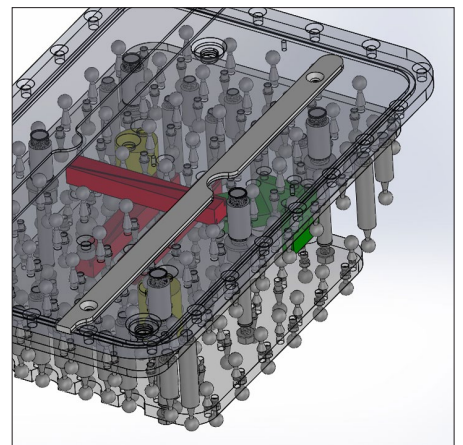


Magphan® RT:
Designed for Radiotherapy
and Diagnostic MR QA

Magphan® RT



**An integrated phantom
and analysis system
with a modular,
easy-to-handle design**



phantomlab

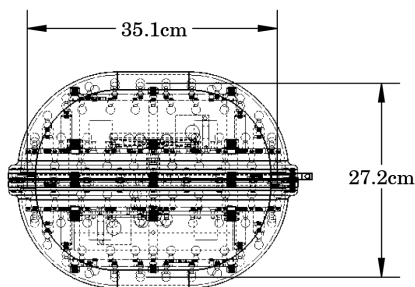
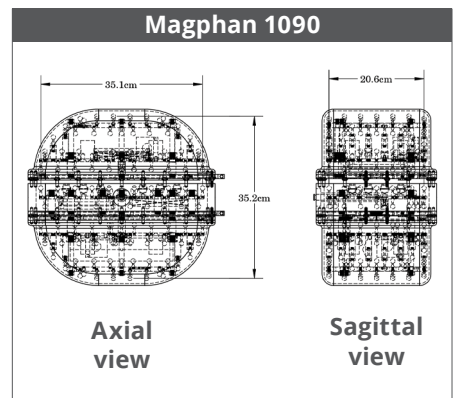
MRI manufacturers have made great strides in reducing MR system distortion. Maintaining acceptable levels of distortion relies on ensuring proper functioning of MRI hardware, firmware, and software, as well as controlling environmental disturbances, scanner configuration, and pulse sequence parameters. The Magphan® RT and the fully-automated Smári analysis platform provide a thorough and sophisticated assessment of an MR scanner, combined with the ease of use suitable for daily or weekly quality control tests. QC tests are performed on actual clinical sequences, providing feedback on scanner configuration and user setting issues that could affect the accuracy and efficacy of the MRI data.

Magphan® RT 820, 1090 & 1230

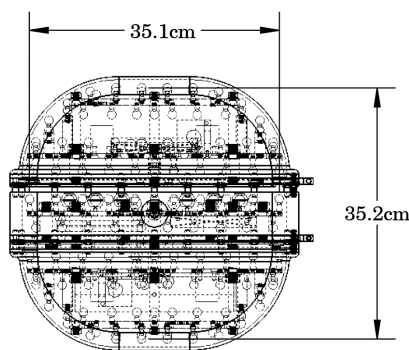
Phantom Design

Magphan® RT phantoms meet the QA needs for MR imaging of large fields of view, such as MR guided radiation therapy. These phantoms provide detailed distortion mapping along with numerous systems performance tests. The Magphan® RT phantoms are available in 3 different torso size configurations.

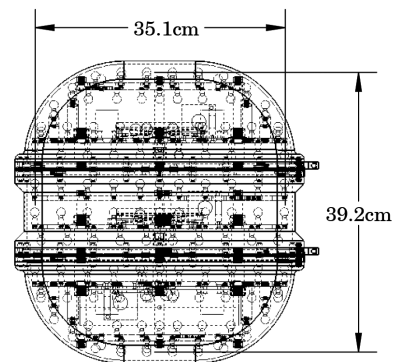
The Magphan® RT's modular design keeps all individual modules under 12 kg, when filled with solution, enabling the phantom to be handled by a single person without special equipment. This design not only allows for easy handling of the phantom but also provides for future system expansion with additional measurement modules.



