Relationships of acoustic quantities associated with a plane progressive acoustic sound wave

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	ξ	v	a	p	J	E	P_{ac}
Particle displacement ξ	–	$\frac{v}{\omega}$	$\frac{a}{\omega^2}$	$\frac{p}{\omega \cdot Z}$	$\frac{1}{\omega}\sqrt{\frac{J}{Z}}$	$\frac{1}{\omega}\sqrt{\frac{E}{\rho}}$	$\frac{1}{\omega}\sqrt{\frac{P_{ac}}{Z \cdot A}}$
Particle velocity v	$\xi \cdot \omega$	–	$\frac{a}{\omega}$	$\frac{p}{Z}$	$\sqrt{\frac{J}{Z}}$	$\sqrt{\frac{E}{\rho}}$	$\sqrt{\frac{P_{ac}}{Z \cdot A}}$
Particle acceleration a	$\xi \cdot \omega^2$	$v \cdot \omega$	–	$\frac{p \cdot \omega}{Z}$	$\omega\sqrt{\frac{J}{Z}}$	$\omega\sqrt{\frac{E}{\rho}}$	$\omega\sqrt{\frac{P_{ac}}{Z \cdot A}}$
Sound pressure p	$\xi \cdot \omega \cdot Z$	$v \cdot Z$	$\frac{a \cdot Z}{\omega}$	–	$\sqrt{J \cdot Z}$	$c\sqrt{\rho \cdot E}$	$\sqrt{\frac{P_{ac} \cdot Z}{A}}$
Sound intensity $J = P_{ak} / A = p \cdot v$	$\xi^2 \cdot \omega^2 \cdot Z$	$v^2 \cdot Z$	$\frac{a^2 \cdot Z}{\omega^2}$	$\frac{p^2}{Z}$	–	$E \cdot c$	$\frac{P_{ac}}{A}$
Sound energy density E or w	$\xi^2 \cdot \omega^2 \cdot \rho$	$v^2 \cdot \rho$	$\frac{a^2 \cdot \rho}{\omega^2}$	$\frac{p^2}{Z \cdot c}$	$\frac{J}{c}$	–	$\frac{P_{ac}}{c \cdot A}$
Sound power $P_{ac} = J \cdot A$	$\xi^2 \cdot \omega^2 \cdot Z \cdot A$	$v^2 \cdot Z \cdot A$	$\frac{a^2 \cdot Z \cdot A}{\omega^2}$	$\frac{p^2 \cdot A}{Z}$	$J \cdot A$	$E \cdot c \cdot A$	–

White = linear sound field strength and gray = squared sound energy strength.

Specific acoustic impedance $Z = \rho \cdot c = \frac{p}{v} = \frac{J}{v^2} = \frac{p^2}{J}$ in $\frac{N \cdot s}{m^3}$

Density of air ρ in $\frac{kg}{m^3}$ is 1.204 kg/m³ at 20 °C

Angular frequency $\omega = 2 \cdot \pi \cdot f$

Frequency f in Hz = $\frac{1}{s}$ in air of 20 °C: Z = 413 $\frac{N \cdot s}{m^3}$

Area through a unit area normal to the direction A in m^2

Displacement of air particles (excursion amplitude) ξ in m

Particle velocity (velocity amplitude) v in $\frac{m}{s}$

Particle acceleration a in $\frac{m}{s^2}$

Sound pressure (excess pressure) $p = \frac{F}{A}$ in $\frac{N}{m^2} = Pa$

Sound intensity $J = p \cdot v = \frac{P_{ak}}{A}$ in $\frac{W}{m^2}$

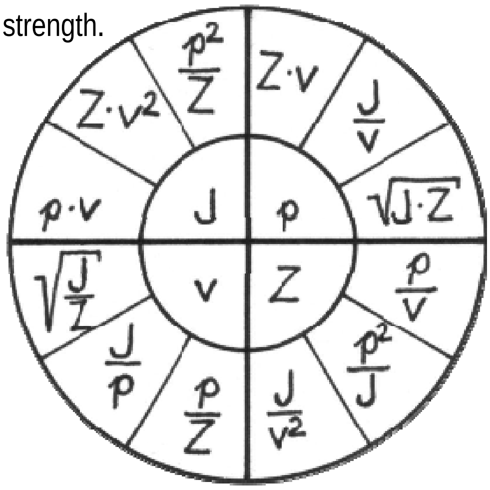
Sound energy density E or $w = \frac{J}{c}$ in $\frac{W \cdot s}{m^3}$

Here is 1 Joule $J = W \cdot s = N \cdot m$

Sound power $P_{ac} = J \cdot A$ in W

Speed of sound c in m/s (at 20 °C is c = 343 m/s)

Because 1 W · s = 1 N · m, the sound energy density is 1 W · s / m³ ≡ 1 N·m / m³ = 1 N / m² and that is the unit of a sound pressure in pascals! To remember: W · s = N · m = J (joule).



To the comparison: U means here V