

Basics of Noise and Its Measurement

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The Decibel Scale

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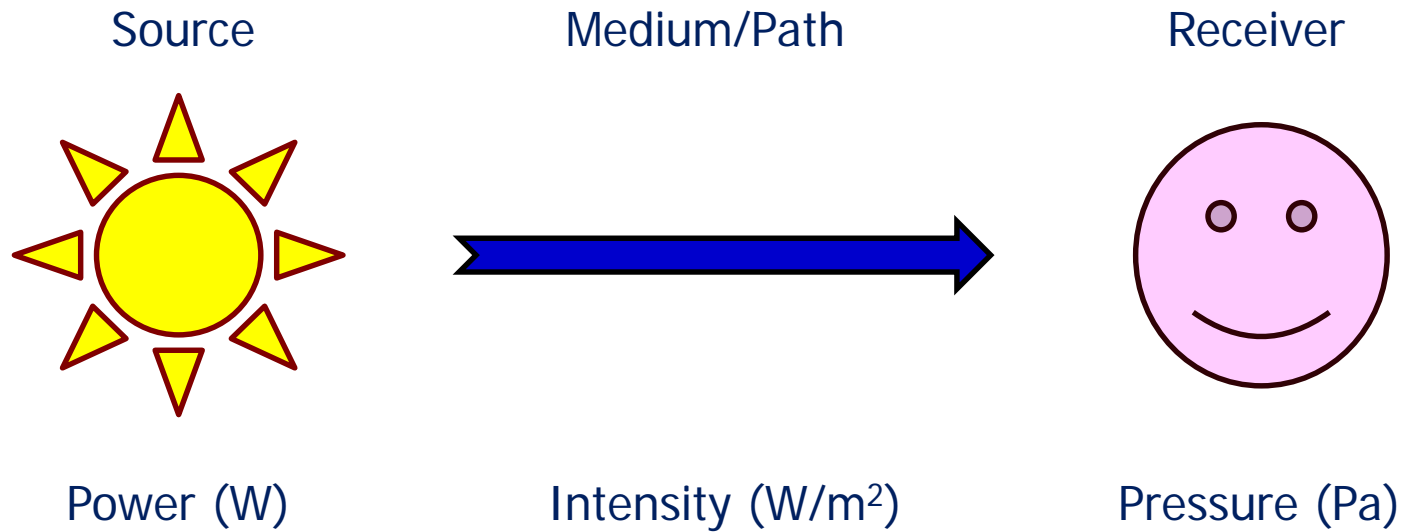
Typical Sound Pressures

Source	Pressure (Pa)
Krakatoa explosion at 160 km	20,000 Pa (RMS)
.30-06 rifle -1 m to shooter's side	7,265
Jet engine at 30 m	632
Threshold of pain	63.2
Hearing damage possible	20
Jet at 100 m	6.32 – 200
Hearing damage (long-term exposure)	0.356
Passenger car at 10 m	0.02 – 0.20
TV (set at home level) at 1 m	0.02
Normal talking at 1 m	0.002 – 0.02
Very calm room	6.32×10^{-4}
Leaves rustling, calm breathing	6.32×10^{-5}
Auditory threshold at 1 kHz	2×10^{-5}

*Pressure due
to a currency
coin on table
= 97 Pa*

Source:
Wikipedia

Measuring Sound



Measuring Sound

$$P_{total} = P_0 + p$$

$$P_0 = 1,01,325 \text{ Pa}$$

Decibel Scale

- Sound power level (L_W)
 - $10 \log_{10} (W/W_{ref})$
 - $W_{ref} = 10^{-12} \text{ W}$
- Sound intensity level (L_I)
 - $10 \log_{10} (I/I_{ref})$
 - $I_{ref} = 10^{-12} \text{ W/m}^2$
- Sound pressure level - SPL - (L_p)
 - $10 \log_{10} (p^2/p_{ref}^2) = 20 \log_{10} (p/p_{ref})$
 - p is rms pressure
 - $p_{ref} = 2 \times 10^{-5} \text{ Pa}$

Power (W)

- Total sound energy emitted by a source per unit time

Source	Power (W)
Rocket engine	1,000,000
Turbojet engine	10,000
Siren	1,000
Heavy truck or rock concert	100
Machine gun	10
Jackhammer	1
Excavator, trumpet	0.3
Chain saw	0.1
Helicopter	0.01
Loud speech,	0.001
Usual talking, typewriter	10^{-5}
Refrigerator	10^{-7}
Auditory threshold at 2.8 m	10^{-10}
Auditory threshold at 28 cm	10^{-12}

Source:
Wikipedia

Pressure & Decibel

Source	Pressure (Pa)	dB
Krakatoa explosion at 160 km	20,000 Pa (RMS)	180
.30-06 rifle -1 m to shooter's side	7,265	171
Jet engine at 30 m	632	150
Threshold of pain	63.2	130
Hearing damage possible	20	120
Jet at 100 m	6.32 – 200	110-140
Hearing damage (long-term exposure)	0.356	85
Passenger car at 10 m	0.02 – 0.20	60-80
TV (set at home level) at 1 m	0.02	60
Normal talking at 1 m	0.002 – 0.02	40-60
Very calm room	6.32×10^{-4}	30
Leaves rustling, calm breathing	6.32×10^{-5}	10
Auditory threshold at 1 kHz	2×10^{-5}	0

Source:
Wikipedia

Other Decibel Scales

- L_a : Acceleration
- L_v : Velocity
- L_f : Force
- L_w : Energy density
- L_E : Energy

Other Decibel Scales

- **La : Acceleration Level**
- **LA : A-weighted, Sound Level.**
- **LA10 : is the noise level just exceeded for 10% of the measurement period, A-weighted**
- **LA90 : is the noise level exceeded for 90% of the measurement period, A-weighted**
- **LAn : noise level exceeded for n% of the measurement period with A-weighted**
- **LAE : Sound Exposure Level : SEL**
- **LAeq : Equivalent A-weighted sound level . LAF : A-weighted, Fast, Sound Level.**
LAFmax. : A-weighted fast, maximum sound level
LAFmin : A-weighted fast, maximum sound level
- **LAS; A-weighted slow, sound level**
- **LAleq : A-weighted impulse sound level**
- **LAS : A-weighted, Slow, Sound Level.**
LASmin ; A-weighted slow, sound level, maximum
- **LASmax; A-weighted slow, sound level minimum**

References

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