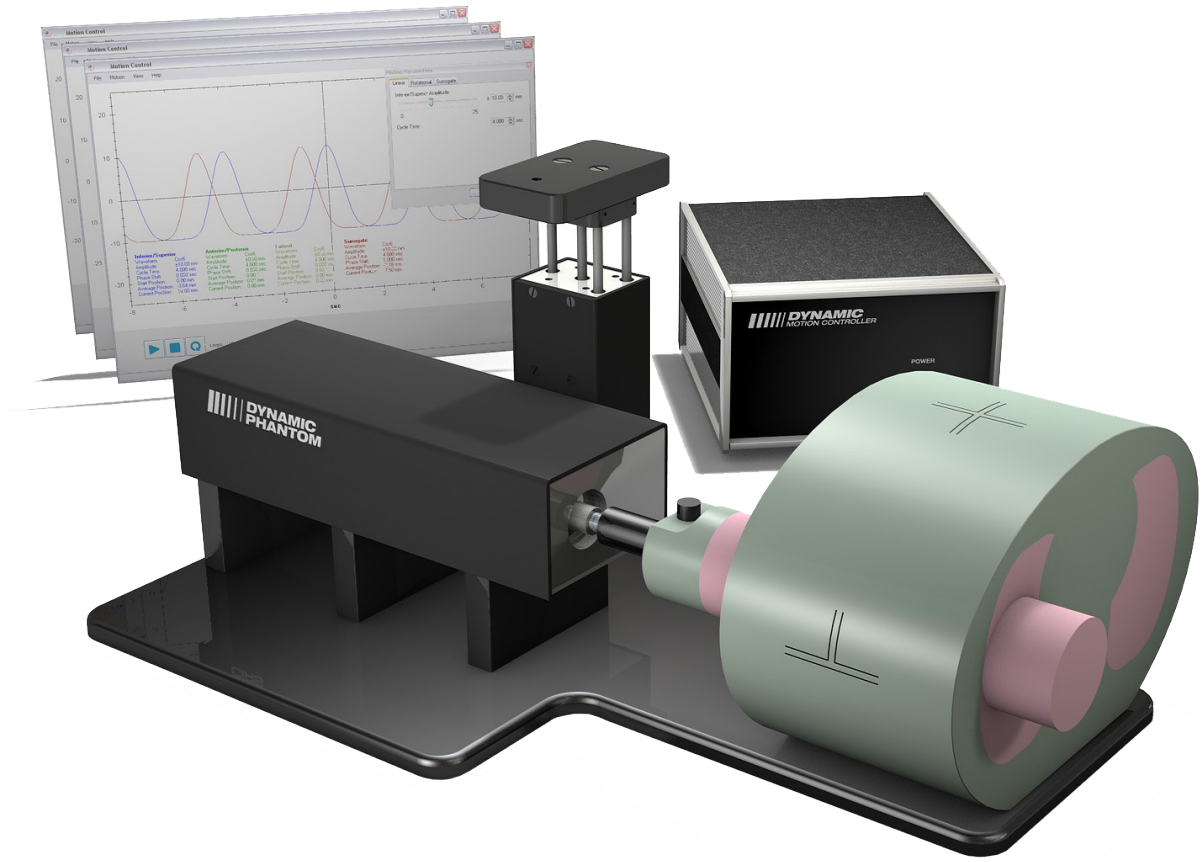


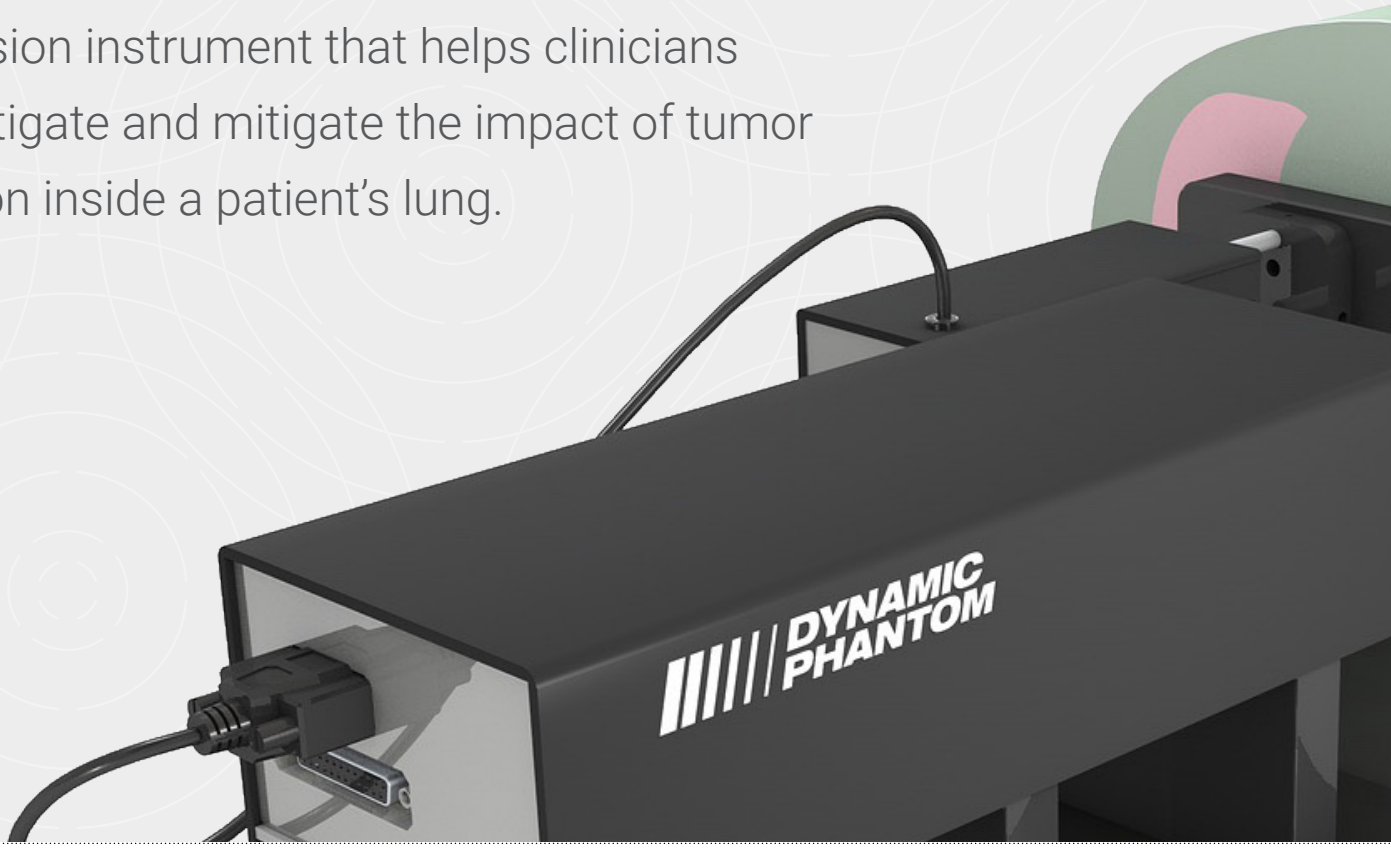
Dynamic Thorax Phantom

Analyze Image Acquisition, Planning & Dose Delivery

SUN NUCLEAR
A MIRION MEDICAL COMPANY

Minimize the Impact of Motion

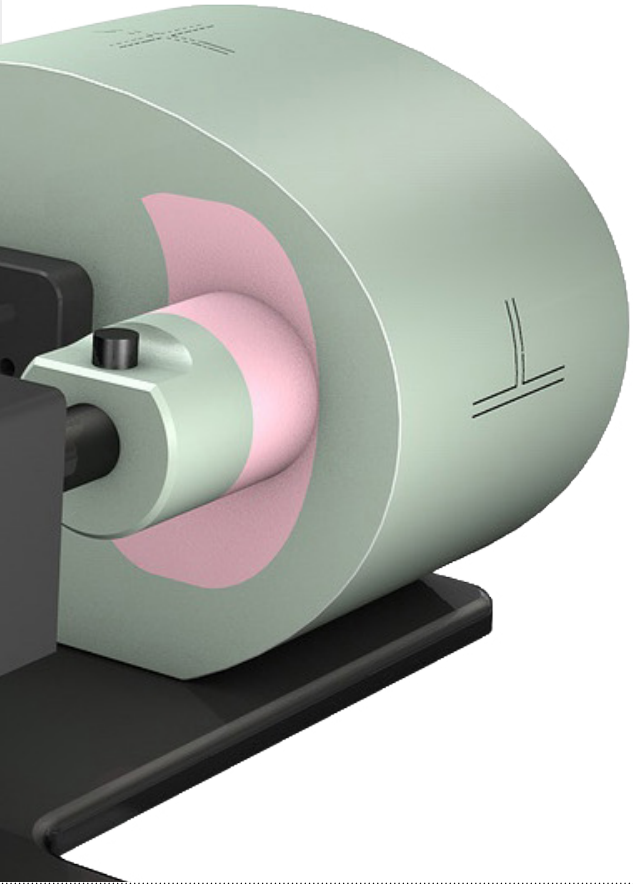
The Dynamic Thorax Phantom is a precision instrument that helps clinicians investigate and mitigate the impact of tumor motion inside a patient's lung.



With tissue-equivalent construction and 3D motion, the Dynamic Thorax Phantom comprehensively analyzes image acquisition, planning, and dose delivery.

The phantom's body approximates an average human thorax shape, proportion, and composition. The body generates 3D motion by rotating a lung-equivalent lobe and rod containing a spherical target. The rod's motion is radiographically invisible because it matches the density of the surrounding material, however, the target and its motion can easily be resolved, given its density difference.

The Dynamic Thorax Phantom can be set up in minutes. Intuitive Motion Control Software manages target and surrogate motion with a variety of built-in, customizable motions. In light of the complex challenges and emerging technologies in image-guided radiation therapy, the Dynamic Thorax Phantom offers a highly sophisticated solution.



Capabilities

- Implement 4D imaging and radiotherapy systems
- Quantify volumetric and positional aliasing of CT with a 3D target motion
- Evaluate imaging systems' ability to accurately locate a static and dynamic target
- Test accuracy and consistency of tumor tracking and respiratory gating devices
- Assess dosimetric accuracy of radiation therapy
- Easily train and evaluate personnel while setting up new equipment and techniques

Features

- Complex 3D tumor motion within the lung
- Sub-millimeter accuracy and repeatability
- Motion software enables different cycles, amplitudes, and wave forms
- Tissue equivalent from 50 keV to 15 MeV
- Compatible with TLD, MOSFET, micro-chamber, OSL, PET/ CT targets and film
- Surrogate breathing platform accommodates numerous gating devices

