

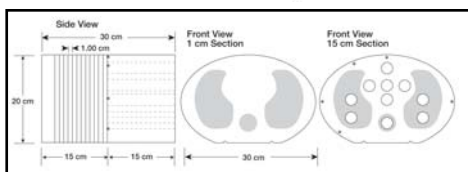
IMRT DOSE VERIFICATION PHANTOMS AND CUBES

CIRS IMRT PHANTOMS

The CIRS IMRT Phantoms for Film and Ion Chamber Dosimetry are designed to address the complex issues surrounding commissioning and comparison of treatment planning systems while providing a simple yet reliable method for verification of individual patient plans and delivery.

CIRS IMRT phantoms are manufactured from tissue equivalent materials that mimic within 1% from 50 keV to 15 MeV for accurate simulation from CT planning to treatment delivery. The interchangeable rod design allows the phantom to accommodate a multitude of dose measurement devices such as ion chambers, TLD, diodes and MOSFET's in the same location within the phantom.* Phantom cross sections accommodate GafChromic® or standard ready-pack films.

CIRS IMRT THORAX PHANTOM



- Verify heterogeneity corrections
- Correlate CTU to electron density
- Check dose distributions in sensitive areas
- Check depth doses and absolute dose
- 2D and 3D isodoses
- Calibrate film with an ion chamber and other detectors*
- Verify individual patient treatment plans

The IMRT Thorax Phantom is elliptical in shape and properly represents an average human torso in proportion, density, and two-dimensional structure. It measures 30 cm Long x 30 cm Wide x 20 cm Thick.

Tissue equivalent interchangeable rod inserts accommodate ionization chambers allowing for point dose measurements in multiple planes within the phantom. Hole placement allows verification in the most critical areas of the chest. One half of the phantom is divided into 12 sections, each 1 cm thick, to support radiographic or GafChromic® Film¹. Additional inserts are available to support a variety of other detectors including TLD's, MOSFET and diodes

Handling, assembly and proper orientation of the phantom is made easy with the use of a unique alignment base and holding device. The surfaces of the phantom are marked for ease of laser alignment. CT markers are included to ensure accurate film to plan registration on the center film.

682-510 IMRT Thorax Phantom Includes

- (1) Thorax section drilled to accommodate rod inserts
- (12) 1cm thorax sections
 - (1) 3cm end section
- (5) Water equivalent solid rod inserts
 - (1) Bone equivalent solid rod insert
 - (4) Lung equivalent solid rod inserts
- (1) Set of CT to film fiducial markers
- (1) Alignment base
- (1) Holding Device

Insert Options

*Customers are encouraged to complete their order with the purchase of at least one (1) of each insert option listed below. Customer must specify ion chamber and cavity code. Refer to the separate ion chamber and cavity codes chart (see Appendix A).

- 682-533 Water Equivalent Rod Insert with Ion Chamber Cavity
- 682-534 Bone Equivalent Rod Insert with Ion Chamber Cavity
- 682-535 Lung Equivalent Rod Insert with Ion Chamber Cavity

Specifications

Overall Dim: 17" x 15" x 9" (43.2 x 38.1 x 22.9 cm)

Weight: 30 lb (11.2 kg)

Phantom Body Material: Tissue Equivalent Epoxy Materials

Insert Material: CIRS Tissue Equivalent Materials (epoxy resin based)

References

Vatnitsky S. Commissioning of Radiotherapy Treatment Planning Systems: Testing for Typical External Beam Treatment Techniques. 1583rd ed. (Brunckhorst E, Gershkevitch E, Ibbott G, et al, eds.). IAEA. 2008.

Gershkevitch, Eduard, et al., Dosimetric Verification of Radiotherapy Treatment Planning Systems: Results of IAEA Pilot Study. 2008 Elsevier Ireland Ltd., Radiotherapy and Oncology 89 (2009) 338-346, pgs. 338-346, March 2009.

Zhao, Y. et al., Monte Carlo evaluation of a treatment planning system for helical tomotherapy in an anthropomorphic heterogeneous phantom and for clinical treatment plans. Med. Phys., vol. 35 (12), pgs. 5366-5374, December 2008.

Luo, W., et al., Analysis of image quality for real-time target tracking using simultaneous kV-MV imaging. Med. Phys., vol. 35 (12), pgs. 5501-5509, December 2008.

Brunckhorst E., et al., Commissioning of Radiotherapy Treatment Planning Systems: Testing for Typical External Beam Treatment Techniques. IAEA, International Atomic Energy Agency, IAEA-TECDOC-1583, pgs. 1-67, January 2008

Altman, M., et al., A Novel Phantom for use in 3-dimensional In Vitro Cell Experiments. Med. Phys., vol. 33 (6), pgs. 2058-2059, Poster # SU-FF-T-40, June 2006.

Item #	Description
682-510	IMRT Thorax Phantom
682-533	Water Equiv Rod Insert with Chamber Cavity Specify Chamber and Cavity Code
682-534	Bone Equivalent Insert with Ion Chamber Cavity Specify Chamber and Cavity Code
682-535	Lung Equivalent Insert with Ion Chamber Cavity Specify Chamber and Cavity Code

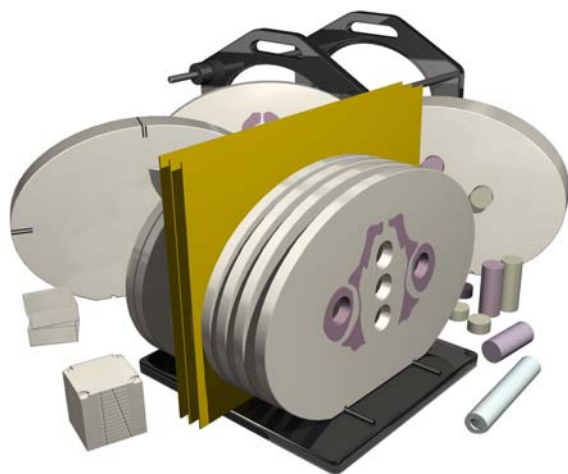
Ion chamber and cavity codes can be found in Appendix A

Item #	Optional Accessories
682-525	Water Equivalent Rods for TLD's, Set of 5
682-526	Single Breast Attachment
682-527	Film Stack for Small Volume 3D Image Reconstruction
682-528	Gel Dosimetry Cassette
682-529	Thorax Region Section Accommodates 682-527 or 682-528
682-530	Homogeneous Section Accommodates 682-527 or 682-528
682-532	Set of CT to Film Fiducial Markers
682-537	Electron Density Ref Plugs Set of 4: lung, bone, muscle, adipose
682-540	Thorax Region Spacer Slab (1 cm)
682-545	Case for IMRT Phantoms and Cavity Slab
682-546	Case for IMRT Phantoms

