Beam Profile & Slice Thickness Phantom

Model ATS 538NH

USER GUIDE

CIRS

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OVERVIEW

The Model 538NH can measure the beam profile and slice thickness of ultrasound imaging systems by evaluating the appearance of a thin plane of echogenic material against an anechoic background.

Scanning the scattering plane from one surface, perpendicular to the thin plane, obtains an image of the beam profile at varying depths of the 538NH. This image contains a great deal of information about the sound beam as it propagates through the tissue-mimicking media such as the focal length, focal zone, beam width, side and grating lobes, and far-field beam divergence. In addition, the near field region of the beam can be easily distinguished from the far field as varying degrees of brightness close to the scan surface versus the homogeneous amplitude further down.

Scanning the scattering plane from a second surface, 45 degrees from the scattering plane, allows users to evaluate the slice thickness of an imaging system at varying depths. Slice thickness or elevational resolution, the third component of spatial resolution, displays reflections produced by structures in front of or behind the beam's main axis. The effect of changes in the slice thickness is identical to those seen with axial and lateral resolution. The thinner the slice thickness, the better the resolution: as the slice thickness increases, the degree of spatial resolution decreases. All ATS urethane phantoms are guaranteed for the useful life of the phantom, defined as 10 years.

Key Tests with Model ATS 538NH

- Tissue Harmonic Imaging Compatibility
- Beam Profile/ Focal Zone/ Lateral Response Width

For more information on these tests, see "Testing Procedures" starting on page 4

INSTRUCTIONS FOR USE

HANDLING AND CARE

For best results the phantom should be kept clean at all times. In particular a build-up of dried coupling gel on the scan surface should be avoided. The phantom may be cleaned with warm water using a lint free cloth. Particularly stubborn stains and dirt may be removed with a mild household cleaner. The use of petroleum solvents should be avoided since they may adversely react with the rubber-based material.

GENERAL GUIDELINES FOR PERFORMING MEASUREMENTS

It is recommended that all measurements be performed at the most frequently used imaging arrangements. The importance of these tests is to make sure that system performance remains constant over an extended period of time. Measurements may also be used to compare the performance of various setups of the same machine or to compare different machines in a quantitative manner.

The following are general steps for imaging all targets:

- If a convex probe is used, center the target within the scan plane in order to minimize degradation and distortion introduced on the outer edges of the probe.
- Always be sure the phantom is scanned while at room temperature. A phantom just received may be colder or hotter than room temperature depending on where it was stored during shipping. Temperature affects the speed of sound and, ultimately, the perceived measurements. The phantom should be stored at room temperature for at least 24 hours before use to ensure its core temperature is correct.
- Most diagnostic imaging systems and tissue-mimicking phantoms are calibrated at room temperature, commonly referred to as 23°C. To ensure measurement accuracy, a thermometer strip is affixed to the outside surface of the phantom housing.
- The sound velocity of most diagnostic imaging systems is calibrated to 1,540 meters per second (mps), the assumed average velocity of sound through human soft tissue. The rubber-based tissue-mimicking material has a sound velocity of 1450 at 0.5db/cm/MHz at room temperature (23°C). The differences in the speed of sound between the assumed calibrated value of the imaging system of 1540 mps and the rubber-based phantoms as given above, if gone un-corrected will cause distortion of the measurements obtained. A simple measurement conversion calculation has been provided, and should be used when indicated in the test procedure.

ESTABLISHING A BASELINE

Before performing routine quality assurance measurements, establish:

1. System settings for each measurement:

   System setup can have a dramatic impact on the results obtained from quality assurance measurements. You must establish and record what system settings should be used for each of the quality assurance tests. These same settings should be used each time the test is performed. If not, then the conclusions drawn may not be valid. CIRS recommends that you use the most commonly used settings for the type of probe tested (i.e. the liver preset values for an abdominal probe) which are called a "normal" technique in the sections that follow.

2. Baseline measurements:

   The first set of measurements taken will be the baseline measurements for the combination of system settings and phantom. Record the system settings and phantom serial number used to acquire each measurement along with your measurement results. On subsequent scans, refer to the baseline results to determine if the ultrasound system has drifted to an unacceptable level. It is each facility's responsibility to establish the magnitude of drift allowed before corrective action is warranted.

