

ME107A  
Experimentation and Measurement

TO: ME107A Consulting Group  
FROM: G. C. Handel, Baroque Acoustics, Inc.  
RE: Standing Wave Tubes for Acoustical Absorptivity Measurement

Our company has recently purchased a set of new standing wave tubes for determining the absorptivity of acoustical materials. However, the preliminary tests on these systems have been somewhat disappointing. We would like your assistance in understanding the basic characteristics of the tubes, and in identifying the sources of some of the problems that we have encountered.

As you know, the absorptivity may be determined from the standing wave ratio in a tube blocked at one end by the acoustic material of interest. When we have determined the absorptivity in this way, our results have often been unsatisfactory. The most problematic situations occur at frequencies near 500 Hz and 1300 Hz. There exists a strong resonance near 500 Hz, while the amplitude of the pressure wave is very small throughout the tube when the excitation is near 1300 Hz. Therefore, we suspect that the problems encountered in these two cases are likely to be different.

The engineer working with this system has suggested several potential problems. She has observed that when the speaker is driven by a sinusoidal signal near one of the system resonances, the microphone output can become quite distorted. On the other hand, at 1300 Hz, she has noted that the signal-to-noise ratio of the output is rather low. In either case, she suspects that the linear standing wave theory on which the absorptivity determination is based may be inadequate. She had intended to quantify her observations by determining the total harmonic distortion plus noise (THD+N) under a range of test conditions, but has been too busy with other projects to do so. We therefore turn to you for this work.

We would like you to make at least three specific sets of measurements.

1. Determine the system's resonant frequencies with an acoustical material (we will supply this) in place at one end of the tube.
2. Measure the rms pressure vs. axial position within the standing wave tube excited at 500 Hz and 1300 Hz under a range of excitation voltages. For each case, provide a best-fit of the pressure profile predicted by the standing wave theory and the associated acoustic absorptivity.
3. Determine the THD+N at the frequencies and amplitudes used in part 2 of this investigation at both pressure nodes and antinodes.

On the basis of your observations, please provide an explanation for the difficulties that we have encountered in making absorptivity measurements at 500 Hz and 1300 Hz. Please also describe the best excitation voltages to use at these two frequencies.

We look forward to receiving your report within two weeks of completion of your work.