

Phantom Patient for VMAT-IMRT Verification

SHANE 13650001



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SHOULDERS, HEAD AND NECK, END-TO-END

CIRS

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OVERVIEW

The CIRS Dose Verification Head and Shoulder Phantom is designed for end-to-end testing of treatment planning systems from imaging acquisition through dosimetry verification. The high fidelity anthropomorphic design contains complex internal anatomy that provides a realistic clinical simulation to evaluate the challenging effects of intra- and extra-cranial anatomies. Head and shoulder portions are manufactured as a single piece to enable use with various fixation devices. The shoulder portion contains thoracic vertebrae, which enables TPS verification to the level of T2 vertebra. Shoulders also include electron density inserts for calibration. Dosimetry measurements for treatment plan verification can be performed using large Radiochromic or radiographic film positioned in the coronal plane of the phantom and using ion chambers or other detectors, which can be positioned in four parallel holes drilled through the phantom in Inferior-Superior direction.

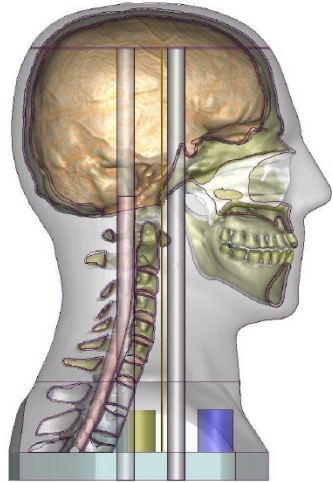


DESCRIPTION OF THE PHANTOM

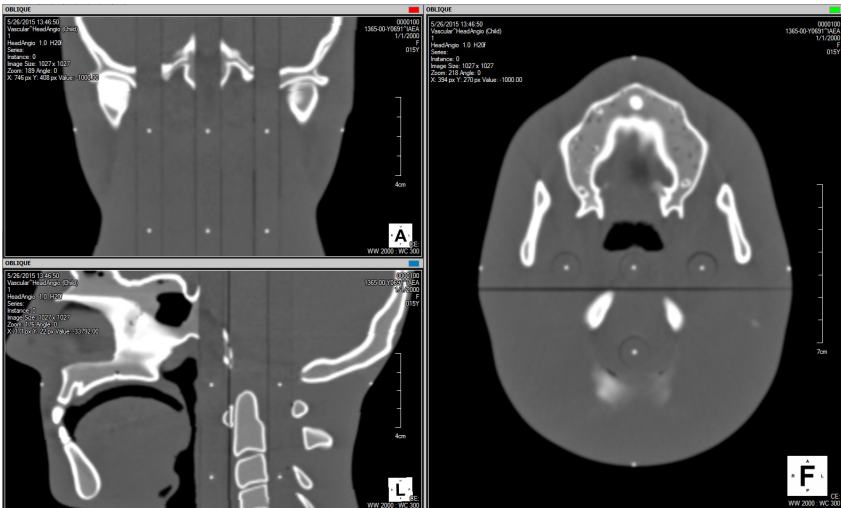
The phantom is based on the standard CIRS Model 038 Stereotactic End-to-End Verification phantom (STEEV) and consists of two major components: head and shoulders that are permanently attached. Head is cut axially at the vertex parallel to the Frankfort horizontal plane. The rest of the phantom is cut coronally and serves as a main dosimetry location. An ABS end plate is attached to the bottom of the shoulders. It measures 2 cm in thickness. Both vertex and shoulder end plate are attached to the phantom using nylon screws. Nylon thumb screws are used to disassemble front and rear portions of the phantom.

An additional black nylon strap with a buckle can be wrapped around the neck to avoid deformation during storing, transportation and phantom use.

Shoulders are reduced in size in superior-inferior (SI) direction down to 7 cm to minimize the weight of the phantom. The shoulders have thoracic spine anatomy T1-T3 to extend the useful dosimetry region.