3. Allowable deviation from baseline measurements:

   The difference between the original baseline measurements and subsequent measurement should be calculated and recorded. At some point the difference will be large enough that some action is required (call service, replace system, etc.). Each facility needs to determine the action level for each test. You should refer to the user’s manual of your ultrasound scanner and note the stated accuracies of the system’s general imaging measurements. These stated accuracies may greatly influence the conclusion made when evaluating the ultrasound system. For example, if the measurement accuracy for your system is 10% for distances up to 2 cm, the scanner may detect 2.0 cm as being any where from 1.8 cm to 2.2 cm and still be functioning properly. The user is responsible for establishing action levels.

4. Frequency of system assessment:

   How often each system is evaluated is also up to each facility to determine. CIRS recommends at least annually.

Reference the accreditation programs established by the ACR and AIUM at www.acr.org or www.aium.org for further guidance on establishing a QA program.

TESTING PROCEDURES

The following sections outline procedures for routine quality control tests with the Model ATS538NH. It may be useful to refer to the target map, shown in the Specifications section of page 10, when reviewing these procedures.

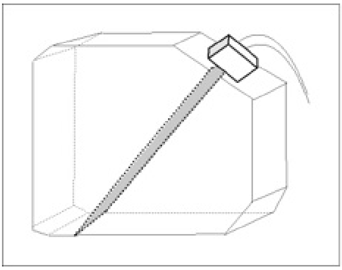
BEAM PROFILE, FOCAL ZONE AND LATERAL RESPONSE WIDTH

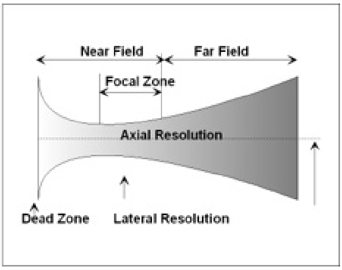
The beam profile or cross-sectional display of the sound beam (termed Lateral Response Width) contains a great deal of information regarding the configuration of the sound beam as it propagates through the tissue-mimicking media. The beam profile clearly displays the near field, focal length, focal zone, beam width, side and grating lobes, and beam divergence in the far field. In addition, amplitude variations in the near field, are displayed as varying degrees of brightness versus the almost homogeniticity of the amplitude in the far field. The beam profile is affected by the performance of the transducer and the pulser/receiver section of the imaging system.

1. Place the phantom on a clean, flat surface with #1 scanning surface positioned for use.

2. Apply a liberal amount of acoustic coupling gel to the scanning surface. It is suggested, when evaluating array systems a low viscosity coupling agent be used to minimize a "snowplowing" affect on the surface of the phantom. When testing, transducer faces with a high degree of curvature, the use of a high viscosity gel is recommended to maintain good coupling.

3. Adjust the instrument settings (TGC, output, etc.) to establish baseline values for "normal" liver scanning. If the penetration is such that the bottom of the phantom is seen, the gain settings are reduced such that the image fades and goes entirely black. These settings should be noted on the quality assurance record and used for subsequent testing.





BEAM PROFILE, FOCAL ZONE AND LATERAL RESPONSE WIDTH (CONTINUED)

4. The phantom is constructed with a scattering plane located in the center of and at 90° to the scanning surface. Place the transducer on scan surface #1. Adjust the position until the profile of the beam is clearly displayed.

   Note: For sector imaging systems, the beam will sweep back and forth as it passes through the scattering plane, imaging the cross-section of the beam. In a multitransducer sector scan head, the image will be the integrated sum of all the beam profiles. To examine the beam profile of the individual transducer, the frame rate must be decreased, until the individual beam profile is displayed. Depending upon the system, it may be necessary to reduce the frame rate to zero.

5. Freeze the image and obtain a hard copy.

6. Examine the display. The image should be "hour-glass" in shape. Note the presence or absence of any grating lobes, which will be displayed as two "horns" on either side of the main beam, usually in the near field. Using the electronic calipers, measure the focal length and beam width at the focal point. If you desire, measurements of the near and far fields can also be obtained.

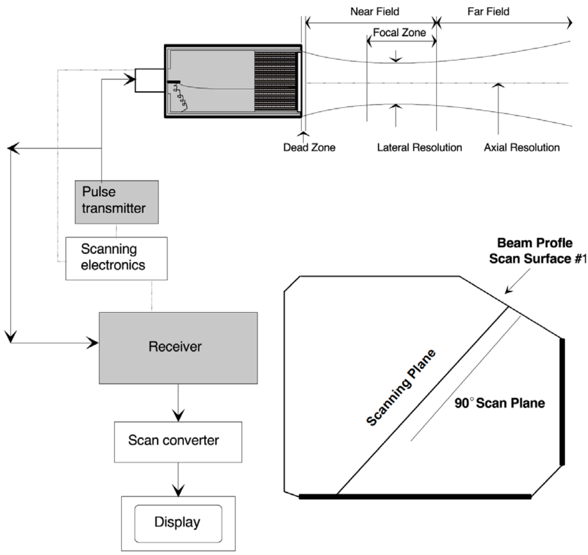
   NOTE: A correction factor of 0.94 adjusts for the speed of sound in ATS urethane (1450 m/s).

