The International Association for the Properties of Water and Steam
St. Petersburg, Russia
September 1992

IAPWS Release on the Values of Temperature, Pressure and Density of Ordinary and Heavy Water Substances at their Respective Critical Points

This Release is a Revision of the Release of 1983

Unrestricted publication allowed in all countries

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This revised release has been authorized by the International Association for the Properties of Water and Steam (IAPWS) at its meeting in Sankt Petersburg, Russia, September 6 - 12 1992, for issue by its Secretariat. The members of IAPWS are Canada, Czechoslovakia, Denmark, the Federal Republic of Germany, France, Japan, Russia, the United Kingdom and the United States of America.

In 1983, The International Association for the Properties of Water and Steam (IAPS) issued a "Statement of the Values, and their Tolerances, of the Critical Pressure, Temperature and Density of Ordinary and Heavy Water Substance", based on the IPTS-68 temperature scale. In this revised release, the critical temperature values have been converted to ITS-90.Conversion to the temperature scale of 1990 (ITS-90) is achieved with equations given in Table 1.6 of the report "Supplementary Information for the ITS-90" prepared by the Comité Consultatif de Thermometrie (CCT) and published by the Bureau International des Poids et des Mesures (BIPM). Compared with the IPTS-68 temperatures given in the original release, one more decimal place has been 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 reference

temperatures such as critical-point values, triple points, etc. have been redetermined or are more accurate than as previously stated on IPTS-68. The material included in the 1983 release was prepared by the"Subcommittee to Study the Situation with respect to Critical Constants and Various Pseudocritical Constants" convened by Dr. J.M.H. Levelt Sengers, National Bureau of Standards, Washington DC, U.S.A.. In accordance with the statutes of IAPS, the material in the release has been presented to and was approved by Deputies of the Members of IAPS (Canada, Czechoslovakia, Federal Republic of Germany, France, Japan, United Kingdom, United States of America and Union of Soviet Socialist Republics).

The method by which the parameter values were obtained and the uncertainties assigned is described in the paper "Assesment of Critical Parameter Values for H_2O and D_2O", by J.M.H. Levelt Sengers, J. Straub, K. Watanabe and P.G. Hill, Journal of Physical and Chemical Reference Data **14**, pp.193-207 (1985).

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

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Ordinary water substance, called H_2O, is of normal isotopic constitution. Heavy water substance, called D_2O, is ^2H_2O with the oxygen isotopes in the same abundance as in ordinary substance. [See Kell, G.S., J. Phys. Chem. Ref. Data, Vol. 6, No. 4, 1977]. The values of the critical temperature, pressure and density, with their estimated uncertainties, are listed in Table 1 for ordinary and for heavy water substance.

TABLE 1

H_2O ordinary water substance		D_2O heavy water substance
$(647.096 + \delta_1)$	T_c/K (ITS-90)	$(643.847 + \delta_2)$
$\delta_1 = 0.000 \pm 0.100$		$\delta_2 = 0.000 \pm 0.200$
$(22.064 + 0.27\ \delta_1 \pm 0.005)$	P_c/MPa	$(21.671 + 0.27\ \delta_2 \pm 0.010)$
(322 ± 3)	ρ_c/kg m^{-3}	(356 ± 5)

T_c is the temperature, P_c is the pressure, and ρ_c is the density at the critical point.

As stated in the preamble, the number of decimal places used in the statement of temperature bears no relation to the accuracy with which the critical temperature is known. The unusual way in which the uncertainties in the critical temperature and pressure values are connected results from the fact that these values, though not known with high precision, are related by the accurately known vapor pressure curve.