RSD
Radiology Support Devices, Inc.

ART Phantom
Alderson Radiation Therapy

ACCURATE ORGAN DOSIMETRY MEASUREMENTS WITH MINIMAL DOSIMETERS

- **Over 10,000 phantoms in use all over the world for 30 years**
- **Indispensable quality-assurance tool**
- **Molded of tissue-equivalent material**

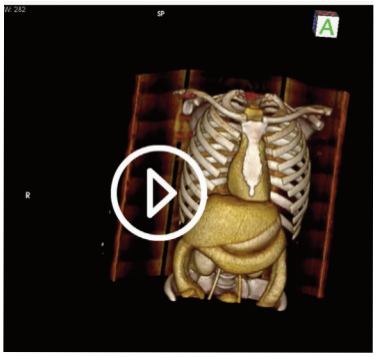
Molded of tissue-equivalent material and intended for accuracy and ease of use, the Alderson Radiation Therapy (ART) Phantom is a refined and improved version of the Alderson RANDO Phantom. ART Phantoms are designed within highly sophisticated technological constraints and follow ICRU-44 standards. Additionally, the phantoms provide integrated tests of the entire chain of treatment planning and delivery.

The ART Phantom is 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. Holder pins may be ordered separately.

Soft-tissue-equivalent coatings produce slices with glass smooth interfaces. These coatings are cut away over the air spaces of the oronasal pharynges, trachea, and stem bronchi. 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 thereby allowing for detailed measurements of dose distributions.

Breast Attachments: Breasts are available in various sizes. They can be sliced in frontal planes, drilled or undrilled for film dosimetry. Slices can receive any of the pins listed in the TLD Dosimeters and Fittings section, below. Breasts of male and female ART Phantoms are contoured to blend realistically with the thoraxes and attached with nylon screws. The male chest with attached breasts serves as a large female.

Lungs: Lungs are molded from syntactic foam, with a specific gravity of 0.30 g/cc.



TLD Dosimeters and Fittings: Phantoms are shipped with all dosimetry holes filled with blank pins. Pins for TLD chips have recesses at one end measuring 3.2 x 3.2 x 0.9 mm. Pins for TLD rods have 1 mm-diameter holes cross-drilled at the centers of the pins. All pins are 2.50 cm long unless otherwise specified. Pins may also be ordered to accommodate various types of OSLD dosimeters. Tissue equivalent plugs specifically machined for TLD chips, TLD rods, TLD bars, TLD cubes, MOSFET detectors, as well as LANDAUER® OSL MicroSTAR® and nanoDot® holders, are also available.

Assembly: ART Phantom slices are held between aluminum plates by nylon tie rods. Knobs at the end of the rods clamp the slices tightly in proper alignment. Both internal and external assembly devices are included. The external assembly facilitates film dosimetry, while the internal assembly is used generally with TLDs or ion chamber

Model Numbers

GRID HOLE SPACING	Undrilled	3cm x 3cm	1.5cm x 1.5cm
Male ART Phantom (Sections 0-35)	ART-200X	ART-200	ART-200A
Male ART Head & Neck Phantom (Sections 0-9)	ART-210X	ART-210	ART-210A
Male ART Chest Phantom (Section 10-25)	ART-211X	ART-211	ART-211A
Male ART Pelvis Phantom (Sections 26-35)	ART-212X	ART-212	ART-212A
Female ART Phantom (Sections 0-32)	ART-300X	ART-300	ART-300A
Female ART Head & Neck Phantom (Sections 0-9)	ART-310X	ART-310	ART-310A
Female ART Chest Phantom (Sections 10-23)	ART-311X	ART-311	ART-311A
Female ART Pelvis Phantom (Sections 24-32)	ART-312X	ART-312	ART-312A

Materials *See page 30 for more information.*

RSD Soft Tissue	RSD Cortical Bone	RSD Trabecular Bone
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Specifications

Packing Size	Packing Weight
147W x 38D x 48H cm	104 kg
58W x 15D x 19H in	230 lb.

Publication References: 1) Flatten V, Friedrich A, Engenhart-Cabillic R, Zink K. A phantom based evaluation of the dose prediction and effects in treatment plans, when calculating on a direct density CT reconstruction. J Appl Clin Med Phys. 2020 Mar;21(3):52-61. DOI: https://doi.org/10.1002/acm2.12824. PMID: 32176455; PMCID: PMC7075385. 2)Hauri P, Schneider U. Whole-body dose equivalent including neutrons is similar for 6 MV and 15 MV IMRT, VMAT, and 3D conformal radiotherapy. J Appl Clin Med Phys. 2019 Mar;20(3):56-70. DOI: https://doi.org/10.1002/acm2.12543. Epub 2019 Feb 21. PMID: 30791198; PMCID: PMC6414138. 3) Sawyer L J, Whittle S A, Matthews E S, Starritt H C, JUPP T P. Estimation of Organ and Effective Doses Resulting From Cone Beam CT Imaging for Radiotherapy Treatment Planning. British Journal of Radiology, Vol. 82, No. 979. 2014 Mar. DOI: https://doi.org/10.1259/bjr/62467578.

