**Introduction**

A PC-based QCT software program for the convenient and reliable derivation of the QCT value of trabecular bone.

This QCT technique does not require the use of external calibration phantoms, but uses internal reference tissues instead. Muscle and fat tissue, positioned in proximity to the lumbar vertebrae, are used as reference tissue to calibrate CT numbers of trabecular bone.

**Applications**

An interactive histogram plotting technique is used to determine the mode CT number of the trabecular bone.

The average BMD value for the lumbar slices is determined and compared to the selected reference population data and the T- and Z-scores are calculated and plotted in color for the final report.

---


CT AutoQA Lite™ Software
Model 49-802

- Fast automated CT analysis for routine QC or acceptance testing
- Generates easy to read results with hardcopy output
- Comprehensive trend analysis
- Can be configured with various vendor phantoms including the Catphan® Phantom (Models 424, 440, 500, and 600)
- DICOM® 3.0 compatible; DICOM storage class provider (SCP) application license provided

Processing features
- **Localizer and table incrementation accuracy** – can be evaluated from the slice width section when the ramps are paired at opposing angles. The slice width test outputs a parameter called Table Position Offset, which is an offset in the z-axis relative to the center of the opposing wire (or test section). Verification of the scanner table incrementation accuracy can be checked by incrementing the table by 30 mm and then returning the table to the starting position and scanning the slice width module. The reported table position offset values should be the same.

### Verification

<table>
<thead>
<tr>
<th>Phantom ID</th>
<th>Phantom center</th>
<th>CTR of base</th>
<th>30.92 ± 2.30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pixel size</td>
<td>Expected (mm)</td>
<td>X-axis (mm)</td>
<td>Y-axis (mm)</td>
</tr>
<tr>
<td>0.47</td>
<td>0.47, 0.47</td>
<td>0.47, 0.47</td>
<td></td>
</tr>
<tr>
<td>Phantom rotation</td>
<td>0.0º</td>
<td>Phantom center is 0.00 mm Right of Center and 0.47 mm Below Center</td>
<td></td>
</tr>
</tbody>
</table>

### CT # linearity

<table>
<thead>
<tr>
<th>Material</th>
<th>Teflon®</th>
<th>Air</th>
<th>LDPE</th>
<th>Acrylic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contrast</td>
<td>0.000197</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contrast (º)</td>
<td>0.32</td>
<td>0.24</td>
<td>0.19</td>
<td>0.16</td>
</tr>
<tr>
<td>Std Dev (º)</td>
<td>4.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Detail (mm)</td>
<td>3.00</td>
<td>4.00</td>
<td>5.00</td>
<td>6.00</td>
</tr>
</tbody>
</table>

### Noise and mean CT number

- Noise (x (mm) y (mm)) – is calculated from several regions of interest (ROI) positioned over a water/uniformity phantom section. The number, size and location of these ROI’s are variable, but typically five are defined: one at the phantom center and the other four along the axes at the same radius covering a 15 x 15 pixel area.

### Uniformity

<table>
<thead>
<tr>
<th>X-axis</th>
<th>Y-axis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uniformity index</td>
<td>0.79</td>
</tr>
<tr>
<td>Std Dev (H):</td>
<td>4.2</td>
</tr>
</tbody>
</table>

### Low contrast

| Contrast (%): | 0.32 | 0.24 | 0.19 | 0.16 | 0.14 | 0.12 | 0.11 | 0.10 | 0.09 | 0.08 | 0.07 | 0.07 | 0.06 |
| Detail (mm): | 3.00 | 4.00 | 5.00 | 6.00 | 7.00 | 8.00 | 9.00 | 10.0 | 11.0 | 12.0 | 13.0 | 14.0 | 15.0 |

### Spatial resolution (MTF)

- The modulation transfer function (MTF) is calculated from the discrete Fourier transform of the average vertical and horizontal LSF’s of the point spread function from the bead or wire test section. The program reports the 50%, 10%, and 2% MTF cutoff values.

<table>
<thead>
<tr>
<th>Spatial resolution (MTF)</th>
<th>Critical frequencies (cyc/cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td>8.15</td>
</tr>
</tbody>
</table>
Processing features (cont)

- **Slice thickness** – is determined from the average full-width at half-maximum (FWHM) of the CT number profile for each wire ramp. The expected slice width is compared with all four measured ramps values. A trigonometric conversion is calculated based on the known ramp angle to yield the slice width. This test provides information on the position of the phantom and the vertical and horizontal tilt values. A rotation of the phantom about an axis perpendicular to the ramps is also computed. Since there are two pairs of ramps orientated along the orthogonal directions, phantom rotations about both the vertical and horizontal axes can be estimated.

- **Uniformity** – vertical and horizontal profiles 10 pixels wide are generated and averaged through the phantom’s center. The fractional uniformity of the profile is calculated as the percentage of the pixels within an acceptable range determined by ± 2 times the central noise or ± 10 H, whichever is smaller.

