Quality Assurance and Lab Accreditation

Chapter 5

Quality Assurance

- Modern medicine is evidence based, or research based
- Sonography labs are only as good as the:
    - Equipment within the lab
    - Sonographers performing the studies
    - Radiologist/Perinatologist reading the studies
- QA programs are essential for patient care
    - Major part of lab accreditation

Quality Assurance

- Goals of a QA program:
  - Proper equipment operation
  - Detect gradual changes
  - Minimize downtime
  - Reduce non-diagnostic exams
  - Reduce repeat scans

Quality Assurance

Term	Definition
Gold Standard	The imaging test that is considered the most accurate test for that type of study (e.g. LEV ultrasound is the gold standard to rule out deep venous thrombosis (DVT).
Sensitivity	How good is the test at finding positive exams?
Specificity	How good is the test at deciding if an exam is normal?
Accuracy	How good is a test overall? In other words, is the test good at finding positive AND negative results?

Quality Assurance

Term	Definition
Reliability	Is the test consistent? Does it consistently provide accurate results?
Positive predictive value (PPV)	How many abnormal (“positive”) exams your imaging test correctly identifies as positive?
Negative predictive value (NPV)	How many normal (“negative”) exams your imaging test correctly identifies as normal?

Preventative Maintenance

- All ultrasound departments should participate in a preventative maintenance program for every piece of equipment in the sonography lab
- American Institute of Ultrasound in Medicine (AIUM) suggests all equipment should be evaluated and calibrated annually
- Routine electrical evaluation should be done by the sonographer to ensure no electrical hazard can occur to both the sonographer and the patient

Preventative Maintenance

- Routine cleaning of the machines vents and outer surfaces should be done to assure everything is in optimal working condition
- The machine should also be disinfected before and after portable exams
- Records of all inspections, evaluations, and calibrations should be maintained in the department
- Any equipment not suitable for use should be tagged accordingly and the service engineer should be contacted
  - Do not use equipment that is out of calibration or produces nondiagnostic images!

Equipment Malfunction and Troubleshooting

- Any malfunctions should be reported immediately
- If the issue is a potential hazard to the sonographer or the patient, it should be pulled from operation until the status of the equipment is assessed
  - Complicated malfunctions may require a service engineer
  - Some issues can be corrected by calling technical support or reviewing the machine's operational manual

Performance Testing

- Daily operations evaluated by the sonographer:
  1. Fraying of electrical cords or transducer cords
  2. Tears in the wiring casing
  3. Evaluate the face of the transducer for cracks or chips
  4. Evaluate the keyboard for sticking keys
  5. Examine the trackball for any issues
  6. Check for caliper malfunctions or irregular technique or depth adjustments

Performance Testing

- Detailed and specific performance testing should be completed on a routinely scheduled basis
  - Gradual degradation of the equipment/image may be difficult to detect
- Performance testing includes scheduled activities that evaluate the accuracy of the system's imaging capabilities

