Ultrasound Selection Guide and Frequently Asked Questions

Ultrasound Tissue Mimicking Materials Comparison Chart

Feature	Zerdine® Hydrogel	HE Gel™	ATS Urethane / Z-skin
Relevant Models	• Multi-Purpose, Multi-Tissue Ultrasound Phantom • Elasticity QA Phantoms • Ultrasound Phantom for 2D & 3D Evaluation • Doppler Ultrasound Flow Phantom • Brachytherapy QA Phantom • Shear Wave Liver Fibrosis Phantoms	• Sono403 Multi-Purpose Phantom • Sono404 Small Parts Phantom • 405 GSX LE: Troubleshooting Phantom • Doppler 403 Flow Phantom • Mini-Doppler 1430 Flow Phantom	• Multi-Purpose Phantom (ATS539) • Multi-Purpose and Endoscopic Phantom (ATS570) • Small Parts Phantom (ATS551) • 3D Calibration Phantom (ATS560H) • Invenia ABUS Phantom • Ultrasound Image Uniformity Phantom[1]
Speed of Sound	1540 m/s	1540 m/s	1450 m/s
Attenuation	0.7 dB/cm/MHz	0.5 dB/cm/MHz	0.5 dB/cm/MHz (at 3.5 MHz)
Attenuation vs. Frequency	Linear	Linear	Nonlinear
Backscatter contrast	f^4 speckle texture	f^4 speckle texture	f^2 speckle texture
Elastography	Yes	No	Limited
Desiccation Risk	Yes	Yes	No
Customer Maintenance	• Weigh and inspect for mechanical damage every 6 months. • Clean after use. • Store at room temperature, with lid closed and inside an airtight container.	• Weigh and inspect for mechanical damage every 6 months. • Clean after use. • Store at room temperature, with lid closed and inside an airtight container.	• Inspect for mechanical damage annually (customer). • Clean after use. • Store at room temperature.
Services	• Rejuvenation program • Product Evaluation / Reinspection • Contact Sun Nuclear Support for additional repair services.	• Rejuvenation program • Product Evaluation / Reinspection • Contact Sun Nuclear Support for additional repair services.	• Product Evaluation / Reinspection • Contact Sun Nuclear Support for additional repair services.

1 The Ultrasound Image Uniformity Phantom is made of Z-skin elastomer, alternative rubber Tissue-Mimicking Materials (TMM) with slightly different acoustic properties from ATS Urethane. See user guide for more information.

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Which Tissue Mimicking Material should I choose?

Zerdine and HE Gel provide better image quality, while ATS Urethane is more durable. Read on for more details.

How does sound speed affect image quality?

Ultrasound systems calculate image distances using the speed of sound, typically set at 1540 m/s. Zerdine and HE Gel match this speed at room temperature, while ATS Urethane Rubber has a lower speed of 1450 m/s, requiring adjustments in target positioning to ensure accurate imaging. This adjustment is crucial for vertical measurements but less so for horizontal ones with linear probes, where transducer array spacing is more relevant. For sector scanning, compensated wire targets are used to correct horizontal measurements.

Furthermore, discrepancies in sound speed can affect image focus, potentially reducing resolution. Some ultrasound systems feature aberration correction to counteract this, improving image quality in materials like ATS Urethane. Zerdine and HE Gel are best used without this correction.

How does attenuation affect ultrasound imaging in different materials?

Zerdine and HE Gel phantoms mimic human tissue, absorbing sound waves linearly with frequency, allowing for deeper penetration at higher frequencies. In contrast, urethane phantoms exhibit a rapid increase in attenuation with frequency, which limits depth penetration. Zerdine has a standard attenuation coefficient of 0.7 dB/cm/MHz, higher than the 0.5 dB/cm/MHz in HE Gel and ATS Urethane, making it suitable for deep tissue imaging as it supports deeper penetration capabilities.

