

Radiologic phantoms for CT imaging experiments

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This list summarizes available phantoms for CT experiments that are available in the Institute of Diagnostic and Interventional Radiology, University Hospital Zurich.

The aim of this list is to encourage and foster collaboration with other research groups in the topic of CT imaging.

For any questions, study ideas and requests please contact Dr. Davide Cester (davide.cester@usz.ch) or Prof. Dr. Hatem Alkadhi (hatem.alkadhi@usz.ch).

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1. Alderson Rando Phantom – Adult

Manufacturer: The Phantom Laboratory, Salem, NY

Dimensions: Standard adult male (height, 175 cm; body weight, 73.5 kg)

Properties for dosimetry: Transected-horizontally into 2.5 cm thick slices. Each slice has holes which are plugged with bone-equivalent, soft-tissue-equivalent or lung tissue equivalent pins which can be replaced by TLD holder pins. Dosimetry holes are drilled in grids 3 cm x 3 cm or 1.5 cm x 1.5 cm in 5 and 7 mm diameters.

Short description: Adult dosimetry phantom

Paper: <https://www.ncbi.nlm.nih.gov/pubmed/27548276>



2. Dosimetry Phantom – Pediatric 5 years

Manufacturer: CIRS

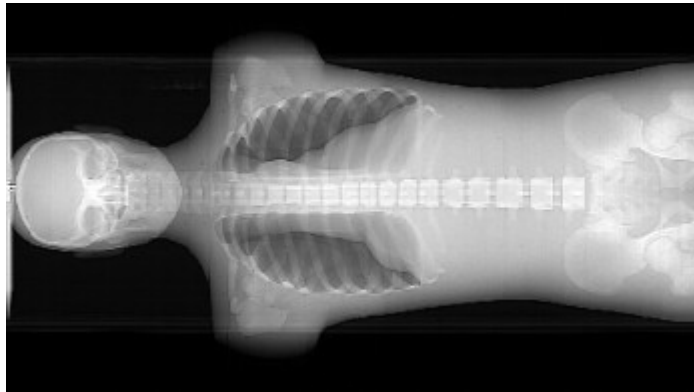
Model: ATOM Model 705-C

Dimensions: Height, 110 cm; Weight, 19 kg

Properties for dosimetry: Holes with 5 mm diameter in a 1.5 x 1.5 cm grid spacing

Short description: Pediatric dosimetry phantom

Paper: <https://www.ncbi.nlm.nih.gov/pubmed/31278575>



DESCRIPTION	HEIGHT	WEIGHT	THORAX DIMENSIONS	PHYSICAL DENSITY, G/CC	ELECTRON DENSITY, 1/CC
Pediatric 5 years	110 cm (17.1")	19 kg (51 lbs.)	14 x 17 cm (2.1 x 2.6")	1.52	$4.801 \cdot 10^{23}$