See following pages to learn how the **Dynamic Thorax Phantom** operates >

Advanced Motion Control Software

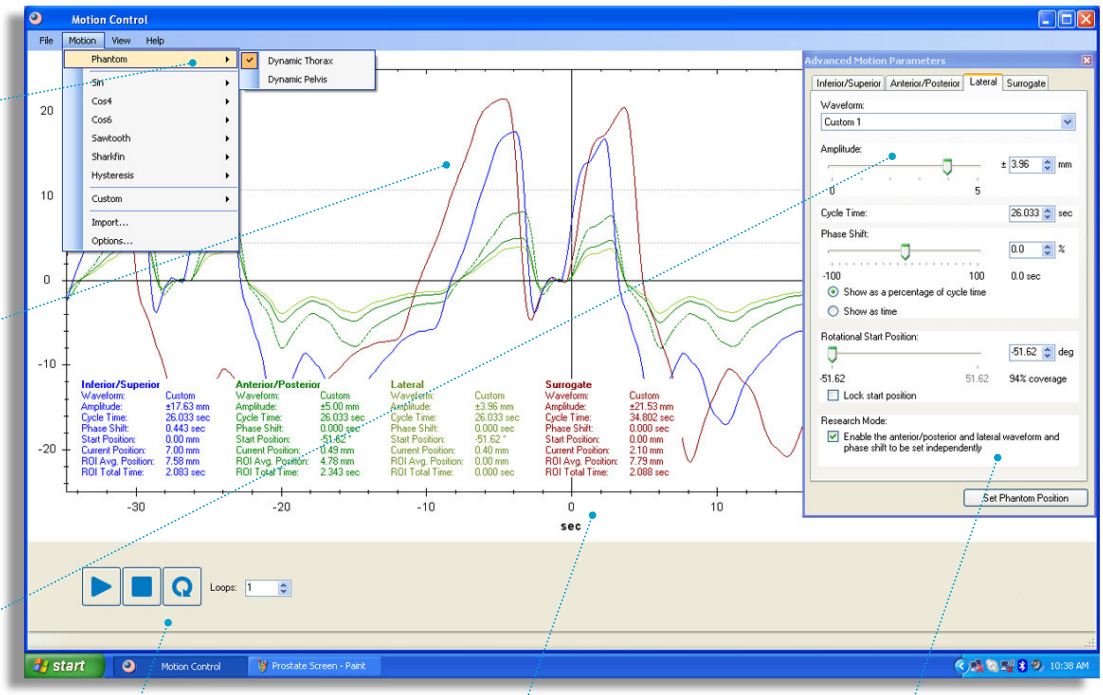
The Dynamic Thorax Phantom is operated with user-friendly Motion Control software, which can be installed on any computer running Windows.

Upon installation, you can easily select the phantom you wish to control. Amplitude, cycle time, and phase shift can be applied to both the surrogate and main phantom using slider bars, or by entering your own values.

Dynamic Phantom Motion Control Selection

Graphical user interface simplifies operation

Adjust motion amplitude, cycle time and phase shift with pull down menus and slider bars



Instantly Start, Stop, Pause or Loop motion

Real time Display of target and surrogate motion parameters

Research Mode to import 3D recorded waveforms

Built-In & Customizable Waveforms

Five built-in waveforms are available from a standard pull-down menu, and an unlimited number of clinically relevant and patient-specific waveforms can be imported, including all brand name tracking devices. In addition, there are also waveform editing, smoothing, and analyzing tools to ease optimization of custom waveforms, which can be conveniently saved for future use.

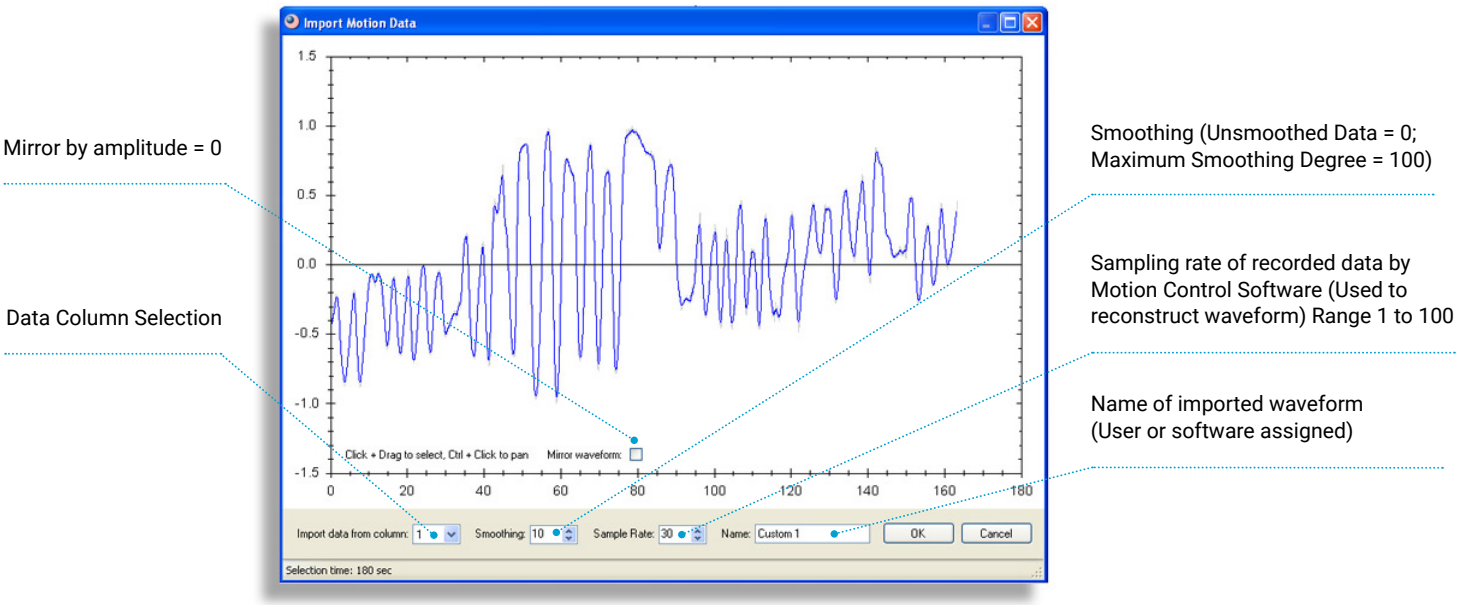
The software displays real-time, relevant information about the waveform selected for each direction of the simulated tumor. In addition, the ROI analyzing function provides the time spent by the target between two chosen amplitudes and the average time-weighted position for that specific ROI.

Unlimited Motion Cycles

You 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 and dynamic testing. Users can also choose the number of cycles to be looped by entering the desired value or choosing continuous looping (1 million cycles).

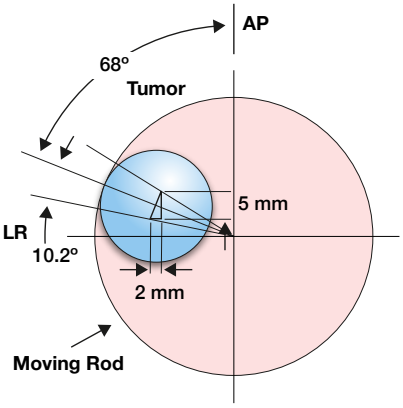
Advanced Motion Parameters

The Advanced Motion Parameters window contains a Research Mode that allows researchers to import 3D (x, y, z) recorded waveforms. In research mode, the software automatically calculates the best scenario to simulate the real 3D waveform to achieve simulated volume.



