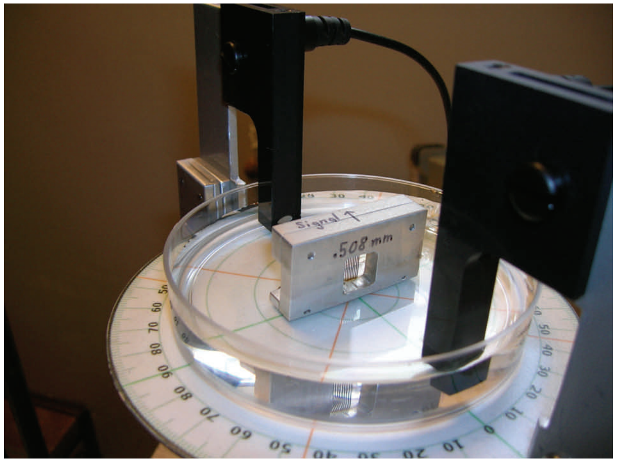
Acoustical Diffraction



Acoustical Diffraction can also be measured on the Protractor Table. The acoustical diffraction grating shown in the picture can be placed in the center of the Protractor Table, oriented perpendicular to the path of the beam, and the receiver Sound Head used to measure the emerging field pattern as a function of angle. Likewise, field patterns of single or multiple slits can be measured.

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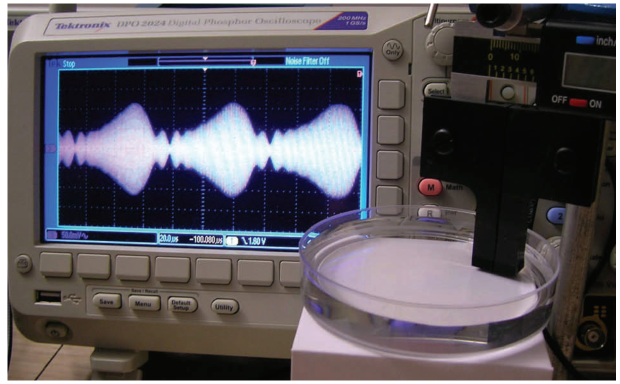
Acoustical Etalon



Measurements can be made on an acoustical etalon with either a sweep generator or noise generator for the source, and an oscilloscope or spectrum analyzer for analysis.

The photo above shows results from a sweep generator and oscilloscope. The arrangement is just the sound heads at close range. The horizontal axis covers the range from 13.2 MHz to 14.0 MHz. The resonances are 267 KHz apart.

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One Instrument, Many Experiments

Two Sound Heads attached to ordinary calipers make a Sound Calipers, capable of measuring many different physical phenomena. Examples are sound velocities, elastic properties of solids, liquids, and gases, reflection and transmission of acoustic pulses, acoustic impedances, and characteristics of acoustic etalons. The following sections describe some of the measurements that can be made with these handy devices.

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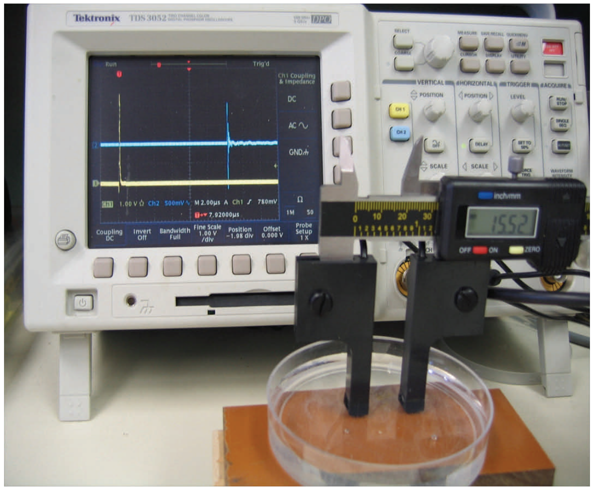
Speed of Sound in Liquids



The simplest measurement is the speed of sound in water. The picture shows the arrangement. A Pulser Box, which is a driver for the Sound Heads, provides an excitation signal to one Sound Head. The other Sound Head is connected directly to the oscilloscope and the time delay from excitation to reception, combined with the distance measured by the calipers gives the velocity. Combine the velocity with the density and you have the elastic stiffness constant of water.

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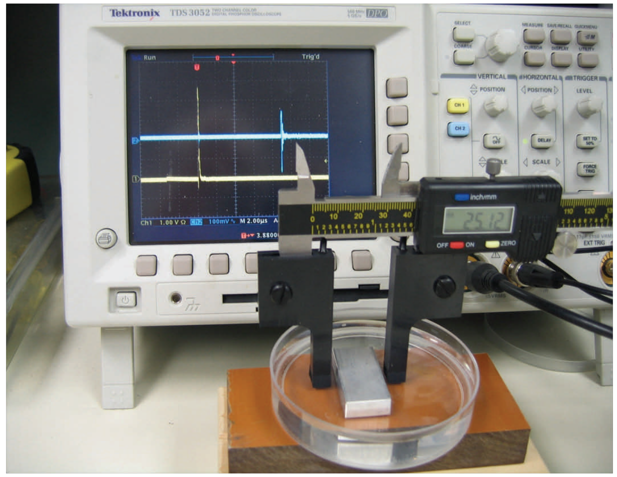
Speed of Sound in Solids



Place a piece of aluminum, plastic, ice, or any other solid in the water between the two Sound Heads as shown in the picture. The basic measurement is now the difference in transit time with and without the solid in the water. The sound velocity in the solid is then given by the equation

$$V_s = 1/(1/V_w - \Delta t/L)$$

where V_w = sound velocity in water, Δt = measured time difference, and L = length of the solid.

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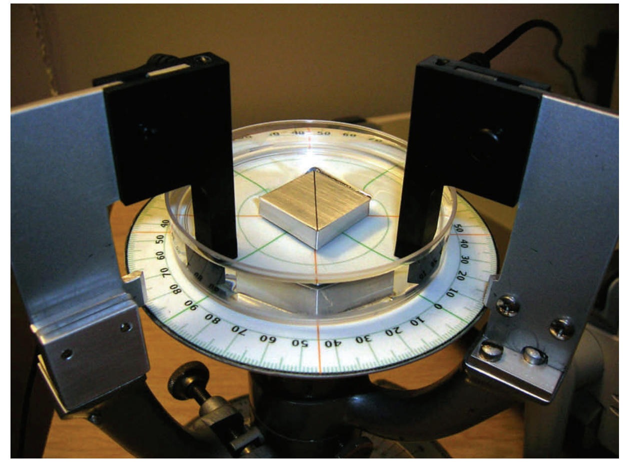
Acoustical Refraction



Acoustical Refraction can be measured with a Protractor Table and swing arm similar to a spectrometer, with Sound Heads in place of optics. The arrangement is similar to a prism spectrometer experiment. The aluminum is not acoustically dispersive as is a prism for light, instead what is measured is the refracted signal for the longitudinal wave and the shear wave. With these results, and the density of the aluminum, all of the elastic constants can be calculated.

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