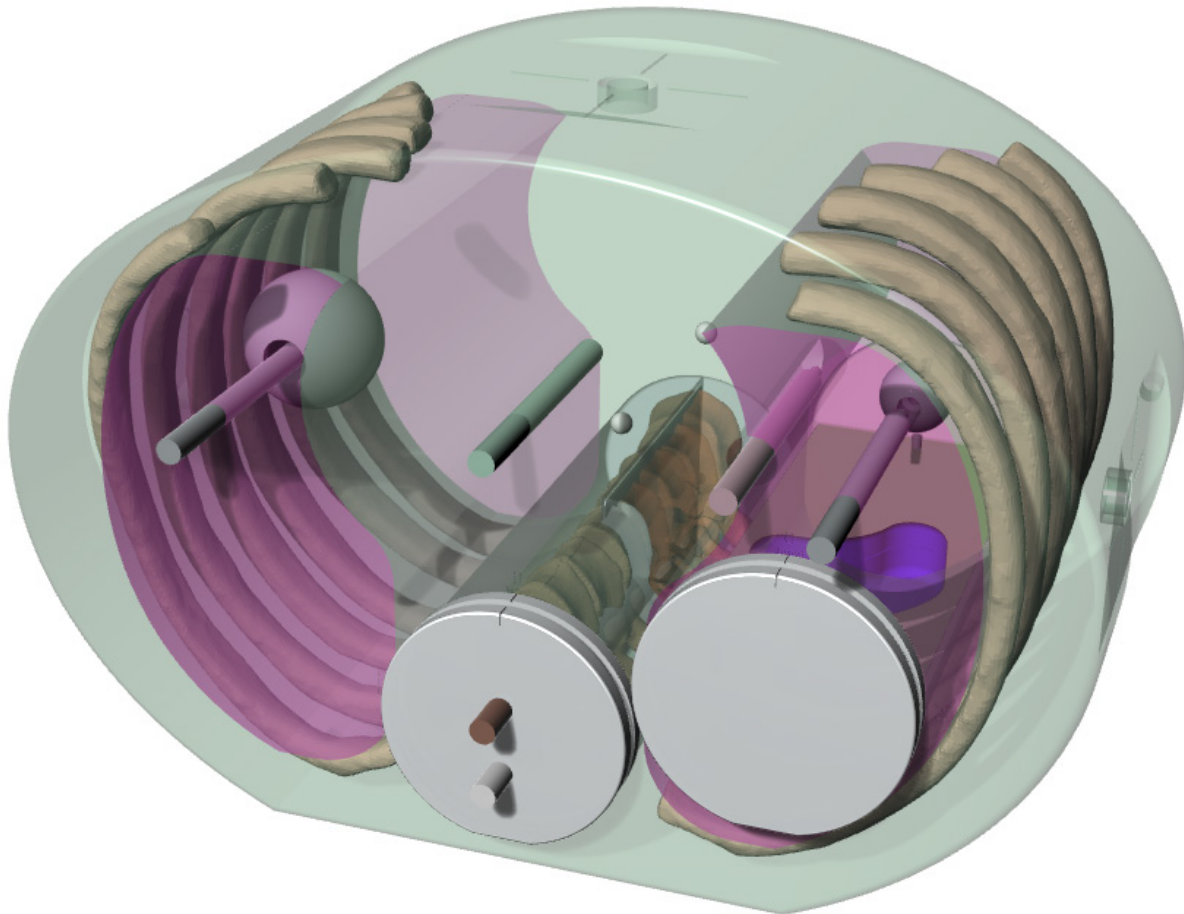


# E2E<sup>®</sup> SBRT Phantom with Removable Spine

Model 036S-CVXX-xx



***“END-TO-END” SBRT TESTING SOLUTION***



## CIRS

900 Asbury Ave • Norfolk, Virginia 23513 • USA • Tel: 757-855-2765 • [WWW.CIRSINC.COM](http://WWW.CIRSINC.COM)

# Overview

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 is a single tool for end-to-end commissioning and routine QA. The anthropomorphic, tissue-equivalent thorax phantom contains articulated spine, ribs, and lungs. All materials are suitable for use in kV and MV energies.