- **Contrast detail (low contrast resolution)** – theoretical Contrast-Detail data is calculated based on the measured noise of the water/uniformity test section.

Note: Low contrast modules (CTP263 and CTP515) are not used in this measurement. This represents a conservative estimate of the minimum contrast level required such that a cylindrical object of a given diameter should be detected.

Result features

CT AutoQA Lite provides two database options for storage of test results. ‘Monitor Database’ is the first database option designated for constancy/monitoring and is linked to the Trend Analysis function. The ‘Service Database’ is the second database option and is designed for more extensive service and/or acceptance testing data sets. If neither of these two options is appropriate, the user can select the option to not store results but only view results.

Specifications

**Minimum computer requirements** Pentium® processor, Microsoft® Windows® 95/NT®, CD-Rom, network connection using TCP/IP protocol, NIC

**Available model(s)**

49-802 CT AutoQA Lite Software

For more information, receive our full product catalog, or order online, contact Radiation Management Services business of Fluke Biomedical: 440.248.9300 or www.flukebiomedical.com/rms.

Specifications are subject to change without notice.

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AAPM CT Performance Phantom
Model 76-410-4130

- Meets guidelines in AAPM Report No. 1 for Performance Evaluation and QC of CT Scanners
- Single system measures nine performance parameters

Features
This ONE phantom evaluates:
- Noise
- Spatial resolution
- Sensitivity (low contrast resolution)
- Absorbed dose
- Size dependence
- Contrast scale
- Slice thickness
- Alignment
- Linearity
- Beamwidth

Introduction
The increasing use of computed tomography (CT) as a diagnostic tool creates the need for an efficient means of evaluating the performance of the CT scanners now in use. Recognizing this requirement, the American Association of Physicists in Medicine established the AAPM Task Force on CT Scanner Phantoms. Its goals are to define CT scanner performance and present practical methods of performance testing through the utilization of special phantoms. This phantom design is based on the guidelines presented in Report #1 of the Task Force and approved by the AAPM.

Applications
The modular AAPM CT Performance Phantom offers the CT user a single system with which to measure nine performance parameters. This phantom permits the routine standardization of alignment, beam width, spatial uniformity, linearity/contrast, spatial resolution, linespread, noise, size independence, and absorbed dose. All components of the phantom are housed in a compact, transparent tank which holds the system together in the correct orientation.

The phantom consists of an 8.50 inch diameter acrylic tank containing a beam-width insert, a spatial resolution and linespread block, a high-contrast insert, and a means for inserting alignment pins and/or TLD holders. Additionally, a 0.25 inch thick Teflon® band, positioned at the base of the tank and concentric to the 8 inch internal diameter, simulates human bone. Attached to the base of the tank is a low-contrast section with resealable cavities (from 1 to 0.125 inch diameter) which can be filled with a diluted dextrose or other appropriate solution to provide a low-contrast media. The optional external resolution and noise ring slides snugly over the outside diameter of the tank, allowing whole-body scanner systems to be evaluated.
Specifications

**Water tank** Made of acrylic, 8.50 inch OD x 8 inch ID x 12.75 inch long. Resealable with fill and drain ports. Low-contrast detectability block is attached to base.

**Linearity and contrast insert** 7.50 inch OD x 2.50 inch long. Contains 1 inch diameter contrast pins of polyethylene, acrylic, polycarbonate, polystyrene and nylon. Density values: polyethylene, 0.95 gm/cc; polystyrene, 1.05 gm/cc; nylon, 1.10 gm/cc; acrylic, 1.19 gm/cc; polycarbonate, 1.20 gm/cc.

*Note:* The contrast pins in each AAPM CT Performance Phantom are identical in density to the contrast pins of similar material in every other Nuclear Associates’ CT Phantom. For example, the nylon pin in every CT Phantom we manufacture has the same density.

This uniform density among all Nuclear Associates’ phantoms provides the user with a standard for comparing the performance of different scanners.

**Resolution insert** 7.50 inch OD x 2.50 inch long with 6 inch diameter solid acrylic block. In the Model 76-410-4130, the block has eight sets of five holes: 1.75, 1.5, 1.25, 1.00, .75, 0.61, 0.5, and 0.4 mm round. In the Model 76-410-4132, the block has nine sets of five holes: 1.75, 1.5, 1.25, 1.00, .75, 0.61, 0.5, 0.4, and 0.2 mm round. In both phantom inserts, the holes are spaced longitudinally on 5 mm centers and vertically on centers equal to twice the hole width. All cavities are filled with air. The 6 inch block is sectored 1.25 inch out on radius. The insert contains 0.014 inch stainless steel wire positioned longitudinally to the insert plates. The wire allows simple computation of linespread functions. A sectored 1.25 inch portion of the main 6 inch block permits an edge gradient to be measured.