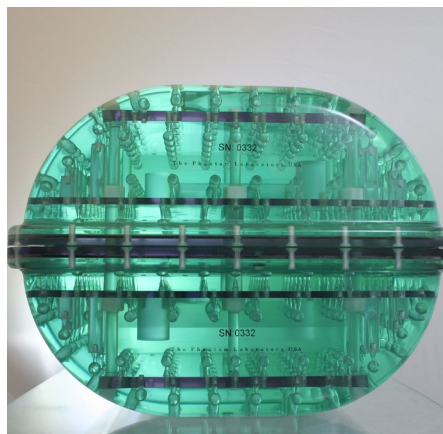
820
Two-piece configuration



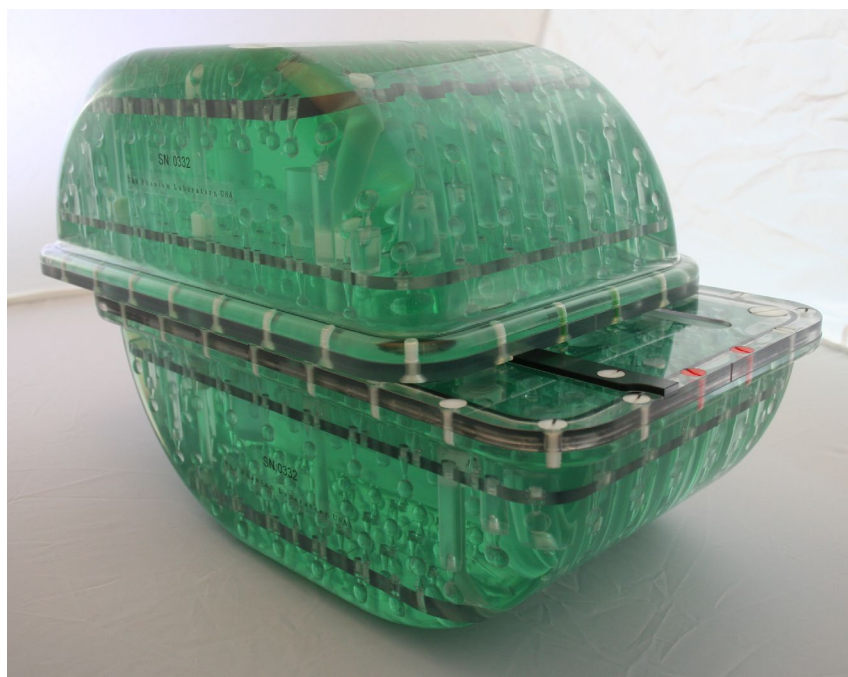
1090
Our most advanced model



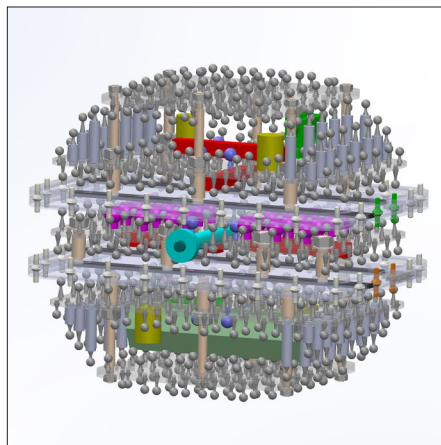
1230
Specialized for extended field



Magphan® RT 820 (TMR022)



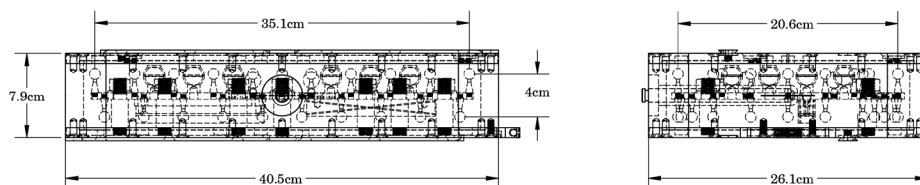
The two-piece configuration (top and bottom) measures geometric distortion and uniformity over a 35 x 27 x 21 cm volume along with tests for laser alignment, slice thickness, resolution, and Signal-to-Noise Ratio. The phantom may be upgraded to the Magphan® RT 1090 or 1230 models with the purchase of the appropriate center module.



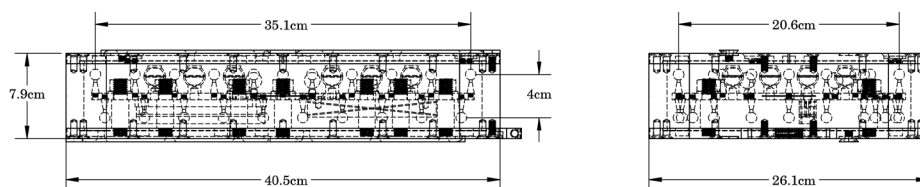
Magphan® RT 1090D (TMR050) 1090 (TMR056)

These are our most advanced large-field-of-view phantoms. The three-piece configuration measures geometric distortion and uniformity over a 35 x 35 x 21 cm volume along with tests for laser alignment, slice thickness, resolution, and Signal-to-Noise Ratio. The central section contains 24 contrast spheres that cover a range of T1, T2, and ADC values, as well as two slice thickness ramps. The smaller Magphan® 820 configuration is achieved by assembling the phantom without the central section.