The Model 036S enables dose measurements to critical structures and high dose-gradient areas using small volume ion chambers, nanoDot dosimeters, and radiochromic film. Concentric circle targets, point targets and alignment marks make isocenter coincidence checks possible.

The optional SBRT Abdominal Phantom provides 3D spine anatomy for film and nanoDot™ OSL dosimetry. The additional bolus material allows dose distribution assessments within the abdomen due to non-coplanar beams.

***“...cumulative system accuracy for the procedure can be significant and needs to be characterized through an end-to-end test using phantoms with measurement detectors and imaging”***

AAPM TG-101 report  
Stereotactic Body Radiation Therapy

*Computerized Imaging Reference Systems, Inc is recognized world wide for tissue simulation technology and is the leader in the manufacture of phantoms and simulators for medical imaging and radiotherapy.*

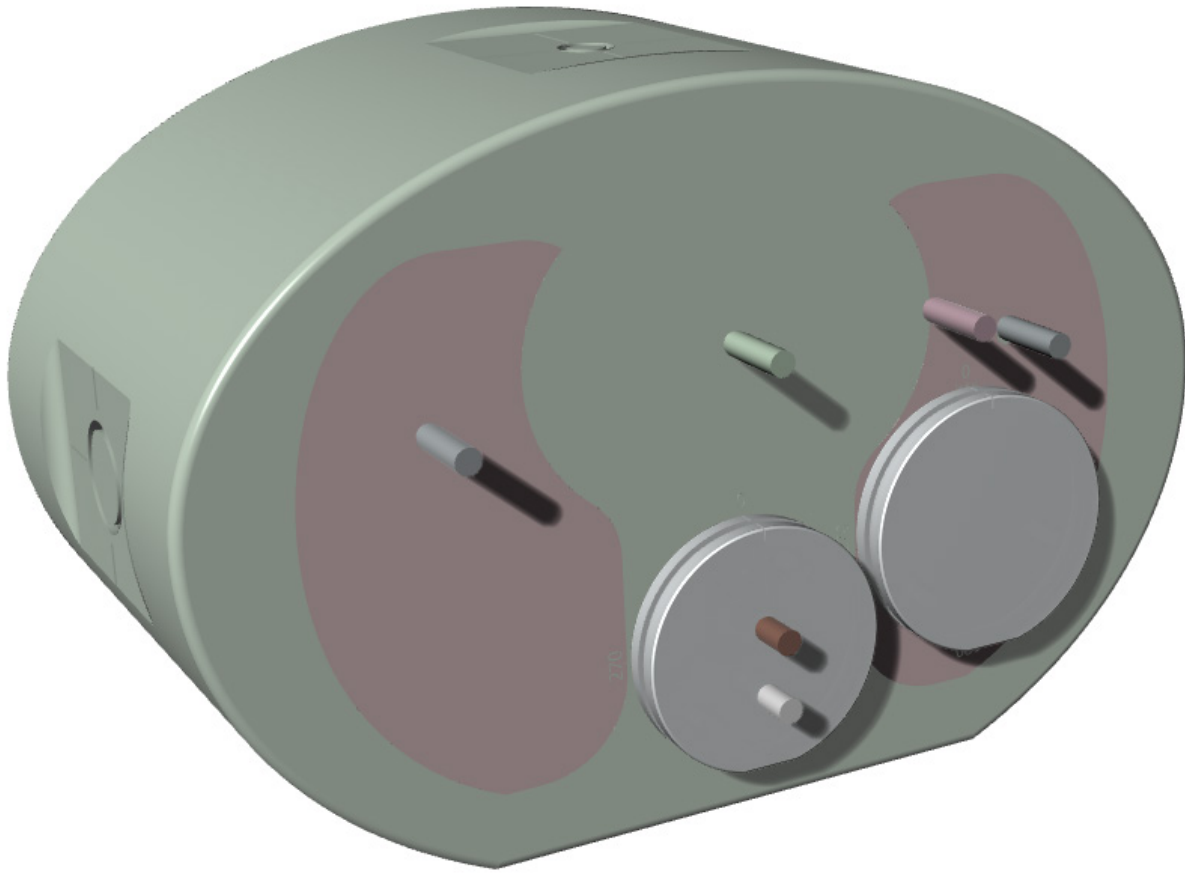
[www.cirsinc.com](http://www.cirsinc.com)

