Lesson 05: Intensity Measurements and Bioeffects

This lesson contains 12 slides plus 6 multiple-choice questions.

Accompanying text for the slides in this lesson can be found on pages 22 through 24 in the textbook:
Intensity Measurements and Bioeffects
How are intensity measurements made?

SATA
SPTA
SATP (SAPA)
SPTP (SPPA)
Where in the beam’s cross section will the measurement be made?

The Beam Uniformity Ratio (B.U.R.) is the ratio of Spatial Peak to Spatial Average.

\[ I_{SP} > I_{SA} \]
**When** (during the pulse - receive interval) will the measurement be made?

For pulse-echo measurements, the result obtained with the TA method is affected by the duty factor.
WHERE - WHEN

SATA
SPTA
SATP(PA)
SPTP(PA)
Which method produces the lowest result?
Which method produces the highest result?

\[ I_{\text{SATA}} \cdot I_{\text{SPTA}} \cdot I_{\text{SATP}} (I_{\text{SAPA}}) \cdot I_{\text{SPTP}} (I_{\text{SPPA}}) \]

Lowest \hspace{1cm} Highest
BIOEFFECTS

HEAT (Thermal)

CAVITATION (Mechanical)
Nonfocused: SPTA < 100 mW / cm$^2$
(0.1 Watt per square centimeter)

Focused: SPTA < 1 W / cm$^2$
TYPICAL METHODS FOR DISPLAY OF RELATIVE INTENSITIES

OUTPUT POWER AT MAXIMUM

SPTA = 20 mW/cm²
PWR = 100 %
PWR = 0 dB
MI = 1.3
TI = 0.6

OUTPUT POWER AT ONE - HALF

SPTA = 10 mW/cm²
PWR = 50 %
PWR = -3 dB
MI = 0.4
TI = 0.1
INTENSITY

INTENSITY = POWER DIVIDED BY AREA

<table>
<thead>
<tr>
<th>POWER</th>
<th>BEAM DIMENSIONS</th>
<th>AREA</th>
<th>INTENSITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 mw</td>
<td>1 cm x 1 cm</td>
<td>1 cm²</td>
<td>100 mW / cm²</td>
</tr>
<tr>
<td>100 mw</td>
<td>1.414 cm X 1.414 cm</td>
<td>2 cm²</td>
<td>50 mW / cm²</td>
</tr>
<tr>
<td>100 mw</td>
<td>2 cm x 2 cm</td>
<td>4 cm²</td>
<td>25 mW / cm²</td>
</tr>
<tr>
<td>50 mw</td>
<td>1.414 cm x 1.414 cm</td>
<td>2 cm²</td>
<td>25 mW / cm²</td>
</tr>
</tbody>
</table>
Answers to the following SIX practice questions were derived from material in the textbook:
Question 1

Which intensity measuring method provides the highest result?

- SPTA
- SPTP
- SATA
- SAPA
Which intensity measuring method provides the highest result?

- SPTA
- SPTP
- SATA
- SAPA
A hydrophone probe can be used to measure the

- ultrasound intensity
- beamformer voltage
- bandwidth
- ultrasound frequency
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Thermal bioeffects of ultrasound energy have been determined experimentally by using

- epidemiological and cavitation studies
- cavitation detectors
- animal and in vitro studies
- hydrophones
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- epidemiological and cavitation studies
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Potential bioeffects of ultrasound can be minimized by

- using high pulse repetition frequencies
- increasing the mechanical index
- increasing the thermal index
- reducing the time of the examination
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Question 5

Since very little is known about bioeffects and assuming that there could be a minimal risk of bioeffects when using diagnostic ultrasound, what would be the best course of action?

- Perform fewer ultrasound examinations but increase the time of each examination
- Perform ultrasound examinations only when a crash cart is available.
- Use pulsed Doppler only for obstetrical studies.
- Use ultrasound when the expected benefit outweighs the potential risk
Question 5

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Sound power is measured in units of

- dB/cm
- mW/cm
- watts/m³
- watts
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END OF LESSON 05

For information on the accompanying textbook, visit the Website:

www.Sonicorinc.com