TMR047 With Insert



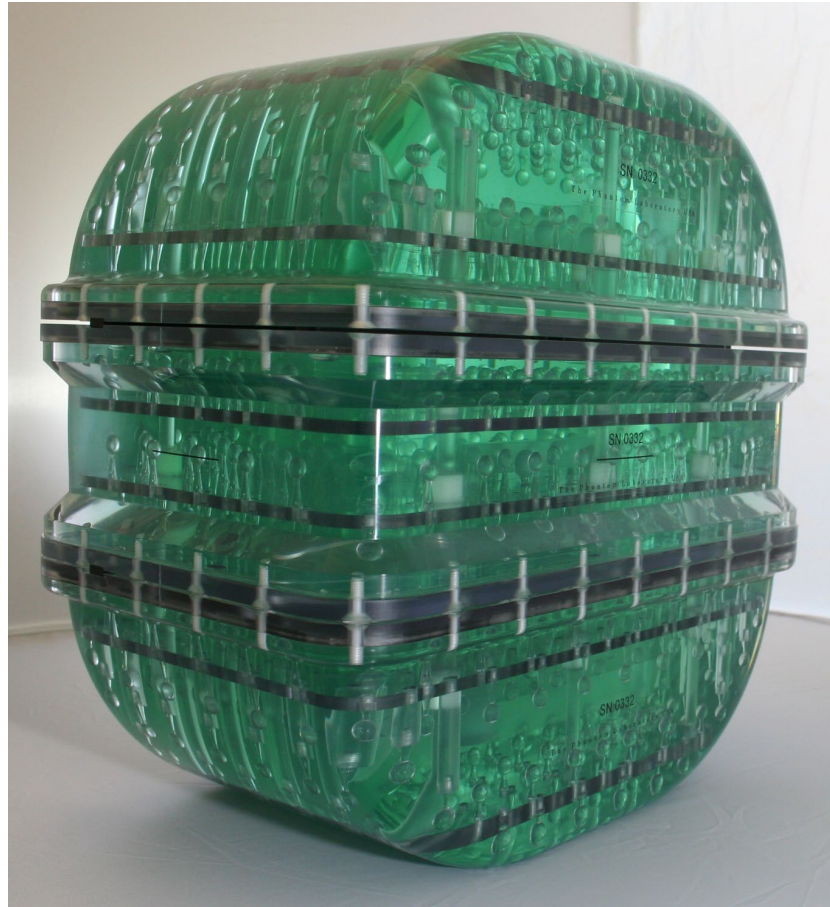
TMR057 Without Insert



The TMR047 central section included in the TMR050 has an additional insert which enables an ion chamber to be placed into the volume of the phantom for use in dosimetry verification measurements. The TMR047 configuration includes the insert, while the TMR057 configuration does not contain the ion chamber insert, but is otherwise identical to the TMR047 configuration. TMR047 OR TMR057 center sections can be purchased to upgrade 820 or 1230 models to the 1090 configuration.

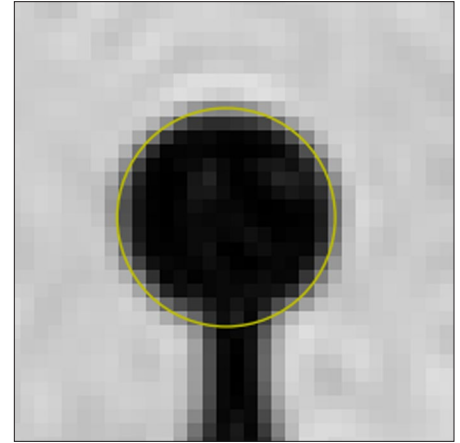
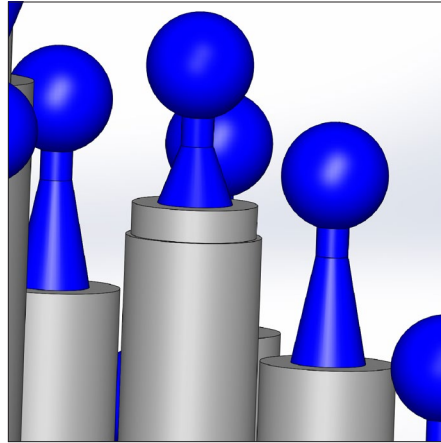
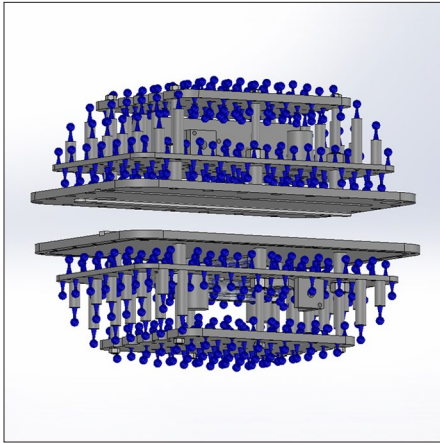
The Magphan® RT 1230 offers a specialized configuration for extending the field of view in the anterior-posterior direction. The full three-piece configuration measures distortion and uniformity over 35 x 39 x 21 cm volume along with tests for laser

Magphan® RT 1230



alignment, slice thickness, resolution, and Signal-to-Noise Ratio. The Magphan® 820 configuration is achieved by assembling the phantom without the central section.

