrast resolution
 - 8) User-controlled Density and Contrast commands
 - 9) Flatfield evaluation
 - 10) Dose monitoring

- f. Annual - Medical Physicist Review

- 8. MRI
 - a. Daily
 - 1) Center Frequency check
 - 2) Transmitter Gain
 - 3) Geometric Accuracy
 - 4) Spatial Resolution
 - 5) Low Contrast Detectability
 - 6) Image Artifacts assessment

 - b. Weekly
 - 1) Bed position and other lights
 - 2) Alignment light
 - 3) Cables
 - 4) Horizontal smoothness of motion and stability
 - 5) Vertical motion smoothness and stability
 - 6) Laser camera
 - 7) Light boxes
 - 8) RF Door contacts
 - 9) RF window-screen integrity
 - 10) Operator console switches/lights/meters
 - 11) Patient monitors
 - 12) Patient intercom
 - 13) Room temperature and humidity
 - 14) Cryogen level indicator
 - 15) Emergency cart
 - 16) Safety warning signage
 - 17) Oxygen monitor

- c. Annual
 - 1) Magnetic field homogeneity
 - 2) Slice position accuracy
 - 3) Slice thickness accuracy
 - 4) RF coil checks
 - 5) Signal-to-noise ratio
 - 6) Image intensity uniformity
 - 7) RF phase stability
 - 8) Surface coils
 - 9) Volume coils
 - 10) Soft copy displays
 - 11) Interslice RF interference

9. Ultrasound

- a. Quarterly (for each transducer)
 - 1) Axial resolution
 - 2) Lateral resolution
 - 3) Depth of penetration
 - 4) Low contrast discrimination
 - 5) Distance accuracy
 - 6) Artifact identification
 - a) Acoustic reverberation
 - b) Side lobes
 - c) Specular reflections
 - d) Aliasing
- b. Annual - Medical Physicist Review

10. Display device – Soft copy – Monitors

- a. Quarterly
 - 1) Gray Scale Display Function
 - 2) Luminance Uniformity
 - 3) Low Contrast Performance (Noise)
 - 4) Resolution and Resolution Uniformity (CRT)
 - 5) Veiling Glare (CRT)
 - 6) Geometric Distortion (CRT)
 - 7) Bandwidth Artifacts (CRT)
 - 8) Dead Pixel Count (LCD)

- b. At Acceptance
 - 1) Specular Reflection
 - 2) Diffuse Reflection
 - c. Annual - Medical Physicist Review
11. Display device – Hard copy – Printers
- a. Weekly
 - 1) Optical Density calibration
 - 2) SMPTE Pattern evaluation
12. The Reading Environment
- a. Quarterly
 - 1) Illumination and Glare Control
 - 2) Sound abatement
 - 3) Ventilation / temperature
13. PACS
- a. Daily
 - 1) Connectivity to critical devices
 - 2) Data Integrity
 - 3) Error reports
 - 4) Issue tracking and logging
14. Mammography
- a. Daily
 - 5) Darkroom cleanliness
 - 6) Processor QC
 - b. Weekly
 - 1) Screen cleaning
 - 2) Phantom Image
 - 3) Viewboxes
 - c. Monthly
 - 1) Visual Checklist

- d. Quarterly
 - 1) Fixer
 - 2) Repeat Analysis
- e. Semi-annual
 - 1) Screen contact
 - 2) Fog
 - 3) Compression
- f. Annual
 - 1) Assembly evaluation
 - 2) Collimation assessment
 - 3) Focal spot performance assessment
 - 4) Automatic exposure control
 - 5) Uniformity of Screen Speed
 - 6) Artifact Evaluation
 - 7) Phantom Image Quality Evaluation
 - 8) kVp Accuracy and Reproducibility
 - 9) Beam Quality (Half Value Layer)
 - 10) Breast Entrance Exposure
 - 11) Average Glandular Dose
 - 12) Radiation Output Rate
 - 13) Viewbox Luminance and Room Illuminance
 - 14) Breast Thickness Scale Accuracy
 - 15) Compression Evaluation
 - 16) mAs Linearity
 - 17) Timer Verification
 - 18) Light Beam Average Illumination

15. Gamma Cameras

- a. Daily floods
- c. Weekly
 - 1) Bars and Phantoms
 - 2) Center of Rotation
- d. Quarterly
 - 1) Sealed Source Inventory
 - 2) Dose Calibrator Linearity

- e. Semi-Annual
 - 1) Sealed Source Leak Tests

- f. Annual Review by the Medical Physicist
 - 1) Radiation Detection Instrument Calibration
 - 2) Dose Calibrator Accuracy Test
 - 3) Image Quality Evaluation of the Gamma Cameras

- 16. P.E.T.
 - a. Acceptance Testing
 - 1) 2D System
 - a) Transverse / Axial Resolution
 - b) Sensitivity
 - c) Scatter Fraction
 - d) Count Rate and Dead time
 - e) Uniformity
 - f) Accuracy of Count Rate, Scatter & Attenuation Correction
 - g) Detector Gains, Position Map, Energy Threshold
 - h) Coincidence Timing
 - 2) 3D System
 - a) Spatial Resolution
 - b) Sensitivity
 - c) Scatter Fraction / Count Rate Performance
 - d) Image Quality
 - e) Accuracy of Count Losses and Randoms Correction
 - f) Detector Gains, Position Map, Energy Threshold
 - g) Coincidence Timing
 - b. Daily
 - 1) QA Scan
 - 2) Mean Coincidence
 - 3) Variance of Coincidence
 - 4) Mean Singles
 - 5) Variance of Singles events
 - 6) Mean Dead Time
 - 7) Timing Mean
 - 8) Sinogram

- c. Quarterly
 - 1) 2D System
 - (1) Normalization
 - (2) Well Counter Correction
 - (3) Geometric Calibration
 - 2) 3D System
 - (1) Normalization
 - (2) Well Counter Correction

17. P.E.T. / CT

Same as for individual P.E.T. and CT except for Registration

There are a few other items of QC that are important to understand:

All maintenance and service personnel should conduct routine testing as part of their maintenance and service to demonstrate that whatever maintenance and service they performed is valid and that they are leaving the equipment in good working order. This is true whether the maintenance and service is provided by an outside vendor or by an in-house group, such as the Biomedical group. However, those tests are **NOT** part of the QC program – they are part of the maintenance and service program. The QC program includes the oversight of all maintenance and service performed and should be conducted by an independent party, not by the same party that just did the maintenance or service. There are a number of tests that fall under a good QC program that the maintenance and service personnel do not perform. Many of the Image Quality tests listed above are good examples of tests that most maintenance and service personnel do not conduct.

Physicists must remain current with technology in order to provide proper advice on the proper testing to be conducted. There are far too many Physicists who have been in the field for many years but who have failed to stay abreast of technology. There are also “Physicists” who have had insufficient training and who cannot provide adequate service. **Require** the Physicist to provide his credentials and to also provide an updated list of Continuing Education (every year or two) so one can determine that he continues to be qualified with your ever-increasingly complex equipment. All of your Physicians and all of your technologist staff are required to stay current, so it would seem obvious that the Physicist should also be required to stay current.

The service contract should detail the services to be performed. And, the service contract needs to be closely monitored and managed.

All new equipment should be Acceptance Tested by the Physicist to provide an independent assessment of the equipment as installed at the time of Turn-Over by the vendor.

Involve the Physicist early in the planning stages so he can assist in Site Planning.

The QC items listed above are recommended by the ACR and/or AAPM.