## Phantom Capabilities

- ***Ideal for commissioning an SBRT program***
- ***Allows daily system checks using Center point fiducial and offset target***
- ***Excellent test environment for Monte Carlo dose calculation verification***
- ***Supports use and testing of Image Guidance capabilities***

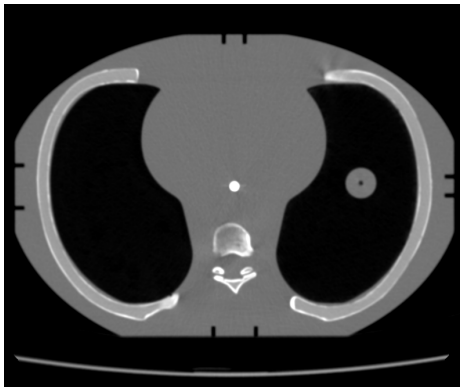
**CIRS**

# Proven Tissue-Equivalent Phantom Technology



The phantom body approximates the average human thorax in both size and structure using simplified geometries. It is constructed of proprietary tissue equivalent epoxy materials. Linear attenuations of the simulated tissues are within 1% of actual attenuation for water and bone, and within 3% for lung from 50 keV to 15 MeV.

The phantom contains a 3D anthropomorphic removable spine with cortical and trabecular bone as internal landmarks. External cross-marks facilitate rapid orientation with positioning lasers and phantom image registration.



Tissue equivalent phantom body with anthropomorphic spine and external alignment marks for phantom image registration

Material	Density, g/cc	Electron Density $\times 10^{23}$ , per cc	Ratio to H <sub>2</sub> O
Plastic Water® DT	1.04	3.35	1.003
Lung	0.21	0.67	0.201
Cortical Bone	1.91	5.95	1.782
Trabecular Bone	1.20	3.86	1.156
Soft tissue target	1.06	3.43	1.028

Linear Attenuation Coefficients To Reference Tissues <sup>(1) (2)</sup>				
	Plastic Water® DT	Trabecular Bone	Cortical Bone	Lung (Inhale)
En, MeV	Ratio, %	Ratio, %	Ratio, %	Ratio, %
0.05	100.8	100.0	100.00	100.3
0.06	100.5	100.1	100.00	101.1
0.08	100.3	100.3	99.99	101.9
0.10	100.2	100.3	99.99	102.2
0.15	100.0	100.4	100.0	102.5
0.20	100.1	100.5	99.99	102.5
0.40	100.1	100.5	100.0	102.7
0.60	100.1	100.5	100.0	102.6
0.80	100.1	100.4	100.0	102.7
1.00	100.1	100.5	100.0	102.7
1.50	100.1	100.5	100.0	102.7
2.00	100.1	100.5	99.99	102.6
4.00	100.0	100.5	99.92	102.1
6.00	99.8	100.3	99.85	101.6
8.00	99.7	100.0	99.79	101.2
10.0	99.6	100.0	99.73	100.7
15.0	99.2	99.78	99.61	100.0
20.0	99.1	99.58	99.55	102.7