Phantom Analysis

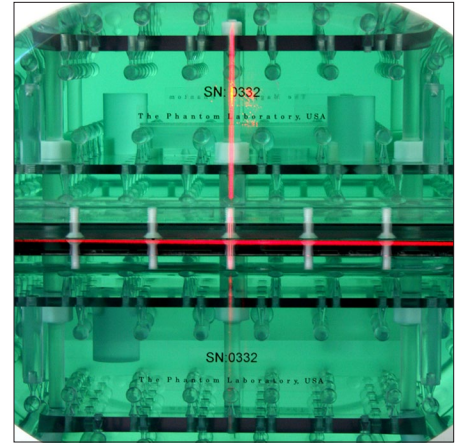


Geometric Distortion

The locations of several hundred 1 cm sphere fiducials are measured across the volume of the phantom. These measured locations are compared to known locations to generate a 3D distortion map. The phantom modules are designed to fit together precisely and the analysis accounts for any residual positional offsets between components. Beyond producing a distortion map, the system tracks several key indicators such as maximum and mean high 10% distortion along the cardinal axes. Analysis of optimized gradient rescaling factors for different objectives is included.

The Magphan® RT measures distortion at sample locations with accuracies far better than a voxel dimension using a high-precision fiducial marker. The markers are one-centimeter-diameter spheres, which, due to their size and symmetry, enable use of a wide range of actual clinical sequences of varying resolution, contrast, and scan plane orientation. Furthermore, in the presence of noise in any image, larger markers such as these offer superior performance due to the averaging effects of the larger edge region of the sphere.

Phantom Analysis *continued*



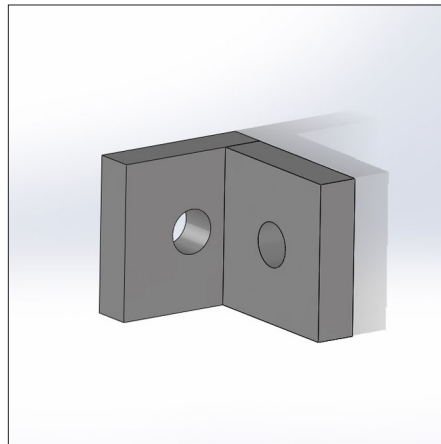
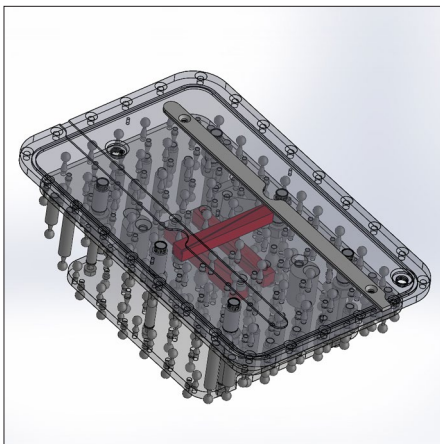
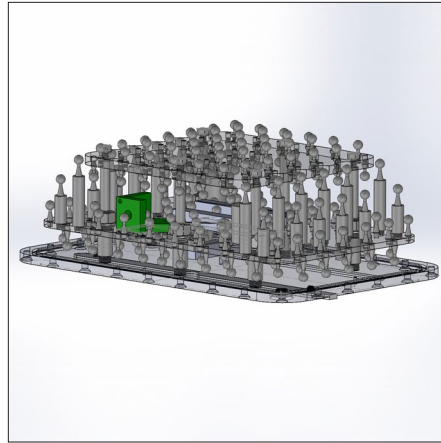
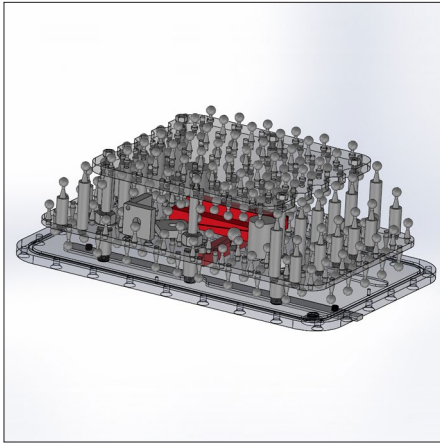
Uniformity

Signal Uniformity can be a useful indicator for common failure mechanisms in subsystems like the RF transmit coil or phased array receive elements. The signal uniformity is measured by sampling several hundred uniform spherical sub-volumes throughout the phantom. The mean signal, normalized standard deviation, and normalized spread are calculated, providing early detection of some of the most common failure events in an MR scanner.

