Dynamic Pelvis Phantom

Model 008P

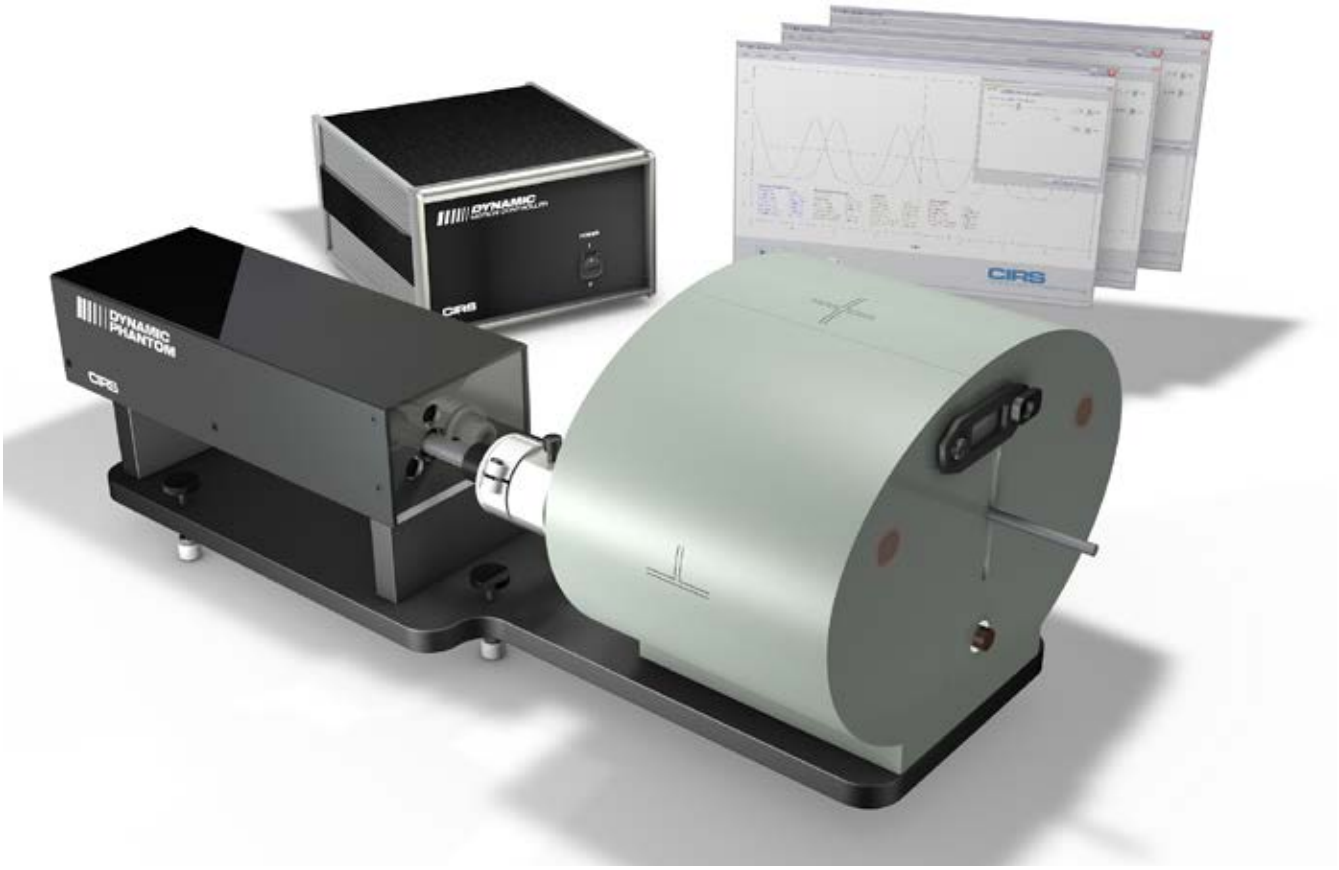

IMAGE ACQUISITION • TREATMENT PLANNING • DOSE DELIVERY

IGRT e2e SCAN PLAN LOCALIZE TREAT

2428 Almeda Avenue Suite 316 • Norfolk, Virginia 23513 • USA
Tel: 800.617.1177 • 757.855.2765 • Fax: 757.857.0523

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CIRS
Tissue Simulation & Phantom Technology

CAPABILITIES

- Commission 4D imaging and 4D radiotherapy systems
- Evaluate static and dynamic target localization accuracy of onboard imaging systems
- Test accuracy and consistency of tumor tracking
- Assess dosimetric accuracy of intensity modulated radiation therapy
- Train and evaluate personnel during implementation of new equipment and techniques

CIRS

Overview

The CIRS Dynamic Pelvis Phantom is a precision instrument for investigating and minimizing the impact of prostate motion inside the pelvis. It provides known, accurate and repeatable two-dimensional target motion inside a water-equivalent phantom. It is designed for end-to-end analysis of image acquisition, planning and dose delivery in image-guided radiation therapy.