1. ICRP 23, Report of the Task Group on Reference Man (1975).

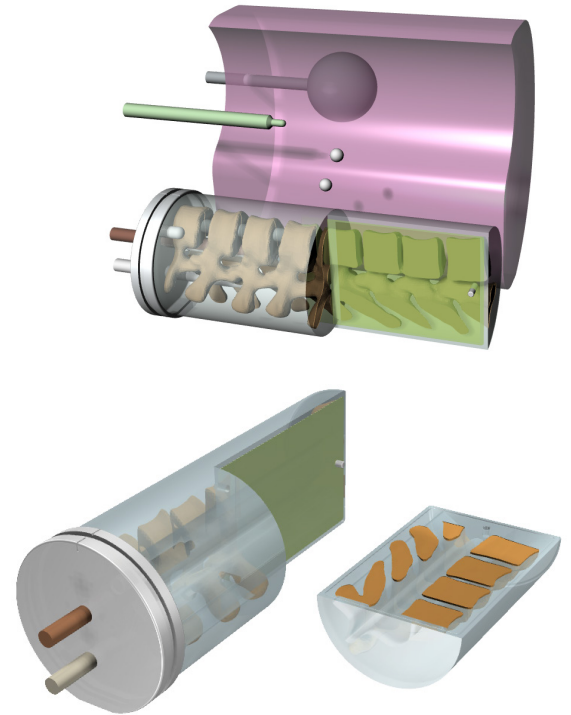
2. Woodard, H.Q., White, D.R., *The Composition of Body Tissues*, The British Journal of Radiology (1986) 59: 1209-1219

# Dose Measurements at Critical Structures

## NANODOT OSL DOSIMETERS

A removable insert in the right lung contains an irregular tumor volume with three nanoDot pockets to allow localized dosimetry measurements. 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.

Additional nanoDot measurement locations are available in the optional SBRT Abdominal Phantom (Model 036-01). Phantoms are shipped with nanoDot-shaped plugs for when nanoDot dosimeters are not in use.



## RADIOCHROMIC FILM

Model 036S 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 chamber 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 degrees for consistent re-positioning.

The Model 036S also receives film in a sagittal slice in the spine insert and in the right lung insert. CIRS Precision Cut EBT3 Film with integral registration holes are available for both the lung insert and spine insert. For ordering information, please refer to page 6.

## SMALL VOLUME ION CHAMBERS

Small volume ion chambers allow for precise measurements at high dose-gradient areas of interest.

The Model 036S contains two lung tumor volumes (4 cm and 2 cm, respectively) with ionization chamber cavities in the center of each target. The phantom also receives small volume ion chambers to the spinal cord, vertebral body, center mediastinum, and mediastinum/ lung interface.

Customers must specify ion chamber at the time of purchase. Please refer to [www.cirsinc.com/support](http://www.cirsinc.com/support) for a list of CIRS cavity codes.

### Six Ion Chamber Locations:

- Left Lung (4 cm soft-tissue target)
- Right Lung (2 cm soft-tissue target)
- Center Mediastinum
- Mediastinum/ lung interface
- Vertebral Body
- Spinal Cord

