

## INSTRUCTIONAL GUIDE

### Contents

- Vacuum chamber with piezo buzzer assembly
- Vacuum tubing with valve and stopper
- 9 V Battery

#### Recommended for Activity:

- **Hand-Held Vacuum Pump (P1-5201)**  
Or
- **Electric Vacuum Pump (P7-6502)**



### Introduction

This apparatus is an updated version of the traditional Bell Jar and Ringer experiment to show that sound does not travel through a vacuum. The sound generator is a battery-powered, high-intensity piezo buzzer. Since everything is contained within the chamber, there is no transmission of sound through connecting leads etc. The only route for sound to reach the observer is through the enclosed air or by vibrations through the support of the buzzer. The latter is minimized by the use of an elastic band support.

The unit is connected to a vacuum pump (either motorized or hand operated) while the end plates are held in place. The external air pressure then pulls everything tightly together to make effective seals. As the air is removed the only way that sound from the generator inside can reach the ears of an observer is through the mounting system which has been reduced to a minimum by the use of a simple elastic band.

Sound waves reaching the container walls can either be transmitted or reflected. The ratio of transmitted to reflected is determined by the relative densities of the contained air and the chamber walls. In the early stages of evacuating the container there is some reduction of the sound reaching the walls through the lower density of the air but the most significant factor is the reduction of the transmission/reflection ratio.

### Background

A motorized pump should evacuate the chamber in about 30s to 1 minute. Removal of air is rapid initially but as the density of the air reduces, the amount removed is less. Running the pump for 2 minutes does not remove twice as much air as for 1 minute.

The sound level from the generator is very high in open air. When it is placed in the Space Tube before evacuation the sound level reduces significantly since transmission to the observer is now through the walls of the chamber which vibrate very little compared to free air. The effect is similar to closing a window to reduce noise from aircraft. Closed windows have much less effect on reducing road traffic noise since much of the transmission in this case is through the ground and the building structure.

## Operation

- Insert the battery into the holder and turn the buzzer off.
- Attach the clear plastic tube to a vacuum pump.
- Turn on the buzzer and fit on the main chamber tube.
- Place the second sealing plate in place at the other end and hold the whole unit together with one hand.
- Turn on the pump (or start squeezing) to evacuate the chamber and squeeze the end plates together to ensure a good seal.
- Notice the buzzer's noise level getting softer. The red indicator shows that the unit is still functioning.
- At this point, turn the valve to the shut position and disconnect the pump.
- Hold the unit together and allow the air to re-enter the chamber slowly by opening the valve.
- Note the sound level increases as the sound is transmitted through the air.

## Related Products

**Bell Jar and Ringer (P7-6500)** The bell jar (named for its shape) and vacuum plate are supplied with a battery-operated electric bell. The bell is mounted on springs to dampen the vibrations, so students can clearly hear the drastic reduction in sound when the air is removed.

**Sound Wave Interference Kit (P7-7600)** Now you can get a complete economical solution for demonstrating wave interference on a classroom size scale. Kit includes signal generator and powered speakers, everything you need for this great demonstration.

**Music Box Mechanism (P7-7330)** Turn your whole chalkboard into a speaker! This music box mechanism is quiet on its own, but just hold it against a large object and hear a dramatic increase in volume!