**Beam width insert** 7.50 inch OD x 3.50 inch long. Contains three 0.020 x 1.00 inch aluminum strips angled at 45°, positioned on the center line and displayed vertically. A simple, direct calculation permits the accurate measurement of beam width. Adjacency is determined merely by a double exposure of two adjacent frames.

**Low-contrast extension** 8.50 inch OD x 2.75 inch long solid acrylic block. Has two each of the following 2.25 inch deep cavities: 1, 0.75, 0.50, 0.375, 0.25, and 0.125 inch diameter, spaced twice the appropriate diameter apart, one row of cavities on each side of the center line. Cavities with screw-locking sealing ports are easily filled with dextrose or sodium chloride solutions of various densities. The user may adjust densities to any value suitable for the scanner. Typically, 2% or 3% differentials in density between cavities are used.

**Alignment pin** 0.25 inch OD x 3 inch long aluminum with tapped hole, allowing pin to be secured to cover plate.

**TLD insert** 0.50 inch OD x 3.50 inch long polystyrene rod drilled 3 inch deep to accept TLD inserts. Resealable cavity. Tapped on other end to allow mounting to cover plate.

**External (whole-body) resolution and noise ring** (Model 76-411) Annulus 12 inch OD x 8.50 inch ID x 2.50 inch long contains the same hole pattern as the Resolution Insert, at two locations 90° apart. Permits whole-body resolution and noise measurements when positioned on the main tank. Inner and outer resolution values are easily determined.

**CT-SSP insert** (Model 76-412) The CT-SSP (Slice Sensitivity Profile) Point Response Phantom can be used as a stand-alone phantom or as an insert with the AAPM CT Performance Phantom. The AAPM CT Performance Phantom meets the guidelines in AAPM Report #1 for Performance Evaluation and QC of CT Scanners. The AAPM CT Performance Phantom is described in the report by the AAPM Task Force on CT Scanner Phantoms. The acrylic and closed-cell foam ball bearing size is 0.010 inch, diameter is 7.50 inch, width is 3.50 inch, and weight is 0.825 lb.

**Low-Contrast CT Resolution Insert** (Model 76-421) The insert consists of an almost-water-equivalent plastic disc, 201 mm Ø x 25 mm thick, protected on both sides by clear plastic. The resolution targets are a series of water-filled holes from 2.5 to 7.5 mm in Ø, in 0.5 mm steps. For each target size, the center-to-center distance between holes is twice the hole diameter to ensure meaningful resolution testing. The insert’s 25 mm thickness eliminates alignment problems. Dimensions are 201.6 cm x 32.5 cm thick. Weight is 1 lb.

**Dimensions** 8.50 in Ø x 15.50 in (d) (21.59 x 39.37 cm)

**Weight** 17.25 lb (7.84 kg)

**Optional accessories**

- **External (Whole-Body) Resolution and Noise Ring** (Model 76-411)
- **CT-SSP Point Response Phantom** (Model 76-412)
- **Low-Contrast CT Resolution Insert** (Model 76-421)

**Available model(s)**

- **76-410-4130** AAPM CT Performance Phantom with Resolution Insert (to 0.4 mm)
- **76-410-4132** AAPM CT Performance Phantom with Resolution Insert (to 0.2 mm)

For more information, receive our full product catalog, or order online, contact Radiation Management Services business of Fluke Biomedical: 440.248.9300 or www.flukebiomedical.com/rms.

Specifications are subject to change without notice.
Nested CT Dose Phantom Kit for Pediatric/Adult Head and Body
Model 76-424-4156

- Uniquely designed for pediatric and adult computed tomography dose index (CTDI) in a lightweight (44 lb, 20 kg) total package
- Can be used with new multi-detector (MDCT) units
- Meets requirements of FDA performance standards
- All new carrying case with wheels and pull handle
- Case includes space for CT Ion Chambers (purchased separately)

Specifications

Weight
- Adult body phantom 25 lb (11.3 kg)
- Adult head/pediatric body phantom 5 lb (2.3 kg)
- Pediatric head phantom 3 lb (1.3 kg)
- 3 nested phantoms 33 lb (15 kg)

Dimensions
- Adult body phantom 15.5 cm long x 32 cm Ø
- Adult head/pediatric body phantom 15.5 cm long x 16 cm Ø
- Pediatric head phantom 15 cm long x 10 cm Ø

Available model(s)
- 76-424-4156 Nested CT Dose Phantom Kit for Pediatric/Adult Head and Body including carrying case with wheels and pull handle
- 76-424-4150 Nested CT Dose Phantom Kit for Pediatric/Adult Head and Body including carrying case without wheels and pull handle

Other CT Dose Phantoms available
- 76-419-4150 CT Dose Phantom Kit for Pediatric/Adult Head and Body including carrying case with wheels and pull handle
- 76-419 CT Pediatric Head Dose Phantom with five plugs
- 76-414 CT Head Dose Phantom with five plugs
- 76-415 CT Body Dose Phantom with five plugs

For ion chamber selection, see next page.