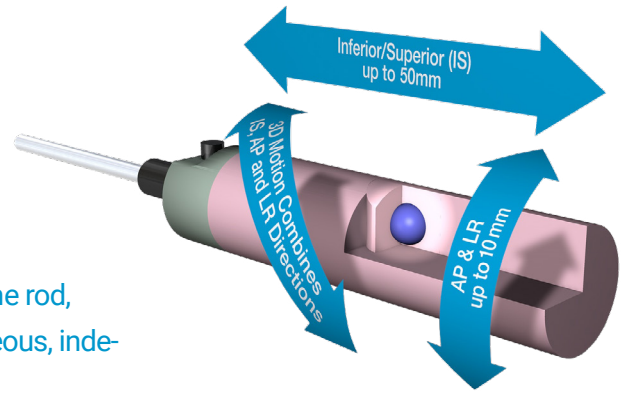
Precise 3D Target Motion

A lung-equivalent rod containing a soft tissue target (and/or dosimeter) is moved within a lobe of similar lung-equivalent material.



Using the Motion Control Software, input your desired range of target motion for the inferior-superior (IS), anterior-posterior (AP), and the left/right (LR) directions, then rotation instructions are sent to the actuator by the software.

- Maximum IS motion is 50 mm
- Maximum AP/LR motion is 10 mm via rotation
- Minimum cycle time is 1 second
- Maximum cycle time is unlimited



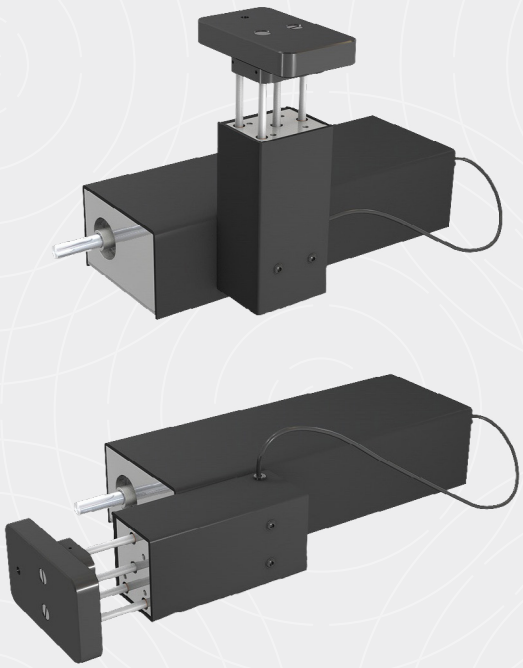
The center of the target is positioned off the central axis of the rod, and complex 3D motions can be achieved through simultaneous, independently controlled linear translation and rotation.

Independently Controlled Surrogate Motion

The surrogate motion, which is independent of the tumor motion, is programmable through the Motion Control Software. The surrogate platform can emulate either chest wall or diaphragmatic motion by manually changing its position. In addition, various gating devices can be attached to the platform, which allows for CT simulation of the diaphragm.

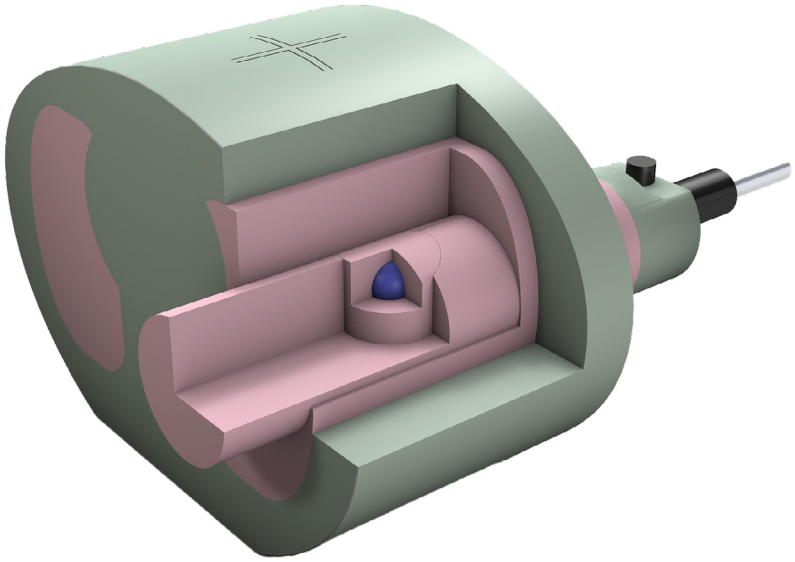
This feature provides even greater flexibility in determining the correlation between surrogate and tumor motion.

- Maximum surrogate motion 50 mm
- Minimum cycle time is 1 second
- Maximum cycle time is unlimited



Proven Tissue Equivalence

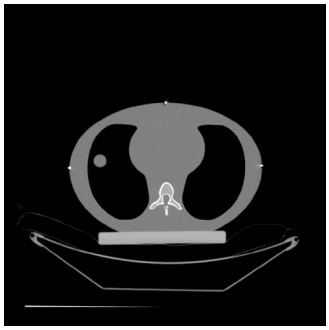
The phantom body approximates an average human thorax shape, proportion, and composition and is constructed of proprietary tissue equivalent epoxy materials.



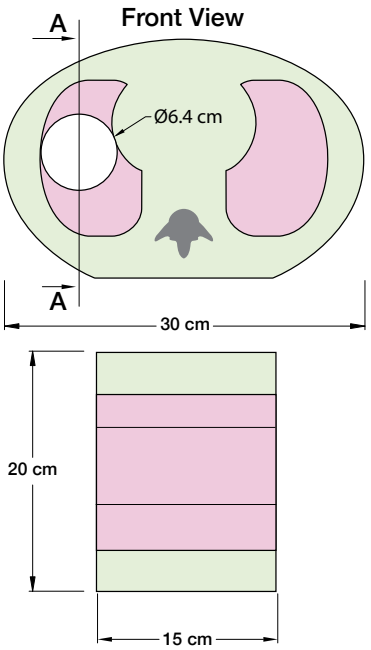
Linear Attenuation of Simulated Tissues

- Within 1% of actual attenuation for water and bone
- Within 3% for lung, from 50 keV to 15 MeV

The phantom contains a 3D anthropomorphic spine with cortical and trabecular bone for internal landmarks. External alignment marks with embedded fiducials enable rapid orientation with positioning lasers and phantom image registration.



