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Phase change measurement, sound speed and attenuation determination from underwater acoustic panel tests

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Material measurements in underwater acoustics are employed regularly for characterization of materials used as acoustic windows. Various techniques have been developed to measure the acoustic attenuation magnitudes of materials. Recently, there has been increased interest in window configurations of complex geometries and of phase response of that material to an acoustic wave. This latter phase parameter can be of high significance for acoustic devices composed of an array of elements. Thus, the phase response of the attenuation is needed to properly characterize material performance on the overall system. This translates into a primary need to measure the complex acoustic attenuation of panels at various angles of incidence. This paper summarizes the methodology to measure the complex attenuation of materials. Case examples of test materials measured will be presented; comparisons to theoretical response will be provided. Considerations given to rigging and required acoustic settling times are discussed. Expansion of the methodology that incorporates a causal relationship between the measured phase response and attenuation to the sound speed of the material will be developed. The model relating these parameters and their implementation via an iterative least squares fitting of the parameters to the measurement data will be discussed.