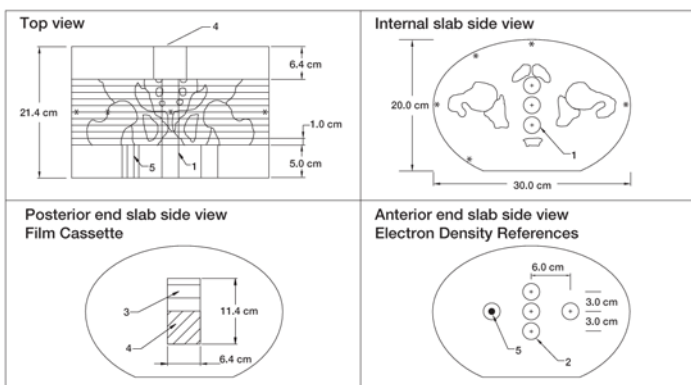
Ion chamber and cavity codes can be found in Appendix A

IMRT DOSE VERIFICATION PHANTOMS AND CUBES

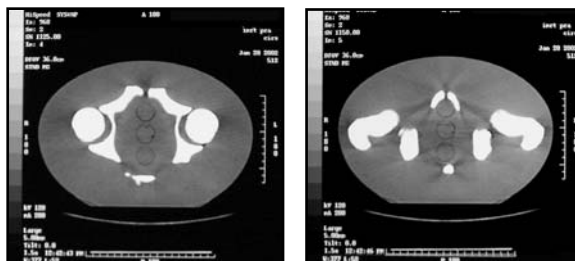
CIRS IMRT PELVIC 3D PHANTOM



Shown with Optional Accessories



- 1 - Holes plugged with rods (Ø 2.5 cm)
- 2 - Holes for electron density inserts
- 3 - Spacers
- 4 - Film stack (cube 2.5 inches)
- 5 - Bone core (diam. 1 cm in water background)



- Verify heterogeneity corrections
- Correlate CTU to electron density
- Check dose distributions insensitive areas
- Check depth doses and absolute dose
- 2D and 3D isodoses
- Calibrate film with an ion chamber
- Verify individual patient treatment plans

The IMRT Pelvic 3D phantom properly represents human pelvic anatomy in shape, proportion and structure as well as density. This enables thorough analysis of both the imaging and dosimetry system.

The phantom is elliptical in shape, approximates the size of an average patient, and has a tissue equivalent, three dimensional skeleton. Tissue equivalent interchangeable rod inserts for ionization chambers allow for point dose measurements in multiple planes in the phantom and film calibration.* The phantom also supports film dosimetry with not only standard radiographic films but also GafChromic® media¹. Additional inserts are available to support a variety of other detectors including TLD's, MOSFET, and diodes.

The IMRT Pelvic 3D Phantom includes four different Electron Density reference plugs which can be interchanged in five separate locations within the phantom. The surface of the phantom is etched with grooves to ensure proper orientation of the CT slices and accurate film to plan registration.

¹ The CIRS line of IMRT phantoms is compatible with the RIT 113 software for film to plan analysis. GafChromic® is a registered trademark of International Specialty Products, Wayne, NJ

Item 682-515 IMRT Pelvic 3D Phantom includes

- (1) 5 cm tissue equivalent reference section for interchangeable electron density inserts
- (10) 1 cm thick contiguous 3D pelvic sections each drilled to accommodate rod inserts
- (1) Homogeneous section that accommodates 682-527 and 682-528 cassettes
- (1) Film Stack for 3D reconstruction
- (5) Water equivalent rod inserts (2.5 cm dia x 5 cm long)
- (20) Bone equivalent solid disks (2.5 cm dia x 1 cm thick)
- (30) Water equivalent solid disks (2.5 cm dia x 1 cm thick)
- (1) Electron density reference plugs, (set of 4: lung, bone, muscle, adipose)
- (1) Set of CT to film fiducial markers
- (1) Alignment base
- (1) Holding device

Insert Options

Customers are encouraged to complete their order with the purchase of at least one (1) of each insert option listed below. Customer must specify ion chamber and cavity code. Refer to the separate ion chamber and cavity codes chart (see Appendix A).

682-533 Water Equivalent Rod Insert with Ion Chamber Cavity

682-534 Bone Equivalent Rod Insert with Ion Chamber Cavity

Specifications

Overall Dim: 14" x 15" x 9" (35.6 x 38.1 x 22.9 cm)

Weight: 28 lb (10.5 kg)

Phantom Body Material: Tissue Equivalent Epoxy Materials

Insert Material: CIRS Tissue Equivalent Materials (epoxy resin based)

References

Gershkevitch, Eduard, et al., Dosimetric Verification of Radiotherapy Treatment Planning Systems: Results of IAEA Pilot Study. 2008 Elsevier Ireland Ltd., Radiotherapy and Oncology 89 (2009) 338-346, pgs. 338-346, March 2009.

Zhao, Y. et al., Monte Carlo evaluation of a treatment planning system for helical tomotherapy in an anthropomorphic heterogeneous phantom and for clinical treatment plans. Med. Phys., vol. 35 (12), pgs. 5366-5374, December 2008.

Luo, W., et al., Analysis of image quality for real-time target tracking using simultaneous kV-MV imaging. Med. Phys., vol. 35 (12), pgs. 5501-5509, December 2008.

Brunchhorst E., et al., Commissioning of Radiotherapy Treatment Planning Systems: Testing for Typical External Beam Treatment Techniques. IAEA, International Atomic Energy Agency, IAEA-TECDOC-1583, pgs. 1-67, January 2008.

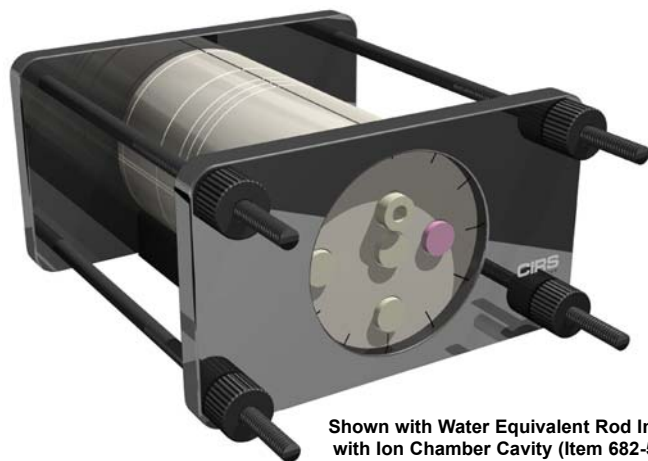
Altman, M., et al., A Novel Phantom for use in 3-dimensional In Vitro Cell Experiments. Med. Phys., vol. 33 (6), pgs. 2058-2059, Poster # SU-FF-T-40, June 2006.

