

ATOM[®] Phantom Family

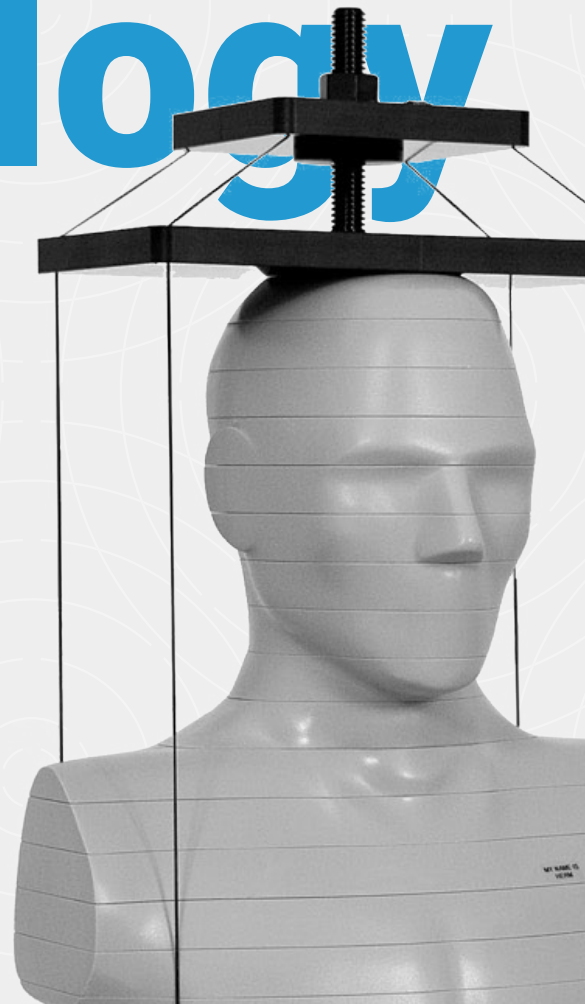
Versatile Dosimetry
Investigation & Verification



SUN NUCLEAR
A MIRION MEDICAL COMPANY

Proven Tissue Equivalence Technology

The ATOM® Phantom Family represents a full line of anthropomorphic, cross-sectional dosimetry phantoms that leverage a wealth of tissue simulation experience and expertise that only CIRS can offer.



ATOM Phantoms are uniquely designed for investigation of organ doses and whole body effective doses, as well as the verification of therapeutic radiation doses.