Performance Testing

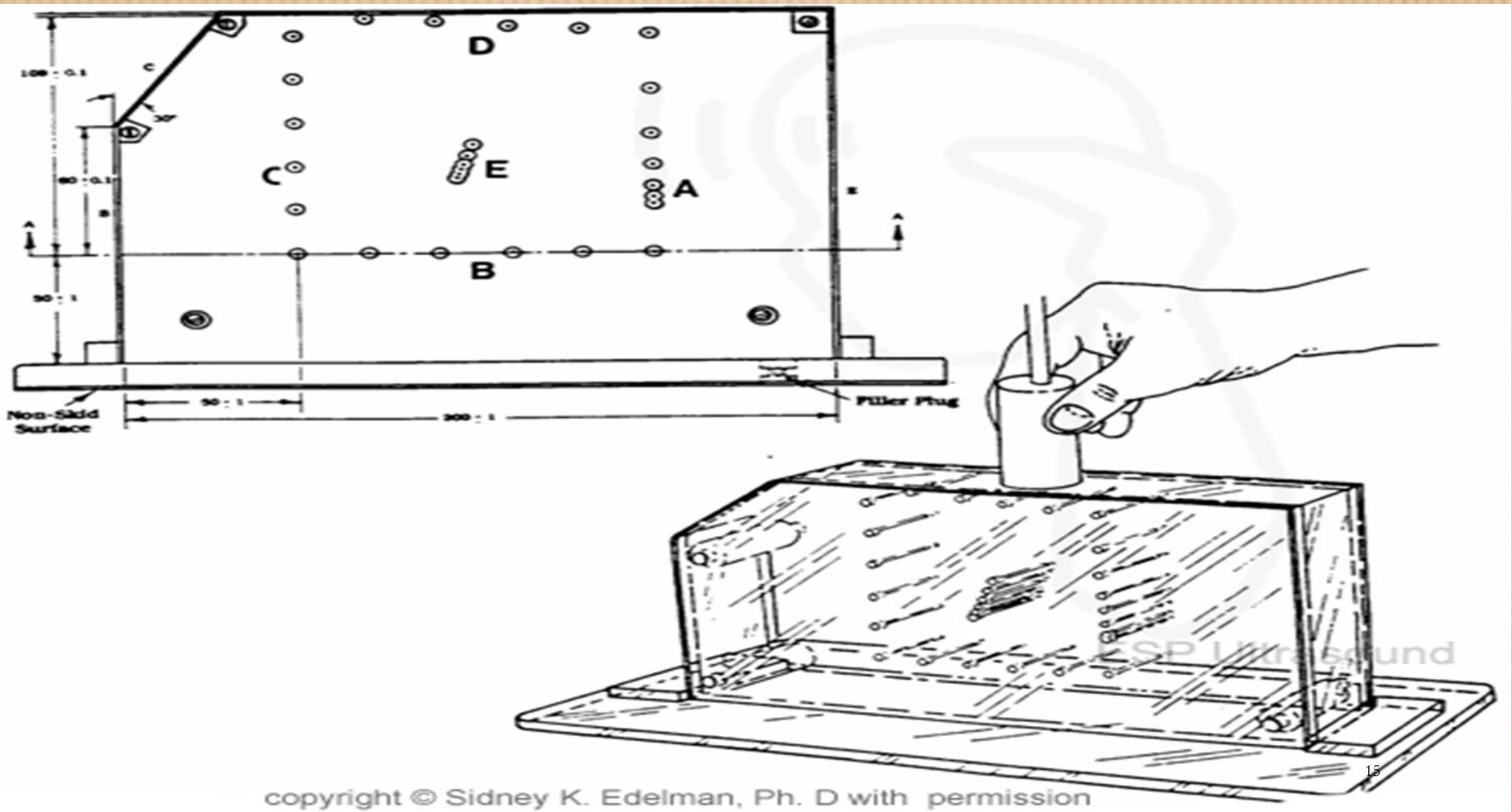
- Imaging capabilities include:
  - Axial resolution
  - Lateral resolution
  - Vertical depth
  - Horizontal calibration
  - Overall registration of data

Performance Testing

- Test objects, or phantoms, are used to accurately calibrate ultrasound imaging equipment
- Phantoms include calibration and slice-thickness test objects, tissue-mimicking phantoms, and Doppler phantoms or test objects
- Each test object has a specific purpose and may have one or more imaging parameters that it can evaluate
- Phantoms are *objective standards*