The Phantom is drilled in four (4) locations to accommodate ion chambers or other dosimetry detectors: one between the spine and trachea, and two (2) holes 3 cm laterally from the central hole at the same coronal plane. These cavities can be used for parotid and nasopharynx plan verification. With the spacer plugs provided, oropharynx and hypopharynx plans can also be verified. A spinal hole is drilled centrally in the spinal cord at the level of C2 vertebra for verification of treatment plan in the neck. All holes measure 13 mm in diameter.



POSITIONING AND FILM REGISTRATION

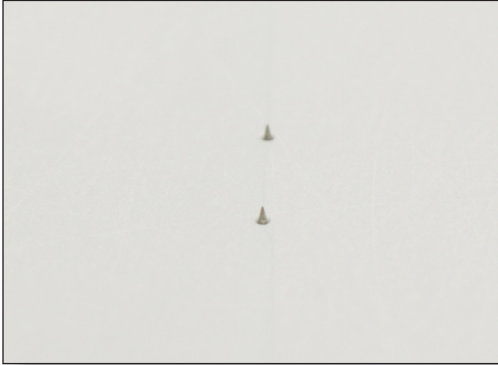
The phantom contains unique features for proper and repeatable orientation, positioning and film-to-treatment plan registration. Laser alignment marks (crosshairs) are aligned with an anterior hole and positioned on the vertex, front and sides of the head and shoulders. Lateral and frontal marks identify the ISO center that is virtually located at the level of nasopharynx in the SI direction. Lateral, Anterior and Posterior laser marks on the head have four (4) ceramic (Al₂O₃) BBs Ø 1.5 mm at the center for imaging plane identification.



There is one (1) solid rod with a single ceramic BB located only at the ISO imaging plane, and there are four (4) solid rods for the IS holes with the same ceramic BBs, located at the ISO imaging plane for ion chamber iso center localization. All rods measure 330 mm in length.

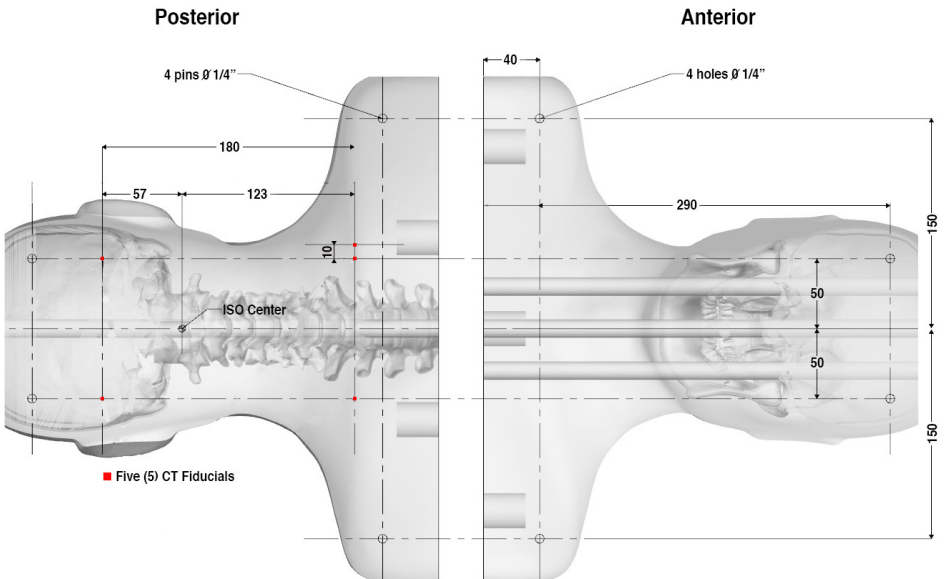


The posterior portion of the phantom contains five (5) CT fiducial pins for film-to-treatment plan registration. Four fiducials are located in an orthogonal configuration and a fifth fiducial is 10 mm offset to avoid mistakes in film registration. They are made of stainless steel and measure \varnothing 1 mm and 5 mm in length. The sharp tips of the fiducials prick the film surface from behind making a precise point on the image. See diagram at the bottom of this page for precise fiducial locations.