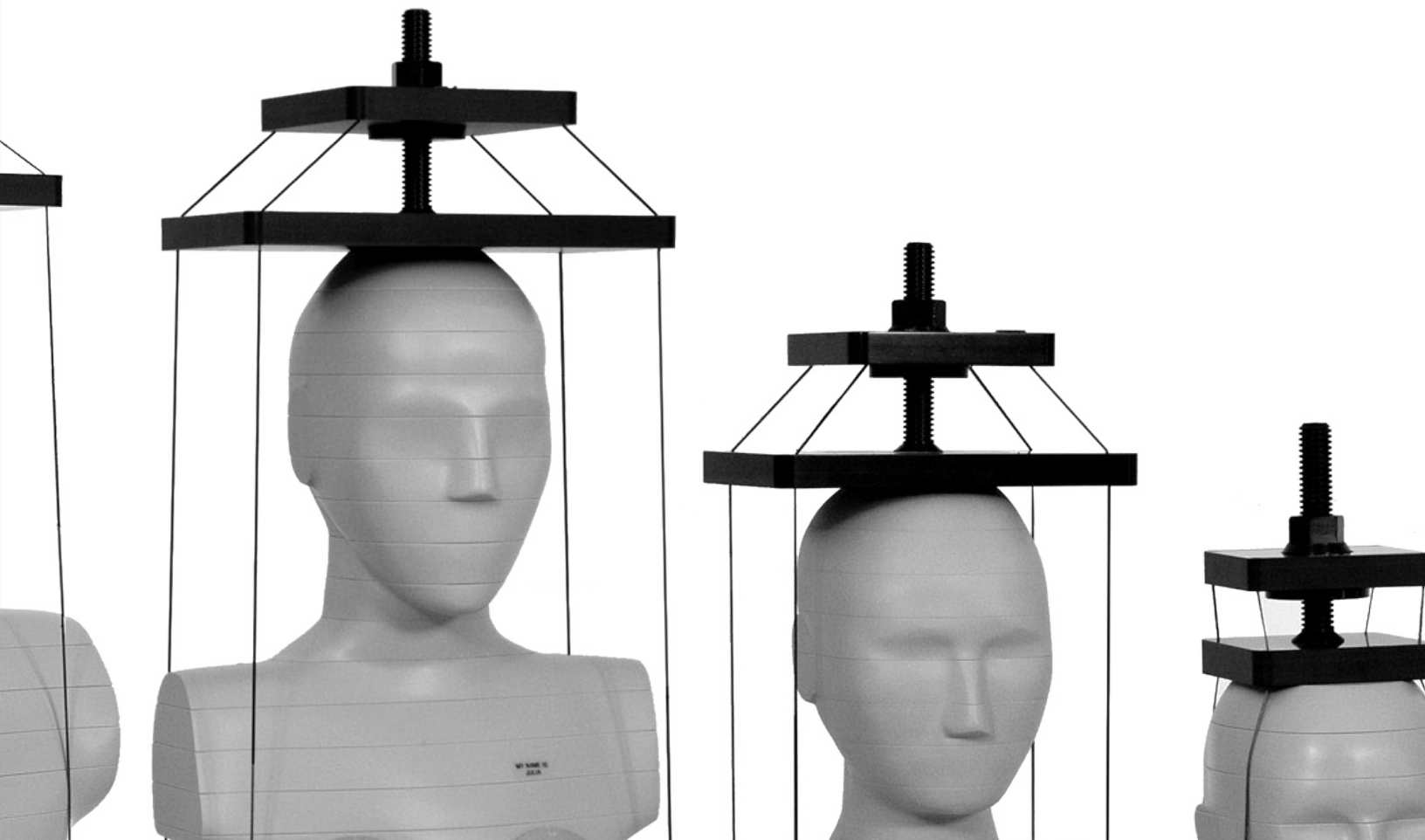
Our proprietary technology enables us to produce ATOM Phantoms with average soft tissue, average bone tissue, cartilage, spinal cord, spinal disks, lung, brain, and sinus tissues.

Linear Attenuation of Simulated Tissues

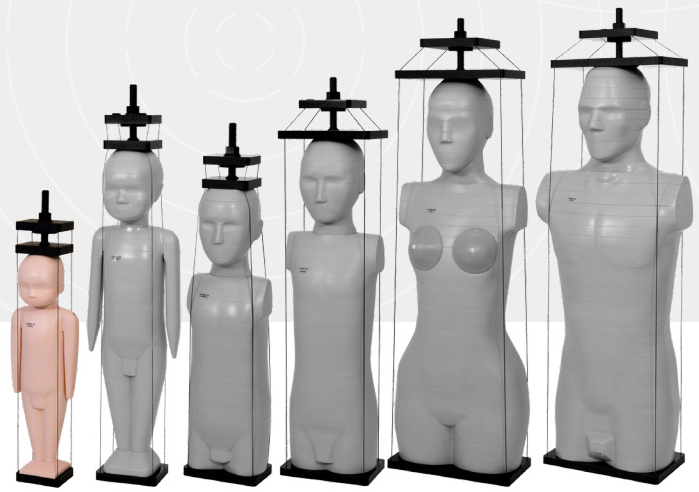
- Within 1% of actual attenuation for soft tissue and bone
- Within 3% for lung, from 50 keV to 15 MeV
- Lung tissue is a low-density inhale formulation equivalent to 0.2 g/cc

Homogenous Bone

- Uses age-specific, averaged mineral density of cortical and trabecular bone ratios to create a homogenous bone, with no distinction in the anatomy
- Eases comparative Monte-Carlo calculations for dose verification
- Makes red-marrow measurements in electron equilibrium easier to obtain



Dosimetry Investigation & Verification



Product Overview

The ATOM family consists of six clinically relevant ages including, a newborn, 1-year old, 5-year old, 10-year old, adult male, and adult female.