Laser Alignment

Precise alignment between the MRI coordinate system and the therapeutic coordinate system is critical to safe and accurate dose delivery. Alignment markers on the phantom allow for precise placement of the phantom. The Smári analysis outputs the actual location and orientation of the phantom in the coordinate system of the MR scanner, allowing precise comparison between the laser alignment system and the MRI coordinate system.

Phantom Analysis *continued*



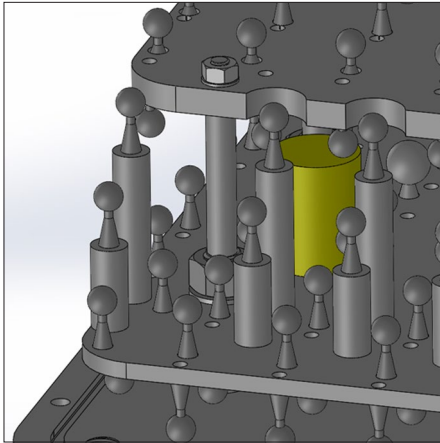
Resolution

The Magphan® RT system and Smári analysis provide an automated analysis of resolution using aperture features. Detailed quantitative outputs are calculated, such as the Point Spread Function, Modulation Transfer Function, and Edge Spread Function, as well as characteristic numerical measurements such as Full-Width-Half-Max and the 10-90% Transition Width of the Edge Spread Function. Three orthogonal apertures are included to provide automated support for measurements along any of the three cardinal axes.

Slice Thickness

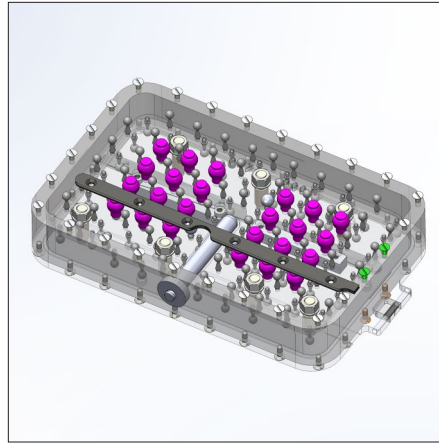
We provide slice thickness ramps to allow for an objective slice thickness measurement on all three orthogonal axes. The automated routine provides higher quality slice thickness measurements versus manual measurements on clinical sequences.

Phantom Analysis *continued*



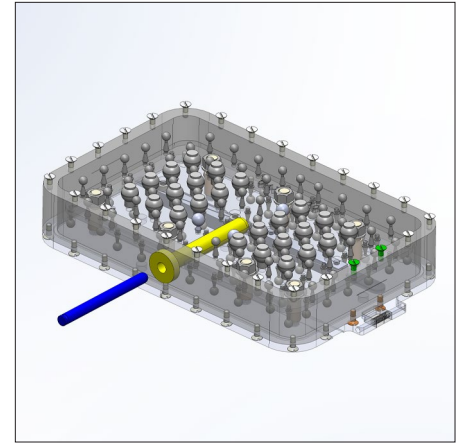
Signal-to-Noise Ratio

The Signal-To-Noise Ratio can provide an early indication of RF coil failures. The Signal-to-Noise Ratio is measured by sampling regions of the background fluid and regions with no signal-bearing fluid. Longitudinal tracking of the data can give early warning of component degradation or failure.



Contrast Spheres

The central sections of the extended field of view configurations (Magphan® RT 1090D and 1090) contain an array of 24 contrast spheres with inner diameter 1.7 cm, filled with solutions covering a range of T1, T2, and ADC values. These solutions can be used for quality control and calibration measurements for quantitative applications.



