WAVES, SOUND & PHYSICAL OPTICS DAY 10: LAB: SPEED OF SOUND WITH A RESONANCE TUBE

CED 14.6 · Skills 3.A/2.D · FRQ: Experimental Design

RETRIEVAL

A tube is closed by water at one end and open at the other. Is its first resonant effective length closer to $\lambda/4$, $\lambda/2$, or λ? Be ready to mark pressure end conditions.

QUESTION AND SAFETY

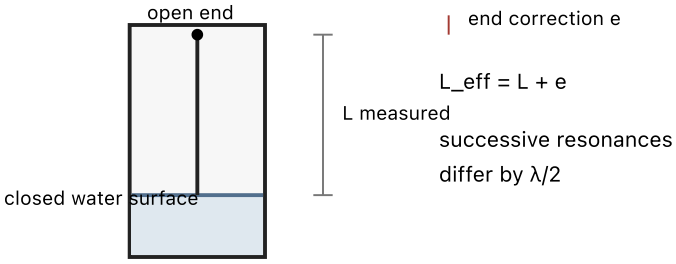
Question: What sound speed follows from measured resonance lengths?

Safety: Use a rubber striker, keep forks away from faces and glass, and stabilize the tube and water reservoir.

NOTES / REASONING

GEOMETRY AND PROCEDURE

CLOSED RESONANCE TUBE



1. Measure tube radius r and estimate $e \approx 0.6r$.
2. Sound a fork above the tube and locate the first clear resonance length L_1.
3. Continue to the next resonance L_2.
4. Repeat each length measurement and average.

$L_{\text{eff}} = L_{\text{measured}} + e$. Also, $L_2 - L_1 = \lambda/2$, so the same end correction cancels in the difference.

NOTES / REASONING

DATA RECORD

trial	f (Hz)	r (m)	L1 (m)	L2 (m)	λ=2(L2-L1) (m)	v=fλ (m/s)
1						
2						
3						
4						

For one trial, also calculate $\lambda = 4(L_1 + e)$. Compare the two wavelength methods.

ANALYSIS AND EVALUATION

1. Calculate the mean sound speed and its range or stated uncertainty.

2. Compare the mean with $343\ \mathrm{m/s}$. Calculate percent difference.

3. Explain why resonance spacing removes a constant end correction.

4. Identify one limitation and a specific improvement.