

Task Group

for the Development of IAPWS-IF97 Backward Equations in Region 3

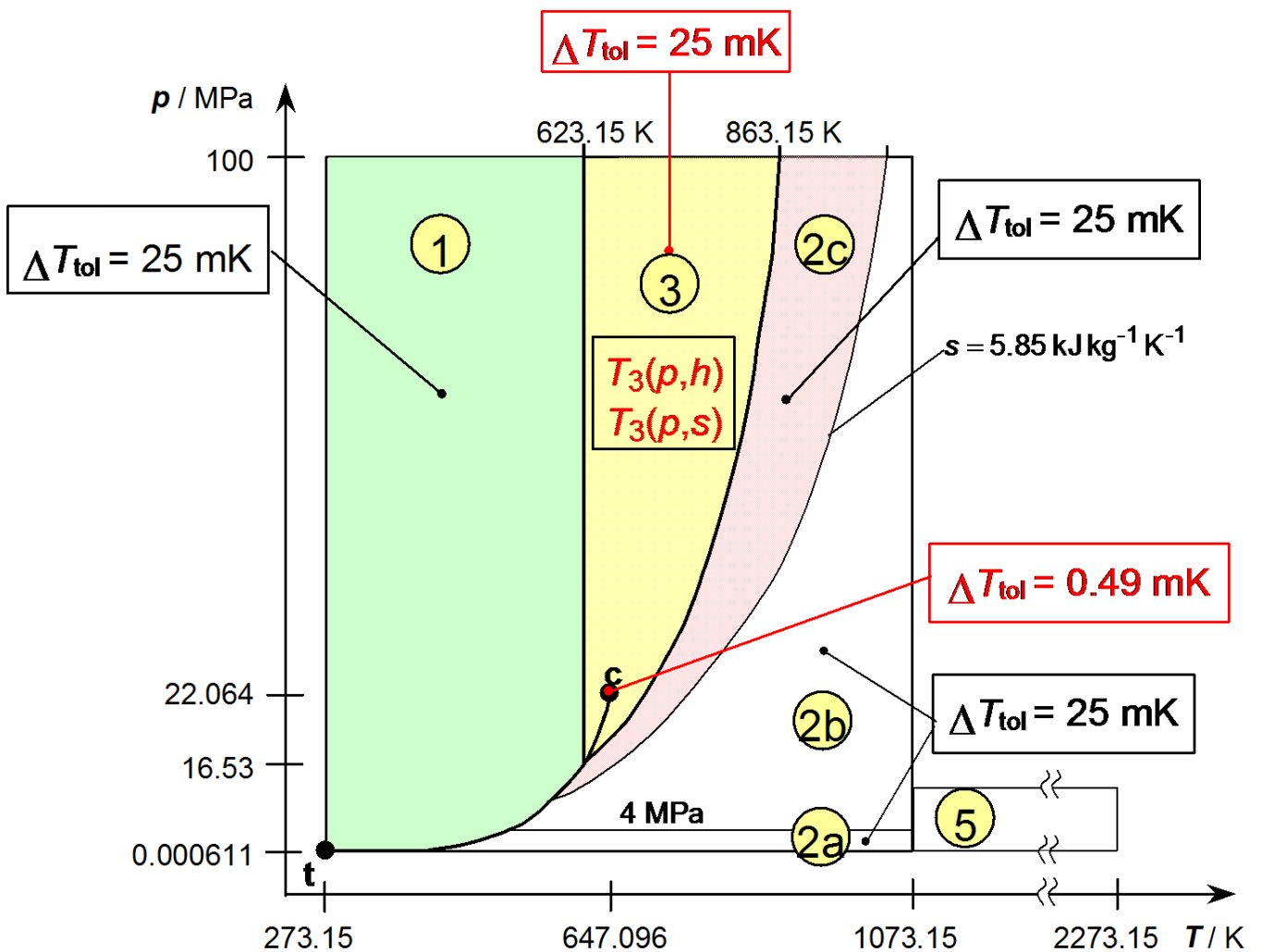
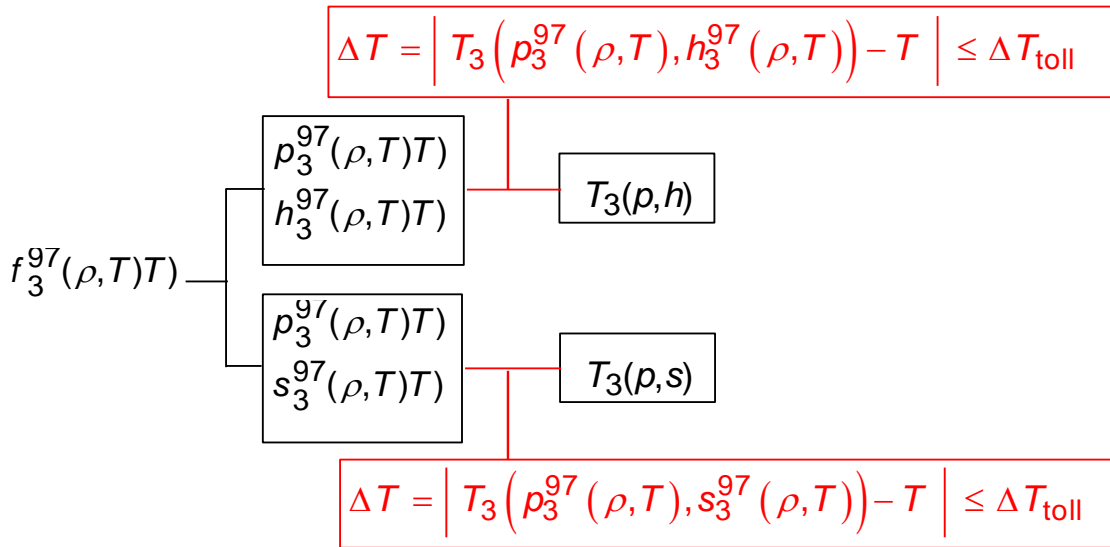
- Current Members: Hans-Joachim Kretschmar (Chair)
Radim Mareš
Wolfgang Wagner
- Progress Report:
K. Knobloch, I. Stöcker, H.-J. Kretschmar, A. Dittmann:
Development of Supplementary Backward Equations $T(p,h)$ and
 $T(p,s)$ for the Critical and Supercritical Regions of Water and Steam.
- Specifications for the Equations $T(p,h)$ and $T(p,s)$
- Name of the Task Group
- Membership
- Time Schedule