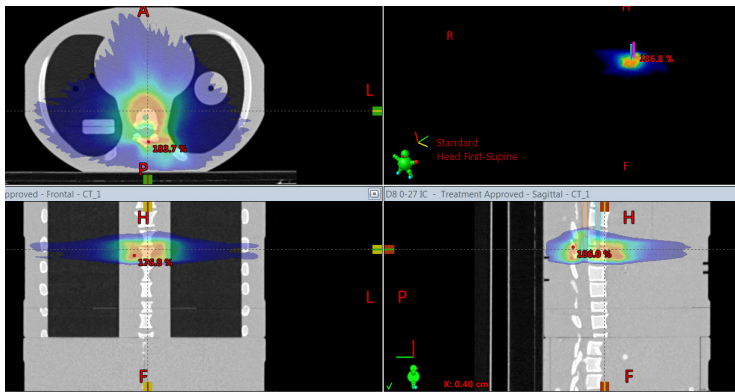


Image 02 <sup>(1)</sup>

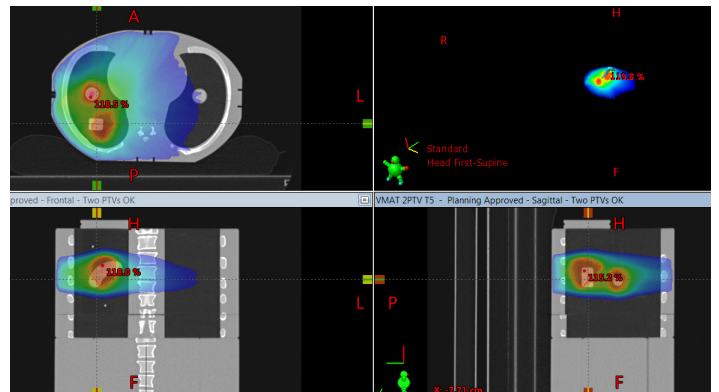


Image 03 <sup>(1)</sup>

(1) Images provided by UZ Leuven, "Evaluating a versatile new-generation anthropomorphic phantom for Stereotactic Body Radiation Therapy", E35-2122

# Daily System Checks

Target positioning through imaging guidance is critical for the accurate delivery of radiation treatment. Verifying that all of the imaging, localization and targeting systems are aligned with the true radiation isocenter is crucial. The CIRS E2E SBRT Phantom with Removable Spine contains concentric circle targets, point targets and alignment marks to make isocenter coincidence checks possible.

The Model 036S contains embedded central and off-set fiducials. The offset target is used to ensure the table offset coordinates generated by kV/MV imaging are accurate by locating the target, moving the table the determined amounts and verifying that the offset target has been positioned at the isocenter. The embedded center fiducial and off-set target measure 6.35 mm in diameter and are made of ceramic.

The exterior of the phantom is machined with concentric circle targets to allow user to objectively assess all setup errors, including rotations, and to easily align the phantom to the true radiation isocenter. The E2E SBRT Phantom is manufactured on CNC machines with tolerance of  $\pm 0.02$  mm. Target positioning accuracy is  $\pm 0.1$  mm.

## Isocenter QA Features

- Embedded Off-set ceramic fiducial
- Embedded Central ceramic fiducial
- External Alignment marks
- Concentric Circle targets

# Optional Configurations

## EVALUATE THE EFFECTS OF THE NON-COPLANAR BEAMS

The SBRT Abdominal Phantom (Model 036-01) is an optional accessory of Model 036S which provides additional bolus to evaluate the effects of the non-coplanar beams on critical structures, including the vertebra body and spinal cord.

The 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 (see page 3).

The central insert is cut in the sagittal plane. A film for high resolution dosimetry measurements can be placed between the two halves. CIRS Precision Cut EBT3 Film is available as an optional accessory, please refer to page 6 for ordering information. Four nanoDot pockets permit for localized dosimetry measurements within the vertebra body (1), spinal cord (2) and spinal disc (1).

The Model 036S and 036-01 are connected using lateral pins, which allow rotation of the central insert about the Inferior-Superior axis.