Mid Phantom Chamber Access

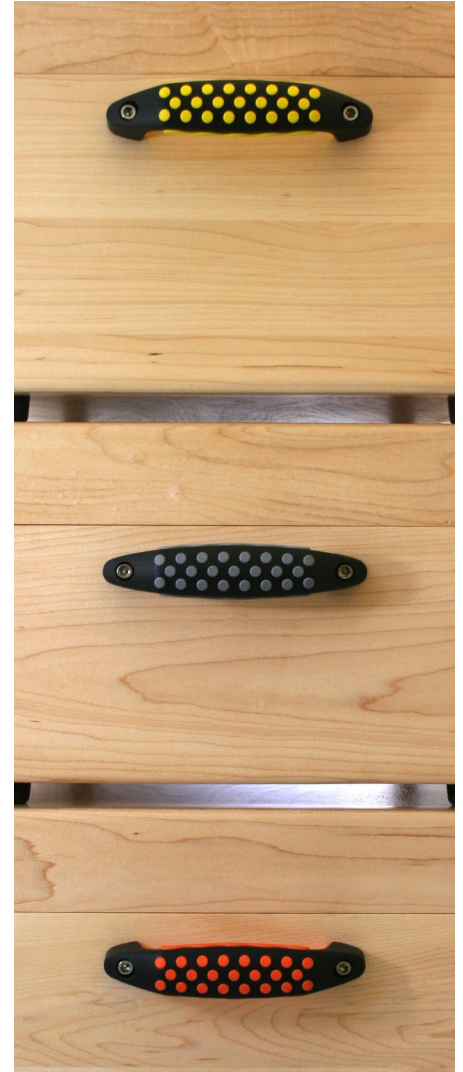
The Magphan® RT 1090D is our only phantom model that enables mid-phantom dose measurements. Measurements are made by inserting a chamber into the 13mm (0.512") ID center chamber access highlighted in yellow. When not using a chamber the center chamber plug highlighted in blue should be inserted into the phantom to reduce susceptibility artifacts due to air interfaces.

Magphan® RT Throughput

Along with taking a comprehensive physics approach to designing the test objects, our engineers focused on user interaction and efficiency. The most important feature is the modular design—each phantom section weighs less than 12 kg (26 lbs)—enabling easy setup by a single person.



Each section of the Magphan® RT phantom is enclosed in a wood case. The case hardware is made from stainless steel to reduce magnetic susceptibility.



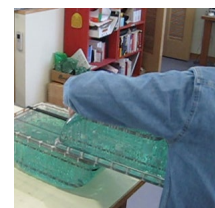
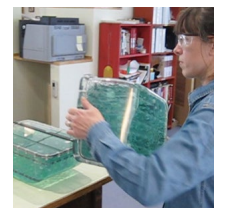
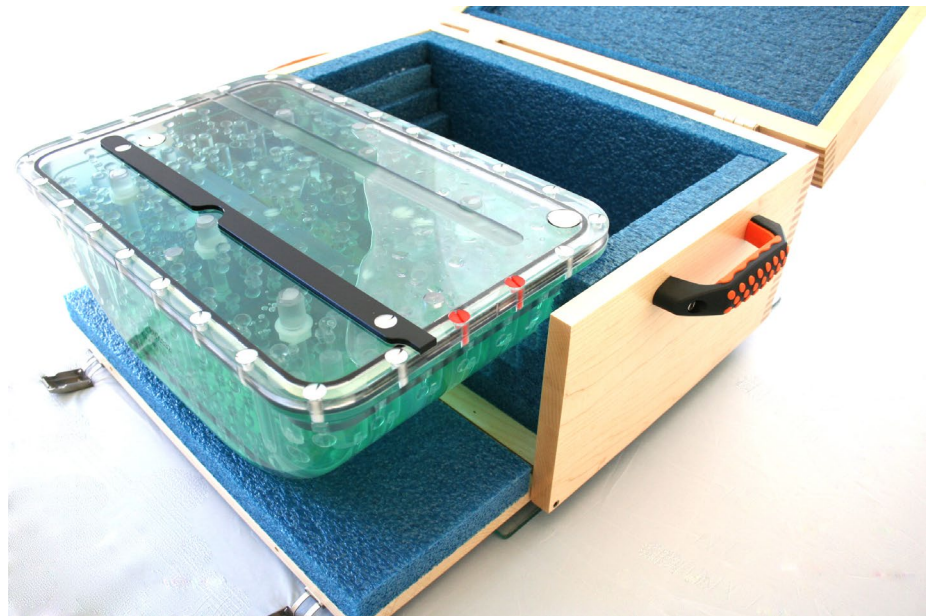
Each case comes with color coded handles so the bottom, top and middle sections can be easily identified without opening the case.

Magphan® RT Throughput *continued*

Case has a front opening panel allowing the phantom to be easily lifted for positioning on the patient couch.

Colored screws

Each phantom has colored screws at one end to simplify position identification for assembly. When assembled the colored screws are positioned over each other. In the 820 configuration, green screws are above orange and in the 1230 configuration, green over green and orange over orange.



The sections of the phantom are assembled on the patient couch for scanning. There are rails that enable each section to be easily slid over the other, preventing the need to lean over the table when assembling the phantom. Once the sections are assembled, they can be locked into place.

