The sound pressure level $SPL(r) = L_p(r) \equiv 10 \log_{10} (p^2(r)/p_o^2) = 20 \log_{10} (p(r)/p_o) (dB)$ and/or sound intensity level $SIL(r) = L_I(r) \equiv 10 \log_{10} (I(r)/I_o) (dB)$ depend on the power *P* and directivity factor *Q* of the sound source, the separation distance *r* from the sound source, and the strength of the reflected sound.

In a <u>free-field</u> situation (*i.e.* far away from any reflecting and/or confining/constricting surfaces), since $I = p^2 / \rho_o c$, we have shown that, to within ~ 0.1 dB:

$$SIL = L_I \equiv 10\log_{10}(I/I_o) = SPL = L_p \equiv 10\log_{10}(p^2/p_o^2) = 20\log_{10}(p/p_o)(dB):$$

The <u>free-field</u> sound intensity <u>directly</u> in front of, and at a distance r away from a sound source having sound power P (*Watts*) and directivity factor Q associated with it is:

$$I_{ff}(r) = \frac{QP}{4\pi r^2} \left(Watts/m^2 \right)$$

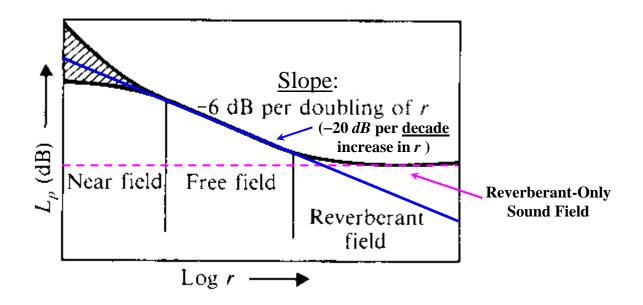
Using the above formulae, it is a straightforward algebraic exercise (please work it out!!!) to show that the *free-field* sound pressure level *directly* in front of this sound source is:

$$SPL_{direct}(r) = L_p^{direct}(r) = L_{Pwr} + 10\log_{10}(Q/4\pi r^2) (dB)$$

Sound Fields:

In analogy to the concept of an electric field distributed in 3-D space in electromagnetism, in acoustical physics we characterize the distribution of sound in 3-D space as a *sound field*.

The nature of a 3-D sound field varies with the distance *r* from the source and depends on details of the acoustic environment, as shown in the figure below:



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