3. Mercury Phantom 4.0

Manufacturer: Sun Nuclear

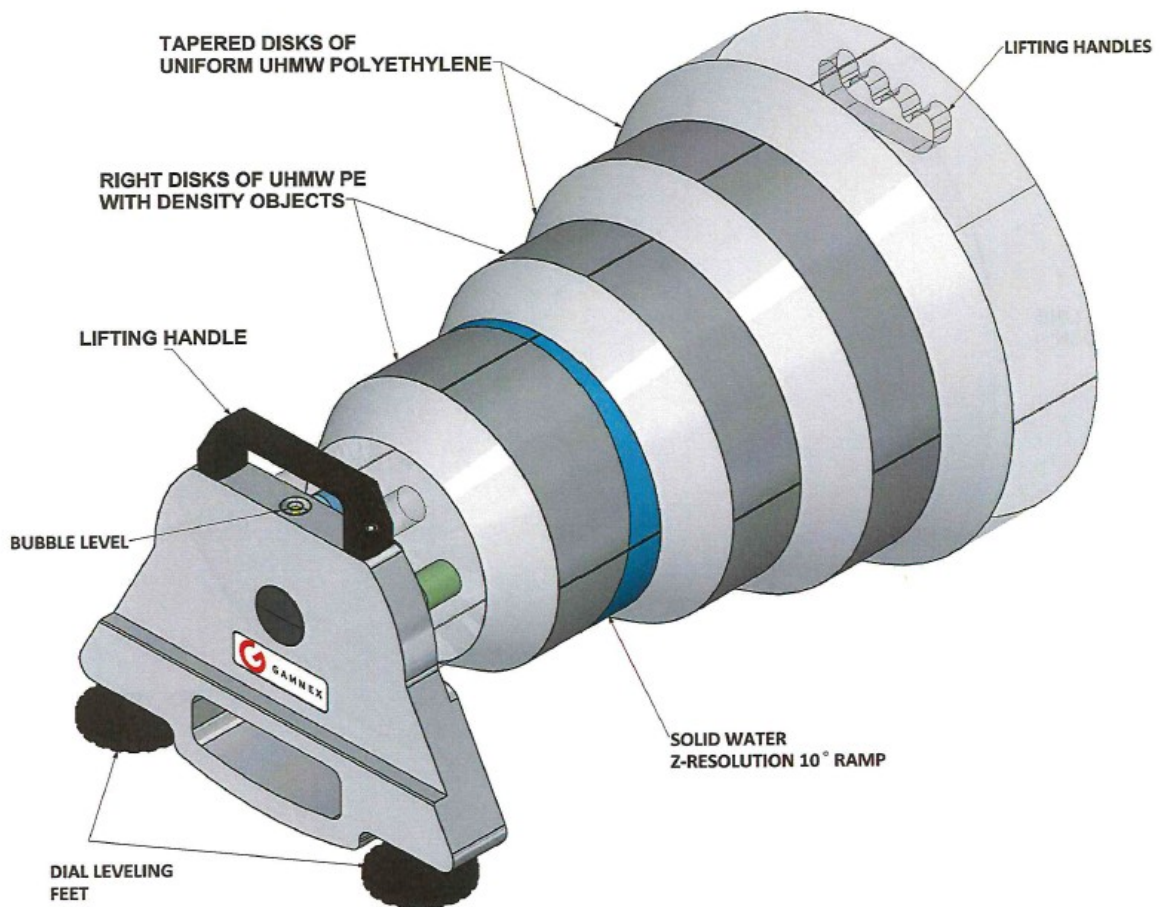
Model: 3853

Short description: Advanced CT Performance Assessment (Noise power spectrum, Task-transfer function, AEC Evaluation, Detectability index)

Mercury Phantom Product Specifications

Figure 1-2. Mercury 4.0 Phantom Specifications

Characteristic	Specification
Material:	Polyethylene
Diameter:	16.0, 21.0, 26.0, 31.0, and 36.0 cm
Length:	52 cm
Weight:	Approximately 29 kg (64 lbs)
Contrast Materials:	HE CT Solid Water®, Bone-mimicking material, Polystyrene, 10 mg/ml Iodine, and Air
Resolution Wedge Material:	CT Solid Water®
Analysis Software:	Phantom includes a license for the Duke ImQuest software



4. Multi-Energy CT Phantom

Manufacturer: Sun Nuclear

Short description: This phantom features a variety of interchangeable inserts of different material with certified electron density. It can be used to test the HU stability of a scanner as well as the material discrimination properties at different energies.



Website: <https://www.sunnuclear.com/products/multi-energy-ct-phantom>

List of available inserts:

Material	Units	Value	Quantity
Aluminum	ρ_e^w	2.36	2
HE Blood 40	ρ_e^w	1.03	1
HE Blood 70	ρ_e^w	1.07	1
HE Blood 100	ρ_e^w	1.10	1
HE Brain	ρ_e^w	1.02	1
HE Calcium	mg/mL	0, 5, 10, 20, 50, 100, 200, 300	1 each
HE CT Solid Water	ρ_e^w	1.00	1
HE General Adipose	ρ_e^w	0.94	1
Iodine	mg/mL	0.2, 0.5, 1, 2, 5, 10, 15, 20	1 each
Iodine, 5.0 mg/mL	diameter Core mm	2, 5, 10	1 each
Iodine + HE Blood	mg/mL	2.0, 4.0	1 each
Stainless Steel	ρ_e^w	6.73	2
Titanium	ρ_e^w	3.74	1

5. Anthropomorphic Abdominal Phantom with Liver and Spleen Insert

Manufacturer: Quality Assurance in Radiology and Medicine (QRM)

Model: QRM-Liver-Phantom; Liver inserts: QSA-453 and QSA-637

Phantom size (without fat rings): 300 x 200 x 100 mm

Fat-equivalent extension rings: M (350x250 mm), L (400x300 mm), XL (600x450 mm), can be also used for the chest phantom (no. 3)

Short description: Two different liver inserts with hypo- and hyperdense lesions containing iodine

Paper: <https://www.ncbi.nlm.nih.gov/pubmed/26002623>

Kugelförmige Läsionen*:

Läsion // HU/120 kV	5 mm	10 mm	15 mm
45 HU	1	2	2
60 HU	1	1	2
120 HU	1	1	1
180 HU	1	1	1

Kapselförmige Läsionen*:

Läsion // HU/120 kV	5 x 7.5 mm	10 x 15 mm	15 x 22.5 mm
45 HU	2	1	2
60 HU	2	1	1
120 HU	1	1	1
180 HU	1	1	1



6. Lung Nodule Phantom

Manufacturer: Quality Assurance in Radiology and Medicine (QRM)