Introduction

The innovative nested CT Dose Phantom can be used with any computed tomography (CT) system designed to image pediatric and adult head and body. Each phantom segment can provide separate dose information. When performing dose profile measurements, the dose phantoms allow the user to collect information for the maximum, minimum and mid-range value of the nominal tomographic section thickness.

This essential phantom kit consists of three parts: an adult body phantom, an adult head phantom that doubles as a pediatric body phantom and the new pediatric head phantom, nested together for easy storage and convenient transport. (All are made of solid acrylic with diameters of 32, 16 and 10 cm, respectively.) Each part contains four probe holes around the perimeter, 90° apart and 1 cm from the edge and the pediatric head (center insert) has one probe hole in its center. The inside diameter of the holes is 1.31 cm. Each part includes five acrylic rods for plugging all the holes in the phantom. A sturdy storage and carrying case with wheels and pull handle that holds all three phantoms is included; as an option, a smaller case without wheels is available.

Applications

The CT Dose Phantoms were designed in accordance with the Food and Drug Administration’s performance standard for diagnostic x-ray systems, which includes regulations specifically applicable to CT systems (21 CFR 1020.33).
CT Ion Chambers

Specifications for 10 cc high sensitivity

Detector type  Vented air ion chamber
Volume  10.1 cc
Sensitive length  10.0 cm
Chamber material  Acrylic (PMMA)
Chamber outside diameter  0.5 in ± 0.015 in (12.7 mm ± 0.4 mm)
Chamber inside diameter  0.45 in (11.44 mm)
Chamber wall thickness  77 mg/cm²
Electrode material  Aluminum, 1100
Sensitivity  3.2 R•cm/nC (nominal) or 0.3/nC
Standard calibration  100 kVCP, 5.5 mm Al HVL (NIST Tech. M100)
Response uniformity along axis  ±3% over central 90% of active length
Beam orientation  Normal to chamber axis
Leakage current (300 V collection potential)  Less than 10⁻¹⁴ A at 10 min polarization time

Specifications for 3.2 cc

Detector type  Vented air ion chamber
Volume  3.2 cc
Sensitive length  10.0 cm
Chamber material  Polystyrene
Chamber inside diameter  6.4 mm
Chamber wall thickness  54 mg/cm²
Electrode material  Aluminum
Sensitivity  10 R•cm/nC (nominal)
Standard calibration  100 kVCP, 5.5 mm Al HVL (NIST Tech. M100)
Response uniformity along axis  ±3% over central 90% of active length
Beam orientation  Normal to chamber axis
Phantom adapter OD  1.27 ± 0.04 cm (0.50 ± 0.015 in)
Leakage current (300 V collection potential)  Less than 10¹³ A at 10 min polarization time
Intensity limits  Continuous beam: 4.86 kR/min (1% recombination loss)
Pulsed beam  51.5 mR/pulse (1% recombination loss)

Available model(s)

660-6  CT Ion Chamber, 3.2 cm³, with UHF termination: used with Victoreen® Model 660 Electrometer
500-100  CT Ion Chamber, 3.2 cm³, with coax BNC for signal & banana plug for bias: used with Model 35040 (ATD), TRIAD™ and TRIAD TnT
500-200  CT Ion Chamber High Sensitivity, 10 cm³ for multislice CT, with coax BNC for signal & banana plug for bias: used with Model 35040 ATD and other electrometer/dosimeters, including TRIAD and TRIAD TnT
6000-100  CT Ion Chamber, 3.2 cm³, with triax BNC: used with Victoreen Models 4000, 6000, 8000 and RAD-CHECK® PLUS
6000-200  CT Ion Chamber High Sensitivity, 10 cm³, for multislice CT, with triax BNC: used with Victoreen Models 4000, 6000, 8000 and RAD-CHECK PLUS

Typical energy dependence for 10 cc high sensitivity ion chamber (phantom adapter removed)

Typical energy dependence for 3.2 cc ion chamber (phantom adapter removed)

For more information, receive our full product catalog, or order online, contact Radiation Management Services business of Fluke Biomedical: 440.248.9300 or www.flukebiomedical.com/rms.