The phantom body represents an average human pelvis in shape, proportion and composition. A water-equivalent cube containing a prostate gland and/or various detectors is inserted into the pelvic cavity of the phantom. The cube is connected to a motion actuator box that induces two-dimensional target motion through rotation of the water-equivalent cube. Motion of the cube itself is radiographically invisible due to its matching density with the surrounding material. The prostate and its motion, given its density difference, can be resolved.

Prostate motion is independently controlled with CIRS Motion Control Software. The graphical user interface provides an unlimited variety of optimized motion profiles while simplifying the operation of the Dynamic Pelvis Phantom to an intuitive level. Patient specific profiles are easily imported and there is no need to make hardware adjustments or have special programming skills.

The Dynamic Pelvis Phantom offers ease of use and portability as well as a flexible selection of motion profiles and dosimeter options. All components are packaged in a protective case. The system requires minimal set-up and can be ready to use in minutes. The CIRS Model 008P Dynamic Pelvis Phantom presents a sophisticated solution for the complex challenges and emerging technologies in Image-Guided 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.

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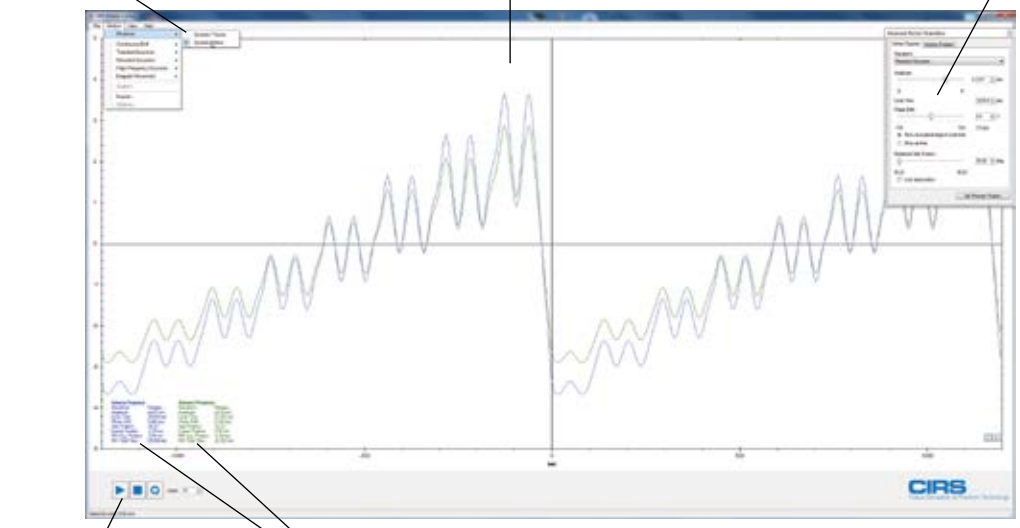
Easy To Use Software



USER FRIENDLY MOTION CONTROL

The Dynamic Pelvis Phantom is operated using CIRS Motion Control Software, a user-friendly graphical user interface that can be used to operate both the Dynamic Prostate Phantom and the Dynamic Thorax Phantom. Upon installation, the user selects the phantom that is to be controlled through a drop down menu on the main screen.

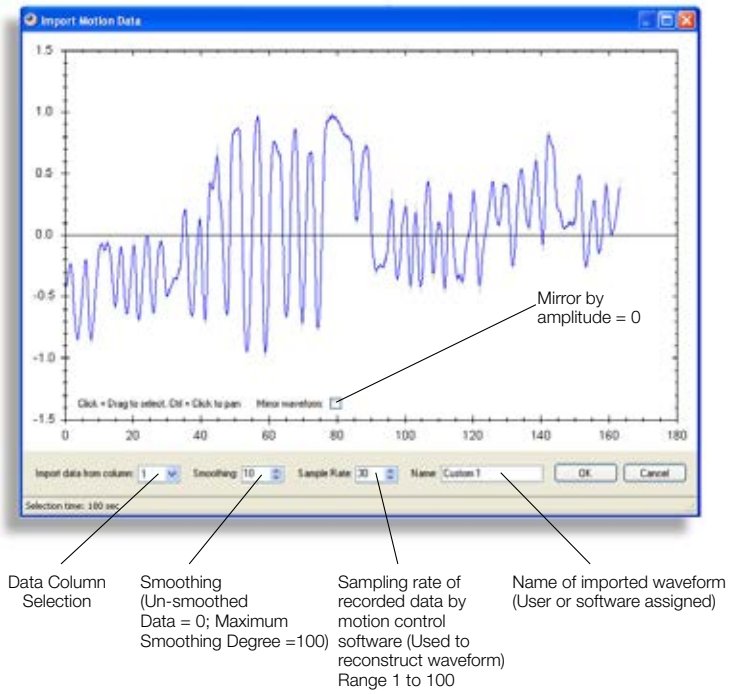
Amplitude, cycle time and phase shift can be applied using slider bars or by entering desired values within the limits of the system. Five different built-in waveforms are available from a standard pull down menu and represent typical prostate motion profiles.

An unlimited number of clinically relevant and user-generated waveforms or correlation models can be imported from tab delimited or comma separated file formats.

