Acoustic Actuators (Loudspeakers) for Industrial Active Acoustic Damping Applications

A loudspeaker (acoustic actuator) designed for high-temperature, low-frequency active acoustic damping application is shown in Figure 1. The cabinet is all metal (made of aluminum) making the speaker suitable for outdoor applications. The 4 ports on the cabinet extend the performance of loudspeaker to lower frequencies. The ports also allow for equalizing the static pressure on both sides of the driver cone as well as air cooling of the voice coil.

Figure 1 High temperature, low-frequency loudspeaker

The gray/dashed line trace in Figure 2 depicts the frequency response function of speaker without the ports (a sealed box). As indicated by the green and red traces, the addition of 4 properly sized ports to the box, the frequency response function extends further into low frequencies. In addition, the ports allow for equalization of static pressure at both sides of the cone. It also allows the cooling air used to cool the voice coil, to flow out of the cabinet.

Figure 2 Frequency response function

Acoustic resonance of the speaker cabinet: By incorporating a perforated liner, tuned to the resonant frequency of the first acoustic mode of the cabinet, into one of the walls of the speaker, acoustic damping (absorption) is introduced into that standing wave; see Figure 3.
Structural resonance: By bracing the side panels of the speaker cabinet (from inside) the low frequency structural resonance of the panels are increased by almost two folds.

Cooling: Provision for air cooling of the motor and the surround are designed and built into the makeup of the speaker. A thermocouple is attached to the motor magnet and one is placed close to the surround, allowing for the monitoring of the temperature at these locations. An aluminum heat sink is epoxied to the bottom of the magnet helping with the dissipation of heat. The flow of air thru the perforated liner further enhances the removal of heat from the motor. Figure 4 shows the port and driver assembly highlighting the cooling provisions of the motor.

Figure 5 depicts the speaker installed on an air duct carrying heated air, in a process industry.