7. Document all measurements and observations on the quality assurance record.

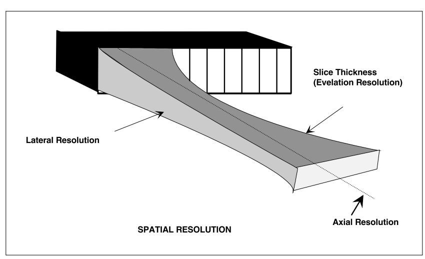
BEAM PROFILE, FOCAL ZONE AND LATERAL RESPONSE WIDTH (CONTINUED)

Results

The beam profile should remain consistent from week to week, when using the same instrument settings, transducer and the Model #538NH phantom. Compare the test results obtained with a baseline or previous test. If the current image demonstrates changes in the system, investigation should be made to determine the cause.

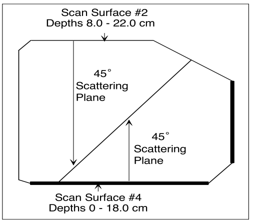


ELEVATIONAL TESTING

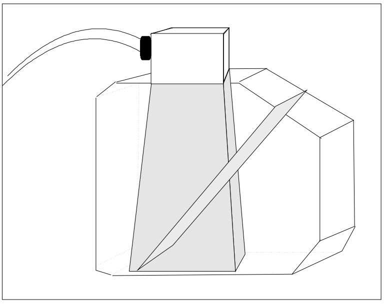


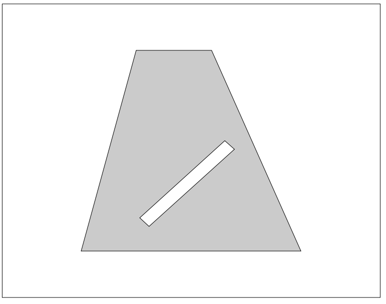
A third component of spatial resolution, the slice thickness, is often referred to as the elevation resolution. A sound beam travels through a medium along the beam axis until it reaches an interface which is perpendicular to the axis of the sound beam, creating a two-dimensional image. The image resolution is depedent upon the degree of axial and lateral resolution of the diagnostic system. Elevational resolution displays reflections produced by structures in front of or behind the beam's main axis. The effect of changes in the slice thickness measurements are identical to those seen with axial and lateral resolution. The smaller the slice thickness measurement the better the resolution, as the slice thickness increases, the degree of spatial resolution decreases. In diagnostic ultrasound, this factor becomes critical in determining an imaging system's ability to detect and display small isolated lesions or structures of low contrast, which may appear to be filled-in and go undetected.

ELEVATIONAL TESTING (CONTINUED)

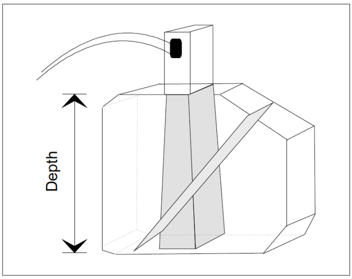


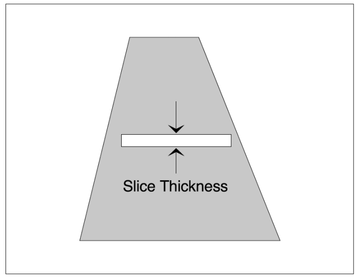
1. Two scan surfaces are provided for obtaining slice thickness measurements. For depths ranging from 8.0 to 22.0 cm scan surface #2 should be used. Scan surface #4 is used when the scanning depths required range from 0 to 18.0 cm. Place the phantom on a clean, flat surface with the proper scan surface positioned for use.
2. Apply a liberal amount of acoustic coupling gel to the scanning surface. It is suggested, when evaluating array systems a low viscosity coupling agent be used to minimize a "snowplowing" affect on the surface of the phantom. However, transducer faces with a high degree of curvature, the use of a high viscosity gel is recommended to maintain good coupling.
3. Adjust the instrument settings (TGC, output, etc.) to establish baseline values for "normal" liver scanning. If the penetration is such that the bottom of the phantom is seen, the gain settings should be reduced such that the image fades and goes entirely black. These setting should be noted on the quality assurance record and used for subsequent testing.
4. Position the transducer on the scan surface providing the proper depth range. The image displayed will appear as a band or thick line positioned at a given depth in an angular plane.