Item #	Description
682-515	IMRT Pelvic 3D Phantom
682-533	Water Equiv Rod Insert with Chamber Cavity Specify Chamber and Cavity Code
682-534	Bone Equivalent Insert with Ion Chamber Cavity Specify Chamber and Cavity Code
682-531	Pelvic Region Slab Accommodates 682-527 or 682-528
682-545	Case for IMRT Phantoms and Cavity Slab
682-546	Case for IMRT Phantoms

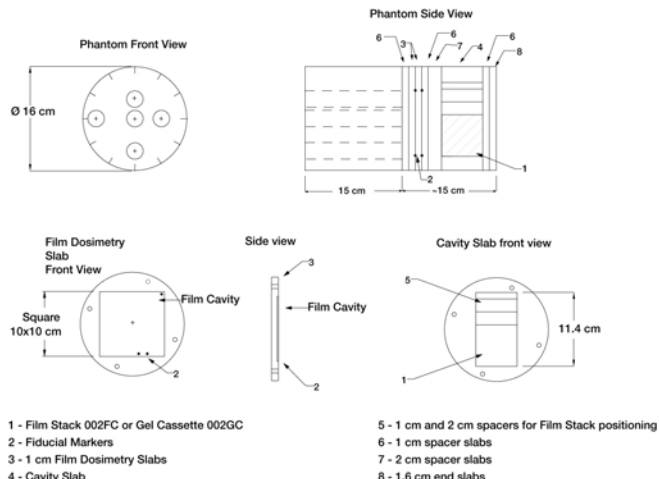
Ion chamber and cavity codes can be found in Appendix A

IMRT DOSE VERIFICATION PHANTOMS AND CUBES

CIRS IMRT HEAD AND NECK PHANTOM



Shown with Water Equivalent Rod Insert with Ion Chamber Cavity (Item 682-533)



1 - Film Stack 002FC or Gel Cassette 002GC
2 - Fiducial Markers
3 - 1 cm Film Dosimetry Slabs
4 - Cavity Slab

5 - 1 cm and 2 cm spacers for Film Stack positioning
6 - 1 cm spacer slabs
7 - 2 cm spacer slabs
8 - 1.6 cm end slabs

- Verify heterogeneity corrections
- Correlate CTU to electron density
- Check dose distributions in sensitive areas
- Check depth doses and absolute dose
- 2D and 3D isodoses
- Calibrate film with an ion chamber
- Verify individual patient treatment plans

The IMRT Head and Neck Phantom is circular in shape and approximates the size of an average patient. Tissue equivalent interchangeable rod inserts for ionization chambers allow for point dose measurements in multiple planes in the phantom, film calibration and isodose normalization.* The phantom also supports film dosimetry with not only standard radiographic films but also GafChromic® media¹. Additional inserts are available to support a variety of other detectors including TLD's, MOSFET and diodes.

The IMRT Head and Neck Phantom accommodates one Ready Pack™ 10" x 12" film in transverse orientation, two radiochromic or radiographic 10 x 10 cm films in transverse orientation and a stack of thirteen radiochromic films precut to 63.5 x 63.5 mm in three different orientations.

The IMRT Head and Neck Phantom has an optional four Electron Density reference plugs which can be interchanged in five separate locations within the phantom. The surface of the phantom is etched with grooves to ensure proper orientation of the CT slices and accurate film to plan registration. An optional cranial bone ring is also available.

Item 682-520 IMRT Phantom Head and Neck Includes

- (1) Water equivalent homogeneous section drilled to accommodate rod inserts (15 cm)
- (2) Film slabs, 1 cm, film cavity 10 x 10 cm with a set of CT to Film Fiducial Markers
 - (1) CT to film fiducial markers in film slabs
- (1) Cavity slab, 6.34 cm, to accommodate Film Stack or Gel Cassette
 - (1) Film Stack for small volume 3D image reconstruction
 - (2) Spacer slabs, 1 cm
 - (2) Spacer slabs, 2 cm
 - (2) End slabs - 1 cm and ~1.6 cm
 - (5) Water equivalent solid rod inserts
 - (1) Bone equivalent solid rod insert
 - (1) Alignment base
 - (1) Holding device

Insert Options

Customers are encouraged to complete their order with the purchase of at least one (1) of each insert option listed below. Customer must specify ion chamber and cavity code. Refer to the separate ion chamber and cavity codes chart (see Appendix A).

- 682-533 Water Equivalent Rod Insert with Ion Chamber Cavity
- 682-534 Bone Equivalent Rod Insert with Ion Chamber Cavity

Specifications

Overall Dim: 17" x 13" x 8" (43.2 x 33 x 20.3 cm)

Weight: 28 lb (10.5 kg)

Phantom Body Material: Tissue Equivalent Epoxy Materials

Insert Material: CIRS Tissue Equivalent Materials (epoxy resin based)

References

Gershkevitch, Eduard, et al., Dosimetric Verification of Radiotherapy Treatment Planning Systems: Results of IAEA Pilot Study, 2008 Elsevier Ireland Ltd., Radiotherapy and Oncology 89 (2009) 338-346, pgs. 338-346, March 2009.

Zhao, Y. et al., Monte Carlo evaluation of a treatment planning system for helical tomotherapy in an anthropomorphic heterogeneous phantom and for clinical treatment plans. Med. Phys., vol. 35 (12), pgs. 5366-5374, December 2008.

Luo, W., et al., Analysis of image quality for real-time target tracking using simultaneous kV-MV imaging. Med. Phys., vol. 35 (12), pgs. 5501-5509, December 2008.

Brunckhorst E., et al., Commissioning of Radiotherapy Treatment Planning Systems: Testing for Typical External Beam Treatment Techniques. IAEA, International Atomic Energy Agency, IAEA-TECDOC-1583, pgs. 1-67, January 2008.

Altman, M., et al., A Novel Phantom for use in 3-dimensional In Vitro Cell Experiments. Med. Phys., vol. 33 (6), pgs. 2058-2059, Poster # SU-FF-T-40, June 2006.