Each phantom age accounts for key variations in tissue composition due to age or sex and accounts for variations in bone mineral density. This results in a more precise physical model with which to investigate the interaction of radiation with different tissues. It allows for more accurate dose calculations in different age groups.

For over 35 years, CIRS tissue simulation technology has been validated through third party testing, and continually refined by monitoring manufacturing applications on a global platform. CIRS has developed materials that mimic the linear attenuation curves of real tissue. With target parameters for tissue simulation based on gold standard ICRP 23 and ICRU 48 reports.

The ATOM phantom line has tissue differentiations between cartilage, spinal cord, spinal disks, lung, brain, sinus, average bone, and average soft tissue.

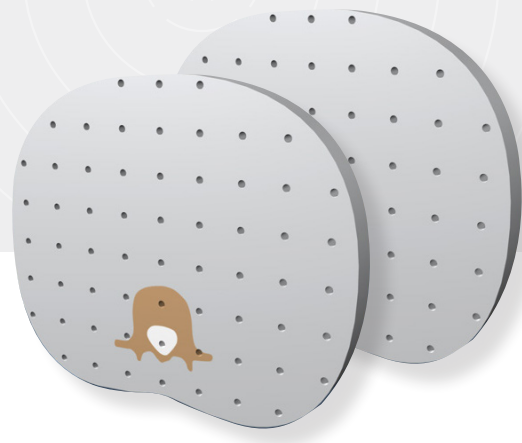
All phantoms are precision sliced into 25 mm thick sections and drilled with an array of holes for dosimeter placement. No coatings are applied to the mating surfaces of the phantom to maintain continuous imaging characteristics. Stacked phantoms are secured with an assembly device and small internal alignment pins between sections; neither of which will interfere with the life-like imaging properties of the phantom.

There are many different phantom configurations available to accommodate your needs and use cases. Limb and breast attachments are also available as optional accessories to measure peripheral and scattered radiation.

Items Included with Each Phantom

Quality	Description
1 set	Numbered Sectional Slabs
1	User Guide
1	Custom-fit, foam lined, hermetically sealed Transport/Storage Case(s)
2 (701 & 702) 1 (703 - 706)	Custom fitted Storm® Transport/Storage cases
1	Reinforcement base
1	Reinforcement top with threaded assembly
1	Open end wrench
1 Bag	Reinforcement assembly cord
2	Push rod for plugs

Dosimeter Hole Configuration



Dosimeter Placement

All ATOM sections are drilled with a series of holes for dosimeter placement. Each hole is initially filled with a solid, tissue equivalent plug. Additional kits of solid plugs or dosimeter accepting plugs can be purchased separately as needed.

ATOM phantoms offer three different hole configurations: organ dosimetry grid, a 3 x 3 cm grid, or a 1.5 x 1.5 cm grid.

Please note, the type of dosimeter to be used in the phantom can restrict some grid configurations options due to the relative size of the dosimeter and hole spacing.

Grid Configurations

CT and Cone Beam CT dosimetry can require organ dosimetry and whole-body dosimetry. The ATOM phantom line offers an organ hole configuration optimized to make precise dose calculations for 22 different radiosensitive organs, using a minimal number of dosimeters.

Each hole is coded and linked to a lookup table that informs the dosimetrist of its associated organ, and any relevant setup information such as detector placement and depth. This configuration eliminates the need to estimate relative organ position, and is supported by extensive anatomical and dosimetry research.

Dose verification studies in radiation therapy may require different standard spacing hole grid configurations depending on the variability of tumor locations. Below is a comprehensive list of available grid configurations and hole configurations for the entire ATOM phantom family.

