

## **A Novel On-Line Ultrasonic Sensor for Simultaneous Density and Speed of Sound Measurements in High Pressure Fluids**

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Simultaneous speed of sound and density measurements, together with data of other complementary quantities (such as temperature and pressure) are of great importance to obtain an enhanced characterization of unknown fluids thermodynamic state or their contaminations. Differently from commercial ultrasonic densitometers, here proposed sensor has been designed to obtain independent density and speed of sound results and to be totally immersed into the fluid. In practice, a speed of sound sensor has been adapted to support an additional piezoelectric transducer, which is coupled to the cell by means of a buffer rod. In this configuration, it is possible to obtain the density,  $\rho$ , of a liquid sample by measuring its acoustic impedance,  $Z$ , and the sound velocity,  $w$ , ( $\rho = Z/w$ ). The newly designed sensor has been calibrated with pure water and tested using *n*-nonane in the temperature range between (258.15 – 318.15) K and for pressures up to 30 MPa. The obtained results have been compared with the literature values and the relative uncertainty is better than 0.2 % for both density and speed of sound.