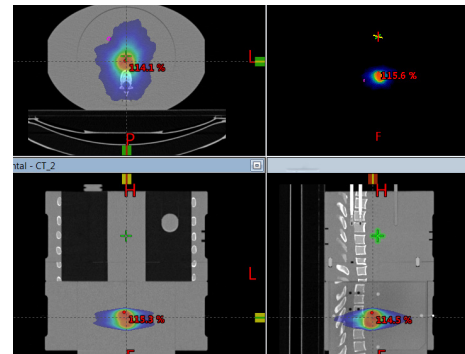
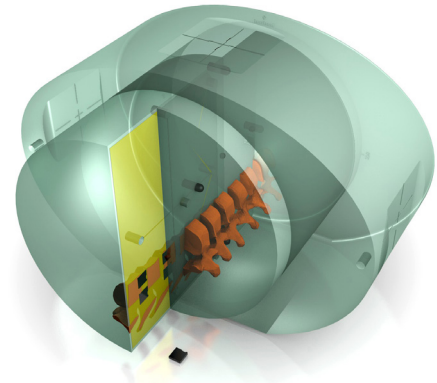
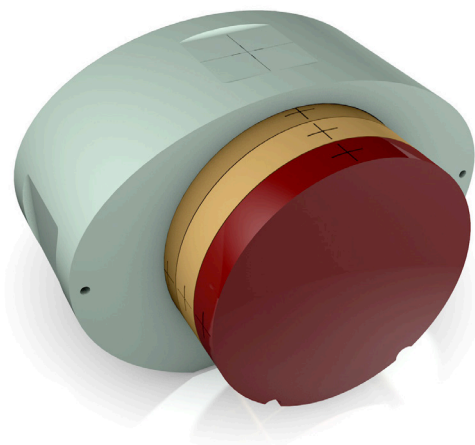


Image 04 <sup>(1)</sup>

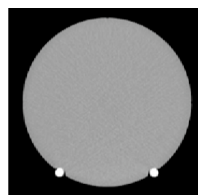


## ASSESS IMAGE QUALITY OF OBI SYSTEMS

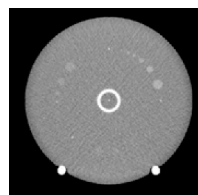
The central insert of the Model 036-01 can also accommodate the CIRS CBCT Image Quality Phantom (Model 062QA-35) to perform image quality assessments of on-board imaging (OBI) systems.

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.

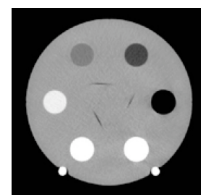
The CBCT Image Quality Phantom is composed of four layers: Uniformity, Low Contrast/Magnification, CT Number Linearity/Slice Thickness, and Spatial resolution. For more information about the Model 062QA-35, please refer to the Model 062MQA Product Brochure.



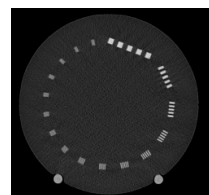
Uniformity



Low Contrast



CT Number Linearity



Spatial Resolution



# Model 036S Specifications & Ordering Information

## SPECIFICATIONS FOR MODEL 036S

<b>DIMENSIONS:</b>	16.5 cm x 30 cm x 20 cm 6.5" x 11.8" x 7.9"
<b>PHANTOM WEIGHT:</b>	~7 kg (15 lb)
<b>MATERIALS:</b>	Proprietary Epoxy Resins

## MODEL 036S-CVXX-XX INCLUDES

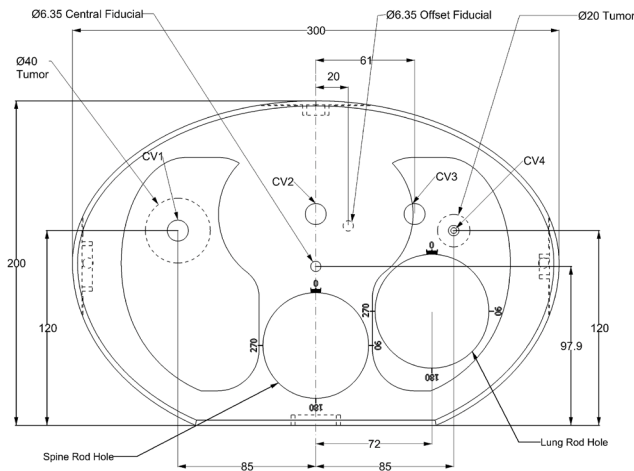
QTY	COMPONENT DESCRIPTION
1	E2E® SBRT Phantom with Removable Spine drilled for customer specified ion chamber* and CV plugs
1	User Guide
1	Foam-Lined Carry Case
-	60 Month Warranty