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

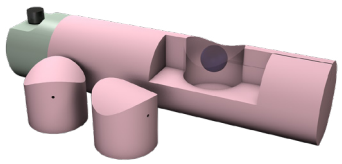


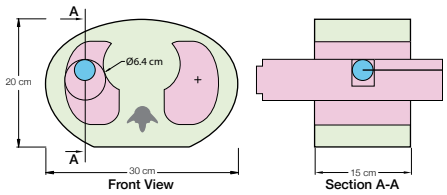
QA & Dosimetry Inserts

The phantom includes ten interchangeable rods, which are easily connected and aligned to the drive shaft for target acquisition and quantitative dose measurements. The lung equivalent inserts accommodate MOSFET, microchamber, film, OSL, PET/CT targets, or gel dosimeters.

Mosfet Insert

The Mosfet Insert is designed for target acquisition and quantitative dose measurements. Each rod includes a 1, 2 and 3 cm soft-tissue equivalent target insert. Each insert is machined to receive the dosimeter at the center of the target volume.

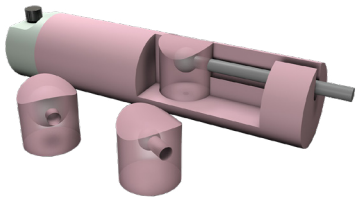


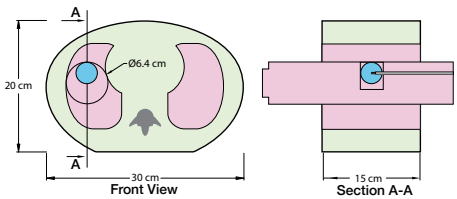


Cutaway illustration to show internal structure of rods

Micro Chamber Insert

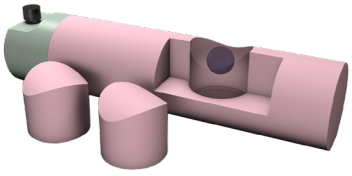
The Micro Chamber Insert is designed for target acquisition and quantitative dose measurements. Each rod includes a 1, 2 and 3 cm spherical target insert. Each insert is machined to receive the dosimeter at the center of the target volume.

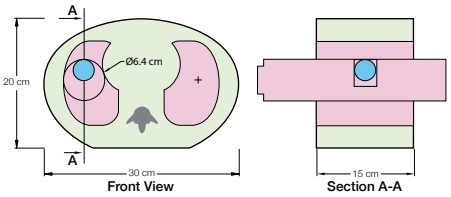




Imaging Insert

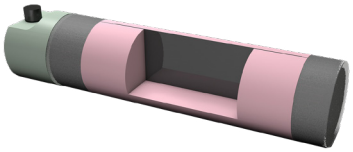
The Imaging Insert is designed to provide solid known diameter targets for imaging applications and includes a 1, 2 and 3 cm soft-tissue equivalent target insert.

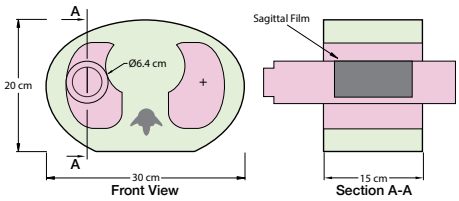




Radiochromic Film Insert

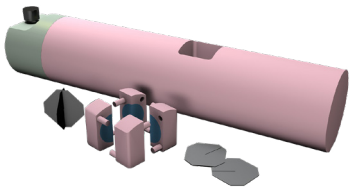
The Radiochromic film insert holds a single 135 X 55 mm film and has three radiographically visible fiducials for registration.

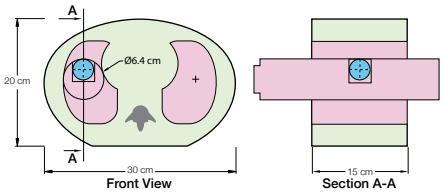




Ball Cube Film Insert

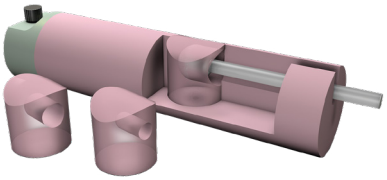
The Ball Cube Film insert contains a 25.4 mm diameter spherical target accommodating two pre-cut Radiochromic films.* Ball cube film sold separately. Contact your local Ashland distributor for more information.

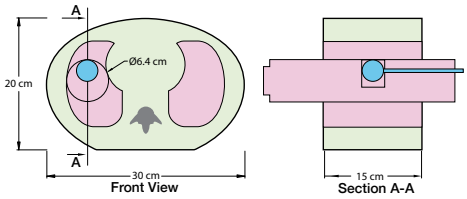




PET/CT Insert

The PET/CT target insert includes hollow spheres of known volume that can be filled with radionuclides to simulate cold or hot spherical "lesions."

