

**electronic supplement attached to Metrologia 2020 submission:**

Refractive index gas thermometry between 13.8 K and 161.4 K

This electronic supplement contains a single spreadsheet file:

“Original microwave data & thermometry.xls”,

composed by five separate sheets, one per every reference isotherm  $T_{90}$  temperature: 13.8033 K; 24.5561 K; 54.3584 K; 83.8058 K; 161.4060 K, respectively, plus one additional sheet for measurements at 273.16 K which were used for a determination of the isothermal effective compressibility  $\kappa_{\text{eff}}$  (see section 4.2).

In each separate sheet are listed for each thermometric gas:

Column A – the reference isotherm  $T_{90}$  temperature in K;

Column B; C – the reference pressure  $p_{\text{ref}}$  in Pa for each investigated ( $p_{\text{ref}}, T_{90}$ ) along an isotherm; the relative uncertainty  $u_r(p_{\text{ref}})$  associated to each pressure determination. This is calculated as the quadrature sum of two contributions; i) the uncertainty of the pressure balance used for calibration; ii) the standard deviation of repeated pressure reading from pressure transducers (section 2.3);

Columns D to L – for three microwave modes (TM11, TM12, TM13) the mean values of the average resonance frequency and the corresponding average halfwidth, both in MHz, for a number (# - as reported in Column M) of repeated acquisitions, the relative standard deviation of these averages (section 2.4);

Column N – the value of the refractive index  $n(p_{\text{ref}}, T_{90})$  evaluated using the ab initio calculated thermodynamic and electromagnetic properties from the sources discussed and referenced in sections 5.2 and 5.3.

In an additional separate sheet a detailed uncertainty budgets for the calibration of cSPRTs at the ITS-90 fixed points as realized and maintained at INRiM in the range between the triple point of equilibrium hydrogen ( $T_{90}=13.8033$  K) and the triple point of water ( $T_{90}=273.16$  K).