There are also waveform editing, smoothing and analyzing tools to ease the optimization of custom waveforms.

The software provides a convenient, real-time graphic display with relevant information about the waveform selected for each direction of simulated tumor. In addition the ROI analyzing function provides the time spent by the target between two chosen amplitudes and the average time weighted position for that particular ROI.

Users can instantly start, stop or pause the motion at any time. New start positions can be graphically selected and applied making the device very useful for static test as well as dynamic testing. Users can also select the number of cycles to be looped by entering the desired value or choose continuous looping (1 million cycles).



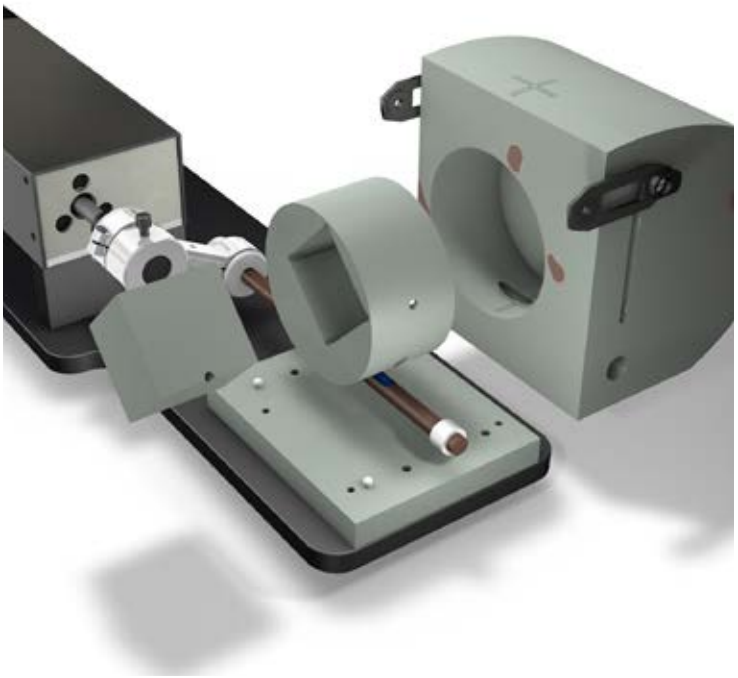
True 2D Target Motion In A Solid Epoxy Phantom

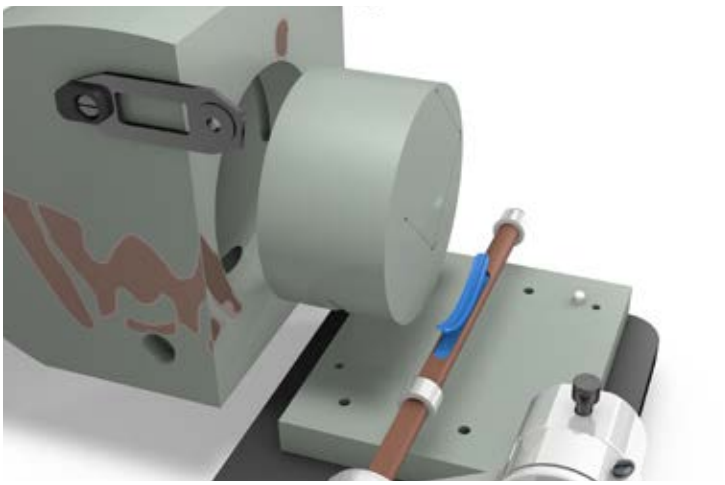
A water-equivalent homogeneous cube containing a prostate and/or dosimeter is moved within the pelvic region of the solid phantom body. Motion of the cube is radiographically invisible due to its matching density with the surrounding material, however the prostate can be resolved given its density difference.

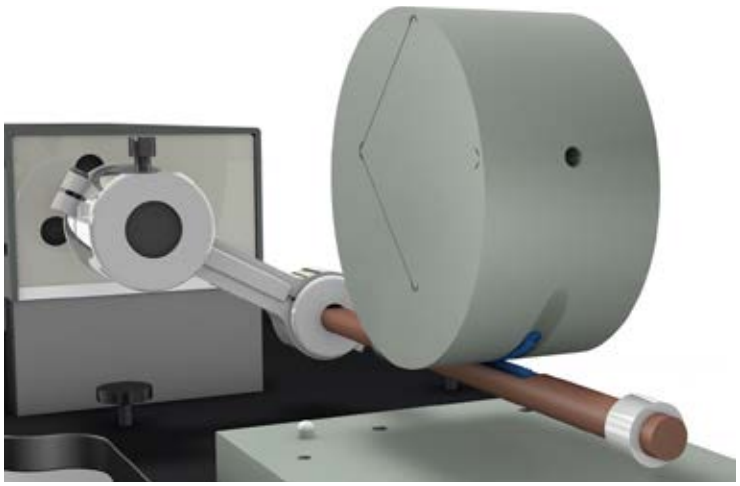
The cube is inserted in a cylinder so that the prostate's isocenter is offset from the center of the encapsulating cylinder, which has on its cylindrical face, a circular gear (pinion) which engages with teeth on a linear gear rod (rack). Complex 2D motions can be achieved thru the rack and pinion system. The actuator box induces linear motion on the linear gear rod. The linear motion of the rack is thereby converted to rotational motion of the cube.