Item #	Description
682-520	IMRT Phantom Head and Neck
682-533	Water Equiv Rod Insert with Chamber Cavity Specify Chamber and Cavity Code
682-534	Bone Equivalent Insert with Ion Chamber Cavity Specify Chamber and Cavity Code

Ion chamber and cavity codes can be found in Appendix A

Item #	Optional Accessories
682-525	Water Equivalent Rods for TLD's, Set of 5
682-528	Gel Dosimetry Cassette
682-532	Set of CT to Film Fiducial Markers
682-537	Electron Density Ref Plugs Set of 4: lung, bone, muscle, adipose
682-547	Case for IMRT Head and Neck Phantom

Ion chamber and cavity codes can be found in Appendix A

IMRT DOSE VERIFICATION PHANTOMS AND CUBES

CIRS IMRT HEAD AND TORSO FREEPOINT PHANTOM



Shown with Water Equivalent Rod Insert with Ion Chamber Cavity (Item 682-533)

Insert Options

Customers are encouraged to complete their order with the purchase of at least one (1) of each insert option listed below. Customer must specify ion chamber and cavity code. Refer to the separate ion chamber and cavity codes chart (see Appendix A).

- 682-533 Water Equivalent Rod Insert with Ion Chamber Cavity
- 682-534 Bone Equivalent Rod Insert with Ion Chamber Cavity

Specifications

- Overall Dim:** 17" x 15.5" x 10" (43.2 x 39.4 x 25.4 cm)
- Weight:** 47 lb (17.5 kg)
- Phantom Body Material:** Tissue Equivalent Epoxy Materials
- Insert Material:** CIRS Tissue Equivalent Materials (epoxy resin based)

References

Gershkevitch, Eduard, et al., Dosimetric Verification of Radiotherapy Treatment Planning Systems: Results of IAEA Pilot Study, 2008 Elsevier Ireland Ltd., Radiotherapy and Oncology 89 (2009) 338-346, pgs. 338-346, March 2009.

Zhao, Y. et al., Monte Carlo evaluation of a treatment planning system for helical tomotherapy in an anthropomorphic heterogeneous phantom and for clinical treatment plans. Med. Phys., vol. 35 (12), pgs. 5366-5374, December 2008.

Luo, W., et al., Analysis of image quality for real-time target tracking using simultaneous kV-MV imaging. Med. Phys., vol. 35 (12), pgs. 5501-5509, December 2008.

Brunckhorst E., et al., Commissioning of Radiotherapy Treatment Planning Systems: Testing for Typical External Beam Treatment Techniques. IAEA, International Atomic Energy Agency, IAEA-TECDOC-1583, pgs. 1-67, January 2008.

Altman, M., et al., A Novel Phantom for use in 3-dimensional In Vitro Cell Experiments. Med. Phys., vol. 33 (6), pgs. 2058-2059, Poster # SU-FF-T-40, June 2006.

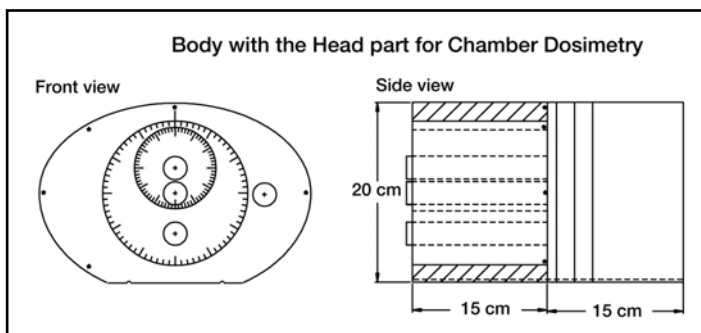
Item #	Description
682-522	IMRT Head and Torso Freepoint Phantom
682-533	Water Equiv Rod Insert with Chamber Cavity Specify Chamber and Cavity Code
682-534	Bone Equivalent Insert with Ion Chamber Cavity Specify Chamber and Cavity Code

Ion chamber and cavity codes can be found in Appendix A

Item #	Optional Accessories
682-525	Water Equivalent Rods for TLD's, Set of 5
682-526	Single Breast Attachment
682-527	Film Stack for Small Volume 3D Image Reconstruction
682-528	Gel Dosimetry Cassette
682-529	Thorax Region Section Accommodates 682-527 or 682-528
682-530	Homogeneous Section Accommodates 682-527 or 682-528
682-532	Set of CT to Film Fiducial Markers
682-535	Lung Equivalent Rod Insert with Ion Chamber Cavity Specify Chamber and Cavity Code
682-537	Electron Density Ref Plugs Set of 4: lung, bone, muscle, adipose
682-538	Lung Equivalent Solid Rod Insert
682-545	Case for IMRT Phantoms and Cavity Slab
682-546	Case for IMRT Phantoms

Ion chamber and cavity codes can be found in Appendix A

Body with the Head part for Chamber Dosimetry



- Ionization chambers, TLD, MOSFET and Diodes easily positioned using interchangeable rods
- Choose any point dose location by rotating the cylinders
- Use radiographic film dosimetry Ready Pack® and/or Gafchromic® film
- Close placement of detectors to film improves film calibration
- CT - film markers ensure accurate film to plan registration
- Surfaces are etched with indices for precise alignment
- Configure with or without heterogeneities.

The IMRT Head and Torso Freepoint Phantom was designed in collaboration with David D. Loshek PhD. With the Freepoint Phantom choose any point dose location within a circular area with diameter of 11.2 cm by simply adjusting the two rotating cylinders. Lung and bone equivalent rods can be positioned at any location within the circular area for assessment of heterogeneity correction. Remove the center cylinder from the phantom body to simulate head and neck set-ups.

Item 682-522 IMRT Head and Torso Freepoint Phantom Includes

- (1) Water equivalent homogeneous torso section with cylindrical inserts (15 cm)
- (2) Spacer slabs, 2 cm
 - (1) Spacer slab, 1 cm
 - (1) Spacer slab, 10 cm
- (4) Water equivalent solid rod inserts
 - (1) Bone equivalent solid rod insert
 - (1) Set of CT film fiducial markers
 - (1) Alignment base
 - (1) Holding device

IMRT DOSE VERIFICATION PHANTOMS AND CUBES

CIRS IMRT PHANTOM ACCESSORIES

For Homogenous, Thorax, Pelvis and Head and Neck



Item 682-525 Short tissue equivalent rods for TLD (set of five). Each rod is 50 mm long by 25.4 mm (1") Outside Diameter and allows the placement of TLDs in the same position as an ion chamber in a multitude of locations along the z-axis. Inside hole \varnothing 5 mm with water-equivalent plugs 25 mm long. Rods are also available in other tissues and length.



Item 682-526 Single breast attachment 350 cc, 50/50 glandular/adipose ratio with TLD holes \varnothing 5 mm, 20 x 20 mm grid spacing with tissue equivalent plugs.



Item 682-527 Film stack 2.5" x 2.5" x 2.5" (63.5 x 63.5 x 63.5 mm) for 3D image reconstruction using 13 layers of X-Ray or Gafchromic® film with 4 mm thick tissue equivalent spacers in between each film.