Magphan® RT Locking Mechanism



Lock push



Lock release

Smári Analysis Service

Two years of Smári analysis service is included with Magphan® RT. The service provides the following benefits:



Complete Automation

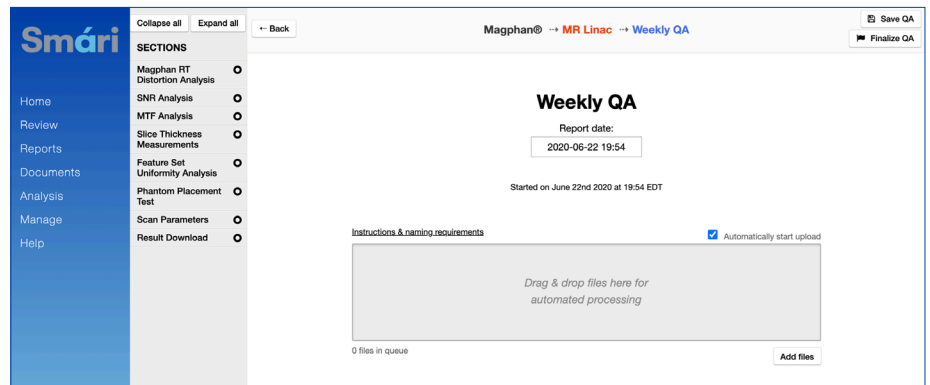
Simply upload the complete DICOM scan series of the phantom. The service automatically identifies the features, performs the analysis and prepares a comprehensive report. Analysis results are saved in a cloud-based database for longitudinal studies, process control, and inter-machine comparisons.

No Installation or Manual Updates Required

The service is accessible from any web-enabled device and requires no local installation. Updates to the service are automatic and require no user actions.

API Available

Smári for Magphan® RT service includes an API that allows users to extend the system with custom analyses or interfaces.