5. Rotate the transducer until the image displayed is positioned in the horizontal plane. This is the slice thickness of the sound beam at a given depth.





Note: For sector imaging systems, the beam will sweep back and forth as it passes through the scattering plane, imaging the cross-section of the beam. In a multi-transducer sector scan head the image will be the integrated sum of all the slice thickness. To examine the slice thickness of the individual transducers, the frame rate must be decreased permitting a single slice thickness to be displayed. Depending upon the system, it may be necessary to reduce the frame rate to zero.

6. Freeze image.

7. Using the electronic calipers, measure the distance from the scan surface to the center of the displayed slice thickness image.

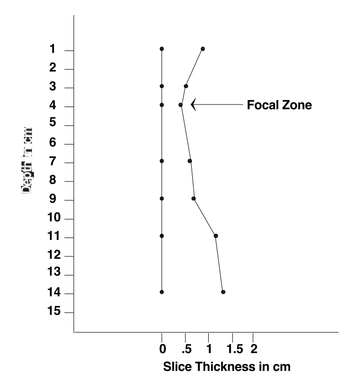
8. Again using the electronic calipers, measure the thickness of the image. This is the slice thickness of the sound beam at a given depth.

9. Obtain a hard copy and document all measurements on the quality assurance record

10. To obtain a series of slice thickness measurements at various depths, slide the transducer along the scan surface. Repeat steps 4 through 9.

ELEVATIONAL TESTING

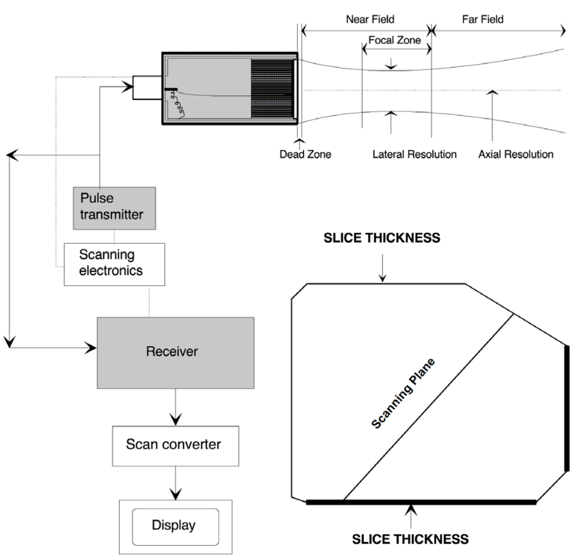
11. Using graph paper, plot the slice thickness measurements obtained at each given depth. Draw a connecting line on each side of the results plotted. The resulting drawing will be a graphical representation of the slice thickness beam profile. Document the smallest measurement of the slice thickness and depth at which it occurred; this area is the focal zone.



NOTE: A correction factor of 0.94 adjusts for the speed of sound in ATS urethane (1450 m/s).