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CT Dose Phantom Kit for Pediatric/Adult Head and Body
Model 76-419-4150

- Specifically designed for pediatric and adult computed tomography dose index (CTDI)
- Can be used with new multi-detector (MDCT) units
- Meets requirements of FDA performance standards
- All new carrying case with wheels and pull handle

**Specifications**

<table>
<thead>
<tr>
<th>Weight</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Body phantom</strong></td>
<td>32 lb (14.5 kg)</td>
</tr>
<tr>
<td><strong>Head phantom</strong></td>
<td>8 lb (3.6 kg)</td>
</tr>
<tr>
<td><strong>Pediatric head phantom</strong></td>
<td>2.85 lb (1.3 kg)</td>
</tr>
</tbody>
</table>

**Optional accessories**

- 89-419 Carrying Case with wheels and pull handle for CT Dose Phantom Kit for Pediatric/Adult Head and Body
- 89-414 Carrying Case for CT Dose Phantom Kit for Adult Head and Body

*For ion chamber selection, see next page.*

**Available model(s)**

- 76-419-4150 CT Dose Phantom Kit for Pediatric/Adult Head and Body including carrying case with wheels and pull handle
- 76-414-4150 CT Dose Phantom Kit for Adult Head and Body including carrying case
- 76-419 CT Pediatric Head Dose Phantom with five plugs
- 76-414 CT Head Dose Phantom with five plugs
- 76-415 CT Body Dose Phantom with five plugs

**Introduction**

These phantoms can be used with any computed tomography (CT) system designed to image pediatric and adult head and body. They can separate dose information for each. When performing dose profile measurements, the dose phantoms allow the user to collect information for the maximum, minimum and mid-range value of the nominal tomographic section thickness.

This essential phantom kit consists of three parts: an adult body phantom, an adult head phantom that doubles as a pediatric body phantom and the new pediatric head phantom. (All are made of solid acrylic, 15 cm thick, with diameters of 32, 16 and 10 cm, respectively.) Each part contains five probe holes, one in the center and four around the perimeter, 90° apart and 1 cm from the edge. The inside diameter of the holes is 1.31 cm. Each part includes five acrylic rods for plugging all the holes in the phantom. A sturdy storage and carrying case that holds all three phantoms is available as an option and includes wheels and a pull handle.

**Applications**

The CT Dose Phantoms were designed in accordance with the Food and Drug Administration’s performance standard for diagnostic x-ray systems, which includes regulations specifically applicable to CT systems (21 CFR 1020.33).
## CT Ion Chambers

### Specifications for 10 cc high sensitivity

<table>
<thead>
<tr>
<th>Detector type</th>
<th>Vented air ion chamber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume</td>
<td>10.1 cc</td>
</tr>
<tr>
<td>Sensitive length</td>
<td>10.0 cm</td>
</tr>
<tr>
<td>Chamber material</td>
<td>Acrylic (PMMA)</td>
</tr>
<tr>
<td>Chamber outside diameter</td>
<td>0.5 in ± 0.015 in</td>
</tr>
<tr>
<td></td>
<td>(12.7 mm ± 0.4 mm)</td>
</tr>
<tr>
<td>Chamber inside diameter</td>
<td>0.45 in (11.44 mm)</td>
</tr>
<tr>
<td>Chamber wall thickness</td>
<td>77 mg/cm²</td>
</tr>
<tr>
<td>Electrode material</td>
<td>Aluminum, 1100</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>3.2 R•cm/nC (nominal)</td>
</tr>
</tbody>
</table>

### Typical energy dependence for 10 cc high sensitivity ion chamber

- **HVL (mm Al)**: 10
- **Indicated / Actual**:
  - 0.7
  - 0.8
  - 0.9
  - 1.0
  - 1.1
  - 1.2

### Specifications for 3.2 cc

<table>
<thead>
<tr>
<th>Detector type</th>
<th>Vented air ion chamber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume</td>
<td>3.2 cc</td>
</tr>
<tr>
<td>Sensitive length</td>
<td>10.0 cm</td>
</tr>
<tr>
<td>Chamber material</td>
<td>Polystyrene</td>
</tr>
<tr>
<td>Chamber inside diameter</td>
<td>6.4 mm</td>
</tr>
<tr>
<td>Chamber wall thickness</td>
<td>54 mg/cm²</td>
</tr>
<tr>
<td>Electrode material</td>
<td>Aluminum</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>10 R•cm/nC (nominal)</td>
</tr>
</tbody>
</table>

### Typical energy dependence for 3.2 cc ion chamber (phantom adapter removed)

- **HVL (mm Al)**: 10
- **Indicated / Actual**:
  - 0.7
  - 0.8
  - 0.9
  - 1.0
  - 1.1
  - 1.2

### Available model(s)

- **660-6**: CT Ion Chamber, 3.2 cm³, with UHF termination: used with Victoreen® Model 660 Electrometer
- **500-100**: CT Ion Chamber, 3.2 cm³, with coax BNC for signal & banana plug for bias: used with Model 35040 (ATD), TRIAD™ and TRIAD TnT
- **500-200**: CT Ion Chamber High Sensitivity, 10 cm³ for multislice CT, with coax BNC for signal & banana plug for bias: used with Model 35040 ATD and other electrometer/dosimeters, including TRIAD and TRIAD TnT
- **6000-100**: CT Ion Chamber, 3.2 cm³, with triax BNC: used with Victoreen Models 4000, 6000, 8000 and RAD-CHECK PLUS
- **6000-200**: CT Ion Chamber High Sensitivity, 10 cm³, for multislice CT, with triax BNC: used with Victoreen Models 4000, 6000, 8000 and RAD-CHECK PLUS

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76-419-4150-ds rev 2 24 mar 05
CT Dose Phantom Kit for Adult Head and Body
Model 76-414-4150

Introduction
These phantoms can be used with any computed tomography (CT) system designed to image both head and body. They can separate dose information for each. When performing dose profile measurements, the dose phantoms allow the user to collect information for the maximum, minimum and mid-range value of the nominal tomographic section thickness.

