

# Zerdine® Hydrogel or ATS Urethane

Specifications	Zerdine® Hydrogel	ATS Urethane	Notes
Speed of sound	1540 m/s	1450 m/s	See “Speed of Sound”
Elastography and multi-modality formulations	Excellent	Limited	Zerdine® is easily formulated to provide a range of elasticities. It can also be formulated for tissue-mimicking contrast in MRI and CT applications.
Desiccation	Yes	No	Zerdine® phantoms come with durable vapor barrier membranes that protect from desiccation; airtight carry cases provide additional protection. Phantoms must still be handled with care.
Durability	Very good	Excellent	See “What About Stability?”
Warranty	4 years	10 years	
Effect of Temperature	May freeze with exposure to low temperatures	Durable, measurements sensitive to temperatures	See “Effect of Temperature”

## Speed of Sound: Why is this Important?

All ultrasound machines use the speed of sound to convert time that an echo returns to a probe into a distance measurement. Most machines assume a sound velocity of 1540 m/s, the average speed of sound through human soft tissue, to make this conversion. The standard formulation of ATS Urethane Rubber has a sound velocity of 1450 m/s at room temperature (23 °C), while a standard Zerdine® formulation has a sound speed of 1540 m/s at room temperature.

Because the speed of sound in ATS Urethane Rubber does not match the assumed speed of sound, the design of rubber phantoms must compensate for this difference. Adjusting the physical position of line targets and anechoic target structures allows users to make horizontal and vertical distance accuracy measurements. Unfortunately, the sound speed difference also results in a loss of image resolution, because most diagnostic imaging systems use the tissue-average sound speed to calculate where to send and focus ultrasound beams when forming images. Some newer ultrasound systems have a feature called aberration correction that provides better image quality in fatty tissue; this feature can be used with ATS Urethane Rubber to eliminate this loss of resolution. In Zerdine®-based phantoms, these corrections are not necessary.

## What About Stability?

Zerdine® is the most stable hydrogel material on the market, and many Zerdine phantoms provide over a decade of useful service. The main failure mode with Zerdine® is water vapor loss through the membrane (or through a damaged housing). CIRS recommends periodically weighing your Zerdine phantom to check for signs of desiccation. Early signs of water loss (about 1%) can easily be corrected by adjusting storage conditions. Phantoms with water vapor loss exceeding 2% should be returned to CIRS for evaluation. In most cases, these phantoms can be repaired.

Urethane rubber has no such concerns with water vapor loss. The acoustic properties of ATS Urethane Rubber production batches have been continually tested since 1995, and in all cases these batch samples have remained within tolerance ( $\pm 1\%$  for speed of sound,  $\pm 10\%$  for attenuation). Mechanical damage to a phantom housing will not cause the ATS Urethane Rubber to change properties, and damaged phantoms can usually be repaired.

## Effect of Temperature

The acoustic properties of all materials are affected by changes in temperature. Most diagnostic imaging systems and tissue-mimicking phantoms are calibrated at average room temperature (23 °C). The speed of sound in ATS Urethane Rubber is more strongly influenced by temperature changes than Zerdine, and so all ATS Urethane Rubber phantoms include a thermometer strip affixed to the outside of the housing to indicate actual room temperature.

If a phantom is left in extreme temperatures for extended periods, wait approximately 24 hours for the phantom to reach room temperature to ensure the full phantom interior has reached room temperature.

Exposure to extreme temperatures will not damage urethane rubber phantoms. Zerdine® hydrogel phantoms may be damaged by the freeze/thaw cycle if allowed to freeze. High temperatures will not cause Zerdine® to melt (unlike other hydrogels), but they will cause the phantom to dry out faster than normal.

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