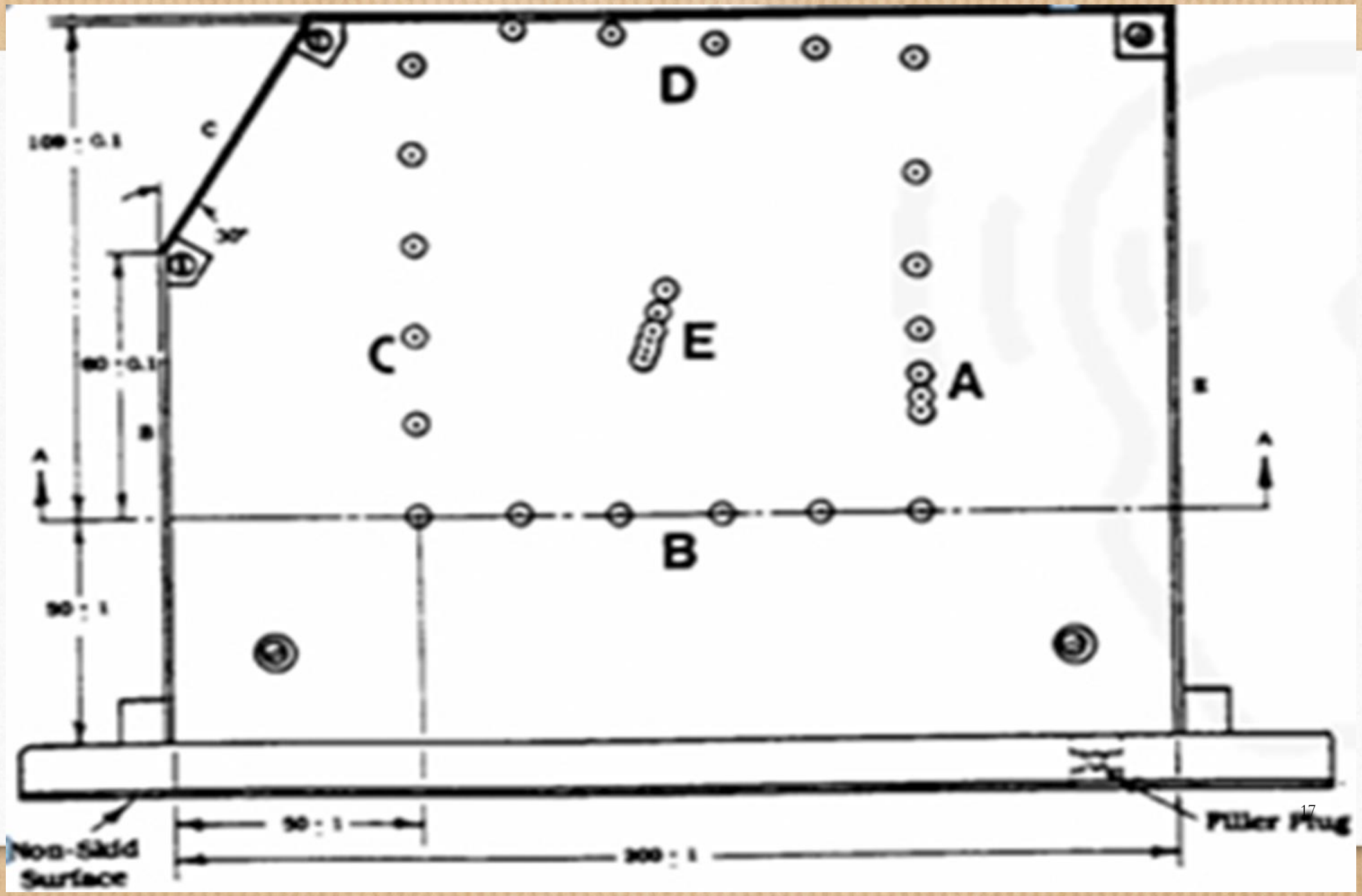
Performance Testing (Test Object)

- Calibration test objects evaluate the measurement accuracy of the machine
  - Contain strategically located steel pins
  - Speed of sound is identical to soft tissue (1,540 m/s)
  - Does not have attenuation properties
    - Grayscale cannot be evaluated
  - Often called AIUM Test Object



Performance Testing (Test Object)

- Evaluates accuracy and performance of the system
  - Axial resolution
    - Evaluated when pins are parallel to the beam
  - Lateral resolution
    - Evaluated when pins are perpendicular to the beam
  - Caliper accuracy
    - Evaluated by comparing distances between reflections of pins
  - Dead zone
    - Evaluated by scanning pins located at the top (close to the transducer)


