TT3010 - Audio technology and room acoustics.
Exercise 3 - Loudspeakers.

September 13, 2021

All tasks are based on chapter 19 in "Science of Sound". It is recommended that the student will try to do every task, but tasks marked *Mandatory* are to be handed in for approval (online). The deadline is specified in blackboard.

Tasks

1. *Mandatory.* Compare the sound power level of a loudspeaker with an efficiency of 1 % to one with an efficiency of 10 % supplied with the same electrical power (the difference should be expressed in dB).

2. Compare the cone areas of speakers having diameters of 20 cm, 30 cm and 38 cm (8 in., 12 in., and 15 in.).

3. A loudspeaker 20 cm in diameter is mounted at the center of a 1-m square baffle board.

    a. Determine the path length from the center of the front side to the center of the back side of the speaker.

    b. At which frequency will this path be equal to one-half wavelength of sound?

4. *Mandatory.*

    a. From the graph shown in figure 1, determine the volume of air that must be moved in order to generate a sound power of 0.1 W at 100 Hz.

    b. How far must a speaker cone move in order to move this volume of air if the cone has a diameter of 20 cm?

5. *Mandatory* If a loudspeaker can produce a sound pressure level of 92 dB for 1 W of input power at a distance of 1 m, estimate its efficiency, in %, in converting electrical power to acoustical power. (Hint: Assume that the sound is uniformly radiated into a hemisphere so that the sound pressure level, $L_p = SPL$, at 1 m is 8 dB less than the sound power level, L_W.)

6. How large a volume of air must be moved by a loudspeaker cone radiating 0.1 W of acoustical power at 50 Hz? How far would the cone of a 30 cm loudspeaker (actual cone diameter is 25 cm) have to move to displace this volume?

7. *Mandatory.* A certain loudspeaker has a compliance of $8.7 \cdot 10^{-4}$ m/N and a mass (cone plus voice coil) of 71 g. Estimate its resonance frequency. (The compliance is the reciprocal of the stiffness or spring constant: $C = 1/K$).

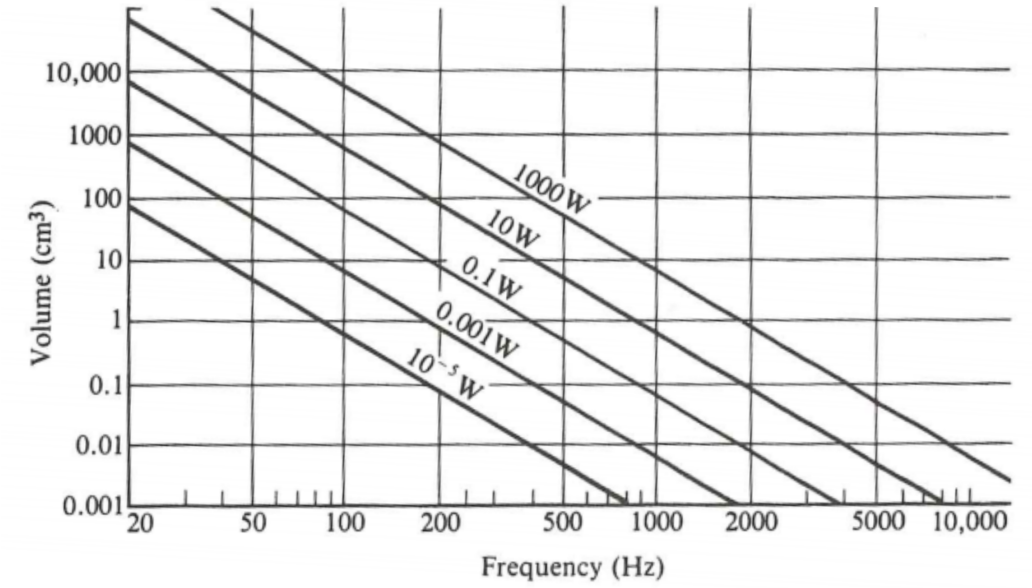

Figure 1: Volume of air moved by speaker as a function of sound power and frequency. Illustration from "Science of Sound", Chapter 23.