FILM DOSIMETRY

Film for dosimetry measurements can be received in a large coronal slice through the head, neck and shoulders. Film slice is located approximately 10 mm from the central axis of the anterior hole. There are five (5) additional CT fiducial pins for image-to-treatment plan registration. Film can be cut to shape if desired before or after placement using a sharp blade or scissors.



ION CHAMBER DOSIMETRY

The phantom is configured for use with PTW 31010 Semiflex 0.125 cc ion chamber (CIRS cavity code CV511C), but can accommodate different ion chambers, diodes or other detectors upon request.

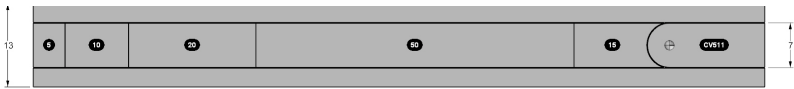
To use an ion chamber through the IS holes in variable positions each phantom is equipped with:

DESCRIPTION	SIZE	MATERIAL	QTY
Sleeve CV511C	115 (L) mm	Soft Tissue (STG)	3
Plug PL-CV511C	330 (L) mm	Soft Tissue (STG)	1
Plug PL-CV511C with BB	330 (L) mm	Soft Tissue (STG)	1
Ø 7mm Spacer Plugs CV511C	Total Length 370 mm	Soft Tissue (STG)	10
Ø 13mm Spacer Plugs CV511C	Total Length 130 mm	Soft Tissue (STG)	8

Ø 7 Spacer Plugs Breakdown: cavity plug to accommodate a tip of chamber CV511C – 15 mm long - qty 1. Cylindrical plugs: 1 x 5 mm Long, 1 x 10 mm Long, 2 x 20 mm Long, 4 x 50 mm Long, and 1 x 100 mm Long.

Ø 13 Spacer Plugs Breakdown: Cylindrical plugs: 2 x 5 mm Long, 2 x 10 mm Long, 2 x 20 mm Long, 2 x 30 mm Long.

Schematics For Ion Chamber Re-Positioning Using Spacer Plugs Inside 7mm Ø Sleeves.



Schematics For Ion Chamber Re-Positioning Using Spacer Plugs in 13 mm Ø



To use an Ion chamber at ISO location or at ISO+50 mm locations phantom includes:

DESCRIPTION	SIZE	MATERIAL	QTY
Cavity Rod CV511C@ISO	320 (L) mm	Soft Tissue (STG)	1
Plug PL-CV511C	217(L) mm	Soft Tissue (STG)	1

DESCRIPTION	SIZE	MATERIAL	QTY
Cavity Rod CV511C@ISO+50	320 (L) mm	Soft Tissue (STG)	1
Plug PL-CV511C	167(L) mm	Soft Tissue (STG)	1