Complex 2D motion profiles can be achieved thru simultaneous, independently controlled translation in inferior-superior and anterior-posterior directions.

There are five (5) prostate motion specific built-in waveforms each with its own default cycle time.

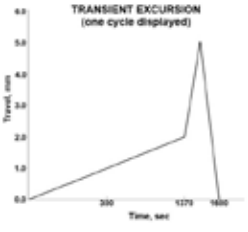




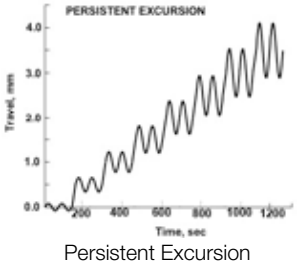


Built-in, prostate-specific waveforms

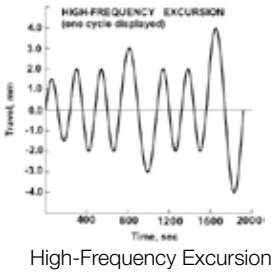
Continuous Drift



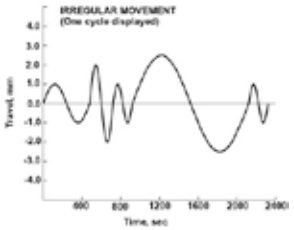
Transient Excursion



Persistent Excursion

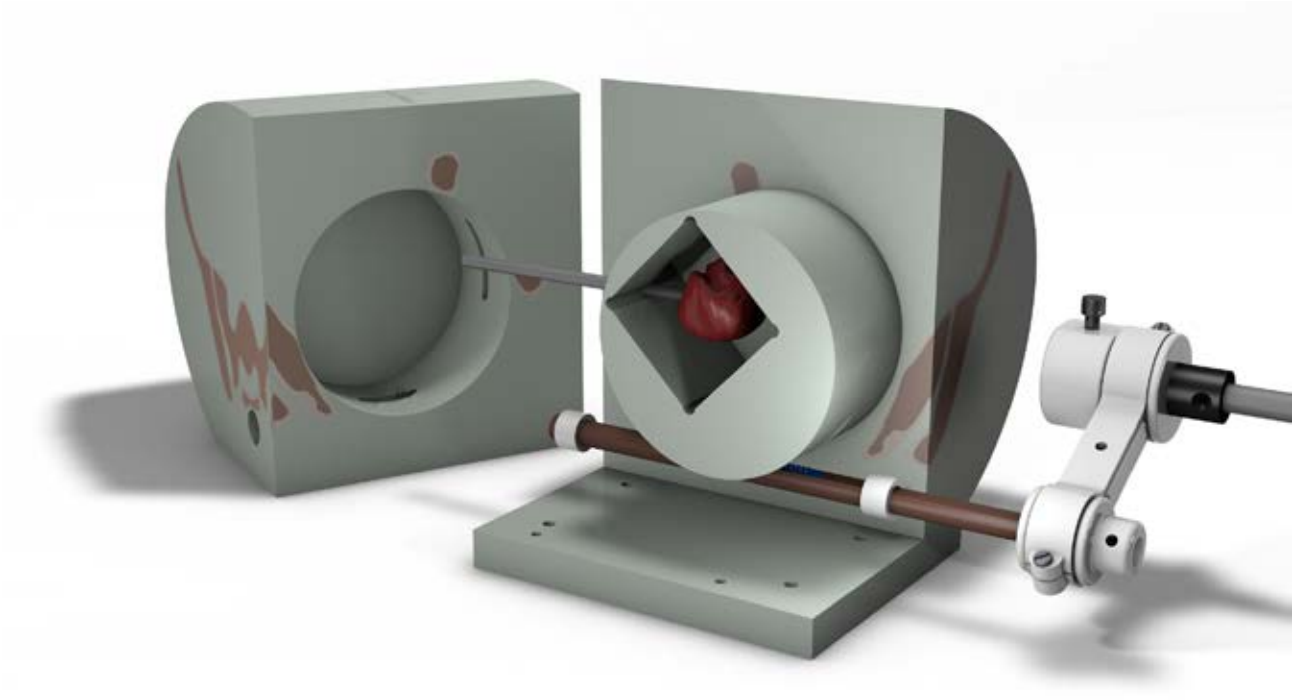


High-Frequency Excursion



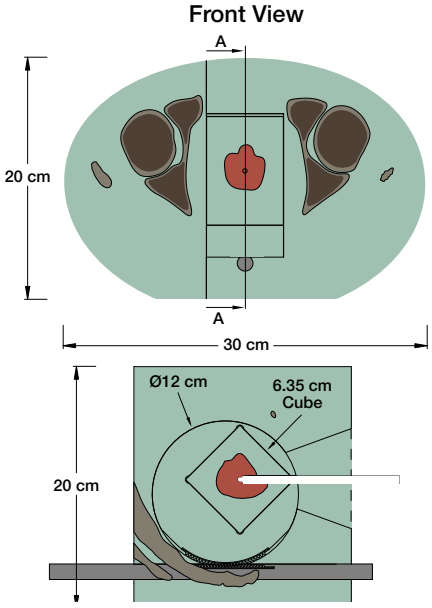
Irregular Movement

Proven Tissue-Equivalent Phantom Technology

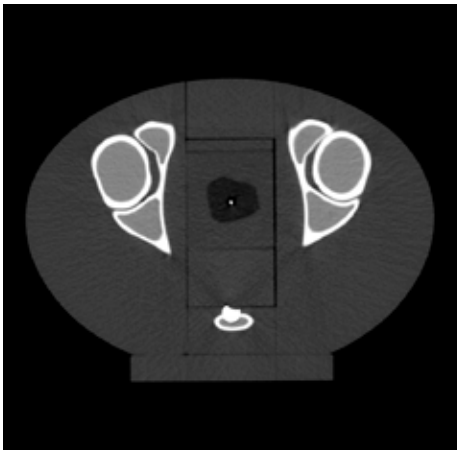


The phantom body approximates the average human pelvis in both size and structure using simplified geometries. It is constructed of proprietary tissue equivalent epoxy materials. Linear attenuations of the simulated tissues are within 1% of actual attenuation for water and bone.

As internal landmarks, the phantom contains a 3D anthropomorphic pelvis with cortical and trabecular bone. External alignment marks with embedded fiducials facilitate rapid orientation with positioning lasers and phantom image registration.



