

Bender Cavity Design

Overview

When a piezoelectric element is supported in an “Edge” or “Nodal” mode, without a case or tuned enclosure, the resulting sound pressure level (SPL) produced will be very low. This is because the acoustical impedance of the piezoelectric element does not match that of any open air loading.

However, by constructing a Helmholtz resonating case (cavity) and utilizing proper mounting techniques for the piezoelectric element, the acoustical impedance of the piezo element and the encased air can be more closely matched to that of open air.

Impact of Mounting Method

How the piezo element is mounted influences the following characteristics:

1. Resonant frequency
2. Impedance
3. Bandwidth
4. Resulting sound pressure level

Utilizing Nodal Circle Mounting

Mounting a piezoelectric bender at its **nodal circle** will result in the following characteristics:

1. Lowest bender impedance
2. Highest resonating frequency
3. A narrow bandwidth
4. Highest sound pressure level

Utilizing Edge Mounting

Mounting a piezoelectric bender at its **edge** will result in the following characteristics:

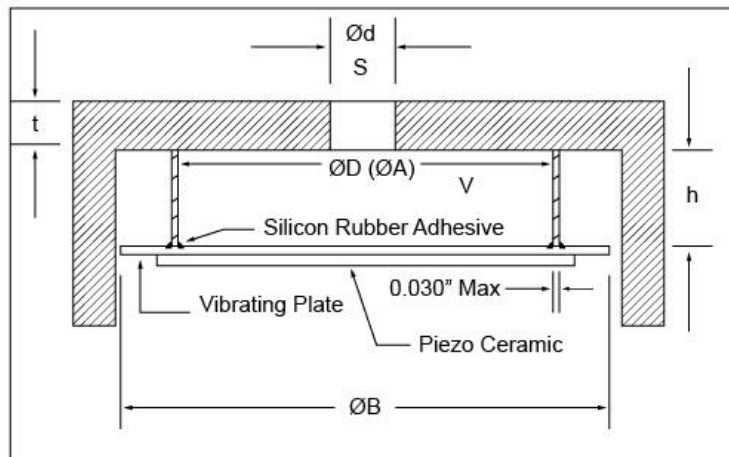
1. Higher bender impedance
2. A lower resonant frequency
3. A broader bandwidth and lower sound pressure level

The following assumptions are made when designing a Bender Cavity:

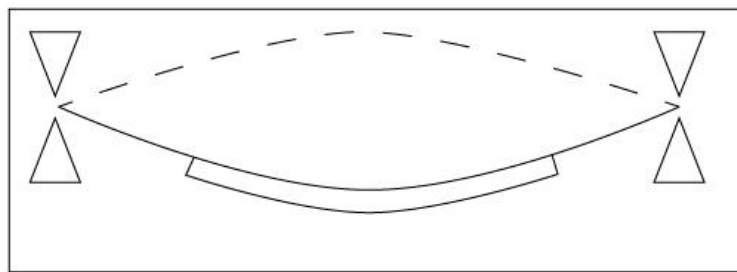
1. All of the resonator cavity and sound emitting hole's dimensions are much smaller than the wavelength of sound at the frequency of interest.
2. The sound emitting hole is tubular in geometric shape.

3. When multiple sound emitting holes are used, all holes are:
 - a. Tubular in geometric shape
 - b. Have equal diameters
 - c. Have equal length
4. The bender bonding adhesive is elastic such as a silicone rubber (RTV) and is configured as a full annular ring.
5. The case material is sufficiently rigid enough to prevent flexure due to bender motion or "in use" shock vibration.

Example: Bender Cavity Design:



Example: Edge Mounting:





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Notes:

1. All cavity dimensions are determined by calculations.
2. For nodal mount, "fD" should be set equal to the bender nodal diameter "fA", which is a calculated result.
3. For edge mount, "fD" should be set equal to "fB" less 0.040 inches.