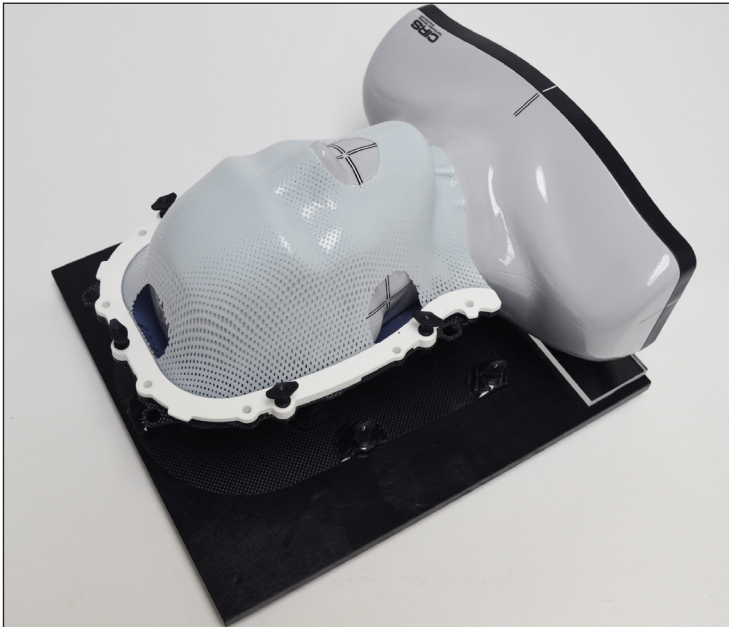
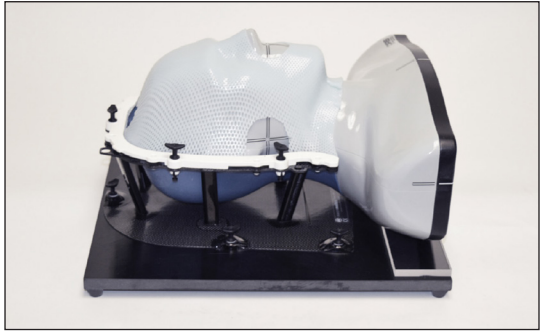
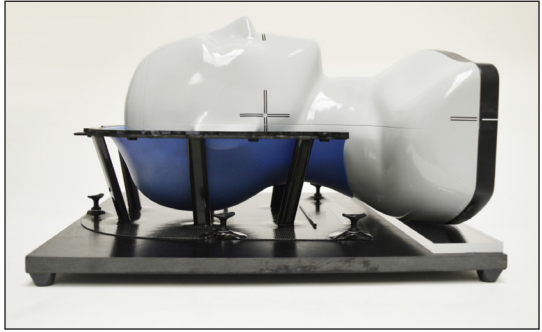
Plugs with BBs can be identified by externally engraved black rings marking the location of the BB.

The various sets of sleeves and rods are color coded on the inferior end.

PATIENT POSITIONING MASKS.

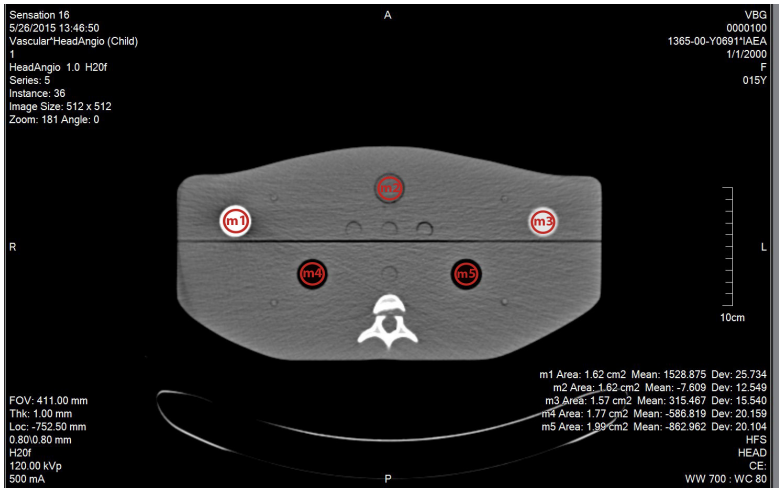
CIRS has successfully tested thermoplastic masks from the following Manufacturers.

- Bionix,
- Klarity,
- Civco,
- Orfit
- Macromedics
DSPS (depicted)



Electron Density

To perform the electron density calibration the shoulders accommodate five (5) permanent locations for electron density plugs: cortical bone, trabecular bone, lung inhale, lung exhale and water. Plugs measure $\text{\O} 2.5 \text{ cm} \times 3 \text{ cm}$ long. Bone plugs are positioned at the approximately humerus locations. Lung plugs are located closer to the center of the phantom on both sides, similar to the top of the lung anatomy. A water vial with lid is positioned in the middle of the shoulders near the trachea. The vial can be filled with distilled water or desired contrast agent. All plugs are located to minimize imaging artifacts.