Material	Density, g/cc	Electron Density x 10^23, per cc	Ratio to H_2O
Plastic Water® DT	1.04	3.35	1.003
Cortical Bone	1.91	5.95	1.782
Trabecular Bone	1.20	3.86	1.156
Prostate	1.08	3.48	1.041



Tissue equivalent phantom body with anthropomorphic pelvis, external alignment marks and CT fiducials for phantom image registration.

Linear Attenuation Coefficients To Reference Tissues [1] [2]				
	Plastic Water® DT	Trabecular Bone	Cortical Bone	Prostate
En, MeV	Ratio, %	Ratio, %	Ratio, %	Ratio, %
0.06	100.5	100.1	100.00	100.19
0.08	100.3	100.3	99.99	100.42
0.10	100.2	100.3	99.99	100.45
0.20	100.1	100.5	99.99	100.56
0.40	100.1	100.5	100.0	100.64
0.60	100.1	100.5	100.0	100.54
0.80	100.1	100.4	100.0	100.62
1.00	100.1	100.5	100.0	100.55
2.00	100.1	100.5	99.99	100.59
4.00	100.0	100.5	99.92	100.28
6.00	99.8	100.3	99.85	100.35
8.00	99.7	100.0	99.79	100.00
10.0	99.6	100.0	99.73	100.00
20.0	99.1	99.58	99.55	98.93

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

Interchangeable Cubes for QA & Dosimetry

There are eight water-equivalent interchangeable 6.35 cm cubes available for use with the phantom. The cubes accommodate either micro chamber, film or gel dosimeters. All cubes can be quickly interchanged.