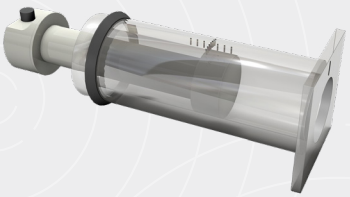


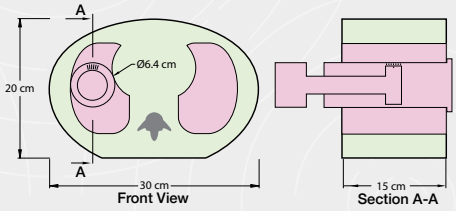


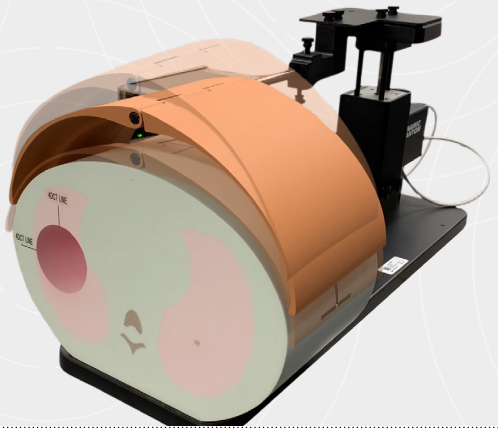
4D CT QA Insert

The 4D CT QA insert option provides a quantitative quality control method for the 4D CT scanner's image binning function. It consists of an acrylic tube with static fiducials in a grid pattern and a moving rod with a single fiducial. The motion of the single fiducial matches the positions of the static fiducials on the acrylic tube at the maximum inhale and maximum exhale phases of the breathing cycle. Users can easily optimize the safety margins of moving tumors by identifying misalignments. The moving cylinder can also be used to investigate artifacts, volumes, and shapes during different breathing motions, including patient-specific profiles, because of its regular size and cylindrical shape.

A Deviceless 4D CT add-on that uses the surrogate platform to provide realistic chest wall motion is available. This add-on was designed specifically for users of the Smart Deviceless 4D system from GE Healthcare.

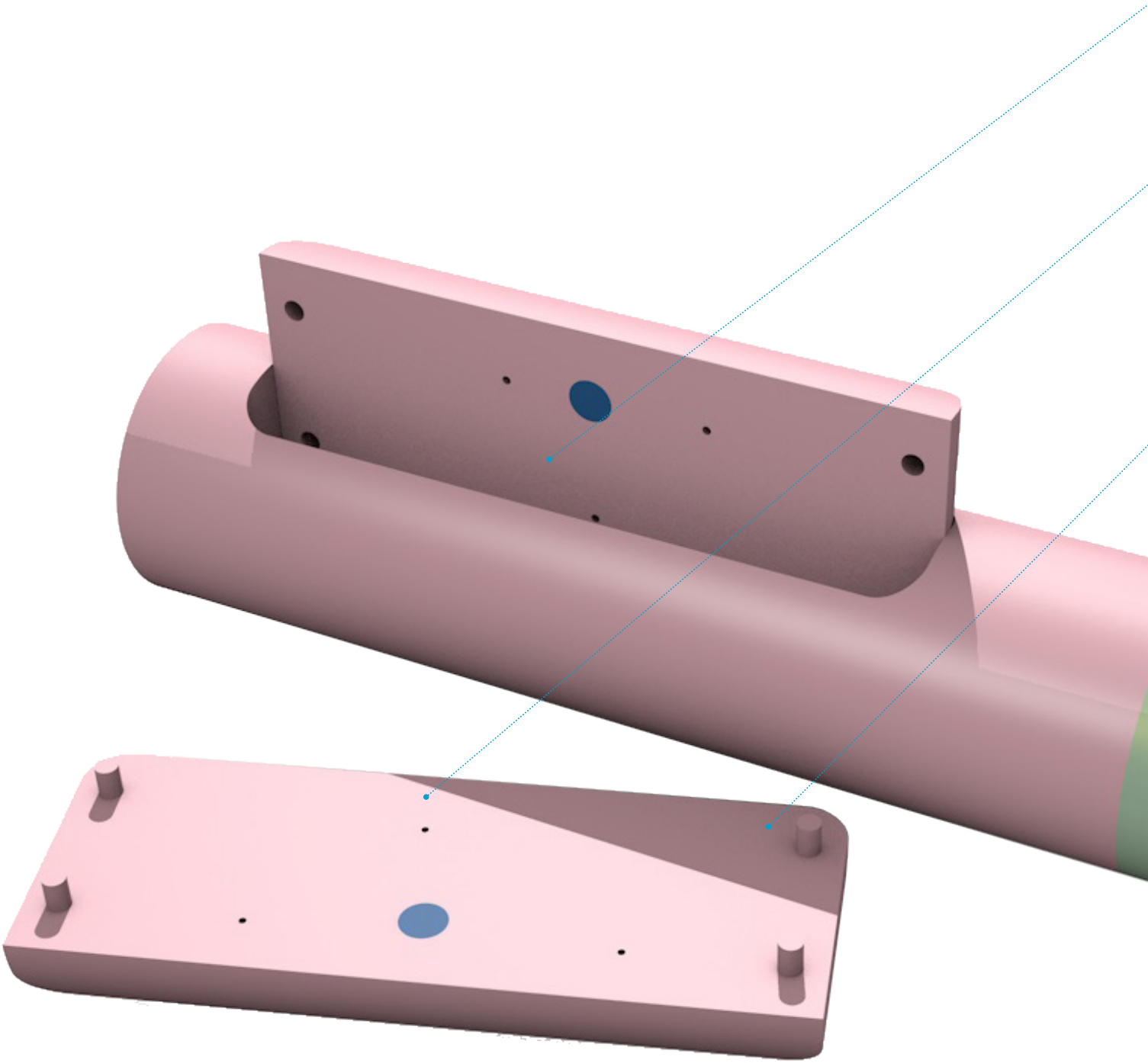






QA & Dosimetry Inserts

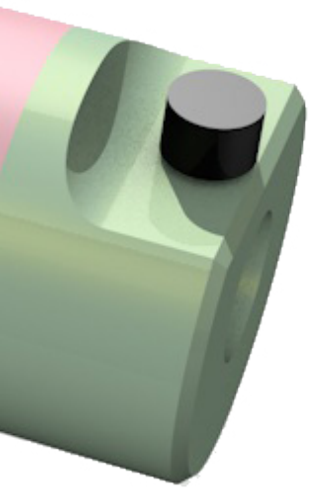
SBRT Rod



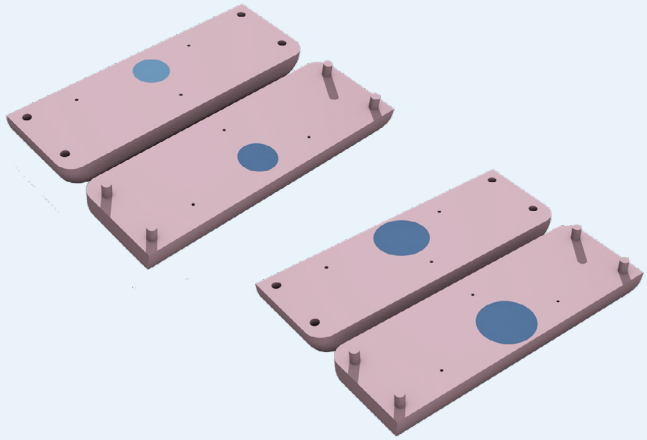
The SBRT Insert contains a cavity that accommodates three interchangeable film inserts, which contain an embedded spherical soft tissue target (1 cm, 2 cm, and 3 cm diameter).