SPECIFICATIONS

Dimensions: 36 cm (W) x 36 cm (L) x 22cm (H)

Weight: 10.2 kg without rods

Materials: CIRS proprietary epoxy resins. See Appendix

The phantom includes:

Qty:	Part No. (if app)
1	Head Vertex
1	Head & Shoulders Anterior part
1	Head & Shoulders Posterior part
1	End plate, ABS black
1	Black nylon strap with a buckle, used for holding head together
4	Solid Rod w/BB @ ISO center & @ + 50 mm, 330 mm long
3	Sleeve CV511C, 115 mm long
1	Plug PL-CV511C solid, 330 mm long
1	Plug PL-CV511C solid w/BB, 330 mm long
1	Plug PL-CV511C solid to fit Cavity Rod @ ISO center, 217 mm long
1	Cavity Rod CV511C for Ion Chamber @ ISO location, 320 mm
1	Plug PL-CV511C solid to fit Cavity Rod @ ISO center + 50 mm, 167 mm long
1	Cavity Rod CV511C for Ion Chamber @ ISO+50 mm location, 320 mm
1	Spacer Plugs CV511C Kit, total length 370 mm x 7mm Ø (10 Pieces)
1	Spacer Plugs CV511C Kit, total length 130 mm x 13mm Ø (8 Pieces)
4	Spare Water vial (original 1 inside phantom)
1	Screw driver
6	Spare set of Nylon screws ¼-20x1-1/4"(original 6 inside phantom)
6	Black nylon thumbscrews ¼-20x1/2"
4	Spare set of Nylon pins 1/4x1" (original 4 inside phantom)
2	User's Guide (Physical)
1	Packing List (physical)
1	USB drive containing electronic user guide and packing list
1	Carry case, foam lined

USE OF THE PHANTOM

GENERAL INSTRUCTIONS

1. Carefully remove phantom from carry case.
2. Position the phantom face up on a clean, flat surface.
3. Unbuckle the nylon strap.



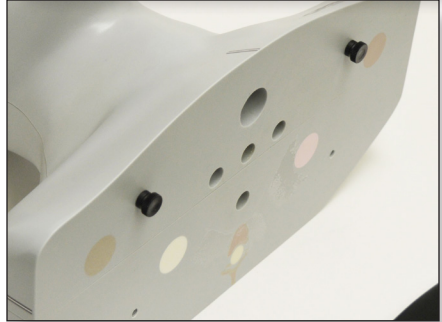
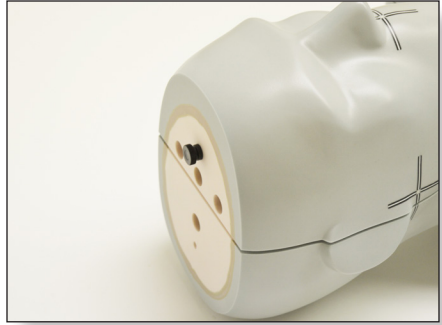
4. Using the screw driver provided, unscrew the two nylon screws from the vertex, starting with the lower screw.



5. Unscrew the four nylon screws from the end plate.



6. Screw the temporary black nylon thumbscrews to the anterior portion of the phantom.



7. Lift anterior portion of the phantom from the posterior end using black thumbscrews. Carefully place on a clean, flat surface.