Item 682-528 Gel dosimetry cassette has the same outside cubic dimensions as the 682-527 film cassette. It receives a disposable Barrex™ cylinder (max \varnothing 50 mm, height 63.5 mm) that can be filled with BANG™ or other dosimetry gel.

Item 682-529 Thorax Region Section - Accommodates 682-527 or 682-528 cassettes. Thickness of sections 2.5" (63.5 mm). Cavity and three water-equivalent spacers are included to allow use of cassette in six different positions inside the phantom. Spacer's thickness is 20, 20 and 10 mm. Extra solid blocks to replace the cassette are included.

Item 682-530 Homogeneous Section - Accommodates 682-527 or 682-528 cassettes. Thickness of sections 2.5" (63.5 mm). Cavity and three water-equivalent spacers are included to allow use of cassette in six different positions inside the phantom. Spacer's thickness is 20, 20 and 10 mm. Extra solid blocks to replace the cassette are included.

Item 682-531 Pelvic Region Slab - Accommodates 682-527 and 528 cassettes.

Item 682-532 Set of CT to film fiducial markers from stainless steel are visible during the CT simulation. They also imprint small but clearly visible indentations on the film. Five fiducials at each phantom to film interface allow for very precise film to plan registration.

Item 682-533 Water equivalent insert with ion chamber cavity (Specify ion chamber and cavity code, see Appendix A).

Item 682-534 Bone equivalent rod with ion chamber cavity (Specify ion chamber and cavity code, see Appendix A).

Item 682-535 Lung equivalent insert with ion chamber cavity (Specify ion chamber and cavity code, see Appendix A).

Item 682-537 Electron density reference plugs (set of 4: lung, bone, muscle and adipose)

ELECTRON DENSITY REFERENCE INSERT

	Density	Electron Density per cc x 10 ²³	Electron Density Relative to H ₂ O
Lung	0.21	0.69	0.207
Bone	1.60	5.03	1.506
Muscle	1.06	3.48	1.042
Adipose	0.96	3.17	0.949

Item 682-538 Lung equivalent solid rod insert

Item 682-539 Water Equivalent Spacer Slab

Item 682-540 Thorax Region Spacer Slab for 682-515

Item 682-545 Case for IMRT Phantoms when ordered with corresponding Cavity Slab: 682-510, 682-515 and 682-522.

Item 682-546 Case for IMRT Phantoms 682-510, 682-515 and 682-522.

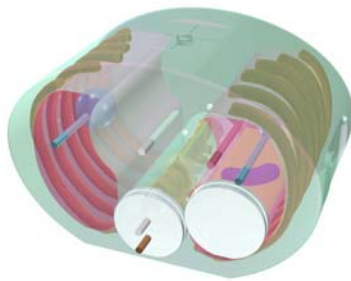
Item 682-547 Case for IMRT Head and Neck Phantom, Item 682-520.

Item #	Optional Accessories
682-525	Water Equivalent Rods for TLD's, Set of 5
682-526	Single Breast Attachment
682-527	Film Stack for Small Volume 3D Image Reconstruction
682-528	Gel Dosimetry Cassette
682-529	Thorax Region Section Accommodates 682-527 or 682-528
682-530	Homogeneous Section Accommodates 682-527 or 682-528
682-531	Pelvic Region Slab Accommodates 682-527 or 682-528
682-532	Set of CT to Film Fiducial Markers
682-533	Water Equiv Rod Insert with Chamber Cavity Specify Chamber and Cavity Code
682-534	Bone Equivalent Rod Insert with Ion Chamber Cavity Specify Chamber and Cavity Code
682-535	Lung Equivalent Rod Insert with Ion Chamber Cavity Specify Chamber and Cavity Code
682-537	Electron Density Ref Plugs Set of 4: lung, bone, muscle, adipose
682-538	Lung Equivalent Solid Rod Insert
682-539	Water Equivalent Spacer Slab (1 cm)
682-540	Thorax Region Spacer Slab (1 cm)
682-545	Case for IMRT Phantoms and Cavity Slab
682-546	Case for IMRT Phantoms
682-547	Case for IMRT Head and Neck Phantom

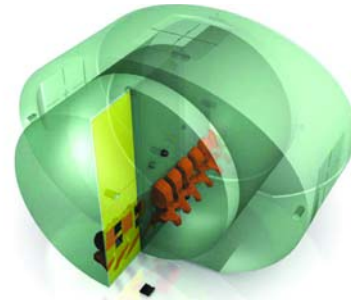
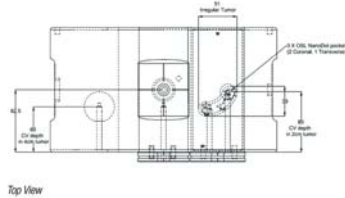
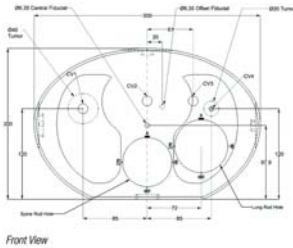
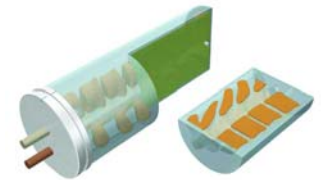
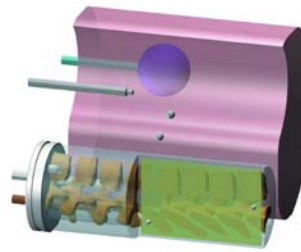
Ion chamber and cavity codes can be found in Appendix A

IMRT DOSE VERIFICATION PHANTOMS AND CUBES

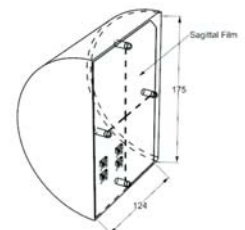
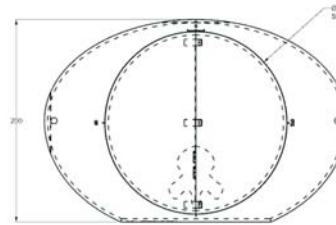
E2E® SBRT PHANTOM WITH REMOVABLE SPINE “END-TO-END” SBRT TESTING SOLUTION



682-575



682-580



- Thorax with articulated spine, ribs and lungs
- Optional Abdomen with film insert
- High Resolution Anthropomorphic Characteristics
- Center point fiducial and offset target for daily system checks
- Ideal for commissioning an SBRT program
- Excellent test environment for Monte Carlo dose calculation verification
- Supports use and testing of Image Guidance capabilities

The high dose per fraction associated with SBRT necessitates a high degree of accuracy in target localization and dose delivery. Small errors can result in significant under treatment of portions of the tumor volume and over dosage of nearby normal tissues. The E2E® SBRT Phantom with Removable Spine provides a means to check the entire treatment chain during commissioning and routine QA.