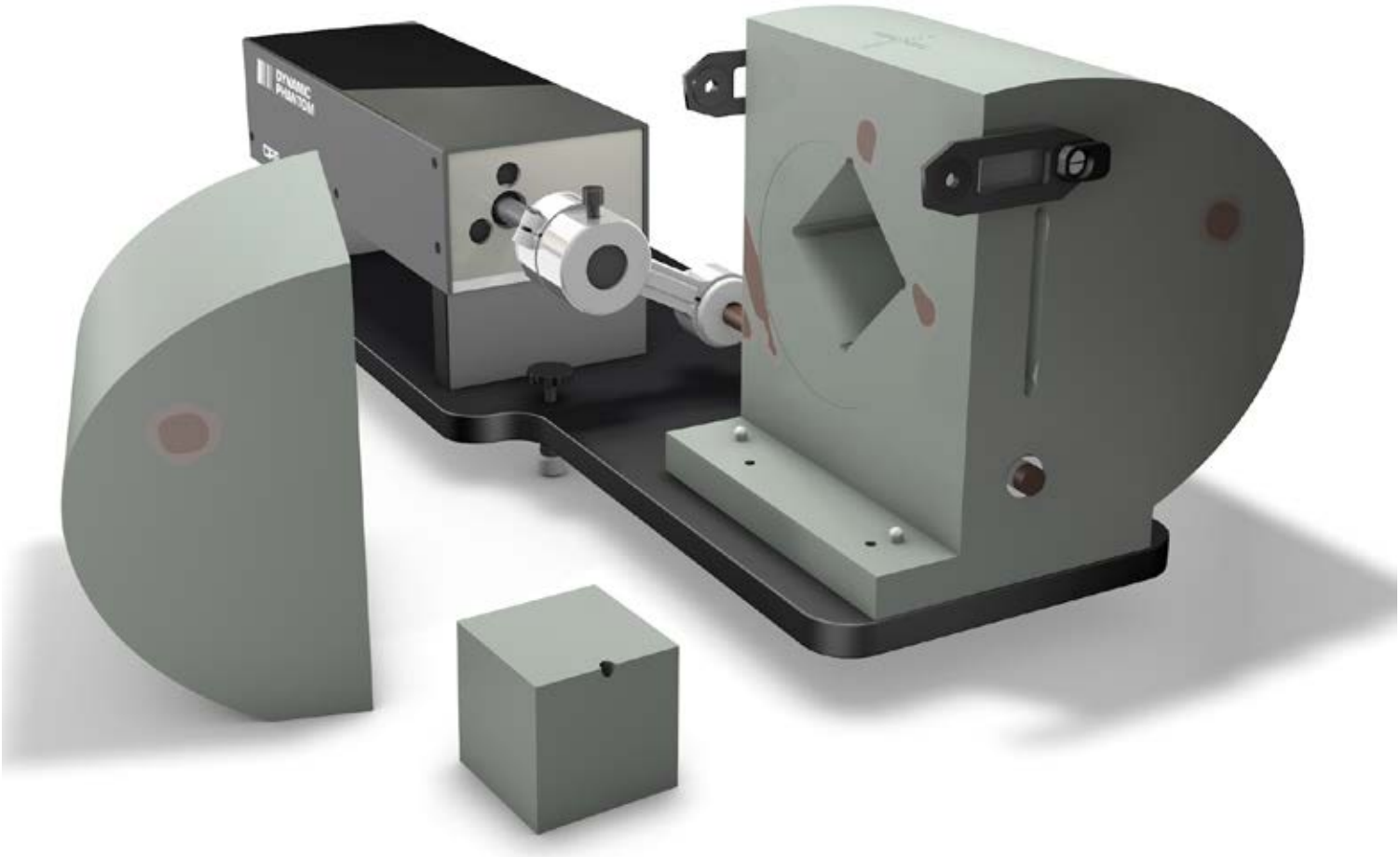
The gel cube receives a standard B9 dose gel container. The container is made from oxygen resistant plastic. Clear walls enable visual inspection of the irradiated gel. The container can be scanned in CT, MRI and optical laser scanners.

The film stack cubic insert accommodates 13 radiochromic films with 4 mm spacing for quasi-3D dosimetry. The cube features groves that enable easy orientation of film scans in the TPS.

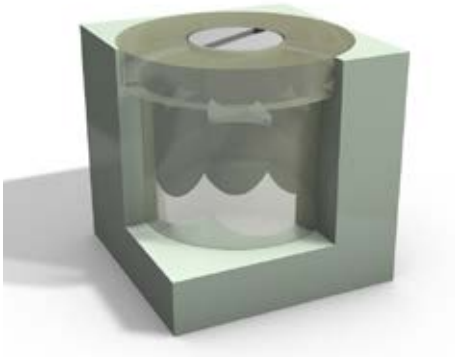
The imaging cubes are designed to include solid known volume targets for imaging applications and include either a 25 cc or 50 cc prostate gland.

The micro chamber cubes are designed for target acquisition and quantitative dose measurements. Each cube includes a prostate gland and is machined to receive the dosimeter at the center of the prostate volume.

The Gafchromic film cubes, which contain a 25 cc or 50 cc prostate gland, are designed for film dosimetry in sagittal plan. The design of film prostate cubes is such that the orientation of the radiated film is easily recognized.