D
C
E
A
B
Non-Skid Surface
Filler Plug

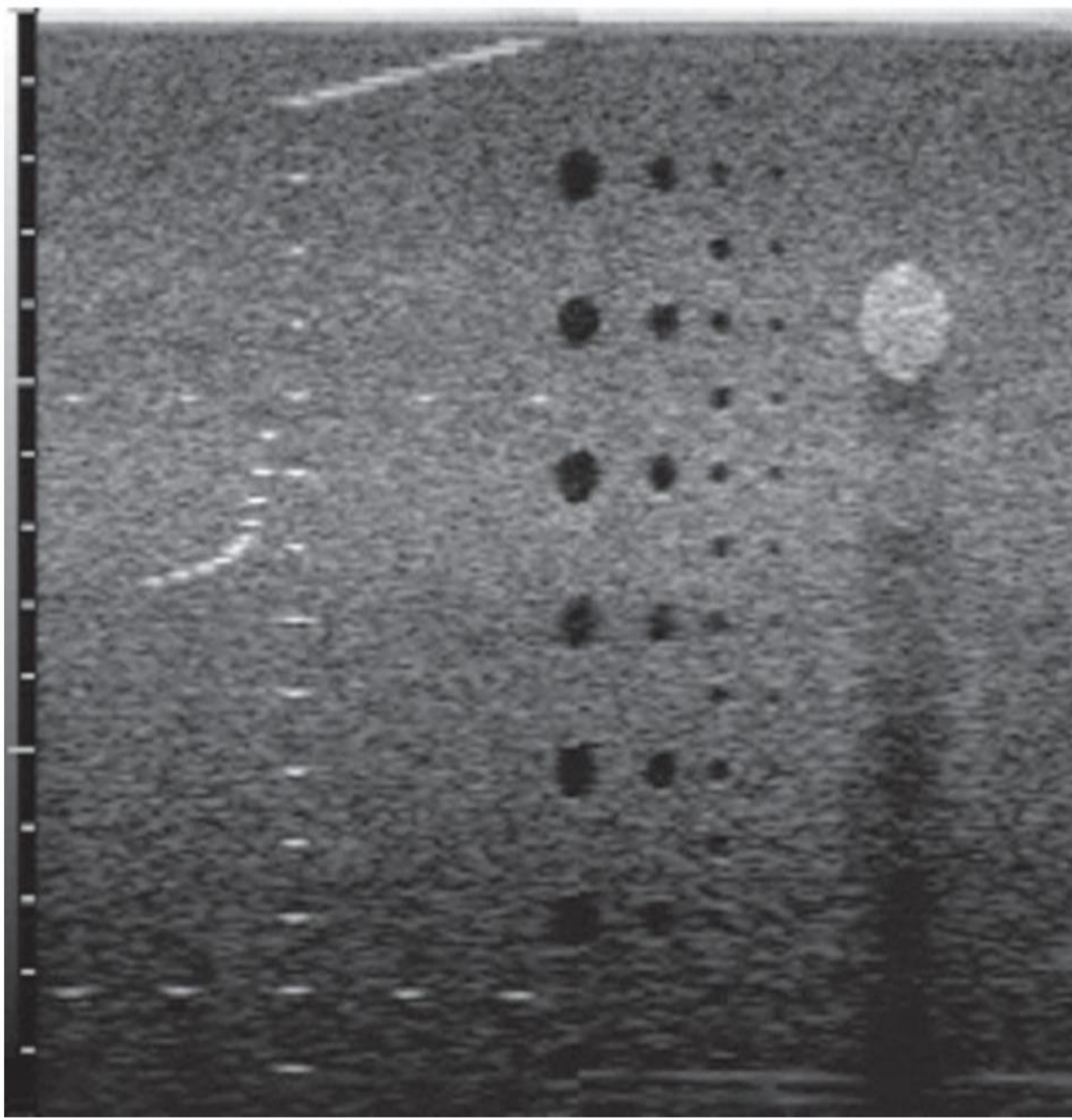
Pin Set	Evaluates
D	Dead Zone
A	Lateral resolution when transducer is on side Axial resolution when transducer is on top
E	Lateral resolution if transducer is on oblique corner Axial resolution if transducer is on top
B	Horizontal registration
C or A	Vertical registration
All pins	Registration

Performance Testing (Tissue Equivalent)