Description	Model	Available Dosimetry Configurations	Height, CM	Weight, KG	Thorax Dimensions, CM	Bone Physical Density, CC	Bone Electron Density, 1/CC
Adult Male	701	B, C, D & G	173	73	23 cm x 32	1.60	5.030 - 10 ²³
Adult Female	702	B, C, D & G	160	55	20 x 32	1.60	5.030 - 10 ²³
Pediatric Newborn	703	B & D	51	3.5	9 x 10.5	1.41	4.498 - 10 ²³
Pediatric 1 Year	704	B, C, D & G	75	10	12 x 14	1.45	4.606 - 10 ²³
Pediatric 5 Year	705	B, C, D & G	110	19	14 x 17	1.52	4.801 - 10 ²³
Pediatric 10 Year	706	B, C, D & G	140	32	17 x 20	1.56	4.878 - 10 ²³

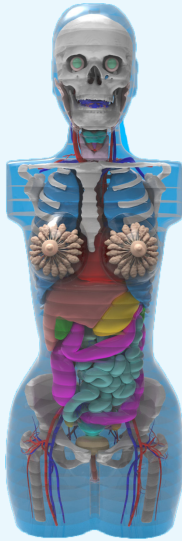
Configuration key

B Configuration = 3 x 3 cm Grid - 5 mm Holes

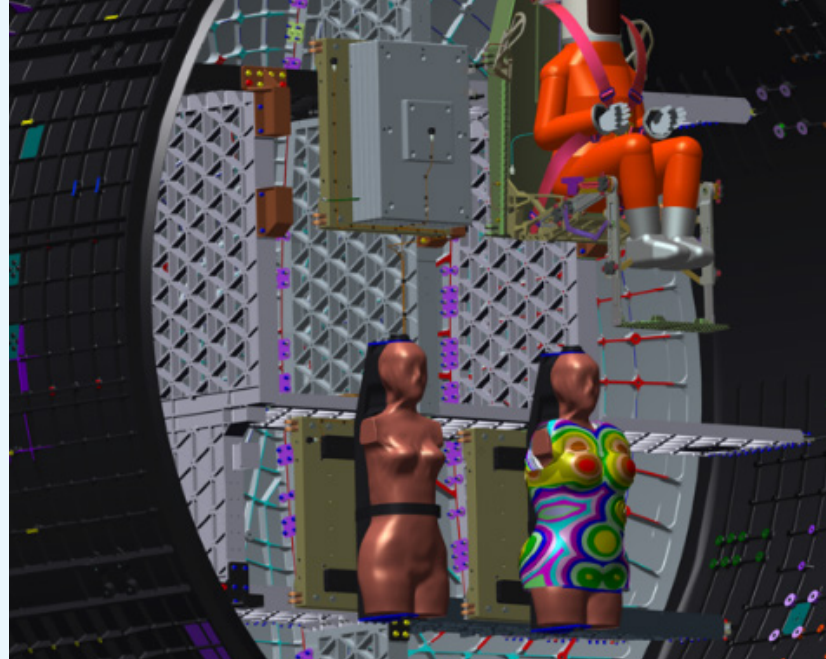
C Configuration = 1.5 x 1.5 cm Grid - 5 mm Holes

D Configuration = Organ Grid - 5 mm Holes

G Configuration = Organ Grid - 14 mm Holes



3D organ rendering shown for illustrative purposes only



Enabling Safer Human Space Travel

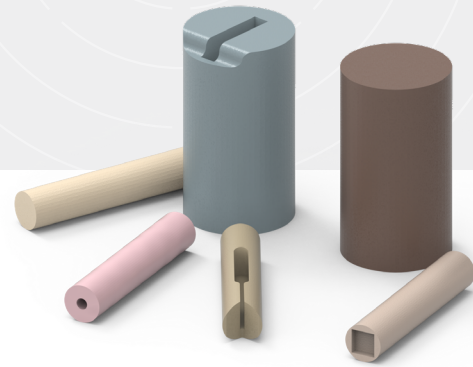
NASA's Artemis I mission to the Moon will feature two custom-designed female ATOM Phantoms from CIRS. "Helga" and "Zohar" will fly as proxies for female astronauts to help determine risk to radiation sensitive organs, and ensure more inclusive possibilities for the future of human space travel.

Learn more: cirsinc.com/news

Images sources: The European Space Agency and DLR



Plug Configurations



Expanding Functionality

Regardless of the grid configuration or hole diameter, all holes in an ATOM phantom come prefilled with an appropriate, tissue equivalent solid plug. These solid plugs can be easily removed and replaced with a dosimeter holder plug for available dosimetry configurations. These special plugs are designed to house a variety of dosimeters, including TLD chips, TLD rods, TLD glass rods, MOSFET detectors, and Landauer Nano Dot holders. This pairing of dosimeter and plug protects the dosimeter and allows it to be placed in any hole in the phantom, with minimal air interface between the device and surrounding tissue.

