

PTB-2006:
A new ^3He vapor-pressure scale from 0.65 K to 3.2 K consistent with the PLTS-2000

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Presently, there are two overlapping but different International Temperature Scales adopted in the low-temperature range between 0.65 K and 1 K: the International Temperature Scale of 1990, ITS-90 [1], and the Provisional Low-Temperature Scale PLTS-2000 [2]. Close to 0.65 K, however, the scales deviate from each other considerably. It is known that in the overlapping range, the ITS-90 – in contrast to the PLTS-2000 – shows clear deviations from thermodynamic temperature [3, 4].

To overcome this unacceptable situation, at PTB a new ^3He vapor-pressure scale (in short: PTB-2006) has been established [5]. The PTB-2006 is consistent with thermodynamic temperature within 0.6 mK standard uncertainty in its whole definition range. Above 2 K it passes into the ITS-90 and below 1 K into the PLTS-2000. Compared to the ITS-90, the PTB-2006 exhibits only one third of the thermodynamic uncertainty between 0.65 K and 1 K.

For establishing the PTB-2006, a data set has been derived for the temperature dependence of the ^3He vapor pressure that covers the total range from 0.65 K to 3.2 K. This data set, as well as an adapted new ^3He vapor-pressure polynomial, has recently been published [5]. The polynomial has exactly the same structure as that used in ITS-90. To allow confirmation by the international community, complete information is given for the PTB-2006 including detailed uncertainty budgets.

The PTB-2006 shows how the ITS-90 and the PLTS-2000 can be combined in future to form one improved and unified International Temperature Scale, which ranges from the lowest to the highest temperatures. This simply can be done by replacing the ^3He vapor-pressure polynomial coefficients used for the definition of the scale ITS-90 with those of PTB-2006. The vapor pressure equation of ITS-90 for ^4He above the lambda point can be used as before.

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