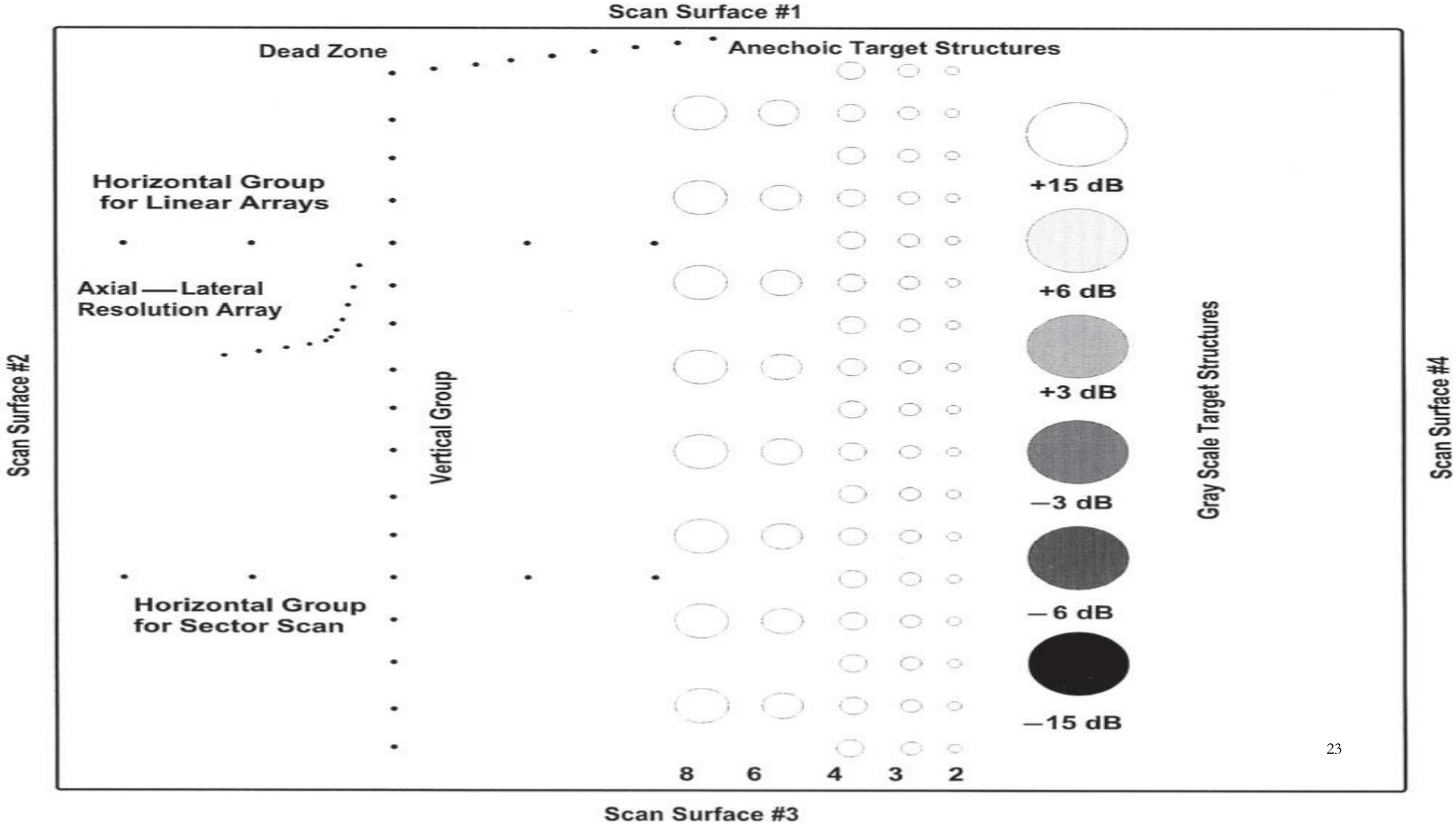
- Tissue-mimicking test objects, or grayscale test objects, evaluate a machine's grayscale sensitivity and contrast resolution
  - Sensitivity is the machine's ability to detect very weak echoes
  - Contrast resolution is the machine's ability to resolve adjacent shades of gray in tissue
- Tissue mimicking test objects are often combined with calibration test objects to create a general-purpose phantom

Performance Testing (Tissue Equivalent)

- Perform very similar to soft tissue:
  - Speed of sound 1.54 km/s
  - Attenuation
  - Scattering characteristics
  - Echogenicity
- Grayscale evaluated (resembles soft tissue)