Custom ART Options Include:

- Dosimetry locations (midline, superior, inferior, etc.) within any organ
- Cross sectional slice thickness as thin as 25mm
- Detector accommodations including TLD, MOSFET detectors, LANDAUER® OSL MicroSTAR® and nanoDot® holders, as well as film, ion chambers, and diodes
- Pathology or fractures based on user requirements

Contact RSD or an authorized RSD Dealer for customization options.

Applications

Organ specific dosimetry for all dosimeters (TLD, OSL nanodots, MOSFET, film, ion chambers, and diodes)

Standard 3cm x 3cm or 1.5cm x 1.5cm hole grids for dosimeters

IMRT organ dose distributions

Modalities

External beams in the 0.04 to 40 MeV

FluoroscopyIntensity-Modulated Radiation Therapy (IMRT)

Stereotactic Body Radiation Therapy (SBRT)

Gamma Knife

CyberKnife

CT

Cone Beam CT

Anatomy

The male ART represents a 175cm (5 ft. 9 in.) tall, 73.5kg (162 lb.) male

The female ART represents a 155 cm (5 ft. 1 in.) tall, 50 kg (110 lb.) female

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RSD Materials

Soft Tissues: There are unlimited, small variations in density and absorption throughout the human body. Phantom soft tissue is closely controlled to have the average density of these tissues.

Skeletons: RSD skeletons are highly detailed polymer moldings which reproduce the shape, mass density and attenuation coefficients of cortical bone and spongiosa. RSD's proprietary moldings allow for continuous production, eliminate the restrictions of human skeleton bones (including limited availability, unethical collection of human bone specimen, variable size, and uncertain chemical composition), and avoid the loss of marrows in dried natural skeletons thereby making RSD skeletons superior to "real bone."

Molds: Molds for the RSD cortical bone and spongiosa were made from human skeletons consistent with the sizes of the soft tissue molds.

ICRU 44: RSD skeletons conform closely to the standards established by the International Commission on Radiation Units and Measurements (ICRU Report No. 44); mass density is reduced slightly to take into account a small decrease in calcium content for older patients.

LINEAR ATTENUATION DATA

1. Monte Carlo simulation was used to calculate linear attenuation coefficients as a function of beam.
2. Monte Carlo results were validated with linear attenuation coefficients derived from Hounsfield Unit measurements at discreet energy levels.
3. RSD Phantom material linear attenuation data was compared to NIST data using ICRU Report 44 compositions of human tissues.
4. NIST data was interpolated when necessary.

MATERIALS	DENSITY (g/cc)
RSD Soft Tissue (Opaque)	1.08
RSD Soft Tissue (Transparent)	1.10
RSD Cortical Bone	1.18
RSD Trabecular Bone	1.17

RSD SOFT TISSUE					
Energy (MeV)	Mean (HU)	Calculated (M)	μ (ICRU 44)	% Difference	Ratio
00.08	60.30	0.1948	0.1932	0.0080	0.9921
00.10	52.88	0.1797	0.1795	0.0015	0.9985
00.12	57.10	0.1717	0.1709	0.0044	0.9956
00.14	52.95	0.1623	0.1624	0.0007	1.0007
00.20	--	0.1477	0.1439	0.0261	0.9746
00.30	--	0.1245	0.1246	0.0004	1.0004
00.60	--	0.0950	0.0941	0.0101	0.9900
00.80	--	0.0825	0.0826	0.0013	1.0013
01.00	--	0.0744	0.0743	0.0018	0.9982
02.00	--	0.0520	0.0519	0.0018	0.9982
03.00	--	0.0351	0.0357	0.0171	1.0174
06.00	--	0.0288	0.0291	0.0088	1.0088
08.00	--	0.0252	0.0255	0.0098	1.0099
10.00	--	0.0229	0.0232	0.0149	1.0151
15.00	--	0.0203	0.0203	0.0015	0.9985
20.00	--	0.0189	0.0189	0.0017	1.0017

RSD CORTICAL BONE					
Energy (MeV)	Mean (HU)	Calculated (M)	μ (ICRU 44)	% Difference	Ratio
00.08	1365	0.4345	0.4280	0.0151	0.9851
00.10	1048	0.3496	0.3562	0.0184	1.0188
00.12	0977	0.3211	0.3274	0.0191	1.0195
00.14	0902	0.2932	0.2986	0.0180	1.0184
00.20	--	0.2511	0.2513	0.0009	1.0009
00.30	--	0.2155	0.2137	0.0084	0.9916
00.60	--	0.1596	0.1598	0.0011	1.0011
00.80	--	0.1403	0.1402	0.0010	0.9990
01.00	--	0.1274	0.1261	0.0106	0.9895
02.00	--	0.0883	0.0885	0.0017	1.0017
03.00	--	0.0611	0.0625	0.0229	1.0235
06.00	--	0.0512	0.0525	0.0246	1.0253
08.00	--	0.0468	0.0474	0.0120	1.0121
10.00	--	0.0446	0.0444	0.0039	0.9962
15.00	--	0.0410	0.0409	0.0016	0.9984
20.00	--	0.0393	0.0397	0.0102	1.0103

RSD TRABECULAR BONE (SPONGIOSA)					
Energy (MeV)	Mean (HU)	Calculated (M)	μ (ICRU 44)	% Difference	Ratio
00.08	551	0.2849	--	--	--
00.10	515	0.2586	--	--	--
00.12	439	0.2337	--	--	--
00.14	318	0.1541	--	--	--