University of Idaho End condition physics are

$\cancel{\hat{p}_c + \hat{U}_c = \hat{U}_{rod}}$

$$\hat{p}_c + \hat{p}_r = \hat{p}_{rod}$$

$$\underline{\hat{U}_c + \hat{U}_r} = \hat{U}_{rod}$$

$$\frac{\hat{p}_c + \hat{p}_r}{\hat{U}_c + \hat{U}_r} = \hat{Z}_o = \frac{\hat{p}_{rod}}{\hat{U}_{rod}} = \frac{\hat{p}_{rod}}{\hat{U}_{rod} S_o'}$$

$$= \frac{\hat{F} / S_o'}{\hat{U}_{rod} S_o'}$$

$$= \frac{\hat{F}}{\hat{U}_{rod}} \cdot \frac{1}{S_o'^2}$$

University of Idaho Recall $\hat{F}_a = -Z_r \hat{u}_{rad}$

$$\Rightarrow \hat{Z}_o = \hat{Z}_r \frac{1}{S_o^2}$$

<u>Recall, for $2ka \ll 1$</u>

$$Z_r = \begin{cases} \frac{1}{2}\rho_0 c S (ka)^2 + j \frac{8}{3\pi} \rho_0 c S (ka) & \text{flanged} \\ \frac{1}{4}\rho_0 c S (ka)^2 + j \rho_0 c S (0.6)(ka) & \text{unflanged} \end{cases}$$

University of Idaho So that, a plane piston model for radiation from an open pipe gives:

$$\hat{Z}_0 = \begin{cases} \frac{1}{2}\frac{\rho_0 c}{S_0}(ka)^2 + j\frac{8}{3\pi}\frac{\rho_0 c}{S_0}(ka) & \text{flanged} \\ \frac{1}{4}\frac{\rho_0 c}{S_0}(ka)^2 + j\,0.6\,\frac{\rho_0 c}{S_0}(ka) & \text{unflanged} \end{cases}$$

Levine & Schwinger 1947

So, for radiation from an open pipe

$$\hat{R} = \frac{\hat{Z}_0 - Z_0}{\hat{Z}_0 + Z_0} \Rightarrow T_\pi = 1 - |\hat{R}|^2 \approx 2(ka)^2$$

flanged (10.3.4)

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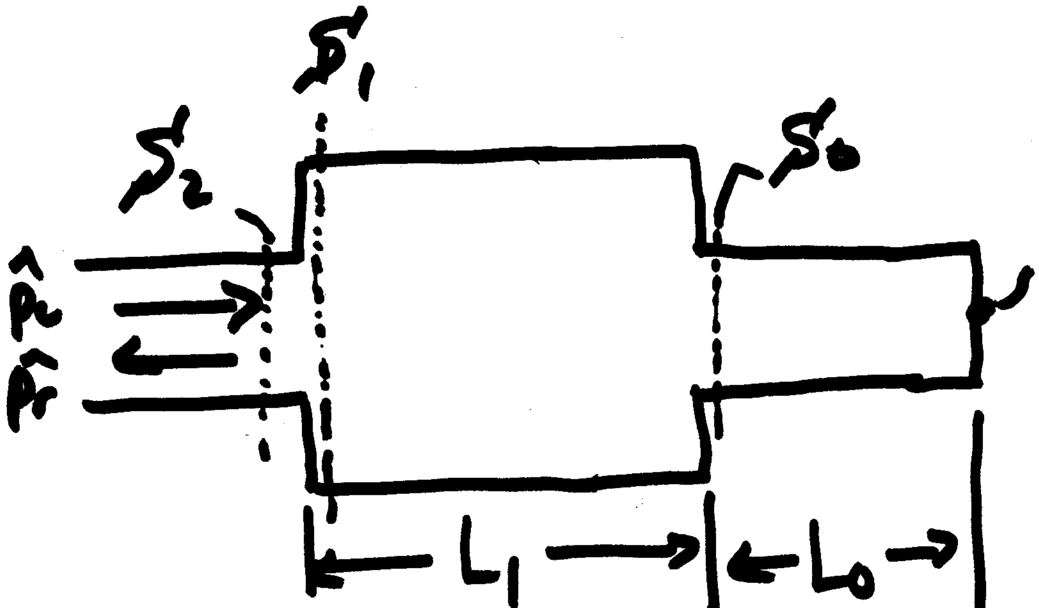
# Low Pass-Section With Open Pipe Outlet (Termination Impedance)