All plugs are sold as kits that contain a variety of tissue types to ensure there is an equivalent plug for any dosimetry configuration and anatomical location

Thermoluminescence Dosimetry (TLD)

Sectioned and drilled ATOM phantoms readily accept TLDs using a 5 mm plug. These plugs are manufactured to hold TLD chips, rods, bars, cubes, and discs in place during the dosimetry study. In applications where varying the depth of the dosimeter within the slab is important, such as in organ dosimetry, these rods can be easily modified by the user to custom depths within the slab.

Metal Oxide Semiconductor Field Effect Transistor (MOSFET)

This specially machined plug can hold MOSFET dosimeters. The plug is manufactured to fit 5 mm diameter holes in an ATOM phantom. A recessed section at the center of the plug accepts the MOSFET sensitive volume and a radius on the end of the plug prevents harsh bends in the cable to prevent damage to the cable when the phantom is assembled.

Nanodot Dosimetry

CIRS nano dot holder plugs are designed to fit Landauer OSL Nano Dot dosimeters and require 14 mm diameter hole configurations to accommodate the device.

Ion Chamber Dosimetry

ATOM phantoms can be custom drilled to accommodate various ion chambers and diodes. The Chamber cavity is drilled in the lateral direction along the midplane of the section. Each chamber cavity is supplied with a soft tissue equivalent plug. Upon order, customers should specify the desired anatomical location of the sensitive volume for the ion chamber as the location of the chamber will affect some holes in the grid configuration.

Description	Part #	Plug Size	Kit Contents
TLD Chip	Part numbers available upon request	5 mm Ø x 25 mm long	5 sets of 10 plugs (soft tissue, lung, brain, adult bone and pediatric bone plugs)
TLD / Glass Rod		5 mm Ø x 25 mm long ID 1.5mm Ø x 12 mm deep	
MOSFET		5 mm Ø x 25 mm long	
NanoDot		14 mm Ø x 25 mm long	5 sets of 10 plugs (soft tissue, lung, brain, adult bone and pediatric bone plugs)
Ion Chambers		By quotation only: contact customer service for a quote	



Limb Attachment Kits

- Newborn and 1 year old include arm and leg attachments
- Limb set (one set includes both arms and legs) can be purchased and drilled with 5 mm or 14 mm holes in an organ configuration
- Part numbers available upon request