Item 682-575 is an anthropomorphic, thorax body phantom containing articulated spine, ribs, and lungs. All materials are suitable for use in kV and MV energies. The thorax section contains two lung tumor volumes with ionization chamber cavities in the center of each target*. The phantom also includes a lung insert with an irregular-shaped lung target. The proximity of the lung target to the vertebral body allows clinicians to measure high-resolution dose distribution to the target and dose to the spinal cord in a single delivery. The surface of the thorax body is machined with concentric circle targets and alignment marks for daily system checks.

This phantom has more options for dose verification in the spine as an organ at risk, including a removable split spine. The removable spine facilitates the use of radiochromic film in the sagittal orientation in the inferior half of the spine rod. Ion chambers cavities are located in the spinal cord and the vertebrae in the superior half of the removable spine rod. Alignment marks at 0°, 90°, 180° & 270° allow for consistent re-positioning. Precision-cut films with integral registration holes are available for both the lung insert and spine insert.

*Customer must specify chamber at time of purchase. Refer to CIRS cavity codes for corresponding CV number.

An optional abdominal section Item 682-580 SBRT Abdomen Phantom with 3D spine for film and nanoDot™ Dosimetry is available separately. Item 682-580 provides extra bolus material to allow dose assessments with the abdomen due to non-coplanar beams. It can also accommodate Item 682-585, the CBCT Image Quality Phantom.

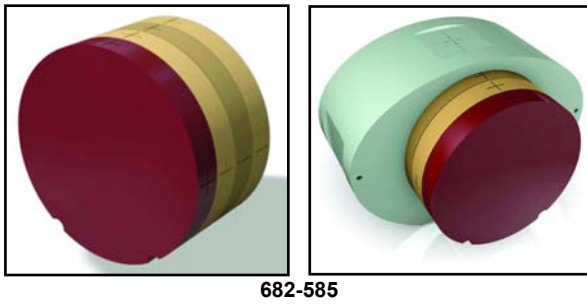
The Item 682-580 SBRT Abdomen Phantom abdomen measures 127 mm long and is machined to receive a central insert, which contains the anatomic spine with cortical and trabecular distinction. All materials are tissue equivalent and suitable for use from 50 keV to 15 MeV.

The central insert is cut in the sagittal plane. A film for high resolution dosimetry measurements can be placed between the two halves. Item 682-582 Precision Cut EBT3 Film is available as an optional accessory. Four nanoDot pockets permit for localized dosimetry measurements within the vertebra body (1), spinal cord (2) and spinal disc (1).

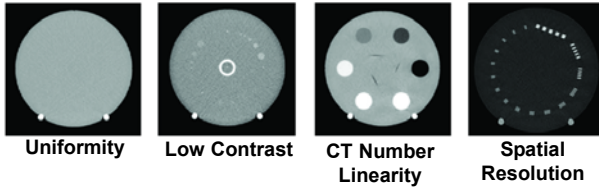
Items 682-575 and 682-580 are connected using lateral pins, which allow rotation of the central insert about the Inferior-Superior axis.

The central insert of Item 682-580 can also accommodate the CBCT Image Quality Phantom, Item 682-585, to perform image quality assessments of on-board imaging (OBI) systems.

IMRT DOSE VERIFICATION PHANTOMS AND CUBES



682-585



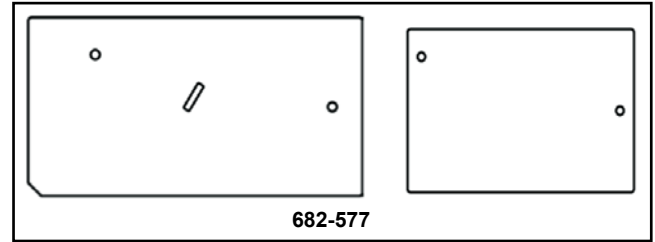
Uniformity

Low Contrast

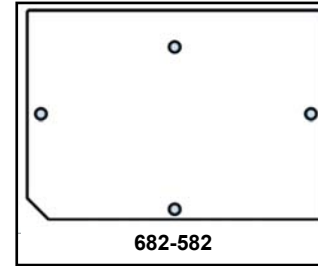
CT Number Linearity

Spatial Resolution

Precision Cut EBT3 Gafchromic Film



682-577



682-582

Item 682-575 Includes:

- 1 - E2E® SBRT Phantom with Removable Spine drilled for customer specified ion chamber*
- 1 - User Guide
- 1 - Foam-Lined Carry Case

*Customer must specify chamber at time of purchase. Refer to CIRS cavity codes for corresponding CV number.

Specifications - Item 682-575

Materials: Proprietary Epoxy Resins

Dimensions: 6.5" x 11.8" x 7.9" (16.5 cm x 30 cm x 20 cm)

Phantom Weight: 15 lb (~7 kg)

OPTIONAL ITEMS

Item 682-577 Precision Cut EBT3 Film Kit for Item 682-575 is a set of 18 spine inserts, 12 lung inserts and 6 calibration strips. Size: 5" x 2.5" and 4" x 2.5"

Item 682-580 SBRT Abdomen Phantom with 3D spine for film and nanoDot™ Dosimetry (includes foam-lined carry case).

Item 682-582 Precision Cut EBT3 Film Kit for Item 682-580 set of 4 inserts plus 6 calibration strips. Size: 5" x 7"

Item 682-585 CBCT Image Quality Phantom

Item #	Description
682-575	E2E® SBRT Phantom with Removable Spine, Specify Chamber
682-577	Precision Cut EBT3 Film Kit for 682-575
682-580	SBRT Abdomen Phantom with 3D spine for film and nanoDot™ Dosimetry
682-582	Precision Cut EBT3 Film Kit for 682-580
682-585	CBCT Image Quality Phantom

Must specify ion chamber at time of purchase

Item 682-585 CBCT Image Quality Phantom

The purpose of image quality measurements is to quantify various image quality indicators for images taken from a selection of image acquisition and reconstruction settings representative of clinical practices. Assessment of the image quality parameters over time can show trends in variation of said parameters helping the user to decide whether or not recalibrations of the imaging system are necessary.

The CBCT Image Quality Phantom is composed of four layers:

1) Uniformity layer - designed to measure the system's ability to produce uniform images across the field of view of an object with highly homogeneous physical properties in all directions.

2) Low Contrast/Magnification layer - intended to assess the system's ability to detect small differences in contrast. It contains three sets of low contrast rods with linear attenuation differences of 0.5%, 1% and 2% relative to the background material. The diameters of the low contrast rods were chosen so as to provide a 0.5 ratio between two adjacent rods by cross section and volume.

