# 15250 String Vibrator, AC

**Purpose:**

This device will drive one end of one or more taut strings at a steady 60 Hz, allowing the formation and investigation of standing waves.

**Description:**

This unit operates on standard 110 V, 60 HZ and is supplied with a three wire, grounded power cord and plug. It's quiet to use and occupies little space. The attached ½" diameter rod can be used to clamp the vibrator to a ring stand or other suitable support.

**Procedure:**

Clamp the attached rod securely to a ring stand or other suitable support. Tie one or more pieces of the included cotton line to the eyelet on the vibrating spring. Lead these away in convenient directions and secure the other end. The vibrating spring is attached to the relay coil by a slotted screw. Some adjustment to the height of the spring may be attained by loosening the screw and sliding the “L” shaped spring steel vibrator closer to or further from the top of the coil. This procedure may be useful to increase wave height (amplitude) for a more “pronounced” wave demonstration. Use of a strobe light dramatically enhance the visibility of the standing wave. The simplest demonstration might be to have a student hold the end of each line. In this way, the mode of vibration can be changed by varying the tension on the line, all with a constant frequency. A group of students might be doing this all at the same time, and sharing ideas and observations. A more formal investigation might have the end of each line lead over a pulley and looped so that a mass pan can be attached to vary the string tension using slotted masses. A 30 gram mass is a good starting point for this experiment.

**Background:**

If a string under tension is pulled sideways and released, the tension in the string is responsible for accelerating a particular segment back towards its equilibrium position. The acceleration and wave speed increase with increasing tension. Since it is more difficult to accelerate and thereby impart a large wave speed to a massive string compared to a light one, the wave speed varies inversely with the mass per unit length of the string. The complete relationship is given by:

Where:

But, the defining relationship for a wave is:

A standing wave can be formed by adjusting the string length and/or the tension in the line until the vibrational node at each end is separated by one or more antinodes. Each internodal segment is one half wavelength long. It follows that if a standing wave is achieved with the apparatus, then the overall length, wavelength, frequency, mass, linear density, tension in the line, and wavespeed can all be determined. The relationships given above can then be examined in various ways, both qualitatively and quantitatively. Using AC (alternating current) the spring solenoid coil induces a wave at the initiation and termination of each cycle. Thus, a 60 HZ current produces a wave frequency of 120 cycles per second in this apparatus.

**Time Allocation:**
To prepare this product for an experimental trial should take less than ten minutes. Actual experiments will vary with needs of students and the method of instruction, but are easily concluded within one class period.

**Feedback:**

If you have a question, a comment, or a suggestion that would improve this product, you may call our toll free number.