$\hat{Z}_t =$ open pipe flanged/unflanged based on $S_0$

$Z_0 = \rho_0 c / S_0$

$$\hat{Z}_0 = \frac{\hat{Z}_t + j Z_0 \tan kL_0}{1 + j \frac{\hat{Z}_t}{Z_0} \tan kL_0} \; ; \; \hat{Z}_1 = \frac{\hat{Z}_0 + j Z_1 \tan kL_1}{1 + j \frac{\hat{Z}_0}{Z_1} \tan kL_1}$$

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$$\hat{R} = \frac{\hat{Z}_1 - Z_2}{\hat{Z}_1 + Z_2} \Rightarrow T_\pi = 1 - |\hat{R}|^2$$

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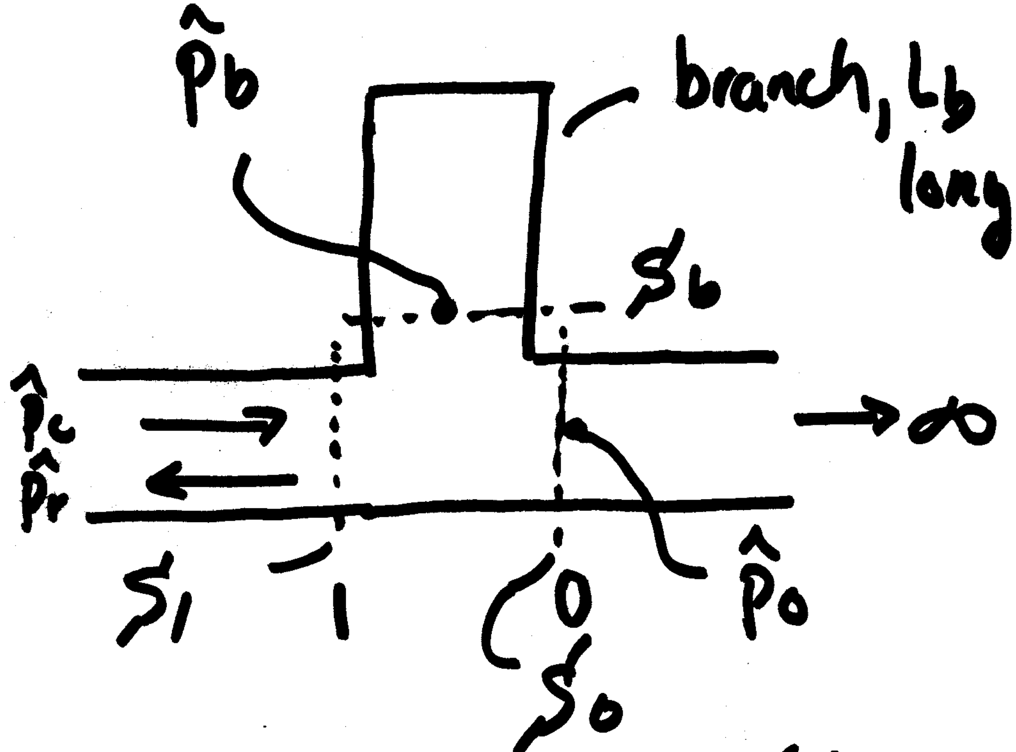
# Branch




$\hat{p}_b$ = total pressure at beginning of branch

$\hat{p}_0$ = total pressure dowstream from branch.

BC's at branch are the following:

continuity in pressure $\Rightarrow$ $\hat{p}_c + \hat{p}_r = \hat{p}_b = \hat{p}_0$

$$\hat{U}_c + \hat{U}_r = \hat{U}_b + \hat{U}_0$$