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DEVELOPMENT OF LOW TEMPERATURE ACOUSTIC AND REFRACTIVE INDEX GAS THERMOMETRY CAPABILITIES AT NRC

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The redefinition of the kelvin in terms of a fixed value of the Boltzmann constant, along with its accompanying *Mise en Pratique*, has led to a renewed emphasis on primary thermometry techniques to realize the unit. Furthermore, primary thermometers are being applied by several National Metrology Institutes to make increasingly accurate determinations of the deviation between International Temperature Scale of 1990 temperature, T_{90}, and thermodynamic temperature, T, in order to improve community consensus estimates of $(T - T_{90})$. At the National Research Council Canada (NRC) a first-generation microwave refractive index gas thermometer (RIGT) has been used for primary thermometry measurements at the temperatures of the triple points of neon, oxygen, argon, xenon and water.

Now NRC has created a new experimental apparatus for more advanced second-generation primary thermometry capabilities in the 4 K to 300 K range. This system consists of a new cryostat built around a cryogen-free pulse-tube cryocooler, an upgraded gas-handling system, and a new diamond-turned copper quasi-spherical resonator (QSR) to enable simultaneous acoustic and microwave resonance measurements.

A summary of NRC's first-generation RIGT results will be presented, followed by a description of the second-generation experimental system (focusing on specific improvements made compared to the older RIGT apparatus), along with a discussion of the new cryostat's performance and QSR characterization. Finally, preliminary microwave and acoustic measurements at the temperature of the triple point of water will be reported.