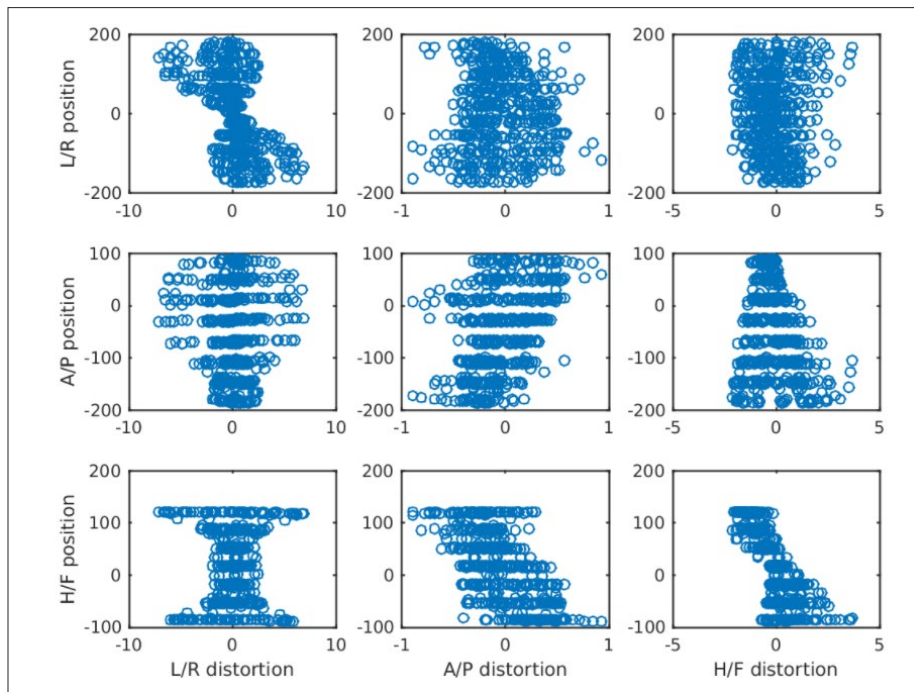
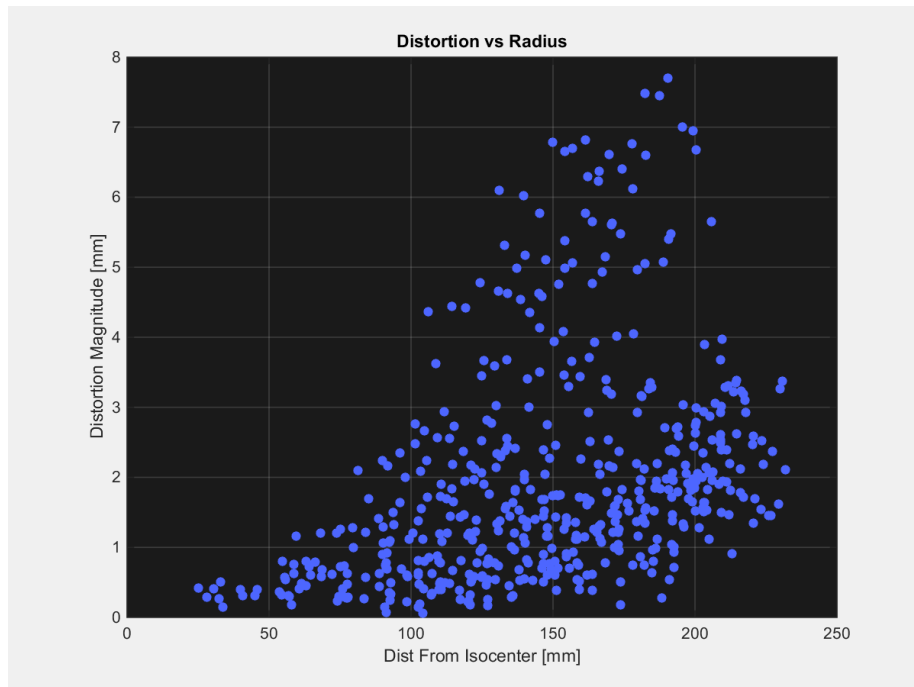
SITE	MACHINE	SCHEDULE	DATE	NOTICES	TESTS PERFORMED	CREATED BY	SIGNED BY	SIGNED ON	COMMENTS
Catphan Hospital	Aquilion Precision	Catphan 700	Jun 19th 2020	Pass	41 / 51 (10)	Phantom Lab			
Magphan®	MR Linac	Weekly QA	Jun 17th 2020	Pass	21 / 21 (0)	Phantom Lab			
Catphan Hospital	TrueBeam	Monthly - Head	Jun 12th 2020	Pass	25 / 38 (13)	Phantom Lab			
Catphan Hospital	Aquilion Precision	Catphan 700	May 20th 2020	Pass	0 / 51 (51)	Phantom Lab			
Catphan Hospital	Aquilion Precision	Catphan 700	May 19th 2020	Pass	41 / 51 (10)	Phantom Lab			
Catphan Hospital	Aquilion Precision	Catphan 700	Apr 24th 2020	Pass	28 / 51 (23)	Phantom Lab			
Catphan Hospital	Aquilion ONE	Center 2	Apr 23rd 2020	Pass	28 / 51 (23)	Phantom Lab	Phantom Lab	Apr 23rd 2020	
Catphan Hospital	Aquilion Precision	Uniformity Study	Apr 23rd 2020	Pass	41 / 51 (10)	Phantom Lab			Hospital 2
Tomophan®	Room 1	Tomophan	Apr 23rd 2020	Pass	35 / 35 (0)	Phantom Lab			
Catphan Hospital	Aquilion Precision	Catphan 700	Apr 23rd 2020	Pass	41 / 51 (10)	Phantom Lab			
Catphan Hospital	Aquilion Precision	Catphan 700	Apr 16th 2020	Pass	28 / 51 (23)	Phantom Lab			
Catphan Hospital	TrueBeam	Monthly - Pelvis	Apr 9th 2020	In progress	38 / 38 (0)	Phantom Lab			
Catphan Hospital	TrueBeam	Monthly - Pelvis	Apr 8th 2020	Pass	38 / 38 (0)	Phantom Lab			
Catphan Hospital	TrueBeam	Monthly - Pelvis	Apr 8th 2020	Pass	38 / 38 (0)	Phantom Lab			
Catphan Hospital	Aquilion Precision	Catphan 700	Apr 8th 2020	Pass	41 / 51 (10)	Phantom Lab			
Tomophan®	Room 1	Tomophan	Apr 7th 2020	Pass	35 / 35 (0)	Phantom Lab	Phantom Lab	Apr 8th 2020	
Catphan Hospital	Aquilion Precision	Catphan 700	Mar 23rd 2020	Pass	41 / 51 (10)	Phantom Lab			
Catphan Hospital	Aquilion Precision	Catphan 700	Mar 10th 2020	Pass	28 / 51 (23)	Phantom Lab	Phantom Lab	Mar 10th 2020	
Catphan Hospital	Aquilion Precision	Catphan 700	Mar 6th 2020	Pass	46 / 51 (5)	Phantom Lab			
Catphan Hospital	Aquilion Precision	Catphan 700	Mar 6th 2020	Pass	46 / 51 (5)	Phantom Lab	Phantom Lab	Mar 25th 2020	

Smári Analysis Service, continued

Reporting, Trending and Data Analysis included

The Smári service provides an informative report, tracks all parameters over time and provides comparative analysis tools between machines.

More information on the flexible Smári service, its database features and flexible report configurations is available at: www.phantomlab.com/smari-image-analysis



**For more information on Magphan® RT,
contact**

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phone: +1 518-692-1190

www.phantomlab.com/magphan-rt

