Sound Pressure from Sound Power, Reverberant Room

Vibrationdata

The total mean square pressure $\langle p^2 \rangle$ in a room is

$$\langle p^2 \rangle = \Pi_{rad}\ \rho\, c_o \left(\frac{D(\Omega)}{4\pi r^2} + \frac{4}{R} \right)$$

The room constant R is

$$R = \frac{\bar{\alpha}\, S}{1 - \bar{\alpha}}$$

In a reverberant room $\frac{4}{R} \gg \frac{Q}{4\pi r^2}$

$$\langle p^2 \rangle \approx \Pi_{rad}\ \rho\, c_o \left(\frac{4}{R} \right)$$

References:

1. Lyon, Sound Radiated by Machines, eq (5.39)
2. NASA/SP—2015–624, page 446

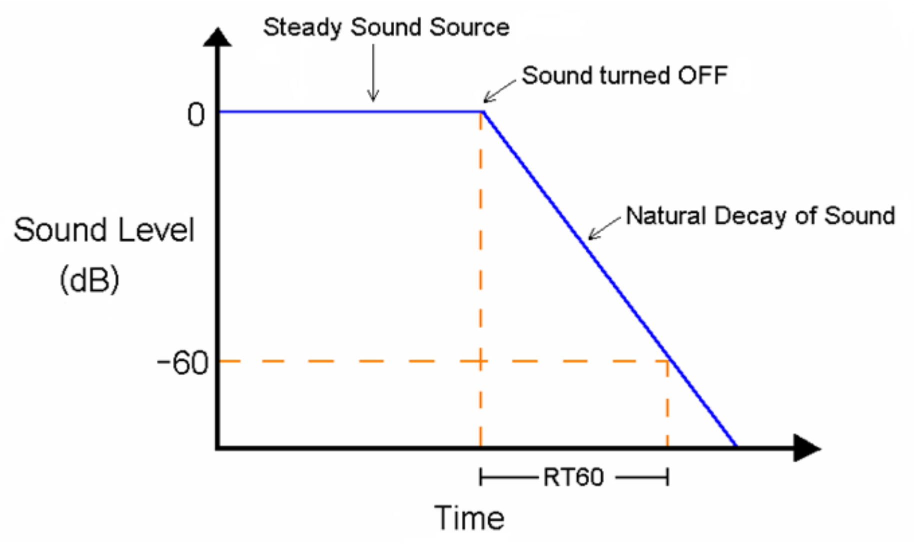
Π_{rad}	Radiated sound power
$\rho\, c_o$	Characteristic impedance
$D(\Omega)$	Quality factor or directivity function, typically 1 for a receiver in a reverberant room
r	Distance from source to measurement location
$\bar{\alpha}$	Average absorption coefficient
R	Room constant
S	Surface area

Sabine Equation

- The reverberation time (sec) in an enclosure for a 60 dB drop in the sound level is

$$RT_{60} = \left(0.049\ \frac{\text{sec}}{\text{ft}}\right)\frac{V}{S_e} \quad \text{for dimensions in feet}$$

$$= \left(0.161\ \frac{\text{sec}}{\text{m}}\right)\frac{V}{S_e} \quad \text{for dimensions in meters}$$



V = enclosure volume

S_e = effective absorbing surface area

$S_e = \alpha_1 S_1 + \alpha_2 S_2 + \alpha_3 S_3 + \ldots + \alpha_n S_n$ for n total surfaces within the enclosure

where α_i is the absorption coefficient for surface area S_i

- The effective absorbing area can be expressed in terms of the total surface area S and the average absorption $\bar{\alpha}$ as

$$S_e = S\,\bar{\alpha}$$