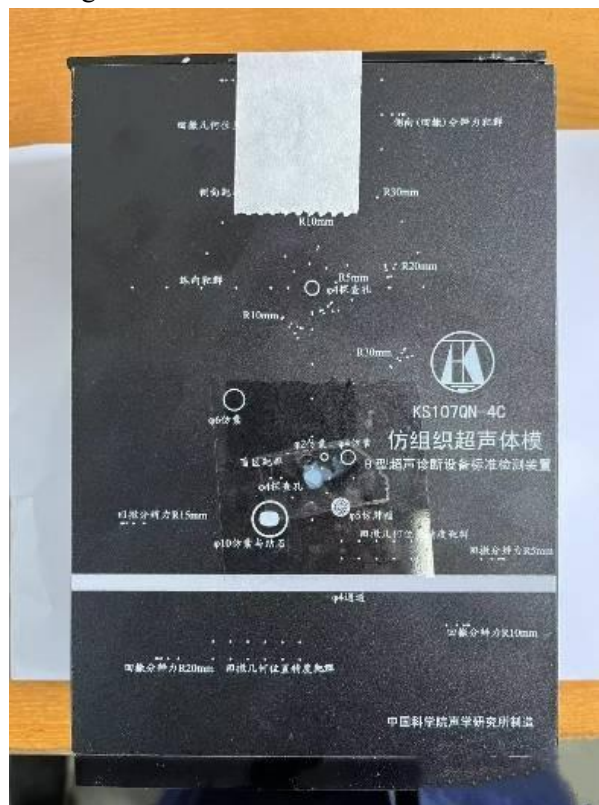


KS107QN-4C Type Artificial Tissue Ultrasound Body Model

(Intracavitary Probe Imaging Ultrasound Body Model)

1. Compliant with the standard YY/T 1659-2019 for the general technical requirements of vascular ultrasound diagnostic equipment.
2. The four walls and the bottom are made by processing and assembling with plexiglass. The outer surfaces of the four walls are covered with plastic film panels for indication and decoration; the overall dimensions are 21cm × 14cm × 6.6cm.
3. The bottom plate has two circular holes with a diameter of 36mm and is sealed with rubber thin layers for injecting maintenance fluid and removing air.
4. It is filled with TM material that meets the requirements of national standards as the standard sound transmission medium.
5. KS107QN-4A has a cavity probe scanning hole with a diameter of $\Phi 3$ mm, KS107QN-4B has a cavity probe scanning hole with a diameter of $\Phi 10$ mm, and KS107QN-4C has a cavity probe scanning hole with a diameter of $\Phi 4$ mm. The probes are inserted into the scanning holes for ultrasound scanning.



6. Technical Parameters :

Sound Velocity of TM Material: 1540 ± 10 m/s ($23 \pm 3^\circ\text{C}$)

Slope of Sound Attenuation Coefficient in TM Material: 0.70 ± 0.05 dB/cm/MHz ($23 \pm 3^\circ\text{C}$)

Nylon Target Wire Diameter: 0.1 ± 0.02 mm

Nylon Target Wire Positional Tolerance: ± 0.05 mm

The target groups within the phantom include: blind zone targets; axial, lateral, and elevational resolution targets; retraction resolution targets; and geometric positional accuracy targets. The simulated lesions include: cystic lesions, solid (tumor-like) lesions, and combined cyst-and-stone lesions.

The following target groups are embedded within the TM material:

(1) O1 – O3 Probe Access Ports.

The top panel of the phantom features two probe access ports, each with a diameter of $\phi 4$ mm; these are positioned at the center of the upper half and the center of the lower half of the panel, respectively. Arranged around access port O1 are the axial/lateral resolution target group, the lateral resolution target group, and the axial resolution target group. Arranged around access port O2 are the blind zone target group, the geometric distortion target group, the simulated cystic lesions, the simulated solid (tumor-like) lesions, and the simulated combined cyst-and-stone lesions. Access port O3 is located on the left and right side panels of the phantom and is used for measuring retraction-direction resolution and retraction-direction geometric positional accuracy. This channel extends completely through the left and right panels, allowing intracavitary probes to be inserted from either side for scanning.

(2) A: Blind Zone Target Group.

The blind zone target group is arranged around access port O2 and consists of a total of 8 target wires, positioned at 45° intervals. The depths of these wires are measured relative to a point directly above the edge of the central access port O2; starting at 1 mm, the depths increase in 1 mm increments, specifically at 1, 2, 3, 4, 5, 6, 7, and 8 mm.

(3) B1 – B4: Axial and Lateral Resolution Target Groups.

The axial-lateral resolution target groups are arranged around the test hole O1. Their lateral branches are positioned along circular arcs located at distances of 5 mm, 10 mm, 20 mm, and 30 mm, respectively, from the edge of the central test hole O1—specifically comprising the four target groups B1, B2, B3, and B4. The individual target lines within these groups are distributed along circular arcs centered on the test hole, with radii of 7 mm, 12 mm, 22 mm, and 32 mm. The lateral spacing between the centers of two adjacent target lines (defined as the chord length between the two lines) is sequentially 3 mm, 2 mm, 1 mm, and 0.5 mm.