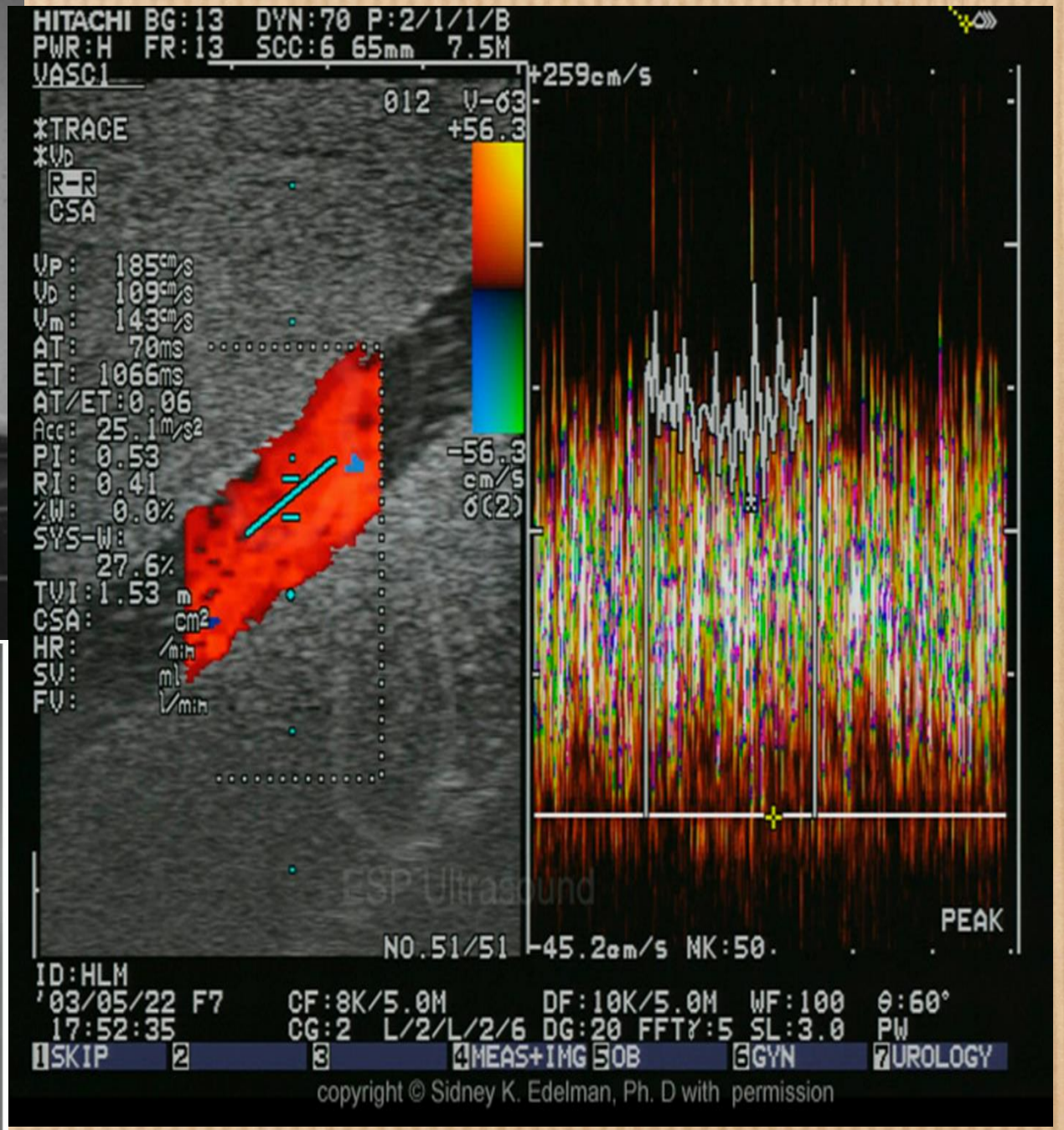


Model 539 Multipurpose Phantom



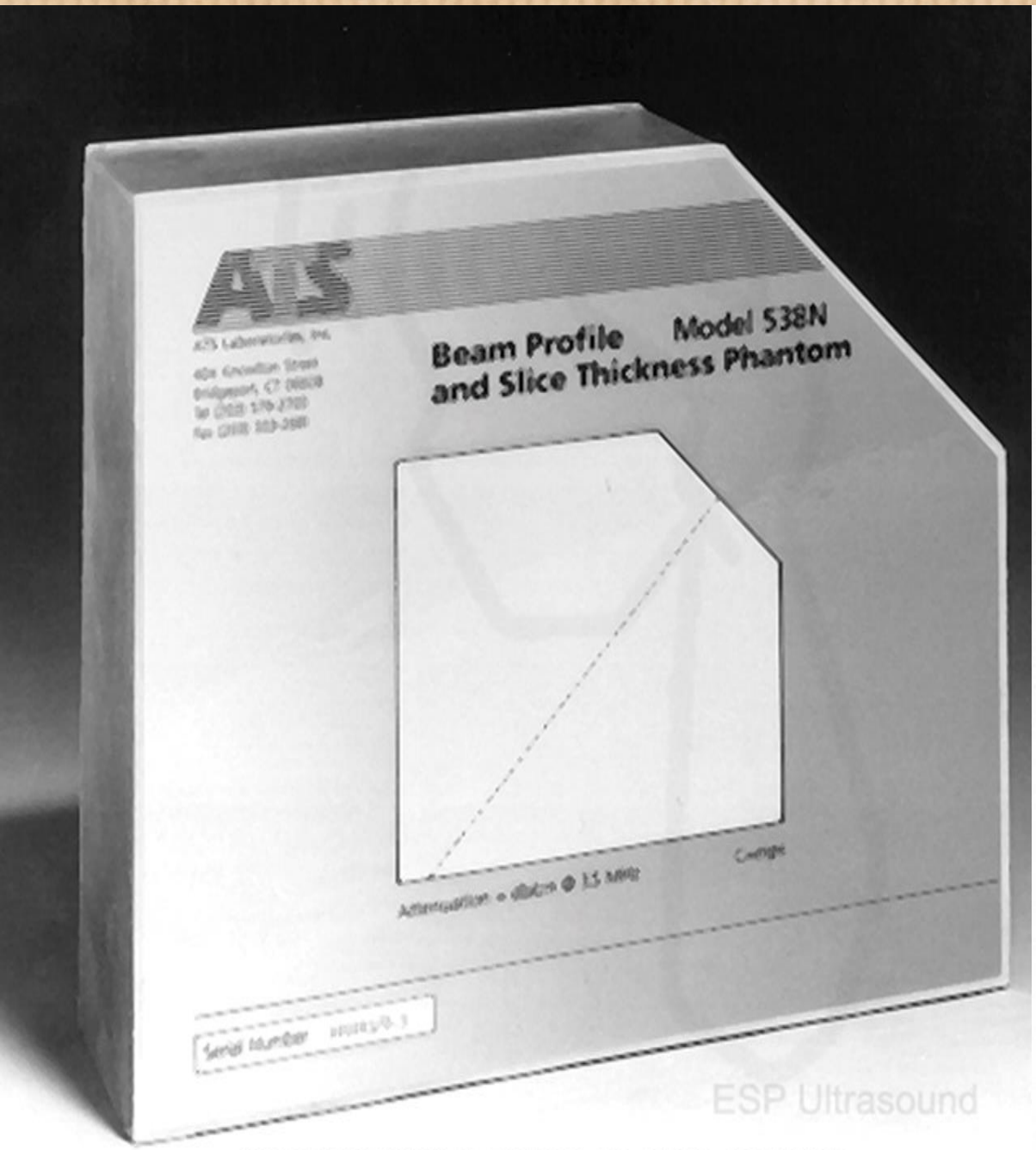
Performance Testing (Doppler Phantoms)