Proposal

Specifications for the Supplementary Backward Equations $T(p,h)$ and $T(p,s)$ in Region 3 of IAPWS-IF97

1. Numerical Consistency with IAPWS-IF97
2. Numerical Consistency at Boundaries Between Subregions
3. Computing Time in Relation to IAPWS-IF97

1. Numerical Consistency with IAPWS-IF97



Numerical Consistency with IAPWS-IF97

Equations $T_3(\rho, h)$:

$$\Delta T = \left| T_3 \left(\rho_3^{97}(\rho, T), h_3^{97}(\rho, T) \right) - T \right| \leq 25 \text{ mK}$$

Equations $T_3(\rho, s)$:

$$\Delta T = \left| T_3 \left(\rho_3^{97}(\rho, T), s_3^{97}(\rho, T) \right) - T \right| \leq 25 \text{ mK}$$

Exception

At critical point the value 647.096 K should be calculated.

$$\Delta T \leq 0,49 \text{ mK}$$

3. Computing Time in Relation to IAPWS-IF97

Computing Time Ratio - *CTR* Value

$$CTR = \frac{\text{Computing time of IAPWS-IF97}}{\text{Computing time of new equations}}$$

Calculation of $T_3(p,h)$: $CTR > 10$

Calculation of $T_3(p,s)$: $CTR > 10$

Proposal
for the name of the Task Group

Task Group on Supplementary Backward Equations for
Region 3 of IAPWS-IF97

Time Schedule for the Development of the Equations $T(p,h)$ and $T(p,s)$ in Region 3

IAPWS Annual Meeting 2001

- Discussion of the specifications
- Presentation of first results

IAPWS Annual Meeting 2002

- Presentation of the final set of equations
- Evaluation Task Group can begin to work

IAPWS Annual Meeting 2003

- Adoption of the equation set

Computing Time Investigations

Iterative Calculation of p & $T(h,s)$ Using IF97 Equations Only

Two-dimensional
Iteration of p and T
from: $s = s^{97}(p, T)$
 $h = h^{97}(p, T)$

Calculation of $p, T(h,s)$ Using the New $p(h,s)$ Equations

$p = p(h, s)$
↓
 $T = T^{97}(p, h)$

Result

The calculation speed is between 10 and 30 times faster than that of the 2-dimensional Newton method, depending on iteration starting values and iteration algorithm.

Summary

Supplementary Release on $p(h,s)$ equations is ready
for adoption by IAPWS