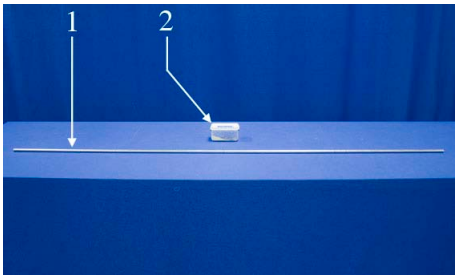
SINGING ROD 3D40.20

Oscillations and Waves | Instruments | Resonance in Plates, Bars and Solids



Concept:

When the rod is stroked, longitudinal vibrations are generated and the resulting standing waves are subject to the same open-end boundary conditions as in an organ pipe. Thus,

$$L = n\frac{\lambda}{2}, \qquad n = 1, 2, 3, \ldots$$

where L = bar's length and λ = wavelength. The resonant frequencies f_n are thus given by

$$f_n = n\frac{v}{2L}, \qquad n = 1, 2, 3, \ldots$$

where v = speed of sound in aluminum = 5.1 x 10^3 m/s and L = 1.82 m. If the rod is firmly held and stroked at $L/2$, $L/4$, and $L/6$, the corresponding audible frequencies are 1.4, 2.8, and 4.2 kHz. Additionally, when the rod is supported at the two locations between $L/4$ and $L/6$, and then excited, *transverse*, *non-sinusoidal* standing waves can be clearly observed (http://en.wikipedia.org/wiki/Bending).

A giant "singing rod" was ingeniously employed by the late UCI researcher, Dr. Joseph Weber, in an attempt to detect gravity waves from deep space (http://www.physics.umd.edu/GRE/GWdetect.htm, http://en.wikipedia.org/wiki/Joseph_Weber).

Equipment:

1. Aluminum Rod (1.82 m)
2. Rosin Powder
3. Plastic Cup (upon request, not pictured)

Procedure:

1. Pinch the rod between two fingers at the pre-marked $L/2$ location.
2. Apply a small amount of rosin to your other hand and slowly but firmly stroke the rod, starting at $L/2$ and continuing to the rod's end. It may require some practice to make the rod sing loudly.
3. Notice the frequency excited in the rod. Place the cup at the rod's end to amplify the longitudinal vibrations.
4. Repeat steps 1-3 while pinching the rod at the $L/4$ and then $L/6$ marks to excited other resonant frequencies.
5. Pinch the rod with both hands at the marks between $L/4$ and $L/6$ and hit it against your knee to excite the transverse, non-sinusoidal standing waves.