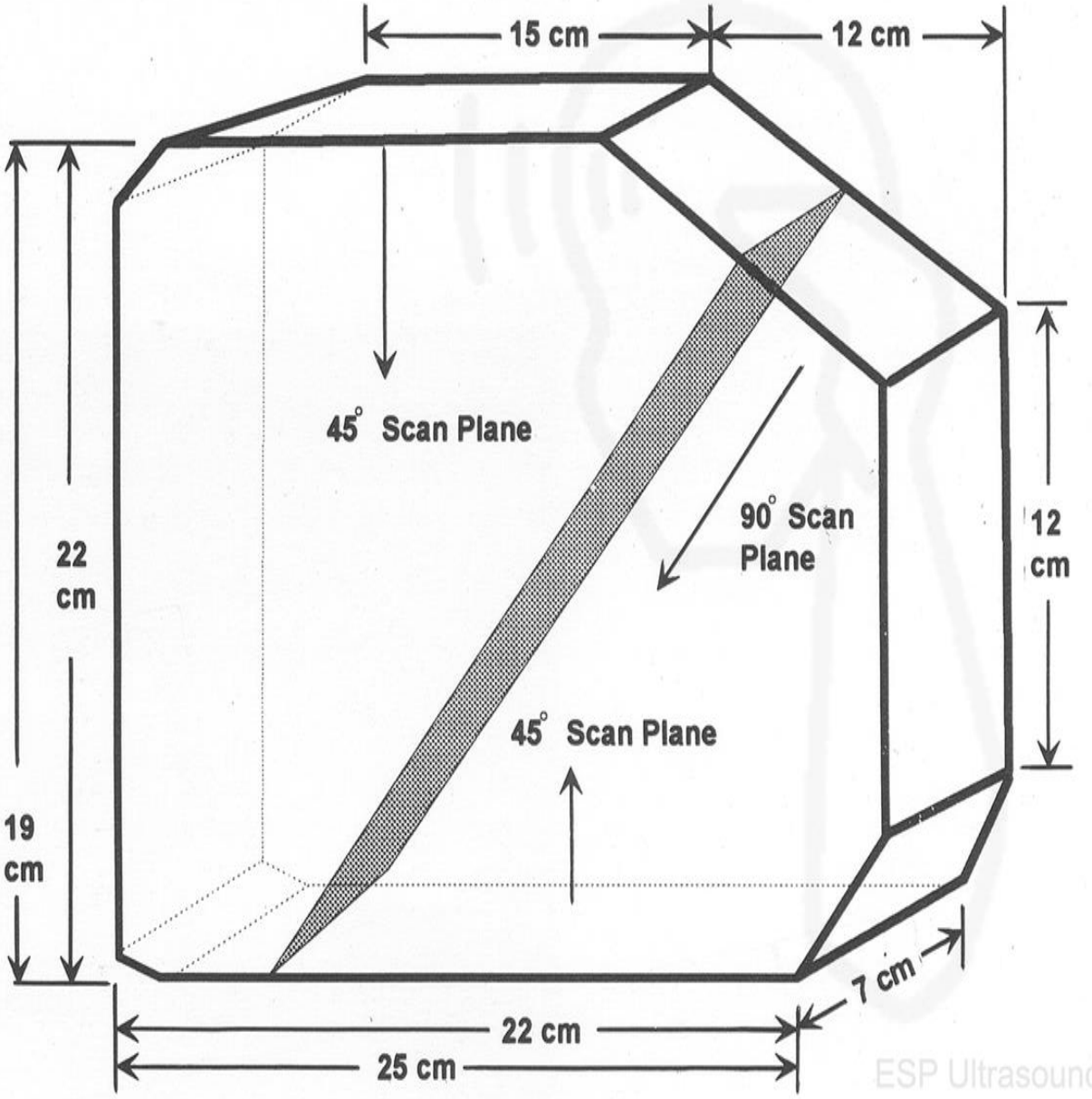
- Doppler test objects are used to evaluate the flow direction, the depth capability (or penetration) of the Doppler beam, accuracy of the sample volume location, and measured velocity
- Multiple types of Doppler phantoms:
  - Flow phantom
  - Vibrating string phantom
  - Moving belt phantom