Alignment Pins

- Used to align each slab during assembly

Anatomy

- Each slab is manufactured with internal anatomy

Breast Attachments - Male



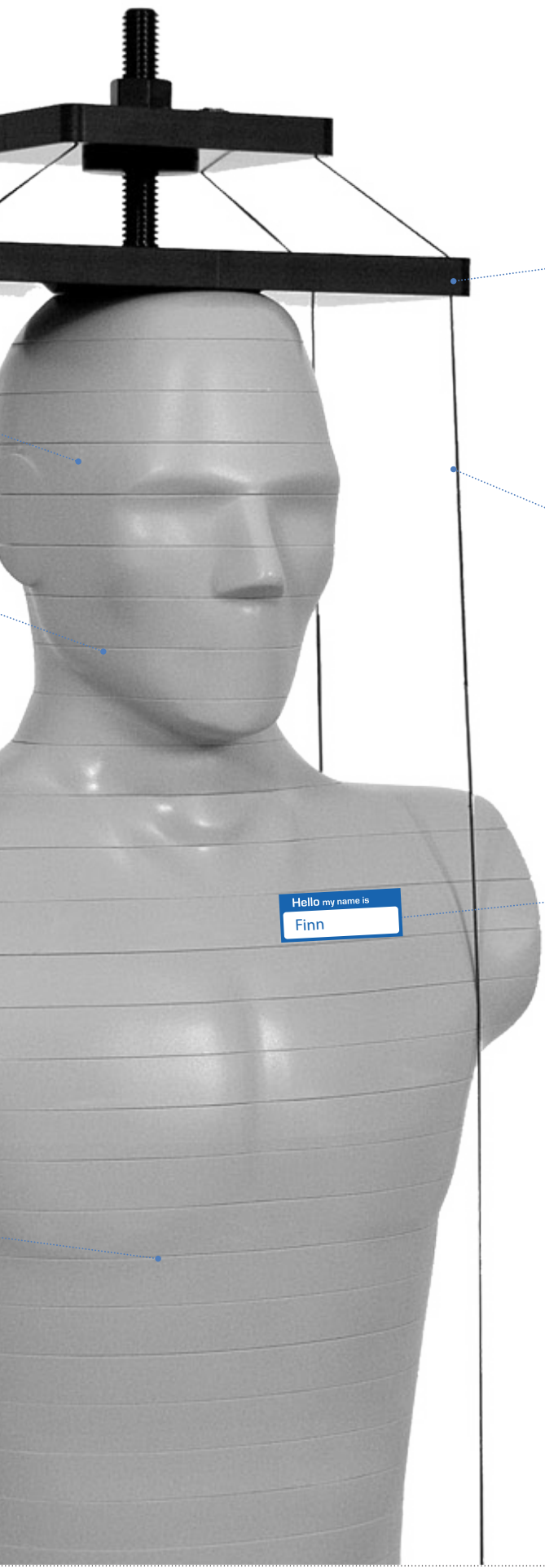
- Available in supine and standing orientations
- Supine - 400cc, 800cc, and 1200cc with 4 holes drilled 3cm from the center
- Standing - 350cc with 4 holes drilled 3 cm from the center
- Part numbers available upon request (sold as pairs)

Breast Attachments - Female



- Available in supine and standing orientations
- Supine - 400cc and 800cc with 4 holes drilled 3cm from the center
- Standing - 190cc and 350cc with 4 holes drilled 3 cm from the center
- Part numbers available upon request (sold as pairs)