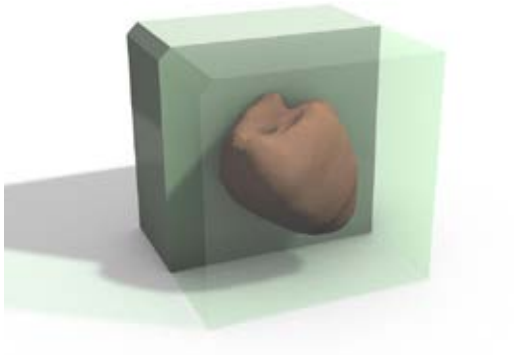


Gel Dosimetry Cassette Model 002GC

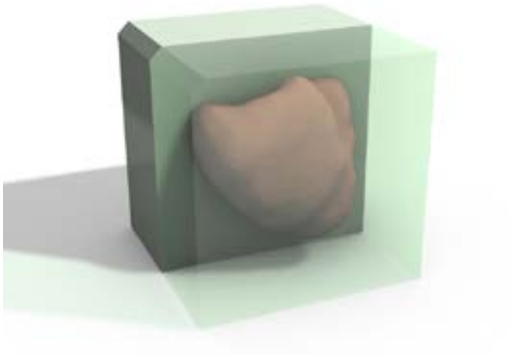


Film Stack Model 002FC

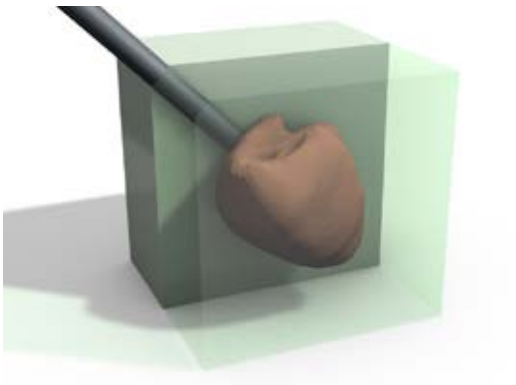
25 cc Imaging Cube Model 008P-02



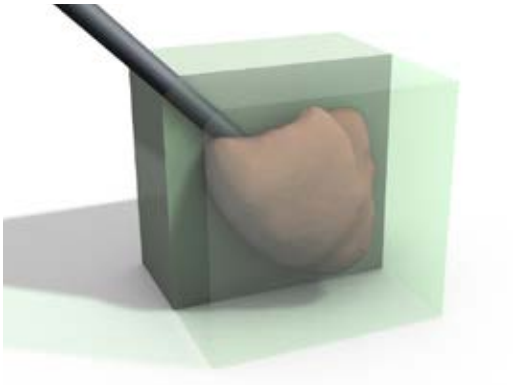
50 cc Imaging Cube Model 008P-03



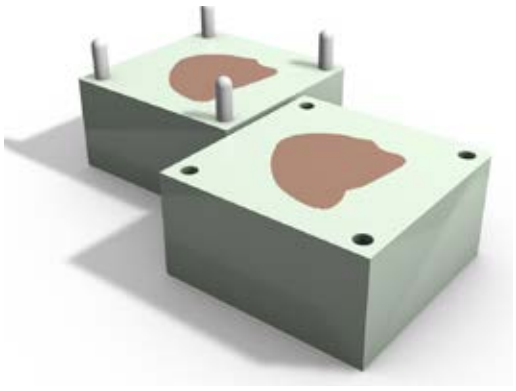
25 cc Microchamber Cube Model 008P-04-CV



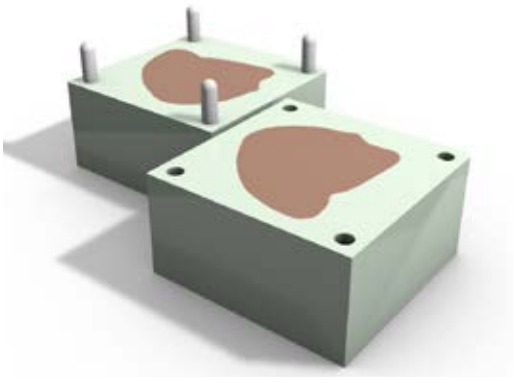
50 cc Microchamber Cube Model 008P-05-CV



25 cc Film Configued Cube Model 008P-07



50 cc Film Configured Cube Model 008P-08



(*Cutaway to show internal structure.*)

Advanced Electromechanical Components

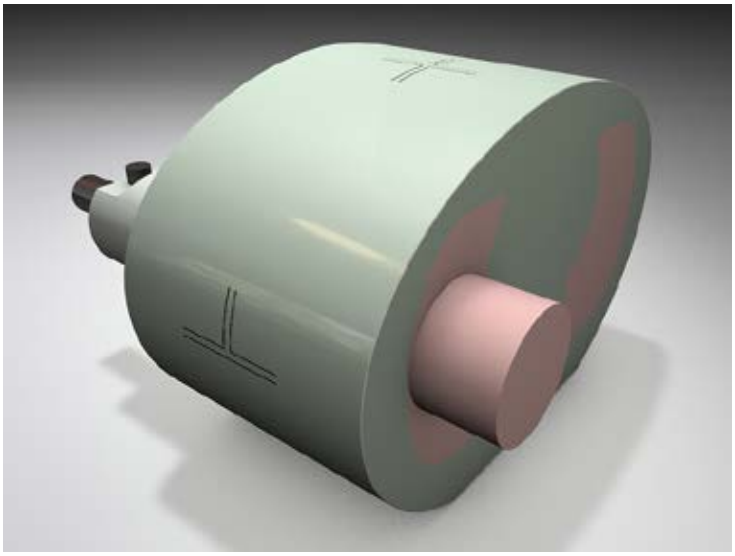
ACTUATOR (ALSO USED FOR MODEL 008A)

Housed within anodized aluminum enclosures, the actuator contains bipolar stepper motors that enable linear motion accuracy of 0.01 mm and rotational motion accuracy of 0.2°. Linear motion of the target in the (IS) direction can be isolated from rotational motion in the axial plane in both frequency and amplitude. Motions can be synchronized to one another with accuracy better than 20 msec. Motion cycle time accuracy is better than 5 msec. Optical sensors ensure precise mechanical positioning. The actuator is designed for continuous operation. If not manually stopped and reset by the user, it will perform 1000000 (in continuous mode) cycles then stop automatically.

CONTROLLER

Motions are generated through a three-axis motion controller. A USB port enables interfacing with most computers. The controller box powers the actuator and sends motion instructions through a 25 pin serial cable. The motion controller can be fully operated through CIRS Motion Control Software (see page 3) from a distance of up to 70 feet with the Ethernet/USB cable provided.