Additional features are designed to evaluate the magnification on the orthogonal axes of the transversal image and provide input for calculation of Point Spread Function and subsequent calculation of Modulation Transfer Function.

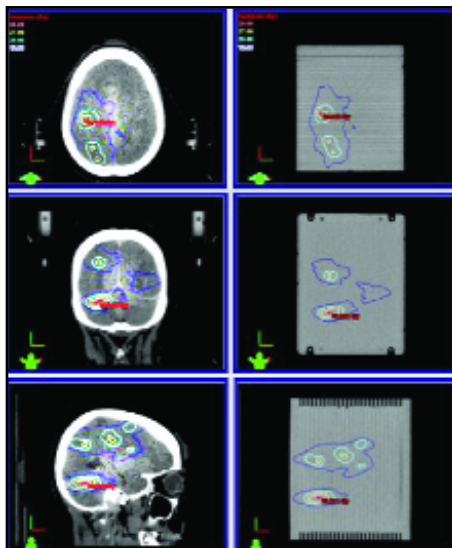
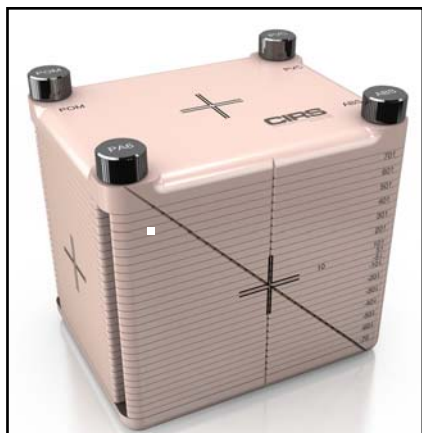
3) CT Number Linearity/Slice Thickness layer - is designed to determine Contrast-to-Noise Ratio (CNR), Hounsfield number accuracy and Slice Thickness Sensitivity. Six rods made of Air, Low Density Polyethylene (LDPE), Polystyrene, Acrylic, Delrin and Teflon are used to measure the CNR and Hounsfield number accuracy. Three angled air channels arranged in an equilateral triangle can be used to assess the Slice thickness sensitivity.

4) Spatial resolution layer - is designed to evaluate the spatial resolution of IGRT systems. Line pair patterns from 1 lp/cm to 16 lp/cm are embedded in the background. In order to minimize artifacts, each line pair pattern is made from a material with 350HU greater than the background attenuation. The line pair patterns are 3D patterns, 12 mm in height along the longitudinal axis of the CBCT Image Quality Phantom. The spatial resolution targets are arranged in a circular pattern.

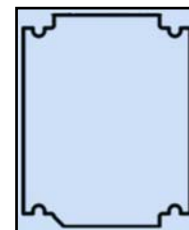
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IMRT DOSE VERIFICATION PHANTOMS AND CUBES

MULTI-LESION BRAIN QA PHANTOM



Clinical Images of Multi-Lesion Brain QA Phantom for SRS



682-658

- Receives up to 29 GafChromic films
- Allows dose measurements to multiple targets with a single delivery
- Alignment marks for repeatable set up with sub-millimeter accuracy
- Pre-loaded polyester sheets allow flexibility in number and location of films
- Accurate film registration markings for dose distribution to treatment plan verification

Our Multi-Lesion Brain QA Phantom provides a unique solution for fast, comprehensive film dosimetry for single isocenter plans treating multiple targets simultaneously. The phantom may be used for thorough validation of multi-lesion treatment methods and for patient-specific quality assurance.

Our phantom is rectangular in shape with rounded corners to minimize CT artifacts and large enough in size to cover brain anatomy variations. Linear attenuation of simulated brain tissue is within 1% of real tissue from 50 keV to 15 MeV.

This phantom has two pairs of asymmetrical imbedded fiducial markers and a central fiducial split in half at the phantom isocenter to aid you during pre-irradiation imaging. You can also align the imaged fiducials (from a CBCT, ExacTrac®, or kV images) and compare them to the reference image of the phantom in order to make more accurate shifts of the phantom with the linear accelerator couch top.

The phantom receives radiochromic film to as many as 29 locations in 5mm increments. Pre-loaded polyester film sheets allow flexibility in film placement without affecting sensitive geometry. External grooves and marking on the phantom sides helps with easy film positioning at only desired locations to cover specific lesions. Film allows multiple planning target volumes (PTVs) to be reviewed individually.

Also offered is pre-cut EBT3 film designed specifically to fit this phantom. A sample pack of Precision Cut™ film is shipped with each phantom. Additional film may be purchased separately.

Four assembly rods, each made of different materials, allows for orientation and registration to ExacTrac® systems.

*ExacTrac® is a registered trademark of Brainlab (Munich, DE)

Item 682-650 includes:

- 1 - Multi-Lesion Brain QA Phantom
- 1 - Sample Precision Cut EBT3 Film Kit
- 1 - User Guide
- 1 - Foam-Lined Carry Case

Specifications

Overall Dimensions: 150 mm (W) x 190 mm (H) x 170 mm (L)

Slab Thickness: Top and Bottom slabs: 15 mm
Spacers: 4.7 mm

Material: Brain Equivalent Epoxy resin

Polyester Sheets (PET):) 29 pcs, 0.3 mm thick

Film Dimensions: 167mm x 150 mm

Weight: 5 kg (11 lbs)

Item 682-658 Precision Cut EBT3 Film Kit for Item 682-650 is a set of 2 inserts plus 6 calibration strips. Size: 7.5" x 6"

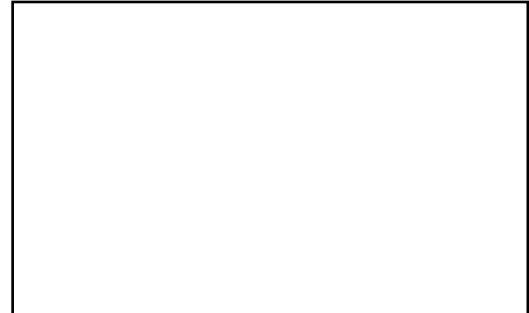
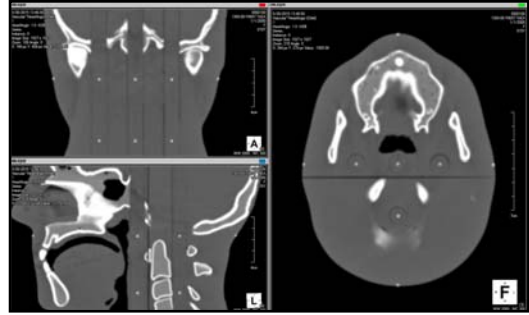
REFERENCES

1. Maurer J, Sintay B, Varchena V. SU-E-T-52: A New Device for Quality Assurance of a Single Isocenter Technique for the Simultaneous Treatment of Multiple Brain Metastases. Med Phys. 2015;42(6):3342.
2. Maurer J, Liu H, Wiant D, Koch K, Manning M, Sintay B. SU-E-T-197: Comparing Quality Assurance Strategies for Single Isocenter Treatments of Multiple Brain Metastases. Med Phys. 2015;42(6):3377.
3. Maurer J, Sintay B, Manning M, Wiant D, Liu H. SU-F-T-510: Single Isocenter Radiosurgery for the Simultaneous Treatment of Multiple Brain Metastases: Volumetric Modulated Arc Therapy or Dynamic Conformal Arc? Med Phys. 2016; 43(6):3580.