Backscatter Contrast in Ultrasound Imaging Materials

Backscatter echoes, or "speckle," are crucial for image contrast in ultrasound. Tissue-mimicking materials like Zerdine and HE Gel use particles under 40 microns ensuring a consistent speckle texture across a broad frequency range (2-18 MHz). In contrast, ATS Urethane uses larger particles (about 100 microns), which may lead to uneven speckle patterns at higher frequencies.

Elastography and Multimodal Imaging

Zerdine is optimal for elastography due to its elasticity. Like HE Gel, it offers adjustable water-like properties for versatile use in multimodal imaging. Conversely, urethane's fat-like characteristics limit its adaptability.

What is the durability of Sun Nuclear Ultrasound Phantoms?

Our ultrasound phantoms are built to last, regardless of material used. All B-mode phantoms have a 4-year warranty and Doppler phantoms have a 2-year warranty. Zerdine and HE Gel maintain chemical stability over time, but the water based Zerdine and HE Gel options may require specific maintenance to maximize their longevity and effectiveness.

Water Loss

Zerdine and HE Gel can be susceptible to water evaporation. Durable vapor barrier membranes can slow the rate of desiccation to less than 1 gram of water per year. These membranes are less effective when the temperature is high, the humidity is low, or the membrane/housing is damaged. Keep the phantoms in a cool, humid environment--preferably in an airtight container.

Lost water vapor can be replaced through a standardized service process known as Rejuvenation. Zerdine phantoms must be evaluated by our team to determine suitability for repair.

Sun Nuclear recommends weighing hydrogel phantoms every 6 months. With early-stage weight loss (~5-10g), the following precautions are recommended:

- Check the membrane and housing for damage. If found, immediately contact Sun Nuclear support to schedule service.
- Improve storage conditions to slow the rate of desiccation.
  - Use a sealed plastic bag to provide an extra layer of protection.
  - Insulate the phantom from overly conditioned spaces. (HVAC systems can dry the air.)
- For HE Gel phantoms, rejuvenation service should be scheduled if the weight loss progresses to the 10-15g range.

For more advanced weight loss, contact Sun Nuclear support to find out if your phantom is a candidate for repair. Signs of advanced weight loss include visible signs of desiccation (sunken appearance in the membrane, imaging artifacts in the phantom), or weight loss is close to 1% of the phantom weight.

Urethane rubber has no such concerns with water vapor loss. The acoustic properties of ATS Urethane Rubber production batches have been monitored over time and have remained within tolerance (± 1% of speed of sound, ±10% for attenuation).

Mechanical Damage

Phantoms are subject to mechanical damage from falls, scratches and thermal stress. Periodic visual inspection is sufficient to ensure the phantom is still usable.

Service Offerings

Product Evaluation/Reinspection: The Sun Nuclear Quality Team repeats the same inspection process performed prior to shipping the phantom and updates the phantom inspection report. This service is available for customers whose internal quality standards require a 3rd party test report according to a set maintenance schedule.

Rejuvenation: Phantom rejuvenation is a standard service available for HEGel and Zerdine to periodically replenish lost water. The service is recommended every two years or if 10-15 grams of water loss is detected. Prior to starting the rejuvenation process, the phantom is inspected, and if any damage is found, the customer will be notified and given the option to proceed with needed repairs. As part of the Rejuvenation Service, an updated Ultrasound Inspection Report is provided.

Repair: All repairs start with an evaluation of the phantom, where our production team determines if the phantom can be repaired or not. Prior to starting the repair, the customer will be provided an estimate for the cost repair and given the option to proceed with the work or have the phantom returned. If returned, the customer will be charged an evaluation fee.

Requests for repair should be accompanied with visual photos and images – such as images of internal structure, current phantom weight, and photos of membrane and phantom exterior. Some issues can be diagnosed remotely, avoiding an unnecessary evaluation fee. For more information, contact Sun Nuclear Support.

Additional Questions? Contact Sun Nuclear Support at globalsupport@sunnuclear.com