

**IAPWS Release  
on  
Surface Tension  
of  
Heavy Water Substance**

**September 1994**

*Unrestricted publication allowed in all countries*

*Issued by the  
International Association for the  
Properties of Water and Steam*

President, J.R. Cooper  
Department of Mechanical Engineering  
Queen Mary and Westfield College  
Mile End Road  
London E1 4NS  
England

Executive Secretary, Dr. R.B. Dooley  
Electric Power Research Institute  
3412 Hillview Avenue  
Palo Alto, CA 94303  
USA

(This release is a Revision of the edition of 1985  
and contains 4 numbered pages)

This release is issued by the International Association for the Properties of Water and Steam (IAPWS) on the authority of the Executive Committee meeting in Orlando, USA, 11-16 September 1994. The members of IAPWS are Argentina, Canada, Czech Republic, Denmark, France, Germany, Japan, Russia, the United Kingdom and the United States of America, and associate member Italy.

IAPS issued a Release on the Surface Tension of Heavy Water Substance, in 1985, based on the International Practical Temperature Scale of 1968 (IPTS-68). A revision of this release has been prepared to provide the values corresponding to the International Temperature Scale of 1990 (ITS-90).

The critical point temperature used for the reference temperature in the equation for the surface tension of heavy water has been taken from the IAPWS Release on the Values of Temperature, Pressure and Density of Ordinary and Heavy Water Substances at their Respective Critical Points (1992). In this revised critical point release, compared with the IPTS-68 temperatures in the original critical point release, one more decimal place is given to the converted ITS-90 temperatures. This ensures that any recalculation to the original IPTS-68 temperatures produces the same figures as given in the original source after rounding to the same number of decimal places. This increase by one decimal place in the conversion of the values to ITS-90 does not imply that the critical point temperature has been redetermined or is more accurate than as previously stated on IPTS-68.

The information provided with this release is recommended as the most accurate representation of the surface tension of heavy water substance from the triple point to the critical point.

Further information can be obtained from the Executive Secretary of IAPWS.

## **International Representation of the Surface Tension of Heavy Water Substance 1994**

### **Experimental values of surface tension of Heavy Water Substance**

Working Group III (on Special Properties) of IAPS, in 1983, had critically examined the experimental results of the surface tension of the interface between the liquid and vapor phases of heavy water and recommended the surface tension values ( $\sigma$ ) and values ( $\Delta\sigma$ ) of the uncertainty associated with each value of the surface tension.

In this revision, the values of surface tension have been examined and values adjusted for the temperature change from (IPTS-68) to (ITS-90) and are given in column 2 of Table 1. The corresponding uncertainty values are given in column 3 of Table 1.

### **Equation for the surface tension of Heavy Water Substance**

The following recommended interpolating equation gives values of surface tension within the stated uncertainty:

$$\sigma = B\tau^\mu(1+b\tau)$$

where

$\sigma$	= surface tension
$\tau$	= $1 - T/T_c$
$T$	= temperature
$T_c$	= 643.847 K
$B$	= 238 mN/m
$b$	= -0.639
$\mu$	= 1.25

This equation is valid between the triple point (3.8 °C) and reference temperature,  $T_c$ .

Values of surface tension calculated from this equation are given in column 4 of Table 1.

Notes: (i)  $T$  denotes absolute temperature, ITS-90.

(ii) The reference temperature is the critical point temperature given in the IAPWS Release on the Values of Temperature, Pressure and Density of Ordinary and Heavy Water Substances at their Respective Critical Points 1992.

(iii) The values of the constants  $B$ ,  $b$  and  $\mu$  are those presented in the release of 1985. Adjustment of the reference temperature produces values of surface tension from the equation for ITS-90 temperatures with improved root mean square deviation compared with the original equation and the surface tension values for the IPTS-68 temperatures in the release of 1985.

