Proposal of a provisional integration of the ITS-90 definition concerning the temperature of the triple point of equilibrium hydrogen

F.Pavese (IMGC), B.Fellmuth (PTB), D.Head (NPL), Y.Hermier (BNM-INM), H.Sakurai (NMIJ), K.Hill (NRC), A.Szmyrka-Grzebyk (INTiBS-PAN), W.L.Tew (NIST)

Having considered Docs. CCT/2000-9, Doc.CCT/01-07 and Doc.CCT/03 “Dependence of the triple-point of diluted mixtures of deuterium (as HD) in protium on the deuterium content” by B.Fellmuth *et al.*, where a natural variability of the T_{tp} of H_2 up to about 0.7 mK was detected as a consequence of the natural variability of the content of HD in commercial hydrogen supplies (and in terrestrial hydrogen isotopic composition),

> having the relationship T_{tp} *vs* ($^2H/^1H$) being studied internationally since 2000 in great detail and an accurate value being now available,
>
> considering that without taking any provision, the use of the present ITS-90 definition of $T_{tp,\,e\text{-}H_2}$ brings to differences in realisations due to this effect up to about 0.7 mK, being the other uncertainty components below 0.1 mK in total, and that this uncertainty component should be added to the uncertainty budget,
>
> considering that, consequently, an unacceptable degradation of the ITS-90 uncertainty below 54 K occurs, with respect to the estimated Scale uncertainty,

the CCT is asked to approve in its meeting of May 2003 the following ITS-90 integration:

“ *The supplementary Information to the ITS-90 is integrated with the following information:*

> For the purpose of the realisation of the fixed points of e-H_2, the requirement of the ITS-90 that the gas is of “natural isotopic composition” implies that
>
> $$x(^2H/^1H) = 10^{-4} \text{ mmol/mol exactly.}$$
>
> Consequently, realisations with a gas of certified isotopic composition require a correction of the R_{tp} measured values by an amount corresponding to the temperature difference between $T_{tp,\,x_{sample}}$ and $T_{tp,\,x(10^{-4})}$.
> The relationship T_{tp} *versus* $x(^2H/^1H)$ and its uncertainty are the following:
>
> $$T_{tp} = \dots\dots\dots \qquad u(T_{tp}) = \dots\dots\dots \qquad (1)$$
>
> The uncertainty of the correction ($T_{tp,\,x_{sample}} - T_{tp,\,x(10^{-4})}$) takes into account also the sample certification uncertainty $u_{x_{sample}}$:
>
> $$u((T_{tp,\,x_{sample}} - T_{tp,\,x(10^{-4})})) = \dots\dots\dots \qquad (2)$$
>
> When a non-certified gas is used, a type B uncertainty component $u_{isotope}$ = 0.20 mK with a rectangular probability distribution must be added to the uncertainty budget of the realisations of the triple point temperature of hydrogen.

WG1 is given the task to fill in eqs.(1) as soon as these results will be published on Metrologia and to express eq.(2).
The integration remains into effect until a revised text of the ITS-90 or/and an internationally recognised value of the conventional isotopic composition of hydrogen will become available.”