

New Developments in Acoustic Gas Thermometry

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The Spanish Metrology Centre (Centro Español de Metrología -CEM) in consortium with the Research Group TERMOCAL of the University of Valladolid are involved in a European project whose main target is the determination of the Boltzmann constant. The expertise of CEM in contact thermometry has been proven over the years by its participation in numerous International Comparison in the ITS-90 range that covers the triple point of argon to the freezing point of silver. Also, the group TERMOCAL has been active for more than 10 years in the measurement of thermo-physical properties and it has participated in European projects in thermal metrology such as HIMERT (development of Metal-Carbon Eutectics as Temperature Standards). Our contribution is focused mainly on three directions: The extension of our experience in highly precise measurements in gases to acoustic thermometry field, by means of our spherical resonator. The improvement of the apparatus and the construction of a new spherical resonator to be measured dimensionally in order to determine its volume. The simulation of the acoustic, thermal and mechanical response of AGT's with finite elements approach, specifically with ANSYS code, aimed to develop new points of view regarding acoustical issues. The equipment consist of a 0.04 m radius stainless steel Spherical Resonator designed to operate in a wide range of temperature 200 K-475 K and pressure 0 MPa-20 MPa. An adiabatic thermostat with five SPRT's, Kapton heaters and three control loops is used for measuring the temperature along the entire range. Two pressure transducers –low and high pressure- with 0.01 % over the entire range –up to 20 MPa-. A fully developed approach that allow us to measure the speed of sound obtained from the lowest five radial modes at each pressure has a typical range of less than 2 ppm after correction according to the acoustical model. The most relevant achievements will be presented.