Regarding the axial branches of this target group, any two adjacent target lines lie along a radius originating from the center of the test hole O1. The difference in radial distance from the center of the test hole to the centers of adjacent target lines is 0.5 mm, 1 mm, 2 mm, and 3 mm, respectively. Taking the axial-lateral resolution targets located at a radius of 7 mm from the test hole center (i.e., 5 mm from the edge of the test hole) as an example, a schematic diagram of the target group distribution is shown in Figure 3. In this context, the spacing between target lines in the axial resolution groups refers to the straight-line distance between the lines, whereas the spacing between target lines in the lateral resolution groups refers to the chord length (rather than the arc length).

(4) C1 – C3: Lateral Target Groups (Used to assess lateral/transverse geometric position accuracy)

The lateral target groups are arranged around the test hole O1, positioned at distances of 5 mm, 10 mm, and 30 mm, respectively, from the edge of the upper half of the central test hole. Specifically, within target groups C2 – C3, the lateral spacing between the centers of adjacent target lines (defined as the straight-line distance between the two lines) is 10 mm. In target group C1, the lateral spacing between the centers of adjacent target lines (straight-line distance) is 5 mm. These target lines are distributed along circular arcs centered on the test hole, with radii of 7 mm, 12 mm, and 32 mm. The lateral target group located at the 5 mm position is distributed in a semi-circular pattern starting from the horizontal position to the left of the test hole, comprising a total of 5 target points; similarly, the lateral target group C2 located at the 10 mm position is distributed in a semi-circular pattern starting from the horizontal position to the left of the test hole, comprising a total of 4 target points. The lateral target group C3, located at the 30 mm position, is distributed in a semi-circular pattern starting from the horizontal position to the left of the probe hole; it comprises a total of 10 target points.

(5) D1 – D2: Longitudinal Target Groups

Longitudinal target group D1 is positioned around probe hole O1; it consists of 6 target lines located at distances of 5, 10, 20, 30, 40, and 50 mm from the left edge of the central probe hole O1.

Longitudinal target group D2 is positioned around probe hole O1; it consists of 4 target lines located at distances of 5, 10, 20, and 30 mm directly below the bottom edge of the central probe hole O1.

(6) J: Image Geometric Distortion Target Group

The image geometric distortion target group is positioned around probe hole O2; it consists of 4 target lines situated at the four vertices of a square, located 10 mm from the edges of the central probe hole O2 in the upward, downward, left, and right directions, respectively.

(7) H1 – H4: Probe Hole Retraction Direction Resolution Target Groups

The retraction direction resolution targets are designed to assess the minimum spacing between two target lines at which the transducer can display two distinct echo signals while being retracted axially along the probe hole. These retraction resolution target groups are positioned near probe hole O3. Target groups H1 – H4 are located at distances of 5, 10, 15, and 20 mm from the edge of the central probe hole O3. The resolution values for each target group, measured from the interior of the probe hole outward, are 3, 2, 1, and 0.5 mm, respectively.

(8) H5 – H6: Acoustic Window Retraction Direction Resolution Target Groups

The acoustic window retraction direction resolution target groups, H5 and H6, are positioned at depths of 5 mm and 10 mm below the acoustic window, respectively. For target group H5, the resolution values—measured from right to left relative to the acoustic window—are 3, 2,

1, and 0.5 mm; for target group H6, the resolution values—measured from left to right relative to the acoustic window—are 3, 2, 1, and 0.5 mm. This set of target groups may also be utilized to assess the lateral resolution of linear array ultrasound probes.

(9) I1 – I2: Target Group for Geometric Position Accuracy of Probe Hole Retraction Direction

The target group for geometric positional accuracy in the retraction direction is positioned near probe port O3. Target group I1 is located at distances of 5 mm and 10 mm from the edge of the central probe port O3 channel; target group I2 is located at distances of 15 mm and 20 mm from the edge of the central probe port O3 channel. The spacing between target lines within each target group is 5 mm.

(10) I3: Target Group for Geometric Position Accuracy of Acoustic Window Retraction Direction

Target group I3—for geometric positional accuracy in the retraction direction—is positioned at depths of 5 mm, 15 mm, and 25 mm below the acoustic window. The spacing between target lines within target group I3 is 5 mm.

7. Simulated Lesions

(1) E1 – E3: Cyst Simulators

Cyst simulators E1 – E3 are positioned around probe port O2 and contain three embedded cystic simulated lesions. All are cylindrical in shape, with diameters of 2 mm, 4 mm, and 6 mm, respectively. The axes of the cylinders are parallel to the target lines, and their central axes are located at distances of 5 mm, 10 mm, and 30 mm, respectively, directly above the edge of the central scanning port O2.

(2) F: Tumor Simulator

The tumor simulator is positioned around probe port O2, specifically located to the lower-right side of the central scanning port O2. The central axis of the tumor simulator is located 10 mm from the edge of the central scanning port O2; it is cylindrical in shape with a diameter of 5 mm, and its axis is parallel to the target lines.

(3) G: Cyst and Stone Simulators

The cyst and stone simulators are positioned around probe port O2. The cyst simulator is cylindrical in shape and located horizontally to the lower-left side of the central scanning port O2, at a distance between 5 mm and 15 mm from the port's edge; it has a diameter of 10 mm, and its axis is parallel to the target lines. The stone simulator is irregularly shaped and situated within the mid-section of the cyst, with a maximum dimension of approximately 4 – 6 mm.