Film inserts hold a single 140 X 54 mm film at mid-plane along the long axis. In addition, one-half of each film insert has three fiducials that are radiographically visible for registration.

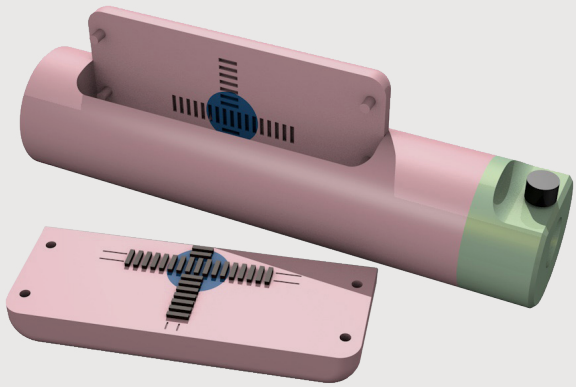
The other half of each film insert is drilled to allow indentation of the film. And all sides and bottom edges of the inserts are rounded with different radiuses for a unique match with the SBRT rod cavity.



Three sizes of spherical targets are included to test multiple dosimetric setups and to help test deformation algorithms (2 and 3 cm targets shown),



OSL Dosimetry Rod with 3 cmTarget Insert



The OSL Dosimetry 3 cm Target Insert accommodates 24 OSL dosimeters for measurements inside a soft-tissue target and the penumbra. It is split into two parts with different thicknesses to allow the positioning of OSL ISO centers.

The OSL pockets are machined along two perpendicular axes to allow measurements in sagittal and coronal planes.

Advanced Electromechanical Components

Actuator

The actuator is designed for linear motion accuracy. Linear motion of the target in the (IS) direction can be isolated from rotational motion, while surrogate motion is independently controlled. The actuator is constructed for continuous operation, with the ability to perform 1,000,000 cycles and then stop automatically.

Adjustable Legs

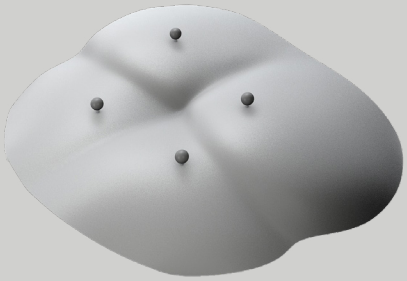
Adjustable legs can be useful in leveling the phantom on curved imaging couches.

Controller

Motions are generated through a three-axis motion controller—which connects by USB to most computers. The motion controller can be fully operated through Motion Control Software from a distance of up to 70 feet with the Ethernet/ USB cable provided.

Additional Items

The optional chest plate is useful for collecting chest motion and breathing data using optical tracking systems.