Item	Description
682-650	Multi-Lesion Brain QA Phantom
682-658	Precision Cut EBT3 Film Kit for 682-650

IMRT DOSE VERIFICATION PHANTOMS AND CUBES

SHANE PHANTOM PATIENT FOR VMAT AND IMRT



N

- High fidelity phantom-patient
- Suitable for use with various commercially available fixation devices
- Enables dose measurements in large regions of head and neck through use of radiographic film
- Allows dose measurements with ion chambers
- Performs Electron Density calibration in shoulders

The CIRS Shoulder, Head and Neck End-to-End Verification Phantom (SHANE) is designed for end-to-end testing of treatment planning systems. The phantom can be used for every step in this process from imaging acquisition to dosimetry verification and patient-specific QA during head-and-neck VMAT and IMRT procedures.

The head and shoulders are cut in the coronal plane to receive large radiochromic or radiographic film for treatment plan verification. The phantom also receives ion chambers or other detectors, which can be positioned in four parallel holes drilled through the phantom in Inferior-Superior direction.

The high-fidelity anthropomorphic design contains complex internal anatomy that provides a realistic clinical simulation to evaluate the challenging effects of intra- and extracranial 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 enable TPS verification to the level of T2 vertebra. Shoulders also include tissue inserts for electron density calibration.

The phantom comes with carry case.

Item 682-680 Includes:

- 1 - Head Vertex
- 1 - Head & Shoulders Anterior part
- 1 - Head & Shoulders Posterior part
- 1 - End plate, ABS black
- 4 - Solid Rod w/BB @ ISO center, 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 - Plug PL-CV511C solid to fit Cavity Rod @ ISO center + 50 mm, 167 mm long
- 1 - Spacer Plugs CV511C Kit, total length 370 mm x 7mm Ø
- 1 - Spacer Plugs CV511C Kit, total length 130 mm x 13mm Ø
- 1 - Cavity Rod CV511C for Ion Chamber @ ISO location, 320 mm
- 1 - Cavity Rod CV511C for Ion Chamber @ ISO+50 mm location, 320 mm
- 5 - Water vial
- 1 - Screw driver
- 12 - Nylon screws 1/4-20x1-1/4"
- 6 - Black nylon thumbscrews 1/4-20x1/2"
- 8 - Nylon pins 1/4x1"
- 1 - Black nylon strap with a buckle
- 1 - User's Guide (electronic copy)
- 1 - Carry case, foam lined

Specifications

Materials: CIRS proprietary epoxy resins

Dimensions: 14.1" W x 14.1" L x 8.6" H (36 x 36 x 22 cm)

Weight: 22.4 lb (10.2 kg) without rods

Item	Description
682-680	SHANE Phantom Patient for VMAT & IMRT

IMRT DOSE VERIFICATION PHANTOMS AND CUBES

MRI DISTORTION PHANTOM FOR SRS

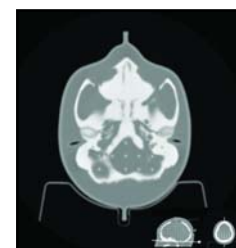
For Assessment of Image Distortion in Treatment Planning Systems



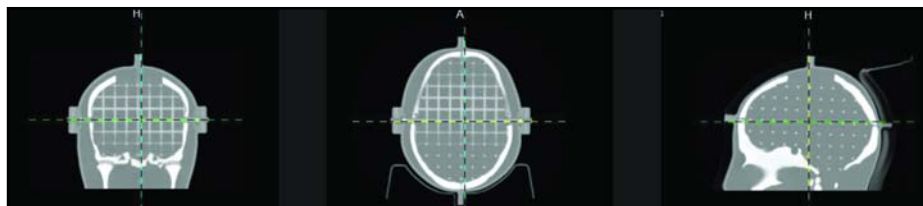
CT



MRI



CT Showing Ear Canals



CT Reconstruction

- Provides a realistic anthropomorphic scenario for CT and MR imaging
- Unique inter-cranial 3D grid design allows assessment of spatial distortion
- Special pads enable use with all fixation frames
- CT/MR markers facilitate positioning and image registration

CIRS Model 603A was designed for assessment of MR image distortion in Stereotactic Radiosurgery Planning. It is also a useful tool for verifying image fusion and deformable image registration algorithms used in various treatment planning systems. The tissue equivalent, anthropomorphic design provides the closest conditions to a clinical imaging scenario. The phantom can be imaged using X-ray, Computed Tomography and Magnetic Resonance. It images well with all MRI sequences tested to date, including T1 weighted, T2 weighted, 3D Time of Flight, MPRAGE and CISS.

The skull is manufactured from a plastic-based bone substitute, and the interstitial and surrounding soft tissues are made from a proprietary signal generating water-based polymer. The entire phantom is encased in a clear plastic shell to protect gel from desiccation. The phantom is supplied with specially designed pads that allow fixation with any stereotactic frame or mounting for end-to-end testing. The phantom is also suitable for frameless SRS QA.

The entire inter-cranial portion of the skull volume is filled with an orthogonal 3D grid of 3 mm diameter rods spaced 15 mm apart. Five extended axis-rods intersect at the reference origin of the grid. The end of each extended axis is fitted with CT/MR markers allowing for accurate positioning with lasers and co-registration of CT and MR image sets.

The phantom includes right and left air voids, 3 mm in diameter by 17 mm long to simulate each ear canal for evaluation of potential distortions commonly found in clinical settings.

682-825 Includes

- (1) 3D Anthropomorphic Skull Phantom
- (1) ABS Cradle
- (1) SRS Frame Support Cups (Set of 4)
- (1) Custom Carry Case
- (1) User Guide
- (1) 48-Month Warranty

Specifications

Overall Dimensions: 32 cm x 24 cm x 18 cm

Weight: 12 lbs (5.5 kg)

Materials

Skull: Plastic-based bone substitute

Interstitial/Soft Tissues: Water-base polymer

Grid: Reinforced nylon

Item	Description
682-825	MRI Distortion Phantom for SRS