8. Position film of the desired size on the flat surface of the posterior portion making sure it covers CT fiducials.



9. CT fiducials are sharp so they can secure the film. **Use care during assembly, disassembly and film placement to ensure you do not scratch yourself or the film, or bend the fiducials.**
10. Reassemble anterior and posterior portions of the phantom, matching pin-holes for best fit. Push down to avoid an air gap between the phantom and film.
11. Screw the end plate and vertex back to place using nylon screws and screw driver. Together with fiducials they will secure film.
12. Insert required solid rods with fiducials, CV511C ion chamber rod(s), or sleeve(s) with spacer plugs.
13. Phantom is ready to image or treat with radiation.
14. Phantom can be originally imaged without film because the air gap between anterior and posterior parts is minimized by centering conical head nylon screws.
15. Replace nylon strap around the neck.

Electron Density Measurements

1. Fill vial with water or contrast liquid and close the lid.
2. Insert vial into the large central hole in a shoulder, container end first.



3. Scan shoulders with a beam slice thru the mid place of the electron density plugs and take ROI measurements.

CARE & HANDLING

Your phantom is manufactured from epoxy resin. Various other chemicals and fillers have been added to the resin using proprietary CIRS tissue simulation technology. See appendix for simulation data. As with most other epoxy plastics, your phantom may discolor slightly over time. This process can be accelerated by direct exposure to sunlight or extreme temperatures. It is recommended that when not in use, the phantom be stored in a dark, fully climatized storage area.

Store and transport a phantom fully assembled and with a Black nylon strap around the neck inside the carry case. Epoxy is quite durable, but can still be damaged if it is dropped on a hard surface; so handle with care!

Most phantoms can be easily repaired. If damaged, contact CIRS. It is recommended that the phantom only be cleaned with mild detergent and water. Avoid solvent based or abrasive cleaning agents. Engineers and physicists at CIRS are available to answer specific questions regarding the materials, design and technical specifications of the phantom. Specific questions regarding quality assurance protocols should be directed toward the appropriate equipment manufacturers and experts in the field.

APPENDIX

DENSITIES AND LINEAR ATTENUATION COEFFICIENTS IN CM⁻¹ FOR TISSUE SUBSTITUTES

Reference:

1. ICRU Report 46, Photon, Electron, Proton and Neutron Interaction Data for Body Tissues (1992).
2. ICRP 23, Report of the Task Group on Reference Man (1975).
3. Electron Density of Water: 3.340×10^{23} /cc

ENERGY- MEV	SPINAL CORD REFERENCE *1	SPINAL CORD, CIRS	RATIO, %
0.04	0.2769	0.2768	99.96
0.06	0.2125	0.2124	99.95
0.08	0.1895	0.1894	99.95
0.10	0.1762	0.1761	99.94
0.20	0.1414	0.1413	99.93
0.40	0.1095	0.1095	100.00
0.60	0.0924	0.0924	100.00
0.80	0.0812	0.0811	99.88
1.00	0.0730	0.0729	99.86
2.00	0.0510	0.0510	100.00
4.00	0.0351	0.0350	99.72
6.00	0.0285	0.0285	100.00
8.00	0.0249	0.0249	100.00
10.0	0.0227	0.0227	100.00
20.0	0.0185	0.0185	100.00
30.0	0.0174	0.0174	100.00
El. Density, $\times 10^{23}$, cm ⁻³	3.449	3.488	99.97
Density, gcm ⁻³	1.04	1.07	-

APPENDIX (CONT.)

ENERGY- MEV	AVERAGE SOFT TISSUE REFERENCE *2	AVERAGE SOFT TISSUE, CIRS	RATIO, %
0.04	0.2679	0.2678	99.96
0.06	0.2087	0.2091	100.19
0.08	0.1871	0.1876	100.27
0.10	0.1742	0.1748	100.34
0.20	0.1401	0.1406	100.36
0.40	0.1086	0.1090	100.37
0.60	0.0917	0.0920	100.33
0.80	0.0805	0.0808	100.37
1.00	0.0724	0.0726	100.28
2.00	0.0505	0.0507	100.40
4.00	0.0347	0.0348	100.29
6.00	0.0282	0.0282	100.00
8.00	0.0247	0.0247	100.00
10.0	0.0225	0.0225	100.00
20.0	0.0182	0.0181	99.45
30.0	0.0171	0.0170	99.42
El. Density, $\times 10^{23}$, cm^{-3}	3.421	3.434	100.38
Density, gcm^{-3}	1.03	1.055	-