Additional Options



DYNAMIC THORAX PHANTOM BODY & SURROGATE PLATFORM

Model 008A-20 includes the Dynamic Thorax Phantom Body and Surrogate Platform. The Dynamic Thorax Phantom Body is interchanged with the Dynamic Pelvis Body while the Surrogate Platform is attached to the Motion Actuator Box. The Dynamic Thorax Phantom Body represents an average human thorax in shape, proportion and composition. Various lung equivalent rods containing a spherical target or various detectors are available and are inserted into the lung equivalent lobe of the phantom. The body is connected to a motion actuator box that induces three-dimensional target motion through linear translation and rotation of the lung equivalent rod. The CIRS Motion Control Software has been pre-programmed to allow the user to select the phantom that is to be controlled by the software.

ADJUSTABLE LEGS

Adjustable legs are available. Legs can be useful in leveling the phantom on curved imaging couches.

Model 008P Specifications

DIMENSIONS:	Overall: 67 cm x 32 cm x 28 cm (26" x 13" x 11") Pelvis: 18 cm x 30 cm x 20 cm (7" x 12" x 8")
WEIGHT:	Overall: 81.1 kg (40 lb) Pelvis: 8.8 kg (19.5 lb)
AMPLITUDE, IS:	± 5 mm
AMPLITUDE, AP:	± 5 mm
MOTION ACCURACY:	± 0.1 mm
CYCLE TIME:	1 - ∞ (adjusted based on amplitude)
BUILT-IN WAVEFORMS:	continuous drift, high-frequency excursion, transient excursion, persistent excursion, irregular movement

CIRS MOTION CONTROL SOFTWARE SYSTEM REQUIREMENTS

Windows XP® / Vista / Windows 7/ Windows 8 (32 and 64 Bit)

Pentium 3® or equivalent
512 MB RAM, 2 MB of available disk space

Ordering Information

INCLUDED WITH MODEL 008P

Part No.	Qty	Component Description
008P	1	Dynamic Pelvis Phantom Body with 3D pelvis (Prostate Cubes) not included
	1	Control unit with firmware installed (110 - 220V, 50 - 60Hz)
	1	Motion actuator box
	1	Base plate
	1	CIRS Motion Control Software CD-Rom
	1	Four in one screwdriver
	1	Suction Cup
	1	Network cable CAT5e, 75'
	1	DB 25 male to male cable
	1	USB cable 1' A/B male
	2	USB extender terminals
	1	Bag of miscellaneous replacement fasteners
	2	2 Amp fast acting fuses
	1	Power cord
	1	User's manual
	1	Carry Case

INTERCHANGEABLE CUBE OPTIONS

Note: Customers must complete their order with the purchase of at least one (1) interchangeable cube option. *Refer to separate CIRS cavity and plug code list for available chamber cavities.

Part No.	Description
008P-02	Imaging Cube with 25 cc Prostate Gland
008P-03	Imaging Cube with 50 cc Prostate Gland
008P-04-CVXX-xx*	Microchamber configured cube with 25 cc Prostate Gland
008P-05-CVXX-xx*	Microchamber configured cube with 50 cc Prostate Gland
008P-07	Film Configured with 25 cc Anthropomorphic Prostate Gland
008P-08	Film Configured with 50 cc Anthropomorphic Prostate Gland
002GC	Gel Dosimetry Cassette (includes b6 Container)
002FC	Film Stack for 3D Image Reconstruction

ADDITIONAL OPTIONS

Part No.	Description
008P-17	Adjustable legs for 008P only
008A-20	Dynamic Thorax Body

LIMITED 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.

Product	**Warranty Period**
Non-Standard or customized products	3 months
Training Phantoms and Disposable Products	6 months
Electrical Products and Dynamic Phantoms	**12 months**
All other standard products	48 months
Plastic Water	60 months

REFERENCES:

Xie Y, Djajaputra D, King CR, et al. Intrafractional Motion of the Prostate During Hypofractionated Radiotherapy. Int J Radiat Oncol Biol Phys. 2008; 72(1): 236–246. doi:10.1016/j.ijrobp.2008.04.051.

MODEL 008P FEATURES

- Complex prostate tumor motion within the pelvis
- Sub-millimeter accuracy and repcubeucibility
- Motion software enables different cycles, amplitudes and wave forms
- Tissue equivalent from 50 keV to 15 MeV
- Compatible with TLD, MOSFET, Dose Gel, micro-chamber, PET/CT targets and film.

CIRS

COMPUTERIZED IMAGING REFERENCE SYSTEMS, INC.
2428 Almeda Avenue Suite 316
Norfolk, Virginia 23513 USA

Toll Free: 800.617.1177
Tel: 757.855.2765
Fax: 757.857.0523
E-mail admin@cirsinc.com

www.cirsinc.com

Technical Assistance
1.800.617.1177

Computerized Imaging Reference Systems, Inc. has been Certified by UL DQS Inc. to **(ISO) 9001:2008**.
Certificate Registration No. 10000905-QM08

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