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Sound Power Output of a Plane Piston Radiator (without proof) is

$$\Pi = \frac{1}{2} R_r U_0^2 \quad \text{in Watts}$$

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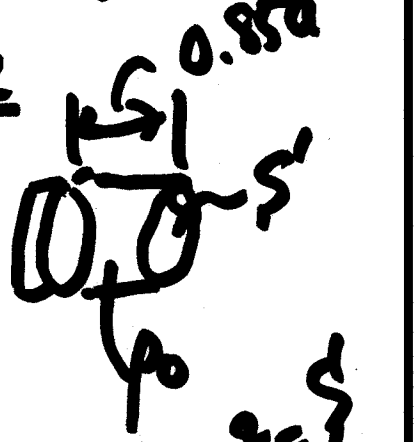
Low- and High-Frequency Asymptotes for the Radiation Impedance



Low Frequency Limit $(2ka \ll 1)$

$R_r \approx \frac{1}{2}\rho_0 c S' (ka)^2$ Weak radiator

$X_r \approx \frac{8}{\pi}\rho_0 c S' (ka) \Rightarrow m_r \approx \rho_0 S' \frac{8a}{3\pi} = \underbrace{\rho_0 S' (0.85a)}_{\text{effective mass}}$

$\Pi = \frac{1}{2} R_r U_0^2$ same result as Π for a simple source located near a rigid wall.

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For the high Frequency Limit

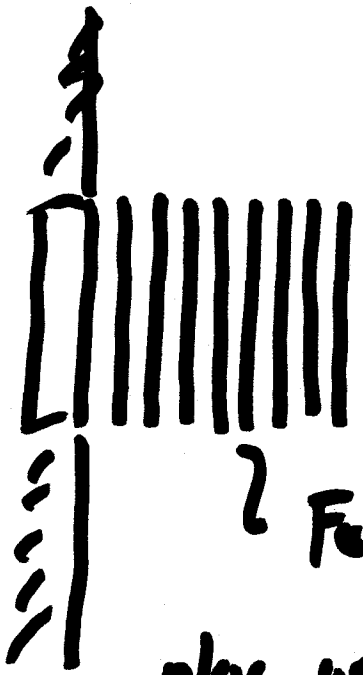
$R_r \approx \rho_0 c S' \,, \quad S' = \pi a^2 \qquad [R_1(2ka) = 1]$

$X_r \approx 0 \qquad [X_1(2ka) = 0]$

We get some insight into the physics for the radiation resistance at very high ka

$\Pi = \frac{1}{2} R_r |\hat{U}|^2$, for high ka $\Rightarrow \Pi = \frac{1}{2} \rho_0 c S' |\hat{U}|^2$

University of Idaho We also said that at high ka, the nearfield for of the plane piston radiator approached a "tube of collimated plane waves",



For plane waves $I = \frac{|\hat{p}|^2}{2\rho_0 c}$ also for plane waves $\hat{u} = \frac{\hat{p}}{\rho_0 c} \Rightarrow I = \frac{(\rho_0 c)^2 |\hat{u}|^2}{2\rho_0 c}$

$$I = \tfrac{1}{2}\rho_0 c |\hat{u}|^2 \Rightarrow \Pi = IS' = \tfrac{1}{2}\rho_0 c |\hat{u}|^2 S'$$