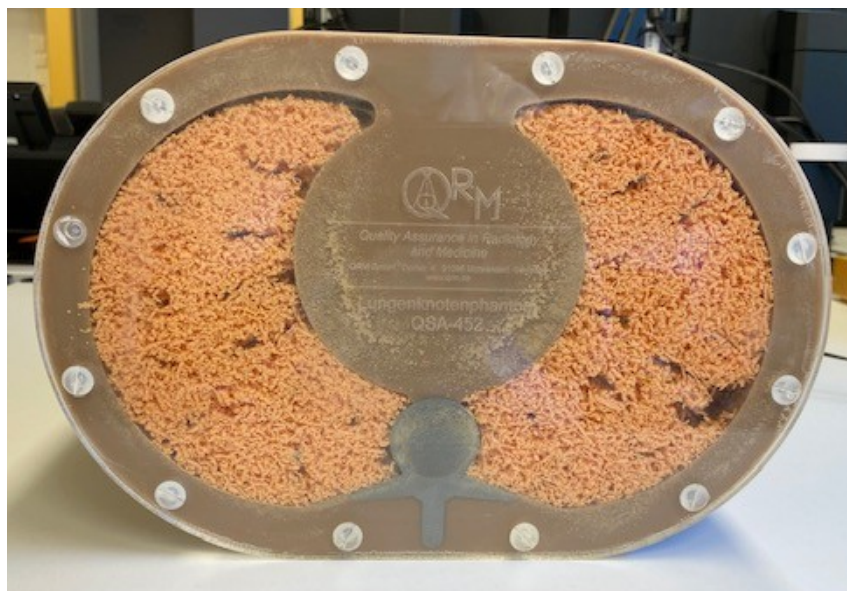
Model: QSA-452

Phantom size (without fat rings): 300x200x200 mm

Fat-equivalent extension rings: M (350x250 mm), L (400x300 mm), XL (600x450 mm), can be also used for the chest phantom (no. 2)

Short description: Lung nodules of different density

Paper: <https://www.ncbi.nlm.nih.gov/pubmed/24598443>



Kugel // HU/120 kV	2 mm	4 mm	6 mm	8 mm	10 mm
20 HU*	1	2	1	1	1
50 HU*	2	1	1	1	1
80 HU*	1	1	2	1	2
-700 HU*	1	2	1	1	1
-750 HU*	1	1	1	2	1
-800 HU*	2	1	1	1	1
-750 HU * mit Kern 50 HU*		1	1	1	

7. Cardio CT Phantom

Manufacturer: Quality Assurance in Radiology and Medicine (QRM)

Model: QRM-Cardio-Phantom

Phantom size (without fat rings): 300x200x100 mm

Material: Base material (resin; app. 35 HU at 120 kV) + lung tissue (app. -800 HU at 120 kV)

Short description: Calcium deposits of different size and density

http://www.qrm.de/content/products/anthropomorphic/cardio_phantom.htm



HA density [mg/cm ³]	Length [mm]	Diameter [mm]	Volume [mm ³]	Area [mm ²]	HA mass [mg]
200	5.0	5.0	98.2	19.6	19.6
200	3.0	3.0	21.2	7.1	4.2
200	1.0	1.0	0.8	0.8	0.2
400	5.0	5.0	98.2	19.6	39.3
400	3.0	3.0	21.2	7.1	8.5
400	1.0	1.0	0.8	0.8	0.3
800	5.0	5.0	98.2	19.6	78.5
800	3.0	3.0	21.2	7.1	17.0
800	1.0	1.0	0.8	0.8	0.6

8. European Spine Phantom – Bone mineral density

Manufacturer: QRM

Model: The European Spine Phantom

Short description: Standardization and quality control in spinal bone mineral measurements

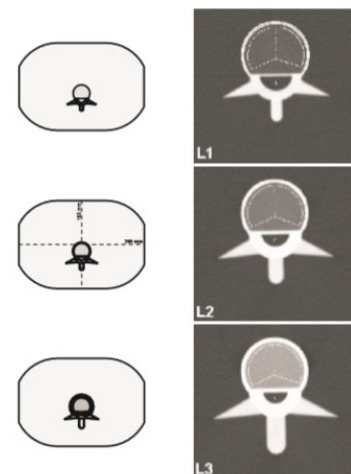
<http://www.qrm.eu/content/products/bonedensity/esp.htm>

Properties:

Material main body:	tissue-equivalent plastic
Spongiuous bone densities:	50, 100, 200 HA(mg/cm ³)
Area density of vertebrae:	0.5, 1.0, 1.5 (g/cm ²)
HA in cortical structures:	400, 800 HA (mg/cm ³)
Accuracy:	~ 3% of specified values ~ 1% of certified values
Phantom body:	260 x 180 mm ² (± 2mm)
Phantom weight:	4300 g



Resin based water-equivalent phantom body approximately oval shape but with flattend sides for ease of positioning.



9. Antropomorphic Liver Phantom

Manufacturer: PhantomX

Short description: this phantom has been custom-manufactured from a human CT dataset (portal venous liver CT).

Website: <https://phantomx.de/>



10. MRI/CT Adult Human Torso

Manufacturer: True Phantom

Size: 85 x 35 x 26 cm (approx.)

Weight: 45 kg (approx.)

Materials:

- Soft tissue and organs:
composition of urethane base soft resin
- Synthetic bones:
Patented ceramic-reinforced epoxy-based composite material



Structures:

11. Anatomically correct spine
12. Lung zones
13. Bones (Ribcage, Pelvis)
14. Anatomically correct heart
15. Below diaphragm hidden areas
16. Liver
17. Stomach
18. Intestines (Large & small)
19. Kidneys
20. Bladder