ENERGY- MEV	TRABECULAR BONE REFERENCE *1	TRABECULAR BONE, CIRS	RATIO, %
0.04	0.4546	0.04536	99.8
0.06	0.2802	0.2806	100.1
0.08	0.2296	0.2303	100.3
0.10	0.2058	0.2065	100.3
0.20	0.1588	0.1596	100.5
0.40	0.1223	0.1229	100.5
0.60	0.1031	0.1036	100.5
0.80	0.0905	0.0909	100.4
1.00	0.0813	0.0817	100.5
2.00	0.0568	0.0571	100.5
4.00	0.0393	0.0395	100.5
6.00	0.0322	0.0323	100.3
8.00	0.0284	0.0284	100.00
10.0	0.0260	0.0260	100.00
20.0	0.0216	0.0215	99.5
30.0	0.0206	0.0205	99.5
El. Density, $\times 10^{23}$, cm^{-3}	3.844	3.863	100.5
Density, gcm^{-3}	1.18	1.20	-

ENERGY- MEV	CORTICAL BONE REFERENCE *1	CORTICAL BONE, CIRS	RATIO, %
0.04	1.2783	1.2693	99.3
0.06	0.6046	0.6025	99.7
0.08	0.4282	0.4273	99.8
0.10	0.3561	0.3560	100.0
0.20	0.2517	0.2513	99.8
0.40	0.1903	0.1903	100.0
0.60	0.1600	0.1601	100.1
0.80	0.1403	0.1404	100.1
1.00	0.1260	0.1261	100.1
2.00	0.0884	0.0885	100.1
4.00	0.0626	0.0624	99.7
6.00	0.0525	0.0523	99.6
8.00	0.0473	0.0471	99.6
10.0	0.0444	0.0441	99.3
20.0	0.0397	0.0391	98.5
30.0	0.0394	0.0387	98.2
El. Density, x10 ²³ , cm ⁻³	5.952	5.956	100.1
Density, gcm ⁻³	1.92	1.93	-

ENERGY- MEV	AVERAGE BRAIN REFERENCE *1	AVERAGE BRAIN BRDT, CIRS	RATIO, %
0.04	0.2791	0.2791	100.00
0.06	0.2135	0.2138	100.14
0.08	0.1902	0.1907	100.26
0.10	0.1767	0.1772	100.28
0.20	0.1418	0.1422	100.28
0.40	0.1098	0.1102	100.36
0.60	0.0927	0.0930	100.32
0.80	0.0814	0.0817	100.37
1.00	0.0731	0.0734	100.41
2.00	0.0511	0.0513	100.39
4.00	0.0352	0.0352	100.00
6.00	0.0286	0.0286	100.00
8.00	0.0251	0.0250	99.60
10.0	0.0229	0.0228	99.56
20.0	0.0186	0.0185	99.46
30.0	0.176	0.0174	98.86
El. Density, x10 ²³ , cm ⁻³	3.458	3.470	100.35
Density, gcm ⁻³	1.04	1.069	-

APPENDIX (CONT.)

ENERGY- MEV	AVERAGE LUNG INHALE REFERENCE *1	AVERAGE LUNG INHALE, CIRS LAA	RATIO, %
0.04	0.0537	0.0524	97.6
0.06	0.041	0.0411	100.2
0.08	0.0365	0.0367	100.6
0.10	0.0339	0.0341	100.6
0.20	0.0272	0.0274	100.7
0.40	0.0211	0.0212	100.5
0.60	0.0178	0.0179	100.6
0.80	0.0156	0.0157	100.6
1.00	0.014	0.0141	100.7
2.00	0.0098	0.0099	101
4.00	0.0068	0.0068	100
6.00	0.0055	0.0055	100
8.00	0.0048	0.0048	100
10.0	0.0044	0.0043	97.7
20.0	0.0036	0.0035	97.2
30.0	0.0034	0.0032	94.1
El. Density, x10 ²³ , cm ⁻³	0.663	0.668	100.8
Density, gcm ⁻³	0.2	0.205	-