Performance Testing (Slice Thickness Phantoms)

- Slice-thickness phantoms evaluates the elevation resolution, or the thickness portion, of the sound beam perpendicular to the imaging plane
  - An overly thick sound beam can create echoes inside a cystic or fluid-filled structure
- Measures beam geometry perpendicular to imaging plane





Lab Accreditation and Credentialing

- Reputable organizations exist that recognize ultrasound lab for their compliance with national performance standards
- Accreditation means that labs have met specific, comprehensive guidelines that govern departmental administration and policies, patient care, scanning protocols, and procedures

Accrediting Agencies

- Major accrediting bodies:
  - AIUM – American Institute of Ultrasound in Medicine
    - AB, small parts, gynecology, OB, and vascular
  - IAC – Intersocietal Accreditation Commission
    - Vascular and echocardiography
  - ACR – American College of Radiology
    - AB, small parts, gynecology, OB, and vascular

Professional Credentialing

- Professional credentialing of sonographers and interpreting physicians is recommended for health care professionals practicing sonographic procedures
  - Lab accrediting organizations require professional certification(s) for practicing sonographers
- Currently, three credentialing organizations exist: the American Registry for Diagnostic Medical Sonography (ARDMS), Cardiovascular Credential International (CCI), and the American Registry of Radiographic Technologists (ARRT)

QUESTIONS

All of the following can be evaluated by a Doppler phantom except:

A. Continuous wave Doppler

B. Color Angio Doppler

C. Motion Mode

D. Color Flow Doppler

E. Pulsed Doppler

What is the major distinction between an AIUM 100mm test object and a tissue equivalent phantom?

A. Attenuation of sound in the tissue equivalent phantom is less than that in the AIUM 100 mm test object
B. Color angio Doppler can be better assessed with a tissue equivalent phantom
C. Speed of sound in a tissue equivalent phantom exceeds the speed of sound in a AIUM 100 mm test object
D. Speed of sound in the tissue equivalent phantom and the AIUM 100 mm test object are the same
E. Gray scale can be better assessed with the use of a tissue equivalent phantom

An ultrasound system measures the distance between two pins in a test object that are 100 mm apart. One pin is located at a depth of 10mm and the other is located at a depth of 110 mm. The calipers on the ultrasound system report the pins as being separated by 90 mm. Another set of pins, 50 mm apart, is evaluated with the same system. How far apart would these pins be reported?

A. 50 mm

B. 45 mm

C. 140 mm

D. 100 mm

E. 10 mm

An ultrasound system measures the distance between two pins in a test object that are 100 mm apart. One pin is located at a depth of 10 mm and the other is located at a depth of 110 mm. The calipers on the ultrasound system report the pins as being separated by 110 mm. Another set of pins, 50 mm apart, is evaluated with the same system. How far apart would these pins be reported?

A. 45 mm

B. 55 mm

C. 50 mm

D. 140 mm

E. 100 mm

All of the following are features of a quality assurance program except:

A. Scan converter cleaning

B. Repairs

C. Preventative maintenance

D. Routine evaluation

E. Record keeping

What standard is best used in a quality assurance program?

A. Subjective

B. Expert

C. Objective

D. Legislative

What form of resolution is evaluated by measuring the width of reflections arising from small, point targets?

A. Lateral resolution

B. Axial resolution

C. Temporal resolution

D. Elevational resolution

What form of resolution is evaluated by visualizing closely spaced pins that are parallel to the sound beam's main axis?

A. Lateral resolution

B. Axial resolution

C. Temporal resolution

D. Elevational resolution