Water Density Measurements in the Temperature Range of (243 and 273) K and Pressures up to 400 MPa

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Although pure water is probably the most studied fluid, there are regions of the phase diagram, at high pressure and low temperature, where thermodynamic properties are still lacking of the needed accuracy. Thus, a pseudo-isochoric method, consisting of a high pressure vessel with an expansion cell, has been realized in order to measure the density of pure water in the temperature range of (243 to 273) K and for pressures between (200 and 400) MPa. Exploiting the expansion cell, mass of the sample is determined at pressure lower than 10 MPa, by means of IAPWS-95 density reference values. The experimental apparatus has been characterized and tested in the temperature range of(278.15 and 343.15) K and at pressures up to 100 MPa, in order to determine the volume of the pressure vessel. Furthermore, the corrections to the volume for the effect of temperature and pressure variations have been considered. The density of subcooled water has been obtained by measuring the pressure as the temperature changes, at constant mass. Terms contributing to the uncertainty in determining the volume and the mass have been considered to obtain a final uncertainty of subcooled water density better than 0.2%.