This essential phantom consists of two parts: a body phantom and a head phantom. Both are made of solid acrylic, 15 cm thick, with diameters of 32 cm and 16 cm, respectively. Each part contains five probe holes, one in the center and four around the perimeter, 90° apart and 1 cm from the edge. The inside diameter of the holes is 1.31 cm. Each part includes five acrylic rods for plugging all the holes in the phantom. A storage and carrying case is available for your convenience.

Applications
The CT Dose Phantoms were designed in accordance with the Food and Drug Administration’s performance standard for diagnostic x-ray systems, which includes regulations specifically applicable to CT systems (21 CFR 1020.33).

Specifications

<table>
<thead>
<tr>
<th>Weight</th>
<th>Body phantom: 32 lb (14.5 kg); Head phantom: 8 lb (3.6 kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optional accessories</td>
<td></td>
</tr>
<tr>
<td>Carrying Case (Model 89-414)</td>
<td></td>
</tr>
<tr>
<td>CT Head Dose Phantom with five plugs (Model 76-414)</td>
<td></td>
</tr>
<tr>
<td>CT Body Dose Phantom with five plugs (Model 76-415)</td>
<td></td>
</tr>
<tr>
<td>Available model(s)</td>
<td></td>
</tr>
<tr>
<td>76-414-4150 CT Dose Phantom Kit for Adult Head and Body, including carrying case</td>
<td></td>
</tr>
</tbody>
</table>

CT Ion Chambers

Specifications

<table>
<thead>
<tr>
<th>Detector type</th>
<th>Vented air ion chamber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume</td>
<td>3.2 cc</td>
</tr>
<tr>
<td>Sensitive length</td>
<td>10.0 cm</td>
</tr>
<tr>
<td>Chamber material</td>
<td>Polystyrene</td>
</tr>
<tr>
<td>Chamber inside diameter</td>
<td>6.4 mm</td>
</tr>
<tr>
<td>Chamber wall thickness</td>
<td>54 mg/cm²</td>
</tr>
<tr>
<td>Electrode material</td>
<td>Aluminum</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>10 R. cm/nC (nominal)</td>
</tr>
<tr>
<td>Standard calibration</td>
<td>100 kVCP, 5.5 mm Al HVL (NIST Tech. M100)</td>
</tr>
<tr>
<td>Energy response</td>
<td>± 5%, 1 mm Al to 10 mm Al HVL</td>
</tr>
<tr>
<td>Beam orientation</td>
<td>Normal to chamber axis</td>
</tr>
<tr>
<td>Phantom adapter</td>
<td>OD 1.27 ± 0.04 cm (0.50 ± 0.015 in)</td>
</tr>
<tr>
<td>Leakage current</td>
<td>(300 V collection potential) less than 1013 A at 10 min polarization time, less than 1014 A at 2 hr polarization time</td>
</tr>
<tr>
<td>Intensity limits Continuous beam</td>
<td>4.86 kR/min (1% recombination loss)</td>
</tr>
<tr>
<td>Pulsed beam</td>
<td>51.5 mR/pulse (1% recombination loss)</td>
</tr>
<tr>
<td>Maximum pulse repetition rate</td>
<td>3.3 kHz</td>
</tr>
<tr>
<td>Cable length</td>
<td>3 ft (0.9 m)</td>
</tr>
<tr>
<td>Weight</td>
<td>1 lb (0.46 kg)</td>
</tr>
<tr>
<td>Available model(s)</td>
<td></td>
</tr>
<tr>
<td>600-6 CT Ion Chamber, 3.2 cm², with UHF termination: used with Victoreen® Model 660 Electrometer</td>
<td></td>
</tr>
<tr>
<td>500-100 CT Ion Chamber, 3.2 cm², used with Model 35040 (ATD)</td>
<td></td>
</tr>
<tr>
<td>500-200 CT Ion Chamber High Sensitivity, 10 cm²: used with Model 35040 (ATD) and other electrometer/dosimeters</td>
<td></td>
</tr>
</tbody>
</table>

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76-414-4150-ds rev 4 24 mar 05

For specifications on 10 cc high sensitivity ion chamber, see previous page.
Spiral/Helical CT Lesion Detectability Phantom
Model 76-409

Introduction
The CT Lesion Detectability Phantom is particularly useful to physicians, CT technologists, and medical physicists who design scanning protocols for abdominal, pelvic, and brain CT. It allows users to test various scanning protocols to verify that small low contrast lesions will be detected. This is the only way to be sure that a CT scanner is “seeing” tumors that are known to be present. The use of this phantom removes any doubt as to the limit of low contrast spherical lesion detectability for various scan protocols.

