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Terminology

- What is a decibel (dB)?
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What is a decibel (dB)?

The decibel is a relative unit, not an absolute. Decibels are used to compare values of like quantities, usually power and intensity, on a numerical scale. For example:

- An intensity ratio of 10 translates to 10 decibels
- An intensity ratio of 100 translates to a level difference of 20 decibels
- An intensity ratio of 1000 translates to a level difference of 30 decibels

To be meaningful, a decibel needs a reference point. For example:

- In water we use a standard reference sound pressure of 1 microPascal
- In air we use a higher standard of reference of 20 microPascals
- It is essential that sound levels expressed in decibels include the reference pressure

Comparison of Various Noise Sources in the Ocean:

Noise Sources	Sound Levels
Lightning Strike on Water Surface	260 dB (approximately) (1)
Seafloor Volcanic Eruption	255 dB (approximately) (2)
Sperm Whale	163-180 dB (3)
Fin Whale	160-186 dB (3)
Humpback Whale	144-174 dB (3)
Bowhead Whale	128-189 dB (3)
Blue Whale	155-188 dB (3)&(4)
Southern Right Whale	172-187 dB (3)
Gray Whale	142-185 dB (3)
Note: All decibels (dB) are re 1 µPa at 1 m.	

References:

1. Hill, R.D. 1985. Investigation of lightning strikes to water surface. JASA 78 (6):2096-2099.
2. Dietz, R.S. and M.J. Sheehy. 1954. Transpacific detection of myojin volcanic explosions by underwater sound. Bull. of the Geolog. Soc. Vol. II: 942-956; and Northrup, J. 1974. Detection of low-frequency underwater sounds from a submarine volcano in the Western Pacific. JASA 56(3):837-841.
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4. Aroyan, J.L., M.A. McDonald, S.C. Webb, J.A. Hildebrand, D. Clark, J.F. Laitman and J.S. Reidenberg. 2000. Acoustic models of sound production

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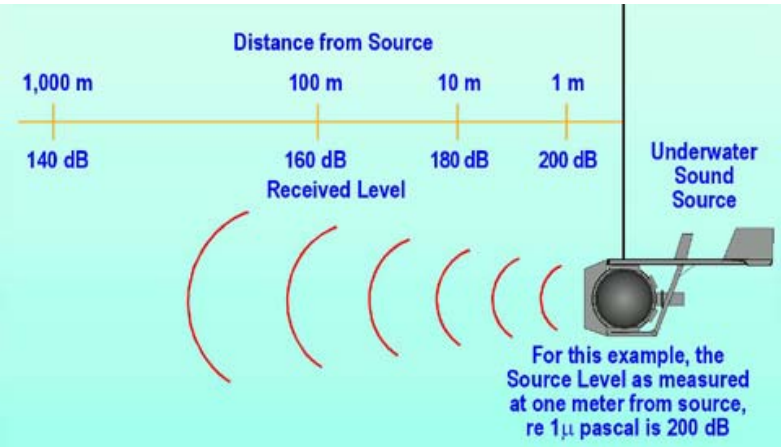
What is Source Level and Received Level?

- In underwater acoustics, source level usually represents the sound level at a distance of one meter from the source, referenced to one microPascal
- The received level is the sound level at the listener's actual position which is usually considerably more distant that the reference source level
- Underwater, loudness decreases rapidly with increasing source-receiver distance



Received levels of sound underwater at 10, 100, and 1000 meters from a 200 dB source level referenced to one microPascal at one meter.

How is Sound in Water Different from Sound in Air?

- Comparing sound levels in air against sound levels in water must be done very carefully. First, by accepted convention, the reference pressure values are different by 26 dB. Second, due to the difference in impedance (the stiffness or density of the medium) between air and water, roughly a 3,500 times greater power level (35.5 dB) is required in air to produce an equivalent pressure level in water. Combining these two values, a 61.5 dB difference, or correction factor, between the two scales is required. Therefore, 61.5 dB must be subtracted from a sound level in water to produce an equivalent acoustic intensity in air. A 60 dB difference represents a million-fold power difference. It is misleading to compare the underwater sound made by a system like SURTASS LFA with sounds heard in the air.
- Given the potential for confusion between sound levels in air and those in water, the EIS generally avoids cross-media comparisons between air and water. All sound values are water-standard values unless otherwise specified. Also, all references are broadband-level values given in dBs, standardized at 1 microPascal at 1 m (dB re 1 microPa at 1 m) for source levels (SL) and dB re 1 microPa rms (root mean squared) for received levels (RL).

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