## OPTIONAL ACCESSORIES

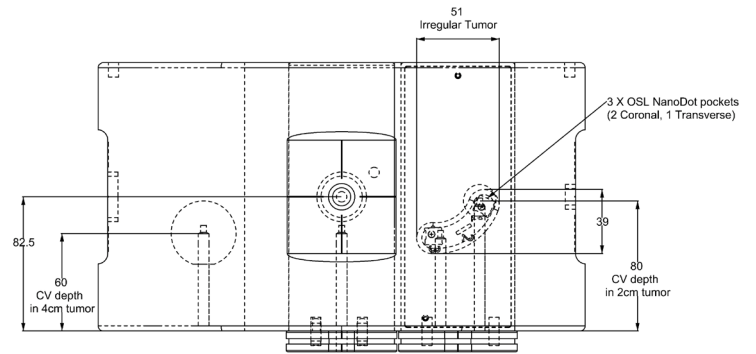
PART NO.	COMPONENT DESCRIPTION
036-01	SBRT Abdomen Phantom with 3D spine for film and nanoDot™ Dosimetry (includes foam-lined carry case)
062QA-35	CBCT Image Quality Phantom
158200-25	Precision Cut EBT3 Film Kit for Model 036S (Set of 18 spine inserts and 12 lung inserts plus 6 calibration strips)
158200-02	Precision Cut EBT3 Film Kit for Model 036-01 (Set of 4 inserts plus 6 calibration strips)

\* Customer must specify ion chamber at time of purchase. Refer to CIRS cavity codes at [www.cirsinc.com/support](http://www.cirsinc.com/support) for corresponding CV number.

## TECHNICAL DRAWINGS MODEL 036S-CVXX-XX

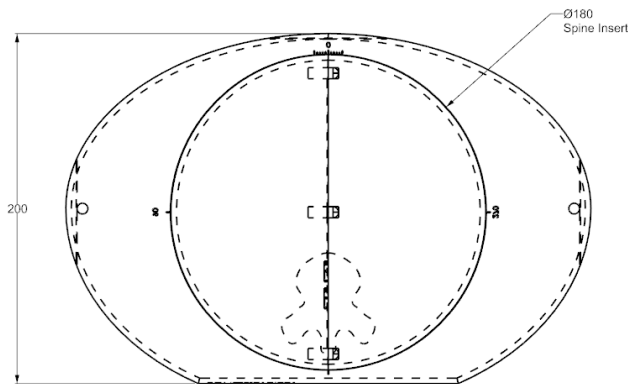


Front View

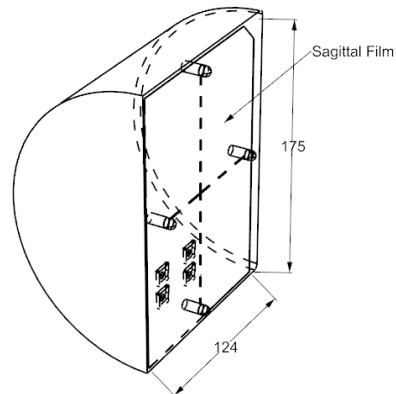


Top View

## TECHNICAL DRAWINGS MODEL 036-01



Front View



Central Insert

# 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 Customer Service prior to returning the product. Call 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
Model 036S-CVXX-xx- E2E SBRT Phantom with Removable Spine	60 Months

## MODEL 036S FEATURES

- **High Resolution Anthropomorphic Characteristics**
- **Tissue-Equivalent from 50 keV to 15 MeV**
- **Thorax with articulated spine, ribs and lungs**
- **Center point fiducial and offset target for daily system checks**
- **Optional Abdomen with spine**
- **Optional Abdomen accommodates image-quality insert**



**COMPUTERIZED IMAGING  
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**Technical Assistance**

1.800.617.1177



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