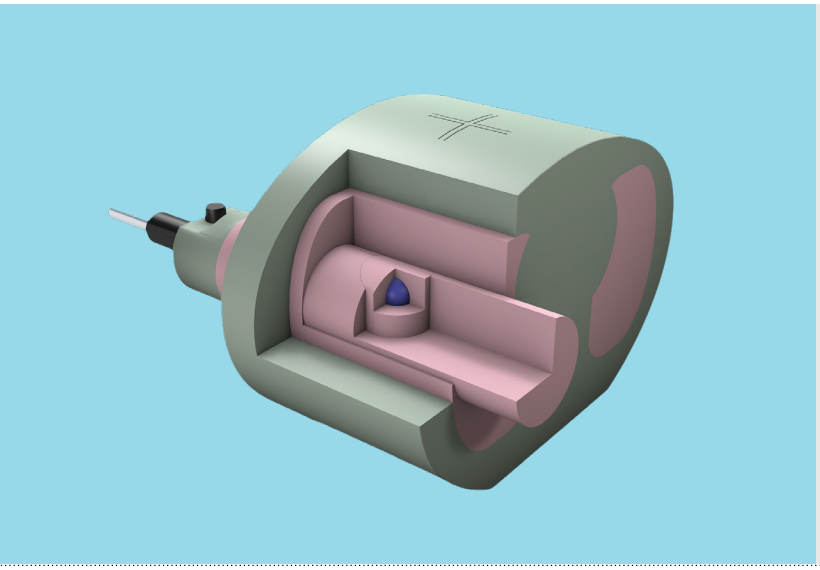
Features and Specifications

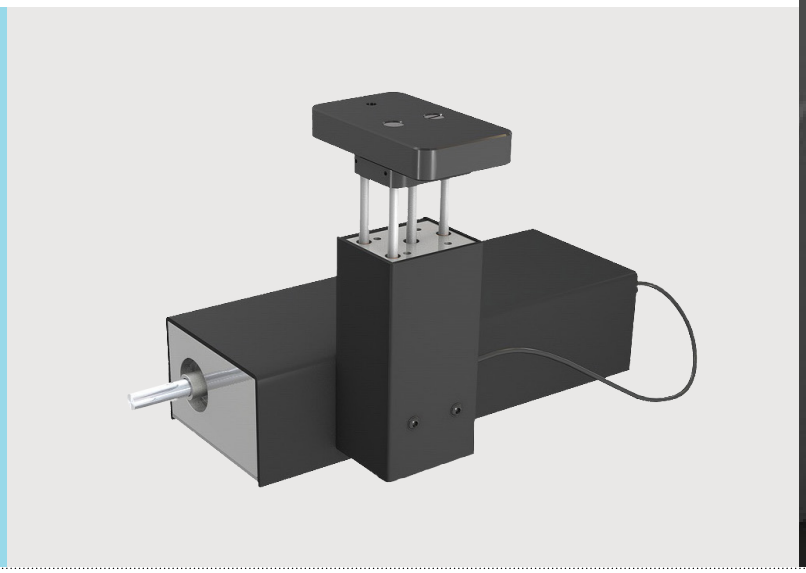
Dynamic Thorax Phantom Specifications

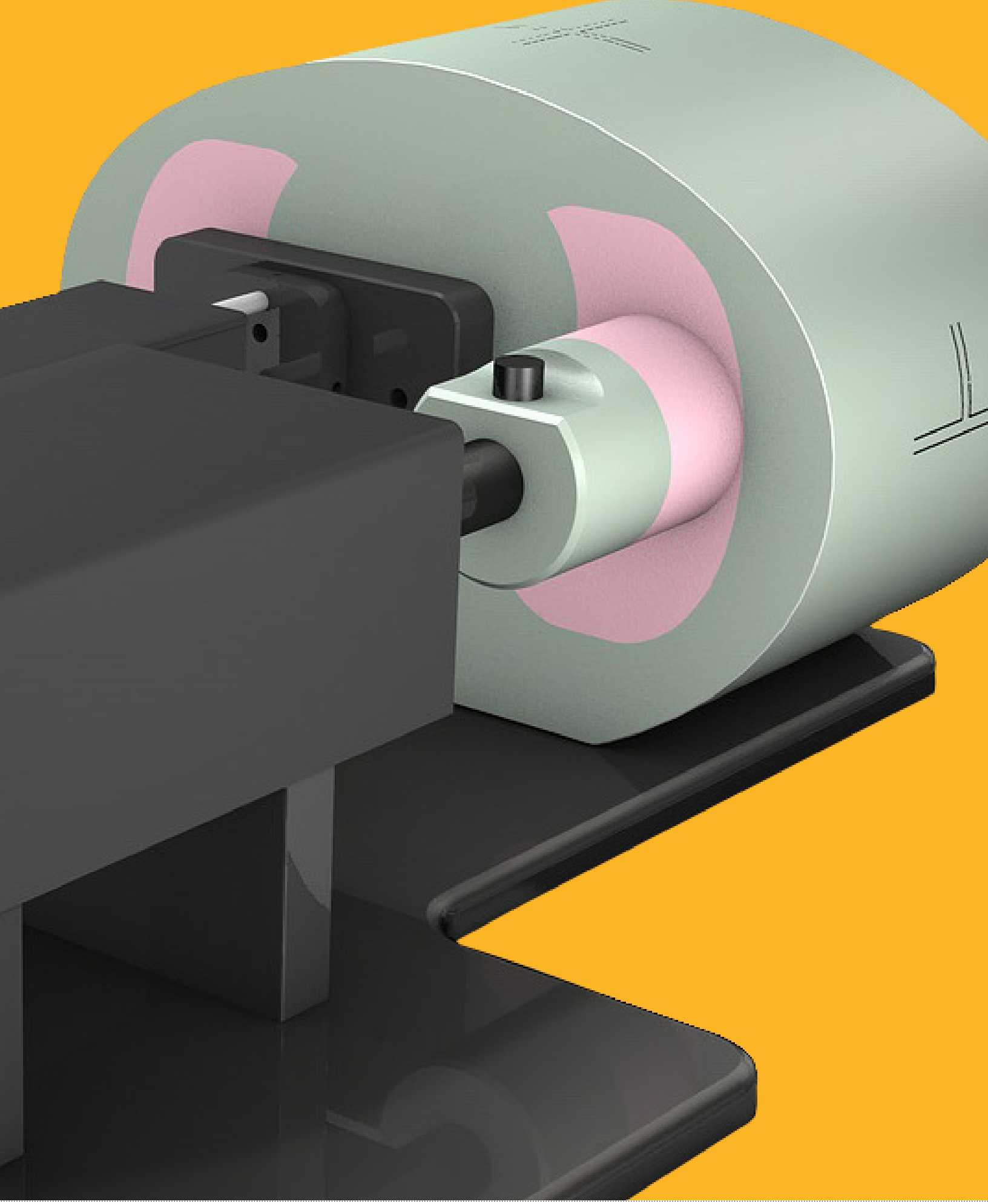
Overall Dimensions	67 cm x 32 cm x 28 cm (26” x 15” x 11”)
Overall Weight	17.2 kg (37.9 lb)
Power	110-250 VAC, 50/60 Hz
Amplitude, IS	± 25 mm
Amplitude, AP/LR	± 5 mm
Amplitude, Surrogate	± 25 mm
Max. Surrogate Platform Load	5.4 kg (12 lb)
Motion Accuracy	± 0.1 mm
Cycle Time	1 - ∞ (adjusted based on amplitude)
Waveforms	sin (t), 1-2cos4(t), 1-2cos6(t), sawtooth, sharkfin
Motion Control Software System Requirements	Windows XP® or later (32 or 64 bit Pentium 3® or equivalent 512 MB RAM 2 MB of available disk space

Items Included

Quantity	Component Description
1	Dynamic Thorax Phantom Body with 3D spine (Dosimeter & QA rods not included)
1	Dynamic Motion Controller with firmware installed (110 - 220V, 50 - 60Hz)
1	Actuator base plate assembly
1	3rd axis gating device (mounted to actuator base plate assembly)
1	Motion Control Software USB
1	Cable kit: USB 3.0 Gigabit Ethernet Adapter, Network cable CAT5e, 75’, DB 25 male to male cable, DB 9 male to male cable, Power cord
1	Accessories Kit: 4 in 1 screwdriver, push rod, fastners pack, 2 spare fuses
1	Adjustable legs kit: level, 4 adjustable legs with feet, post with screw
1	User’s guide (PDF user guide and catalog included on provided USB)
1	Carry Case







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