Table 1 Surface Tension of Heavy Water Substance

(1)	(2)	(3)	(4)	(5)
Temp. t, °C	Surf. Tension experimental $\sigma$ mN/m	Uncertainty $\Delta\sigma$ mN/m	Surf. Tension calculated $\sigma_{\text{calc}}$ mN/m	difference $\sigma_{\text{calc}} - \sigma$ mN/m
3.8	74.98	0.53	74.93	- 0.05
5	74.80	0.52	74.76	- 0.04
10	74.10	0.51	74.06	- 0.04
15	73.37	0.51	73.34	- 0.03
20	72.63	0.51	72.61	- 0.02
25	71.87	0.50	71.86	- 0.01
30	71.10	0.50	71.09	- 0.01
35	70.32	0.49	70.32	- 0.00
40	69.52	0.49	69.52	0.00
45	68.70	0.48	68.71	0.01
50	67.87	0.48	67.89	0.02
55	67.03	0.47	67.06	0.03
60	66.18	0.47	66.21	0.03
65	65.31	0.46	65.34	0.03
70	64.43	0.45	64.47	0.04
75	63.54	0.45	63.58	0.04
80	62.63	0.44	62.67	0.04
85	61.72	0.43	61.75	0.03
90	60.79	0.43	60.82	0.03
95	59.85	0.42	59.88	0.03
100	58.90	0.41	58.93	0.03
105	57.93	0.41	57.96	0.03
110	56.95	0.40	56.98	0.03
115	55.96	0.39	55.99	0.03
120	54.96	0.39	54.99	0.03
125	53.95	0.38	53.98	0.03
130	52.93	0.37	52.95	0.02
135	51.90	0.36	51.92	0.02
140	50.87	0.36	50.87	0.00
145	49.82	0.35	49.82	- 0.00
150	48.77	0.34	48.75	- 0.02
155	47.70	0.33	47.67	- 0.03
160	46.63	0.33	46.59	- 0.04
165	45.55	0.32	45.50	- 0.05
170	44.46	0.31	44.39	- 0.07
175	43.36	0.30	43.28	- 0.08
180	42.25	0.30	42.16	- 0.09
185	41.13	0.29	41.03	- 0.10
190	40.00	0.29	39.90	- 0.10
195	38.86	0.27	38.76	- 0.10
200	37.71	0.26	37.61	- 0.10

Surface Tension of Heavy Water Substance

Table 1 continued

(1)	(2)	(3)	(4)	(5)
Temp. t, °C	Surf. Tension experimental $\sigma$ mN/m	Uncertainty $\Delta\sigma$ mN/m	Surf. Tension calculated $\sigma_{\text{calc}}$ mN/m	difference $\sigma_{\text{calc}} - \sigma$ mN/m
205	36.55	0.26	36.45	- 0.10
210	35.38	0.26	35.29	- 0.09
215	34.21	0.26	34.12	- 0.09
220	33.03	0.26	32.95	- 0.08
225	31.83	0.26	31.77	- 0.06
230	30.62	0.26	30.59	- 0.03
235	29.40	0.26	29.41	0.01
240	28.19	0.26	28.22	0.03
245	26.99	0.26	27.03	0.04
250	25.79	0.26	25.84	0.05
255	24.59	0.25	24.65	0.06
260	23.40	0.25	23.45	0.05
265	22.20	0.24	22.26	0.06
270	21.01	0.23	21.07	0.06
275	19.82	0.23	19.88	0.06
280	18.64	0.22	18.69	0.05
285	17.46	0.21	17.51	0.05
290	16.27	0.20	16.33	0.06
295	15.09	0.19	15.15	0.06
300	13.94	0.18	13.99	0.05
305	12.79	0.17	12.83	0.04
310	11.66	0.17	11.68	0.02
315	10.54	0.16	10.55	0.01
320	9.43	0.15	9.43	- 0.00
325	8.33	0.14	8.32	- 0.01
330	7.24	0.14	7.24	- 0.00
335	6.18	0.13	6.18	- 0.00
340	5.14	0.12	5.14	0.00
345	4.14	0.11	4.14	- 0.00
350	3.17	0.10	3.17	0.00
355	2.24	0.10	2.26	0.02
360	1.39	0.10	1.40	0.01
365	0.64	0.10	0.64	0.00
370	0.06	0.10	0.05	- 0.01