ENERGY- MEV	AVERAGE LUNG EXHALE REFERENCE *1	AVERAGE LUNG EXHALE, CIRS LH	RATIO, %
0.04	0.1342	0.1313	97.8
0.06	0.1025	0.1012	98.7
0.08	0.0912	0.0904	99.1
0.10	0.0848	0.084	99.1
0.20	0.068	0.0675	99.3
0.40	0.0526	0.0523	99.4
0.60	0.0444	0.0442	99.5
0.80	0.039	0.0388	99.5
1.00	0.0351	0.0349	99.4
2.00	0.0245	0.0243	99.2
4.00	0.0169	0.0167	98.8
6.00	0.0137	0.0135	98.5
8.00	0.012	0.0117	97.5
10.0	0.011	0.0106	96.4
20.0	0.009	0.0085	94.4
30.0	0.0085	0.0079	92.9
El. Density, x10 ²³ , cm ⁻³	1.658	1.648	99.4
Density, gcm ⁻³	0.5	0.5	-

NOTES:

WARRANTY

All standard CIRS products and accessories are warranted by CIRS against defects in material and workmanship for a period as specified below. During the warranty period, the manufacturer will repair or, at its option, replace, at no charge, a product containing such defect provided it is returned, transportation prepaid, to the manufacturer. Products repaired in warranty will be returned transportation prepaid.

There are no warranties, expressed or implied, including without limitation any implied warranty of merchantability or fitness, which extend beyond the description on the face hereof. This expressed warranty excludes coverage of, and does not provide relief for, incidental or consequential damages of any kind or nature, including but not limited to loss of use, loss of sales or inconvenience. The exclusive remedy of the purchaser is limited to repair, recalibration, or replacement of the product at manufacturer's option.

This warranty does not apply if the product, as determined by the manufacturer, is defective because of normal wear, accident, misuse, or modification.

NON-WARRANTY SERVICE

If repairs or replacement not covered by this warranty are required, a repair estimate will be submitted for approval before proceeding with said repair or replacement

RETURNS

If you are not satisfied with your purchase for any reason, please contact your local distributor prior to returning the product. Visit <https://www.cirsinc.com/distributors/> to find your local distributor. If you purchased your product direct through CIRS, call Customer Service at 800-617-1177, email rma@cirsinc.com, or fax an RMA request form to 757-857-0523. CIRS staff will attempt to remedy the issue via phone or email as soon as possible. If unable to correct the problem, a return material authorization (RMA) number will be issued. Non-standard or "customized" products may not be returned for refund or exchange unless such product is deemed by CIRS not to comply with documented order specifications. You must return the product to CIRS within 30 calendar days of the issuance of the RMA. All returns should be packed in the original cases and or packaging and must include any accessories, manuals and documentation that shipped with the product. The RMA number must be clearly indicated on the outside of each returned package. CIRS recommends that you use a carrier that offers shipment tracking for all returns and insure the full value of your package so that you are completely protected if the shipment is lost or damaged in transit. If you choose not to use a carrier that offers tracking or insure the product, you will be responsible for any loss or damage to the product during shipping. CIRS will not be responsible for lost or damaged return shipments. Return freight and insurance is to be pre-paid.

WITH RMA NUMBER, ITEMS MAY BE RETURNED TO:

CIRS
Receiving
900 Asbury Ave,
Norfolk, Virginia, 23513 USA

PRODUCT	WARRANTY PERIOD
Model1365-00	60 months

CIRS

**COMPUTERIZED IMAGING
REFERENCE SYSTEMS, INC.**

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