Applications
The phantom is designed to permit complete testing of low contrast lesion detection when various scan or image reconstruction parameters are varied. These include: collimation, pitch, reconstructed field of view, reconstruction algorithm, z-axis (patient’s long axis) interpolators, kVp, mA, and rotation time. This lesion detectability testing can be applied to protocols designed for imaging of the liver, spleen, pancreas, kidneys, and adrenal glands. It can also be used for mass detection in the brain.

Specifications
Note: The CT Lesion Detectability Phantom is a tissue-equivalent test object that consists of an 18 cm diameter right circular cylinder with a CT value of 50 HU at 120 kVp. Within the phantom is an 18 cm diameter, 4 cm deep right circular void in which a soft-tissue-equivalent disk (containing low contrast spheres) can be placed. The cylindrical void is in a plane containing the z-axis of the scanner. The soft-tissue-equivalent disk also has a background CT value of 50 HU. Embedded within the disk are three sets of simulated spherical lesions. One set is 5 HU below background, a second set is 10 HU below background, and the last set is 20 HU below background. Each set contains one sphere each of the following diameters: 2.4, 3.2, 4.0, 4.8, 6.3 and 9.5 mm. These diameters were chosen to encompass the full range of clinically significant lesions. The disk can also be placed at the end of the phantom when axial scanning detectability testing is desired.

Low-contrast sphere diameters 2.4, 3.2, 4.0, 4.8, 6.3 and 9.5 mm
Disk dimensions 18 cm Ø x 4 cm thick
Phantom dimensions 20 cm long x 18 cm Ø
Weight 11.9 lb (5.4 kg)
Available model(s) 76-409 Spiral/Helical CT Lesion Detectability Phantom

• Incorporates clinically-relevant lesion shape (spherical) and size
• Provides clinically-relevant absolute HU values for soft tissue
• Provides a clinically-relevant HU differential (i.e. tumors have a slightly lower HU than background)

Features
• Designed for use on all conventional and spiral (helical) CT scanners
• Compact, rugged
• Features three cylindrical reference plugs made of the same material as the spherical lesions
• Valid for x-ray energies from 80 to 140 kVp
• Background Hounsfield Units (HU) approximate liver tissue
• Contains clinically-relevant sphere sizes of 2.4, 3.2, 4.0, 4.8, 6.3 and 9.5 mm in diameter
• Spheres are 5, 10, and 20 HU below background HU
• Carrying case is designed for use as a phantom support during scanning procedure
Mini CT QC Phantom
Model 76-430

- Lightweight, compact, and extremely portable
- Ideal for field service use
- Used with any CT scanner, for measurement and analysis of all major CT scanner functions and radiation dose
- Makes inhomogeneity corrections in radiation oncology

**Accurately evaluates:**
- Laser beam alignment
- Slice thickness, spacing, and contiguity
- Table movement
- CT numbers and noise level
- CT number uniformity
- Relative radiation dose
- Video monitor and image processing equipment
- Scout and axial scan correspondence
- High contrast resolution
- Low contrast resolution (with optional insert)

**Specifications**

| Dimensions | 6 inch Ø, 1 inch thick, with six 1.125 inch through-holes and four 0.50 inch through-holes |
| Lucite disk | The Lucite disk is attached to the side of the base by two removable nylon, slotted screws |
| Inserts | Phantom is supplied with seven inserts for 1.125 inch holes; 1 each of: Plastic Water®, bone-equivalent, polystyrene, polycarbonate, polyethylene, nylon, and one acrylic high-contrast resolution insert |
| Lucite base | 11.94 inch long x 1.81 inch wide x 0.69 inch thick, with copper wire (approx. 0.020 inch) fixed into a 0.020 inch deep groove centered on the base |
| Weight | 3 lb (1.36 kg) |

Optional accessories
- Low Contrast Resolution Insert (Model 76-430-1000): designed for determining the CT unit’s ability to detect slight differences in contrast. Two materials with very similar CT numbers are incorporated into the low contrast resolution insert to assess the low contrast detection capability of the unit. |
- Teflon® and Lung Inserts (Models 76-430-2000 and 76-430-3000): these inserts provide the CT number and density that are important when treatment planning parameters are being established for radiation therapy patients. |
- Teflon-Bone Semi-Ring (Model 76-430-4000): this accessory is used as a beam hardening ring for simulating clinical conditions. The ring has been machined to slide easily over the phantom, so that each of the inserts will have the effect of beam hardening. |
- Acrylic Insert with Wire, 0.50 inch (Model 76-430-1212) |
- Acrylic Insert (Model 76-430-6000) |
- Fillable Insert (Model 76-430-7000) |
- Aluminum Insert (Model 76-430-8000) |
- Carrying Case (Model 89-430) |
- Flex Film Cassette, 8 x 10 in (Model 07-800-8010) |
- Flex Film Cassette, 10 x 12 in (Model 07-800-1012) |