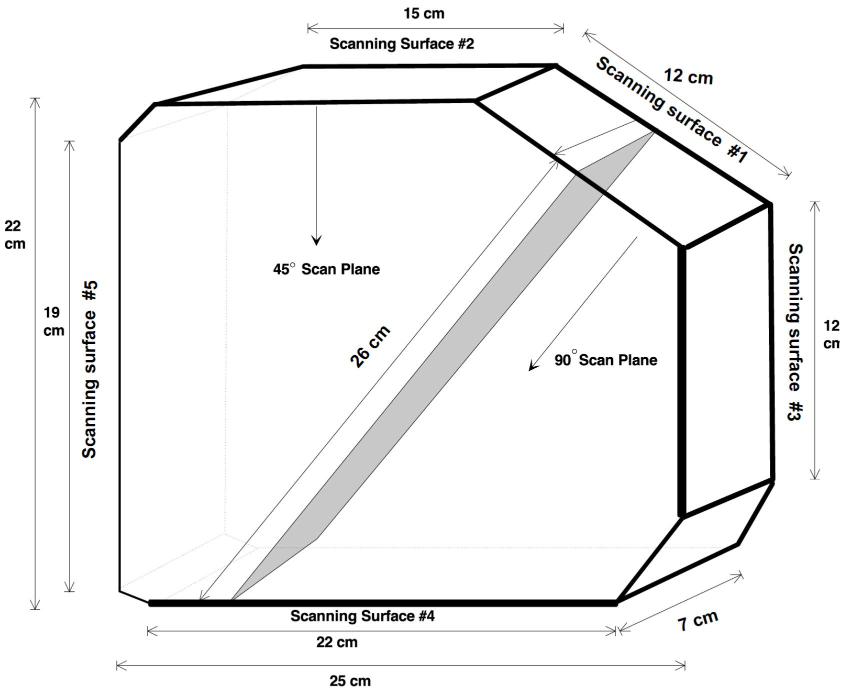
Results

The slice thickness of the beam should remain consistent from week to week, when using the same instrument settings, transducer and the Model #538NH phantom. Compare the test results obtained with a baseline or previous test. If the current image demonstrates changes in the system, investigation should be made to determine the cause.



SPECIFICATIONS

TARGET LAYOUT



PHANTOM

Housing	PVC
Overall Dimensions	25 x 22 x 7 cm (10" x 9" x 3")
Weight	5.1 kg
Scanning Surface Dimensions	15.0 x 7.0 cm, 12.0 x 7.0 cm, 12.0 x 7.0 cm, 22.0 x 7.0 cm, 19.0 x 7.0 cm

URETHANE PROPERTIES

Freezing point:	< -40°C
Melting point:	Above 100° C
Speed of Sound:	1450 m/s at 23°
Attenuation Coefficient:	0.5 dB/cm/MHz (measured at 3.5 MHz)

TARGETS

Scattering plane oriented at 45° to the scan planes used to measure slice thickness, and 90° to the beam profile scan plane

Size:	26 x 7 cm
Depth:	0 to 22 cm

WARRANTY

All standard CIRS products and accessories are warranted by CIRS against defects in material and workmanship for a period as specified below. During the warranty period, the manufacturer will repair or, at its option, replace, at no charge, a product containing such defect provided it is returned, transportation prepaid, to the manufacturer. Products repaired in warranty will be returned transportation prepaid.

There are no warranties, expressed or implied, including without limitation any implied warranty of merchantability or fitness, which extend beyond the description on the face hereof. This expressed warranty excludes coverage of, and does not provide relief for, incidental or consequential damages of any kind or nature, including but not limited to loss of use, loss of sales or inconvenience. The exclusive remedy of the purchaser is limited to repair, recalibration, or replacement of the product at manufacturer's option.

This warranty does not apply if the product, as determined by the manufacturer, is defective because of normal wear, accident, misuse, or modification.

NON-WARRANTY SERVICE

If repairs or replacement not covered by this warranty are required, a repair estimate will be submitted for approval before proceeding with said repair or replacement.

RETURNS

If you are not satisfied with your purchase for any reason, please contact your local distributor prior to returning the product. Visit https://www.cirsinc.com/distributors/ to find your local distributor. If you purchased your product direct through CIRS, call Customer Service at 800-617-1177, email rma@cirsinc.com, or fax an RMA request form to 757-857-0523. CIRS staff will attempt to remedy the issue via phone or email as soon as possible. If unable to correct the problem, a return material authorization (RMA) number will be issued. Non-standard or "customized" products may not be returned for refund or exchange unless such product is deemed by CIRS not to comply with documented order specifications. You must return the product to CIRS within 30 calendar days of the issuance of the RMA. All returns should be packed in the original cases and or packaging and must include any accessories, manuals and documentation that shipped with the product. The RMA number must be clearly indicated on the outside of each returned package. CIRS recommends that you use a carrier that offers shipment tracking for all returns and insure the full value of your package so that you are completely protected if the shipment is lost or damaged in transit. If you choose not to use a carrier that offers tracking or insure the product, you will be responsible for any loss or damage to the product during shipping. CIRS will not be responsible for lost or damaged return shipments. Return freight and insurance is to be pre-paid.

WITH RMA NUMBER, ITEMS MAY BE RETURNED TO:

CIRS
Receiving
900 Asbury Ave,
Norfolk, Virginia, 23513 USA

PRODUCT	WARRANTY PERIOD
Model ATS538NH - Beam Profile & Slice thickness Phantom	120 Months

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