Sliced slabs have minimal air interface



Reinforcement Base

- Holds ATOM firmly in place
- Easily adjustable
- Included with each phantom

Fixture Wire

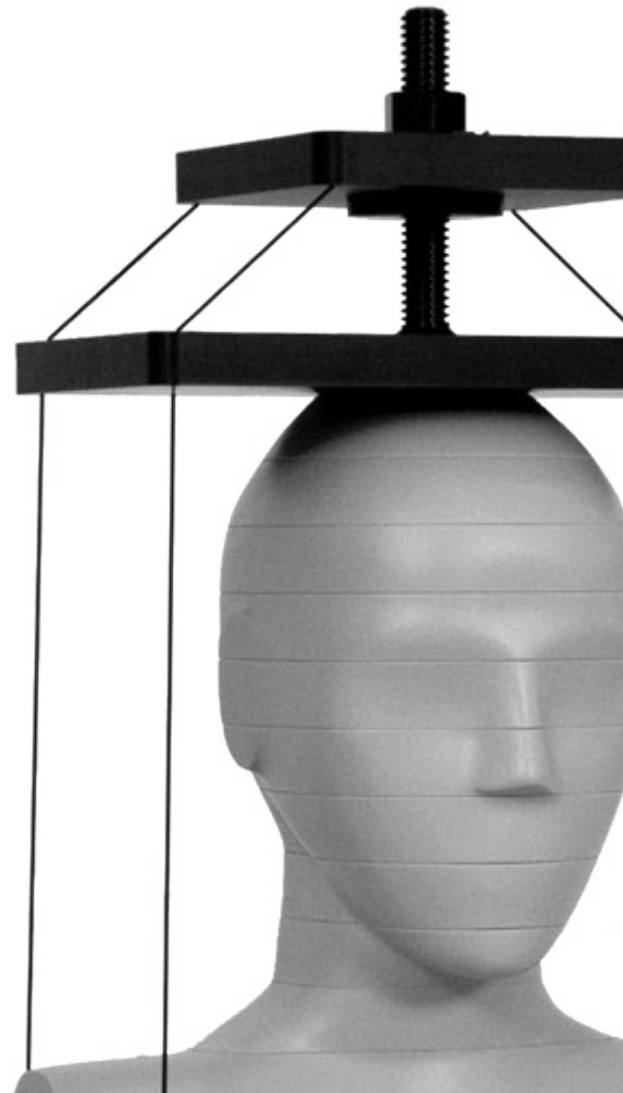
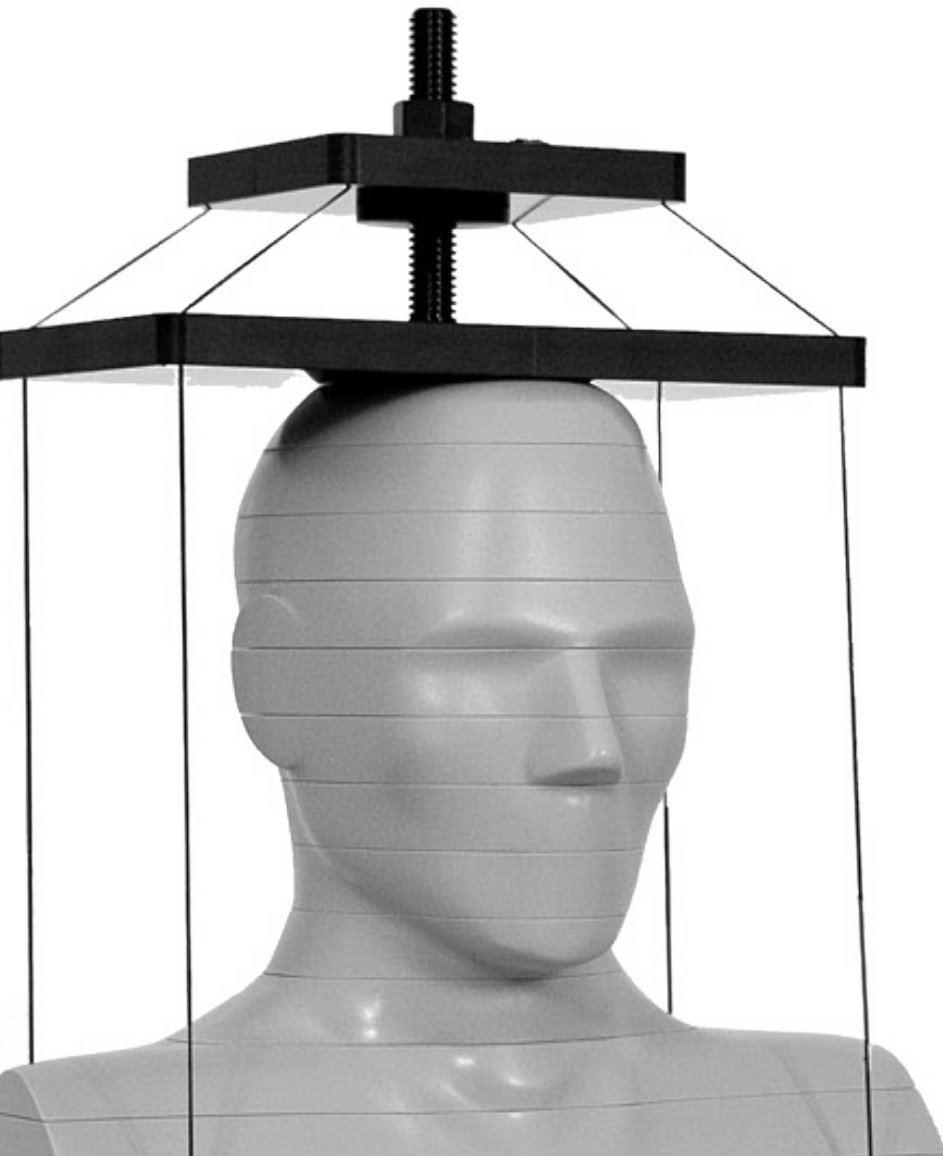
- Doesn't interfere with imaging
- High strength
- Included with each phantom

Unique Name Tag

- Each ATOM phantom has their own unique name

CIRS' wealth of experience in tissue simulation materials allows us to make ATOM with average soft tissue, average bone tissue, cartilage, spinal cord, spinal disks, lung, brain and sinus tissues.

Learn more: cirsinc.com



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