**Available model(s)**

- 76-430 Mini CT QC Phantom, includes seven inserts |
- 76-430-5555 Mini CT QC Phantom Kit, includes phantom, seven standard inserts, all seven optional inserts, teflon-bone semi-ring and carrying case |

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Interventional Triple-Modality 3D Abdominal Phantom
Nuclear Associates Model 84-357

Introduction
This anthropomorphic phantom is made from proprietary materials which accurately mimic human tissues under magnetic resonance imaging (MRI), ultrasound, and computed tomography (CT). It is designed for image-guided interventional procedures.

Applications
The phantom contains simulated lungs, liver, hepatic vessels, ribs, vertebra, kidneys, abdominal aorta, inferior vena cava, muscle fat and interstitial tissues. Embedded within the lung and liver are simulated lesions available in a range of sizes and relative contrasts.

Each phantom is protected by a fat-equivalent urethane membrane and ABS end-caps. These features make the phantom durable enough for extended scanning sessions and enable insertion of various surgical instruments, as needed.

Specifications
Material  Zerdine**, urethane, epoxy, and ABS
Dimensions  28 (w) x 12.5 (d) x 20 cm (h)
Weight  12 lb (5.5 kg)
Available model(s)
  84-357  Interventional Triple-Modality 3D Abdominal Phantom

Features
- Improve performance of freehand abdominal biopsies
- Test new equipment
- Validate automated biopsy systems
- Demonstrate CT, ultrasound and MRI scan techniques
- Optimize imaging protocols

Needle not included


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CT Spiral Phantom*  
Model 76-432

- A supplemental phantom to the CT Performance Phantom, described in a report by the AAPM task force on CT scanner phantoms
- Quality of axial and spiral scanning can be assured
- Accuracy of clinical diagnosis based on the object’s size, shape and location will be improved
- Users can evaluate scanners objectively and independently of CT manufacturers
- No film exposures and no radiation profile measurements are necessary
- All test results can be evaluated visually by the users in their image displays
- Scanner evaluation is more realistic; what you scan, is what you see

Introduction
The accurate indexing capability and exceptional image quality of the computed tomography (CT) scanners not only guarantee the object’s location and its size and shape, but also improve the diagnosis accuracy. The index and performance parameters of the CT scanners cannot be confirmed without objects of known specifications. The CT Spiral Phantom from Nuclear Associates provides specific details necessary to confirm the integrity of both conventional and spiral scanning. What makes the phantom unique is that it allows the user to visually evaluate all test results in their image displays.

Applications
The phantom consists of five Lucite® plates of different sizes, all affixed to a flat rectangular base. Specific hole patterns are drilled on each side of these plates. When imaging, the holes within the x-ray field will appear in the phantom images. By the hole appearance, both index and performance parameters can be confirmed qualitatively and quantitatively.

Features
Parameters that can be confirmed by the phantom, based on the hole appearance in the phantom images include:

Index parameters
- Light localizer orientation
- Light localizer and image slice congruence
- Slice thickness accuracy
- Gantry inclination
- Couch index accuracy
- Ruler (angle and distance) accuracy

Performance parameters
- Slice geometric uniformity
- Image geometric distortion
- Image slice overlap
- Slice thickness change by pitch factor and image interpolation
- Noise level of imaging protocols

This versatile phantom can be used by:

End users, to:
- Set up baseline standards for future reference
- Verify scanner performance in the acceptance test
- Assist in routine equipment quality control testing
- Evaluate vendor-supported imaging protocols
- Customize image parameters for special applications

CT manufacturers, to:
- Evaluate equipment hardware design
- Improve imaging software
- Facilitate equipment installation, calibration, and preventive maintenance

Research laboratories, for:
- Testing image reconstruction algorithms and interpolation approaches

Regulatory agencies, to:
- Set up the standards for CT scanners, and measure their compliance

Specifications
Material Lucite
Plate dimensions 10 x 10 cm, 15 x 15 cm, 20 x 20 cm, 25 x 25 cm
Phantom dimensions 25 (w) x 20 (d) x 25 cm (h)
Weight 7.18 lb (8.2 kg)
Available model(s) 76-432 CT Spiral Phantom, with Bubble Level

* Designed by Jung T. Ho, Ph.D., Department of Radiology, LAC+USC Medical Center, Los Angeles, California 90033.