

4.5.3: Procedure

1. Connect the channel one output of the mic pre-amp to channel one of the oscilloscope with a BNC to BNC cable. Connect the microphone to the channel one input of the mic pre-amp. Turn on the mic pre-amp and set the gain to 3/4ths maximum. Turn on the oscilloscope and select the *Quick Menu* button. For initial settings, set *Bandwidth* to 20 MHz instead of Full, set the *Horizontal Time Base* to 4 milliseconds per division and the *Vertical Amplitude* to 200 millivolts per division. Turn on the *Frequency Measurement* function. Speak into the mic to make sure that you are getting a signal on the oscilloscope display.

Variation of Length

2. Obtain four lengths of pipe of the same diameter. Measure their lengths and diameter, and record in Table 1.
3. Compute the ideal and end-corrected resonant frequencies using the formulas above and record in Table 1.
4. Clean the top of the longest tube and hold it near (but not directly in front of) the microphone. Close off the bottom with your thumb and blow across the open end until you hear a clear tone. This may require slight repositioning of the tube near your mouth. Once you are able to achieve a clear, solid tone, check the oscilloscope display to make sure that it is showing one to two cycles of the wave and that the amplitude fills the vertical portion of the display without going beyond it. Adjust the oscilloscope's *Horizontal* and *Vertical* controls to achieve this if necessary.
5. Read the frequency measurement from the oscilloscope and record in Table 1.
6. Repeat steps 4 and 5 above using the remaining tubes, recording the appropriate values in Table 1.

Variation of Diameter

7. Obtain three identical lengths of pipe of different diameters. Measure their lengths and diameters, and record in Table 2.
8. Compute the ideal and end-corrected resonant frequencies using the formulas above and record in Table 2.
9. Clean the top of the widest tube and hold it near (but not directly in front of) the microphone. Close off the bottom with your thumb and blow across the open end until you hear a clear tone. This may require slight repositioning of the tube near your mouth. Once you are able to achieve a clear, solid tone, check the oscilloscope display to make sure that it is showing one to two cycles of the wave and that the amplitude fills the vertical portion of the display without going beyond it. Adjust the oscilloscope's *Horizontal* and *Vertical* controls to achieve this if necessary. Note that wider tubes may need to be held slightly away from the lips and may require greater force of exhale.
10. Read the frequency measurement from the oscilloscope and record in Table 2.
11. Repeat steps 4 and 5 above using the remaining tubes, recording the appropriate values in Table 2.

Variation of Force

12. If excessively large exhaling force is used, it is possible to “over blow” the tube which will result in it producing a strong third harmonic, or three times the fundamental resonant frequency. Using one of the thinner pipes from Table 2, copy its measured frequency into Table 3. Blow across it, this time using much greater force, until a noticeably higher pitch is obtained. Record this new frequency in Table 3.

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