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Quality Control in CT
CE - CT 2
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Preventive Maintenance and Quality Control
- Proper performance of x-ray units
- Optimum Image Quality
- Minimum Dose to Patients
- Problems Found Before Seriously Affecting
  - Image Quality
  - Patient & Personnel Safety
- Avoid repeats
  - Save Time & Money

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Quality Control Tests†
- Radiography
- Fluoroscopy
- Conventional Tomography
- Computed Tomography
- Film Processing

†Based on NYC/NYS Regulations
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**Computed Tomography**
- Weekly Tests (Some Perform Daily)
- Monthly Tests
- Semi-Annual Tests
- Annual Tests

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**Weekly Tests (Technologist)**
- Noise
- CT Number of Water

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**Noise & CT # Water**

400 mm² Area
Measure Mean and Std. Dev.
(0 +/- 3)
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Monthly Tests
(Service Personnel or Technologist)

- CT Number Uniformity
- Low Contrast Resolution
- High Contrast Spatial Resolution
- Hard Copy Output Devices

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CT Number Uniformity

400 mm² Area Measure Mean at Center and at Edge

Center Value +/- 3

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Low Contrast Resolution – GE

1 mm thick polyethylene in 10 mm thickness of water

See 4 holes in 8% contrast phantom
See 3 holes in 4% contrast phantom
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High Contrast Spatial Resolution

Slots/Spaces: 0.5, 0.6, 0.8, 1.0, 1.3, 1.6 mm
See 0.8 mm with standard algorithm and 0.6 mm with bone algorithm.

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Monitor & Hard Copy - SMPTE Pattern

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Semi-Annual Tests (Physicist)
- All Weekly and Quarterly Tests
- Laser Alignment
- Slice Thickness
- Low Contrast Resolution
- High Contrast Resolution
- Index Accuracy and Couch Positioning
- Contrast Scale
- Linearity of CT# with attenuation coefficient (μ)
- Distance Accuracy
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Laser Alignment

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Slice Thickness

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Contrast Scale
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**Indexing Accuracy**
- Construct ruler with opaque markers separated by fixed distance – 10 mm
- Move couch to position of first marker
- Run series of scans to verify indexing – each additional marker appears in one of the scans in the series

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**Couch Positioning and Laser Accuracy**
- Place thin opaque marker (part of metal paper clip) on phantom
- Position phantom with laser so that marker is centered in scan plane
- Run thin scan and look for marker in image
- Move couch by several cm, then return
- Run thin scan and look for marker in image

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**Annual Tests (Physicist)**
- Semi-Annual Tests
- Patient Dose
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CT Head Dose - Head Phantom & Ion Chamber

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After Tube Change (Physicist)

- Semi - Annual Tests
- Annual Tests

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Marconi / Picker CT Phantom

Hole diameters in 0.35% Medium: 2.0, 2.5, 3.0, 4.0, 5.0, 8.0 mm
Distance between Screws: 45 mm, 111 mm (±1 mm)
CT Numbers: Acrylic 121HU, Polyethylene -91HU (±5 HU)
Philips / Marconi / Picker CT Phantom

- Noise and Std. Dev. - Scan Uniform Water Bath
- MTF - Scan 1 mm Diameter Metal Pin
- Slice Thickness - Scan Angled Aluminum Ramps
- System Software Performs Calculations for MTF and Slice Thickness

Additional Tests

- Technique factors: kVp, mA, sec (rotation time)
- Dose: CTDI, MSAD, CTDI<sub>100</sub>, CTDI<sub>water</sub>, CTDI<sub>eff</sub>, effective dose, DLP, scout view dose
- Half-value layer
- All mechanical operations: tile, table vert & horiz
- Room scatter and shielding survey

ACR CT Accreditation

- Phantom Testing: Image Quality
  - Slice thickness
  - CTF accuracy
  - Low contrast resolution
  - High contrast resolution
  - Image uniformity
- Dose – Reference CTDI<sub>water</sub>
  - Adult Head: 60 mGy
  - Adult Abdomen: 35 mGy
  - Pediatric Abdomen: 25 mGy
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**ACR CT Accreditation Phantom**

- Four contiguous modules – 20 cm diam, 4 cm wide
  - Positioning and alignment, CT# accuracy, slice thickness
  - Low contrast resolution
  - CT# uniformity and noise, distance accuracy
  - High contrast resolution

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**Additional Phantoms**

- Other manufacturers phantoms and QC protocols
- CATPHAN
- CIRS Spiral Phantom
- ACR CT Accreditation Phantom – RMI

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**References**

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- McCullough CH and Zink FE: Performance evaluation of CT systems. In RSNA Categorical Course in Diagnostic Radiology Physics: CT and US Cross-Sectional Imaging 2000, pp 189-207
- AAPM Reports No. 1 and No. 39 at www.aapm.org
- FDA Web Site: fda.gov/medical
- UK Web Site: www.impactscan.org
- ACR CT Accreditation Web Site: www.acr.org